

Aug. 1, 1950

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2,516,918

SUBMERSIBLE BEARING CONSTRUCTION

Original Filed Dec. 14, 1945

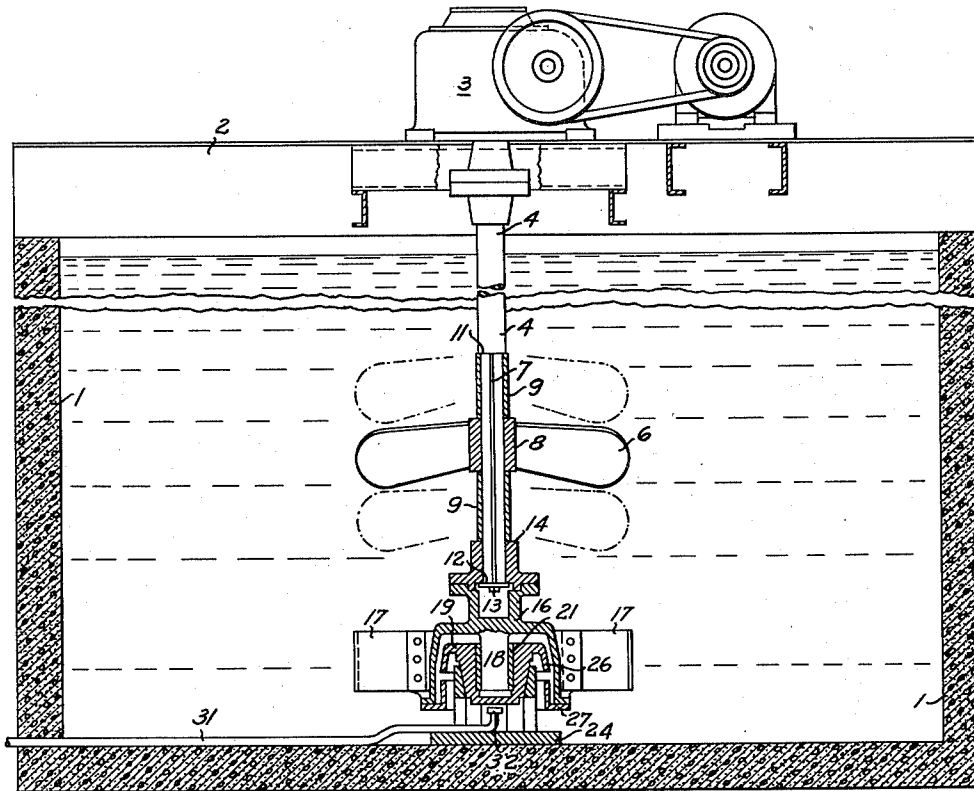


Fig. 1

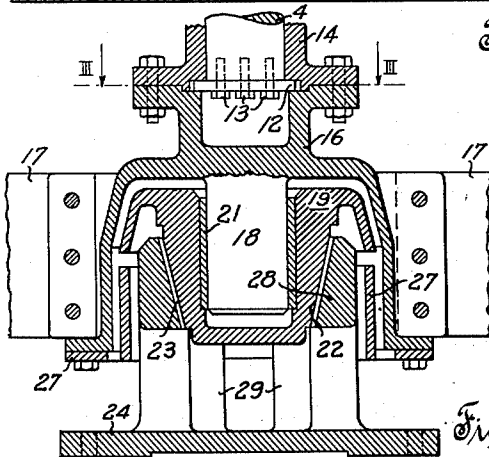


Fig. 2

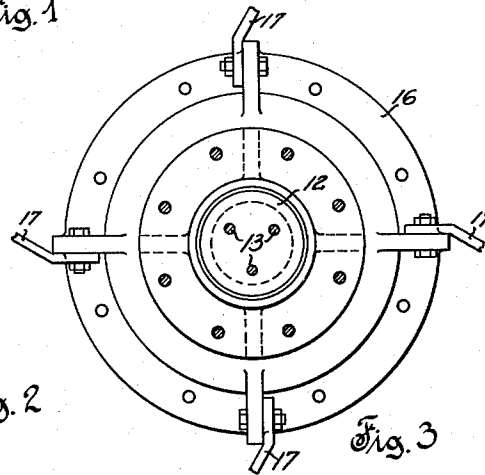


Fig. 3

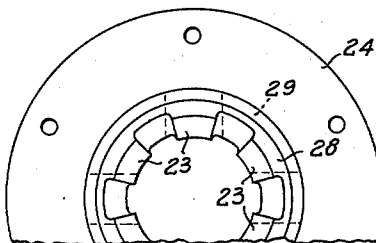


Fig. 4

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2,516,918

SUBMERSIBLE BEARING CONSTRUCTION

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Original application December 14, 1945, Serial
No. 634,931. Divided and this application No-
vember 13, 1946, Serial No. 709,623

7 Claims. (Cl. 308—36.1)

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This application is a division of an application Serial No. 634,931, filed December 14, 1945, by the same inventor for Agitator, and relates in particular to submerged bearings for vertical shafts.

The principal object of this invention concerns the provision of a submerged bearing of improved type for location of the lower end of a vertical rotating shaft in a tank, in which the operative bearing surfaces are protected from the entrance of liquids by the diving bell principle, both in operative position and during lifting and lowering of the shaft and bearing structure through the body of liquid in the tank.

Another object is the combination of the bearing structure mentioned above with a device for maintaining a gaseous atmosphere in the bell and blowing settled solids away from the vicinity of the bell in operation.

The above mentioned and still further objects and advantages may be secured and carried into practical effect as described below with reference to the accompanying drawing in which:

Fig. 1 is a vertical sectional view of an agitator having a bearing according to the present invention;

Fig. 2 is an enlarged vertical sectional view of the submerged shaft end and bearing structure shown in Fig. 1;

Fig. 3 is a cross sectional view taken on the line III—III of Fig. 2; and

Fig. 4 is a top elevation of the bearing receiving base shown in Fig. 2 with bearing structure removed.

In a preferred embodiment of the invention illustrated in the drawing, a tank 1 for containing a body of fluid mixture to be agitated, has a frame 2 extending across the top, on which is mounted an agitator drive mechanism 3 for supporting and rotating an impeller shaft 4 extending vertically downward into and substantially to the bottom of tank 1. The shaft supporting assembly 2—3 and shaft 4 is arranged so as to be removable upwardly from and replaceable downwardly to the operative position illustrated.

Secured to shaft 4 intermediate its length, and within the tank when the shaft 4 is in operative position, is a fluid impeller, which in the present embodiment is a propeller 6. Propeller 6 is arranged to propel fluid mixture generally downwardly in the vicinity thereof, along shaft 4, when the shaft is rotated in operating direction on its axis.

As shown, and according to the present invention, the propeller 6 is keyed in axially slidable driven relation to shaft 4. A conventional key-

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way is shown at 7 for reception of a conventional key (not shown) suitably engaging the hub 8 of propeller 6 in known, suitable, manner to prevent relative rotation of the propeller and shaft in operation. Propeller locating spacer sleeves 9 are provided to fit slidably on the propeller mounting portion of the shaft 4. A shoulder 11 forms an abutment limiting the axial movement in one direction of the sleeves 9, and hub 8, which are arranged in selected order on the shaft 4 in series abutting relation to shoulder 11. It will be clear that if the hub 8 abuts 11 with all sleeves 9 between it and the lower shaft end, the propeller 6 will occupy an uppermost position shown by broken lines in Fig. 1; and if all spacer sleeves 9 are placed above the hub 8 the propeller 6 will occupy a lowermost position shown by broken lines in Fig. 1, as compared with the position of the propeller 6 as indicated in full lines in Fig. 1. The sleeves 9 and hub 8, assembled in selected order on the shaft 4, are clamped in position between shoulder 11 and clamp plate 12 as shown in Fig. 1. Plate 12 is secured, as by cap screws 13, to the lowermost end of shaft 4, and projects beyond the shaft periphery sufficiently to engage the sleeves 9 or hub 8 in clamping relation, either directly (not shown), or indirectly through an additional end spacer, which, in the drawing, is shown as a flanged coupling member 14 adapted for attachment of a bearing housing member 16, described hereinbelow.

Bearing housing 16 is externally provided with generally radially extending blades 17 forming an auxiliary impeller for centrifugally impelling fluid radially outwardly near the bottom of tank 1, thus cooperating with axial propeller 6 to cause a flow of fluid down along the shaft and outwardly over the tank bottom. Adjustment of the propeller 6 axially relative to the auxiliary impeller 17 will provide for optimum effectiveness on various fluid mixtures according to their flow characteristics.

In order to provide a steady bearing for positively locating the submerged end of shaft 4 in operative position against displacement by laterally acting forces, a bearing surface, such as cylindrical stub shaft 18, is provided within the housing 16. Housing 16 is arranged to form a fluid tight bell housing adapted to retain a gaseous fluid atmosphere under pressure, which will prevent access of a liquid mixture in tank 1 to the bearing surface of 18 so long as the housing 16 is fluid tight down to a level substantially below any part of the bearing surface of 18.

In radial bearing engagement with the bearing

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surface of 18 is a relatively rotatable bearing member or housing 19 which may be provided, as shown, with a self-lubricating liner 21 forming an actual bearing surface. Bearing member 19 is preferably closed at the bottom to make it cup shaped, but need not be so closed provided it has no opening extending below the fluid tight portion of the bell housing 16. As shown, bushing 19 is formed with a frusto-conical external surface 22 which forms a pilot bearing, or lateral thrust transmitting and centering surface adapted to engage a complementary surface 23 on a pilot bearing base 24, in the tank bottom. Further, the bushing 19 may have a lateral extension or extensions 23 cooperating with a retaining ring or lifter plate 27, which is secured to the housing 16 after assembly of bushing 19 on stub shaft 18, to limit axially outward motion of bushing 19 relative to housing 16.

Pilot bearing base 24 may be formed as shown, as an annulus 28 supported by an open cage 29 secured to the tank bottom in any suitable manner. However, any suitable device for freely receiving bushing 19 in lateral thrust transmitting relation may be substituted for base 24.

In order to provide for establishing, maintaining or renewing a gaseous atmosphere under pressure within the bell housing 16, and for admission of excess air, a pipe 31 is provided with nozzle tip outlet 32 vertically below the opening of bell housing 16 when in operative position. Pipe 31 is connected with a suitable source of gaseous fluid under pressure (not shown).

In operation of the agitator described above, a fluid mixture, such as a liquid with fine solids suspended therein, is placed in the tank 1. Rotation of shaft 4 causes propeller 6, properly set to best level for the particular material being treated, to propel liquids or liquid suspensions downward along shaft 4. Impeller blades 17 cause liquid surrounding housing 16 to be impelled radially outward over the bottom of tank 1. These actions cooperate to create an optimum agitation of fluids in the tank. Supply of air through pipe 31 and nozzle 32 maintains a gaseous atmosphere under pressure in housing 16 which, by the diving bell principle, prevents the entrance of any liquid into bell 16 above a level determined by the fluid pressure within bell 16. The liquid level in bell housing 16 is maintained sufficiently low to prevent intrusion of liquid into the relatively rotating interengaging bearing surfaces of elements 18 and 19.

Occasionally, for example, as a result of stoppage of the impeller, solids may collect in the vicinity of the opening of bell 16 and around the blades 17 which would, if not removed, tend to impede rotation of the impeller and tend to intrude into the housing 16. To prevent this, and to effectively maintain the atmosphere in bell 16, excess air may be intermittently or continuously forced through pipe 31 and nozzle 32. Excess air so supplied will escape around the mouth of the bell 16 and force any settling solids away from the vicinity of the housing, bearing and impeller structure, thus increasing the effectiveness of the device in maintaining or obtaining a homogeneous mixture in the tank.

When it is necessary to lift shaft 4 with its impellers, for any reason such as repairs, it will be seen that lifter plate 27 will engage projections 26 and lift bushing 19 with the housing 16. This provides for lifting of the whole operative bearing structure with the shaft. Reinsertion of the agitating mechanism in a full tank will be facili-

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tated by provision of the self-centering pilot surfaces 22 and 23. Since surface 23 is supported by a cage, no fluid can be trapped when surface 22 is engaging surface 23. Accordingly, the shaft 4 may be freely lifted and lowered from and to operative position without danger of fouling of the bearing by the liquid mixture in the tank.

While a specific embodiment of the invention has been illustrated and described, it will be understood that the invention is intended to include such modifications and equivalents as may be within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. In a submersible bearing for a shaft adapted to have one end lifted and lowered from and to an operative position below the level of a body of liquid, a bell housing on the submersible end of said shaft adapted to be lifted and lowered with said shaft, bearing means within said housing rotatably engaging said shaft, means limiting axial freedom of motion of said bearing means relative to said bell housing during lifting of said shaft and housing, and means on said bearing means adapted to engage a submerged surface in lateral thrust transmitting relation when said shaft and bearing means are in operative position.

2. A bearing according to claim 1 in which means are provided to supply a gaseous fluid under pressure to the interior of said bell housing while submerged in operative position.

3. A diving bell type bearing for operation submerged in a body of liquid comprising an element rotating on a substantially vertical axis to be supported against lateral displacement relative to said axis, bearing means rotatably engaging said element in coaxial relation, means limiting axial movement of said bearing means relative to said element during lifting of said element, a bell housing surrounding said element and said bearing means in upwardly fluid tight relation, the opening of said bell housing being everywhere below any opening in said bearing member, and said bearing member being provided with means for engaging a submerged surface in lateral thrust transmitting relation and upwardly removable from said surface solely by relative movement of said means and said submerged surface.

4. A bell protected bearing for insertion and removal into lateral thrust transmitting relation with a liquid submerged surface, comprising a downwardly open upwardly fluid tight bell housing, a bearing surface within said housing, a bearing element engaging said bearing surface in relatively rotatable bearing engagement within said bell, a lateral thrust transmitting surface on said bearing element adapted to engage in lateral thrust transmitting relation with said submerged surface upon being lowered into engagement therewith, and means limiting axial freedom of motion of said bearing element relative to said bell housing during disengagement of said lateral thrust transmitting surface from said submerged surface.

5. In a bearing unit for locating a rotary shaft relative to another member, a journal surface on said shaft, a protective bell element on said shaft coaxially surrounding said journal surface in radially spaced relation, a bearing sleeve member rotatably engaging said journal surface within said bell element and having an external lateral thrust transmitting surface radially spaced from the internal surface of said bell element, and sleeve retaining means including relatively rotat-

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able portions carried by said sleeve and shaft, said portions being operatively engageable to prevent removal of said sleeve from said journal and bell by axial movement of said sleeve relative to said shaft and bell.

6. In a submersible steady bearing for a rotary element, a cylindrical bearing surface on said element coaxial with the axis of rotation of said element, a bell housing on said element surrounding said bearing surface, a bearing sleeve engaging said bearing surface in rotatable relation within said housing, said bearing sleeve having a lateral thrust transmitting surface adapted to engage a suitably formed steady rest in lateral thrust transmitting relation, and retaining means carried by said sleeve and element, said retaining means being operatively engageable to prevent removal of said sleeve from said bell by relative axial movement.

7. In a steady bearing for a rotary element having a vertical axis of rotation, a steady rest having a bearing receiving socket, said element having

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a downwardly open bell housing, a cylindrical bearing surface on said element within said bell housing, a bearing sleeve engaging said bearing surface in rotatable relation within said housing, sleeve retaining means carried by said sleeve and element axially engageable to prevent removal of said sleeve from said bell housing, said sleeve having a lateral thrust transmitting surface engageable in said socket by relative axial movement in lateral thrust transmitting element centering relation.

ALEXANDER J. ROUBAL.

REFERENCES CITED

- 15 The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
714,007	Mittag	Nov. 18, 1902
2,143,373	Gaertner	Jan. 10, 1939