July 23, 1940. W. L. SIMPSON 2,209,287

APPARATUS FOR MIXING

Filed April 7, 1938 2 Sheets-Sheet 1

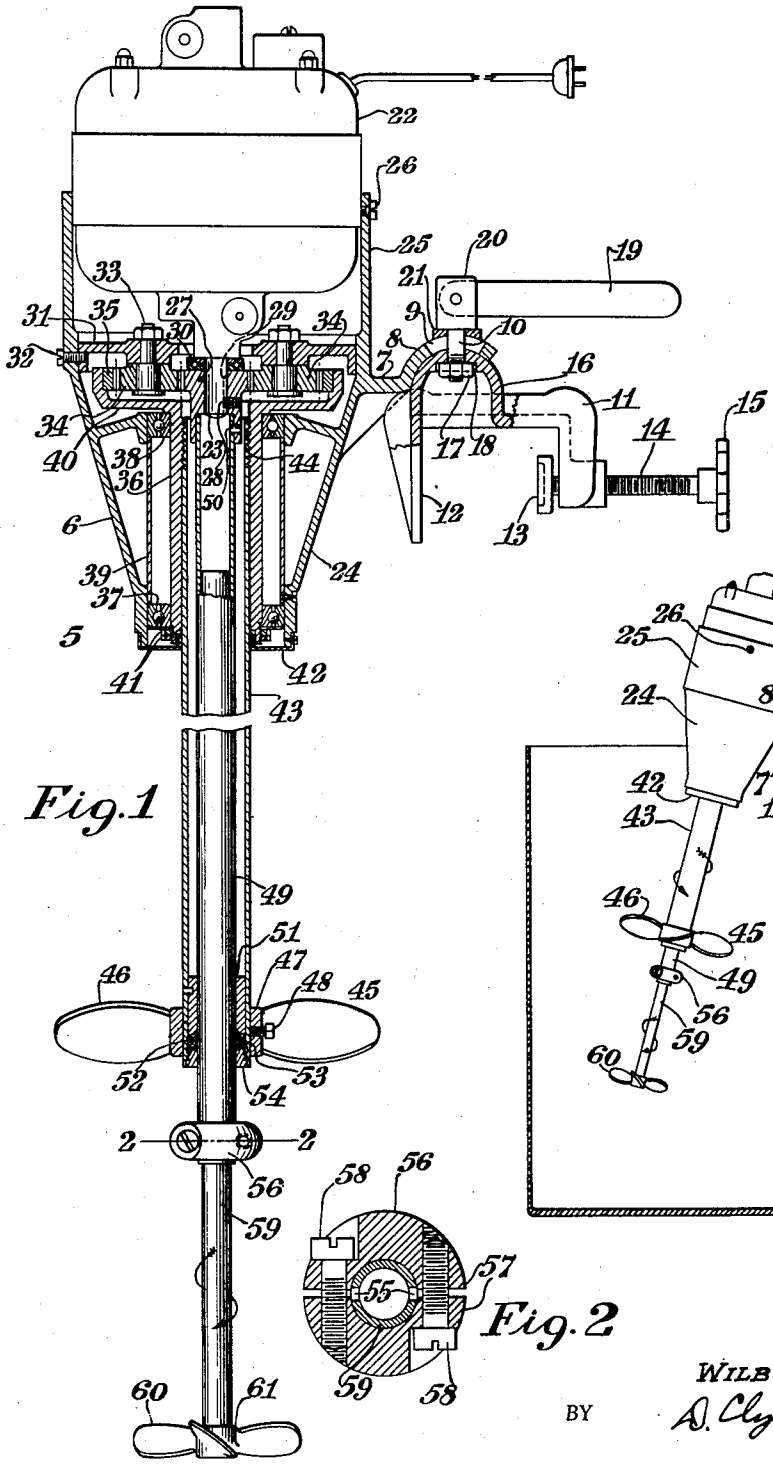

Fig. 1

Fig. 3

Fig. 2

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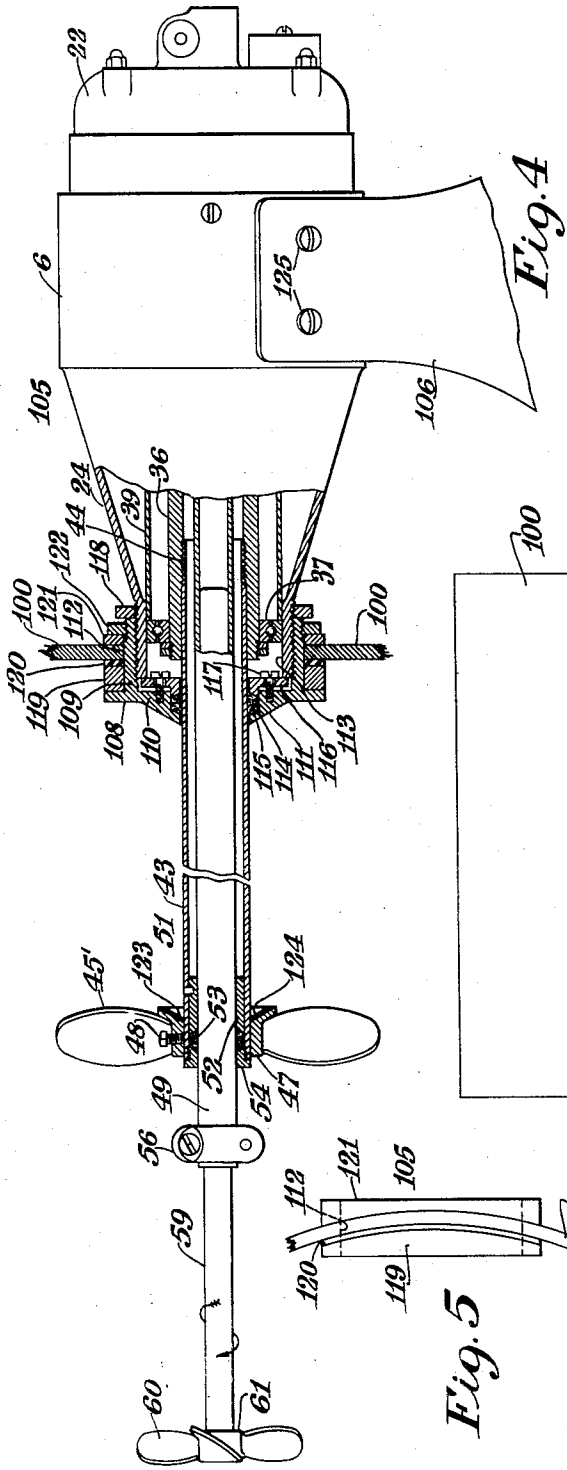

Fig. 4

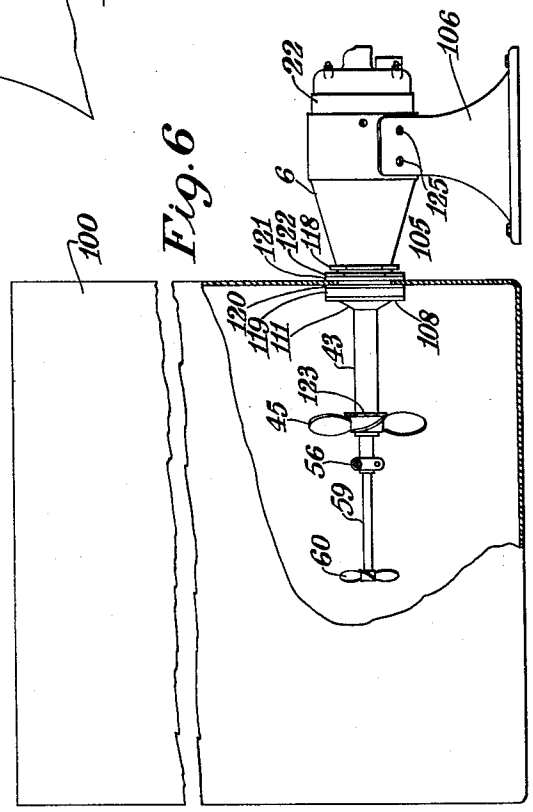

Fig. 6

Fig. 5

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APPARATUS FOR MIXING

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7 Claims. (Cl. 259—105)

This invention relates to an apparatus for mixing.

One of the greatest disadvantages that has arisen in the art of commercial mixing has been the creation of a steady whirling or rotation of the mix about the mixing tank in a constant path so that the actual intermingling of the particles of the mix has required a relatively long time. This whirling is due to the fact that one or more screw-type propellers mounted on a shaft projecting into the mix have been generally used with the result that the propellers thrust streams which rotate about the axis of the propellers, and soon cause the entire mix to take a circular motion in the tank with the major part of the mix traveling only in a fixed path without any true intermingling or mixing of the material. While this problem has long been recognized in the art, no satisfactory solution has been found. For example, it has been proposed to provide stationary baffle plates within the mixing tank either permanently fixed thereto or adjustably mounted on supports secured to the tank, to break up the excessive whirling of the mix. These baffle plates have only partially reduced the tendency of the mix to whirl since they only modify the whirling motion and do not provide a complete intermingling of the material to be mixed. Further, the baffle plates not only render the tank difficult to clean or repair, but also increase the hazard to the workmen by providing projecting portions adjacent a revolving propeller.

The present invention reduces the whirling of the liquid to a minimum in a very simple and efficient manner without the use of either fixed or adjustable baffle plates and provides a thorough and continual intermingling of the material to be mixed and consequently reduces the time required to mix a given quantity of material. The present mixer comprises a self-contained unit, obviating the necessity of any accessories such as baffle plates and the like.

It is an object of this invention to provide an apparatus for mixing which sets up two rotating streams within a mix, which streams rotate in opposite directions and at different speeds.

It is another object of this invention to provide an apparatus for mixing which develops the mix a rotating stream of relatively small diameter directed against a wall of the mixing tank and develops a second stream moving at a slower rate of speed and of larger diameter than the first-mentioned stream directed toward the smaller and faster moving stream whereby the larger stream provides a continuous baffle for the high speed stream as it is deflected from the mentioned tank wall.

It is a further object of this invention to provide a mixer having two propellers of different sizes, means being provided for driving the propellers in opposite directions.

It is a further object of this invention to provide a mixer which is adapted to be directed toward the central axis of the tank whereby a more uniform mixing action is obtained.

It is a further object of this invention to provide a novel manner of sealing a mixer in a side wall of the tank whereby the packing for the seal may be replaced without emptying the contents of the mixing tank in the event that a leak should develop. This manner of sealing a mixer in a tank wall is particularly adaptable to continuous mixing processes, since the material being mixed need not be emptied to repair or replace the sealing material.

Other features and advantages of the invention will appear from the detailed description and claims when taken with the drawings in which,

Fig. 1 is a longitudinal section of a mixer made in accordance with this invention,

Fig. 2 is a transverse section taken on line 2—2 of Fig. 1,

Fig. 3 illustrates one application of the mixer shown in Fig. 1,

Fig. 4 is a side view of a modified type of mixer with a portion of the mixer being shown in section to illustrate the details of construction,

Fig. 5 is a plan view of a tank wall showing the radius washers for maintaining the adapter gasket in sealing engagement with the tank wall,

Fig. 6 is a side view showing the mixer of Fig. 4 applied to a tank, a portion of the tank being broken away to show the relation of the propellers to the tank.

The mixer shown in Figs. 1, 2 and 3, generally indicated by reference character 5, comprises a housing 6 having a clamp bracket 7 projecting from the wall thereof. This bracket, which may be integral with or detachably secured to the housing, includes a spherical portion 8 having a slot 9 to receive the clamping bolt 10. A clamp 11, having a fixed jaw 12 and a movable jaw 13 adjustable by means of the screw 14 terminating in the hand wheel 15, is provided with a domed portion 16 for seating in the spherical portion 8 of the bracket 7. The clamping bolt 10 extends through an aperture in the domed portion 16 and carries on one end thereof a nut 17

non-rotatably seated in a recess 18. A handle 19 is pivoted in the bifurcated head 20 of the bolt 10, while a radius washer 21 is carried by the bolt 10 between the bifurcated head 20 and the spherical portion 8.

A motor 22, having a shaft 23 projecting toward the tapered end 24 of the housing, is removably secured within the large end 25 of the housing 6 by means of a plurality of screws 26. Motor shaft 23 has a pinion gear 27 secured thereto by means of the set screw 28 seated in a key slot 29 in the shaft. The thrust bearing 30 mounted on the motor shaft between the motor casing and the motor pinion gear 27 takes the upward thrust of the propeller tube to be later described. A pinion-gear spider plate 31 suitably secured within the housing 6 as by means of screws 32 is provided with pinion studs 33 on which are rotatably mounted the idler pinions 34 in mesh with the motor pinion 27. Although it is preferred to use three or four idler pinions, depending upon the load on the mixer, it will be understood that any suitable number thereof may be provided. The idler pinions 34 are in mesh with an internal ring gear 35 carried on the internal ring-gear sleeve 36, which rotates in a direction opposite that of the motor pinion gear and at a lower rate of speed. This ring-gear sleeve is supported in the housing 6 by means of the ball bearings 37 and 38 which are maintained in proper relation by a spacer sleeve 39. The bearing 38 abuts the ring-gear holding portion 40 of the ring-gear sleeve 36 while the opposite end of the sleeve is externally threaded to receive the bearing clamping nuts 41. The tapered end 24 of the housing 6 may be closed by means of an annular housing cap 42 which snugly encircles the outer propeller tube or shaft 43.

An outer propeller tube 43 is screwed into the internal ring-gear sleeve 36 as indicated at 44 so that the rotation of this sleeve is transmitted directly to this propeller tube. The outer end of the propeller tube carries the large propeller 45 comprising the blades 46 and hub 47 having a set screw 48 for clamping the propeller to the propeller tube 43 in adjusted position. While a three bladed propeller is preferred, propellers having any desired number of blades may be used.

The inner propeller tube or shaft 49 is pinned to the motor pinion 27 as indicated at 50 so that the rotation of the motor shaft is transmitted directly to this tube. The inner propeller tube is journaled in the bearing 51 carried by the outer propeller tube. An end wall of this bearing together with the adjacent surface of the outer propeller tube provides a stuffing box 52 for the reception of the packing 53. The packing 53 is compressed by means of an externally threaded gland 54 having threaded engagement with the projecting end of the outer propeller tube 43. The projecting end of the inner propeller tube 49 is provided with opposed slots 55, as shown in Fig. 2, and carries thereon a split clamp 56 comprising the jaws 57 and the clamp screws 58. This clamp cooperates with the slotted end of the inner propeller tube to lock the propeller shaft 59, which is slidably mounted within the inner propeller tube 49, in adjusted position. The outer end of the propeller shaft 59 carries a smaller propeller 60 secured to the shaft in any desired manner, although it is preferred to provide a tapped hole in the hub 61 of the propeller shaft for engagement with the threaded end of the propeller shaft. As in the case of the propeller 45, it is preferred to provide three blades on the propeller 60, although propellers having any desired number of blades may be used. It should be noted that the propeller 60 is substantially smaller than and of a hand opposite to that of the propeller 45.

From the above description it will be seen that the large propeller 45 will rotate in one direction and at a given speed while the smaller propeller 60 will rotate in the opposite direction at a much higher rate of speed. Since the propellers are of opposite hand and rotate in opposite directions they will both thrust the material to be mixed toward the bottom of the tank 61' (Fig. 3). The small, direct motor-driven propeller 60 will thrust a stream of the material, moving at a high rate of speed, toward the tank bottom, while the larger and slower rotating propeller 45 will thrust a larger but slower moving stream of material toward the tank bottom and around the faster moving stream from the small propeller. The two streams will be twisting or rotating in opposite direction with the result that a thorough mixing will be obtained and further the larger but slower moving stream from the large propeller will meet the faster moving stream of the small high-speed propeller after this latter stream has been deflected by the tank bottom with the result that whirling of the mix about the tank is substantially prevented and thorough mixing of the materials is obtained. It will be seen that there has been devised a mixer which may be operated at full motor speed without the usual whirling or continual rotation of the particles of the mix in a fixed path. The large propeller obviates the necessity of baffle plates and accomplishes the result sought by the use of baffle plates in a much more satisfactory manner. A modified mixing action can be obtained by using propellers of like hand or by using propellers which thrust the material to be mixed upwardly toward the top of the tank.

In Figs. 4, 5 and 6 there is shown a slightly modified type of mixer adapted to extend horizontally through an opening in a side wall of the mixing tank 100 with the axis of the propellers passing through the vertical axis of the cylindrical tank. It will of course be understood that either of the preferred types of mixers herein disclosed may be used with tanks other than of cylindrical form. However, it has been found that the best results are obtained by having the axis of the propellers lie in a plane passing through substantially the center or central vertical axis of the tank.

The mixer 105 embodies the same principles and is similar to the mixer 5. The same reference characters have been used to indicate the elements of the mixer 105, which correspond to the elements of the mixer 5. The motor and gearing for driving the inner and outer propeller tubes 43 and 49 respectively of the mixer 105 may be identical with that used in the mixer 5 and therefore, the detailed showing of these parts has been omitted from Fig. 4. However, instead of securing the inner propeller tube 49 to the motor pinion 27 by means of the pin 50, it is preferred to provide external threads on the end of the inner propeller tube 49 which engage corresponding internal threads on the motor-pinion 27. The bracket 7 and clamp 11 of the mixed 5 have been replaced by a bracket 106 bolted to or formed integrally with the housing 6, and which may be of any desired construc-

tion for supporting the mixer on a suitable base or platform.

A tank adapter 108 including an internally and externally threaded sleeve portion 109 and an annular end wall 110 having an outer conical surface 111, is inserted in an opening 112 in the tank wall 100. The reduced end 113 of the housing 6 is externally threaded for engagement with the internal threads of the adapter 108. The end wall of the adapter, adjacent the propeller tube 43, is provided with a recess 114 which serves as a stuffing box to retain the packing material 115. A gland 116 movable into the stuffing box by rotation of the housing 6 relative to the adapter, compresses the packing 115 to seal the adapter about the outer propeller tube 43. While assembling the mixer the gland is maintained in position by means of the screws 117 carried by the adapter and passing through suitable apertures in the gland. A lock nut 118 provided on the externally threaded end of the housing 6 secures the housing and the adapter in adjusted position.

The adapter 108 carries a radius washer 119 having a plane surface abutting the flange formed by the end wall 110 of the adapter and a convex surface for holding a gasket 120 against the inner surface of the cylindrical mixing tank. A concave radius washer 121 mounted on the adapter 108 engages the outer surface of the mixing tank. The gasket 120 is drawn snugly into engagement with the tank wall to effectively seal the adapter in the opening 112 by tightening the nut 122 carried by the adapter. While radius washers 119 and 121 have been shown, it will be understood that flat washers may be used when mounting the mixer in a tank having flat walls.

The large propeller 45', corresponding to the propeller 45 of mixer 5, is provided with a conical surface 123 having suitable gasket material 124 thereon for sealing engagement with the conical surface 111 of the adapter when it is desired to repack the stuffing box as will appear hereinafter.

In continuous mixing processes employing mixers sealed in an opening in the wall of the mixing tank, it has heretofore been necessary to empty the tank before the seal at the opening could be repacked, resulting in a great loss of time and material. In the event that it becomes necessary to repack the stuffing box 114, the tank need not be emptied since the present construction permits the packing to be replaced from outside the tank without danger of the material in the tank from leaking through the opening in the side wall thereof. To repack the stuffing box, the screws 125 are removed, the lock nut 118 is backed away and the motor housing 6 is rotated to unscrew the housing from the tank adapter 108. After the threads on the housing have been disengaged from the threads on the tank adapter, the housing and the propeller tubes are moved in a direction away from the tank until the conical surface 123 of the propeller 45' engages the conical surface 111 of the adapter. The gasket material 124 on the conical surface 123 will provide an effective seal to prevent the liquid in the tank from leaking through the opening 112 in the tank wall while the packing 115 is being replaced. The housing may be rotated to disengage the threads 44 of the internal ring-gear sleeve 36 from the propeller tube 43. The motor pinion 27 may be removed from the inner propeller tube 49 by rotating these members relative to each other to disengage their threads. The motor and motor housing may then be removed from the propeller tubes, providing free access to the stuffing box 114.

The action of the mixer 105 is similar to that of the mixer 5 except that the small propeller 60 will direct a high-speed rotating stream of material against the side wall of the tank, which stream will be deflected in all directions by the tank wall, while the large propeller 45' will direct a slower moving stream twisting or rotating in a direction opposite to that of the stream thrust by the small propeller, toward the high speed stream. The large slower moving stream from the large propeller surrounds the smaller and faster moving stream from the small propeller and tends to baffle the stream from the small propeller as it is deflected from the tank wall and thereby prevent excessive whirling of the material being mixed in a fixed path about the tank.

In many mixing processes it is desirable to have the mixer disposed entirely below the level of the material to be mixed, in the manner shown in Fig. 6. However, prior to the present invention this arrangement has had the disadvantage of creating a constant whirling of the material about the tank. As previously mentioned, it has been the practice, but with very little success, to provide baffle plates within the tank to break up this steady flow of material about the tank walls. The present invention overcomes this disadvantage by providing two propellers of different sizes, which thrust streams moving at different speeds whereby a constant intermingling of different parts of the mix is obtained and also resulting in effective baffling of the faster stream by the slower stream and thus preventing any tendency of the high speed stream from creating a whirling of the material in a constant path within the tank.

The propellers of each of the mixers herein disclosed may be adjusted in order to modify the mixing action or to adapt the mixer to various size tanks. Each of the propellers 45 and 45' are adjusted by loosening the set screw 48 and sliding the propeller along the propeller tube 43. The spacing of each of the small propellers 60, with relation to the tank wall or bottom and to the large propellers 45 or 45' may be accomplished by loosening the clamp 56 and sliding the propeller shaft 59 within the inner propeller tube 49. By loosening the clamping bolt 10 the angle of the mixer 5 relative to the tank wall may be adjusted to suit conditions by rotating the mixer about the axis of the bolt 10, or by tilting the mixer relative to the side wall of the tank.

A mixer, similar to the mixer shown in Fig. 4, mounted in a tank of 5 gallons capacity in the manner shown in Fig. 6 and provided with two three-bladed propellers of 1½" and 3¼" diameter respectively, and rotating at approximately 1800 R. P. M. and 600 R. P. M. respectively was operated with the tank approximately three-quarters filled with water. A number of grape seeds were placed in the water and the action of the mixer was photographed by means of a high-speed stereoscopic motion picture camera which reduced the motion of the propellers and the grape seeds approximately seventy-five times. From a study of the stereoscopic motion pictures thus produced it was found that there were practically no stagnant spots within the liquid and no constant rotation of the liquid in a fixed path about the tank but rather a constant turnover and uniform intermingling of the liquid, as was evidenced by the movement of the seeds throughout the tank.

The present disclosure is given merely by way of example, and it will be understood that there can be many modifications and variations therein within the scope of the appended claims without departing from the spirit of the present invention.

I claim:

1. A device of the class described comprising a tank adapted to contain material to be mixed, said tank having an opening in a side wall thereof, an adapter secured in said opening, a mixer shaft projecting into said tank and movably mounted in said adapter, a seal carried by said adapter snugly engaging said shaft, and means carried on said shaft within said tank and normally spaced from said adapter, said means being movable for engaging a portion of said adapter to provide a temporary seal about said shaft.

2. A device of the class described comprising a tank adapted to contain material to be mixed, a propeller of a given hand mounted in said tank for rotation therein, a second propeller of opposite hand mounted in said tank, coaxially with said first-mentioned propeller, for rotation therein, said propellers being spaced apart a substantial distance, one of said propellers being larger than the other, means for rotating the small propeller in a given direction, means for rotating said larger propeller in the opposite direction and at a slower speed than said small propeller, the hand and direction of rotation of said large propeller being such that the material to be mixed is thrust from said large propeller toward said small propeller.

3. A mixing device comprising a tank, concentric shafts extending into said tank, means for supporting said shafts for angular adjustment on a side wall of said tank, means for rotating said shafts in opposite directions and at different speeds, a propeller of a given hand fixed on one of said shafts, and a second propeller of opposite hand fixed on the other of said shafts, said second propeller being larger than said first-mentioned propeller.

4. A mixer comprising a tank adapted to contain material to be mixed, a pair of concentric shafts extending into said tank in substantially a horizontal direction and toward the center thereof, a propeller of a given hand mounted on the inner shaft, a second larger propeller of opposite hand mounted on the outer shaft, and means for rotating said shafts in opposite directions at different speeds, said larger propeller being adapted to thrust the material being mixed toward the smaller propeller.

5. A device of the class described comprising a tank adapted to contain material to be mixed, said tank having an opening in a side wall thereof, an adapter disposed in said opening, said adapter comprising a sleeve having an annular end wall thereon disposed within the tank and adjacent the inner surface thereof, a mixer shaft mounted in said adapter and projecting into said tank, a seal in said adapter snugly engaging said shaft, a propeller carried by the part of the shaft projecting into said tank and normally spaced from said adapter, said propeller being movable into engagement with the annular end wall of said sleeve, and means on said propeller adapted to cooperate with said annular end wall to form a temporary seal therewith.

6. A device of the class described comprising a tank having an opening in a side wall thereof, an adapter secured in said opening, a portion of said adapter being disposed within said tank, a shaft projecting into said tank and mounted in said adapter, a seal in said adapter snugly engaging said shaft, a propeller mounted on said shaft, within said tank, and normally spaced from said adapter, and sealing means on said propeller adapted to cooperate with said adapter to provide a temporary seal therewith.

7. A mixing device comprising a tank having an opening in a side wall thereof, an adapter including a sleeve having an annular end wall provided with an outer conical surface, means for securing said adapter in said opening with the annular end wall adjacent the inner surface of the tank wall, a shaft mounted in said adapter and projecting into said tank, a seal in said adapter snugly engaging said shaft, a propeller mounted on said shaft within said tank, and normally spaced from said adapter, said propeller having a conical surface complementary to the conical surface on said adapter and engageable therewith for providing a temporary seal.

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