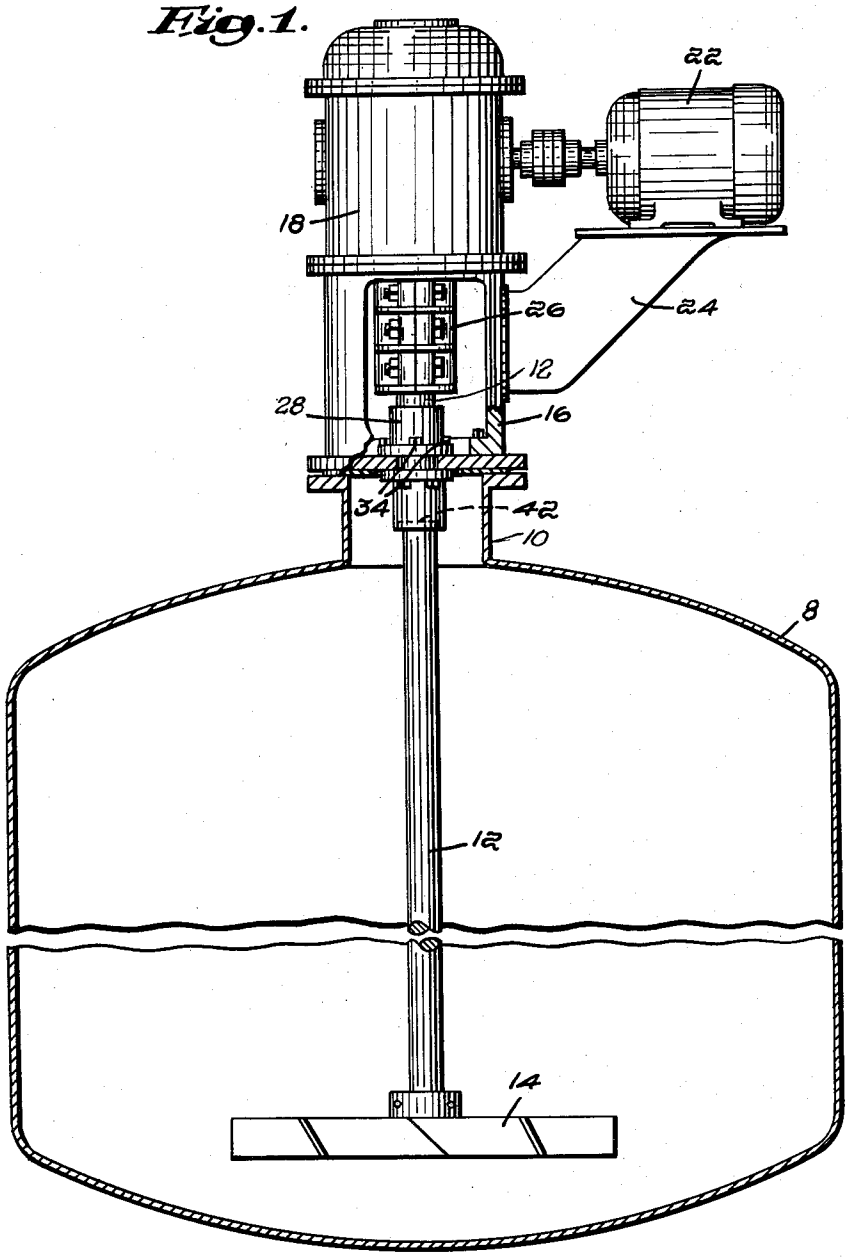
Dec. 24, 1963 J. J. LENNON 3,115,333

APPARATUS WITH SEALED ROTARY IMPELLER SHAFT

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Fig. 1.



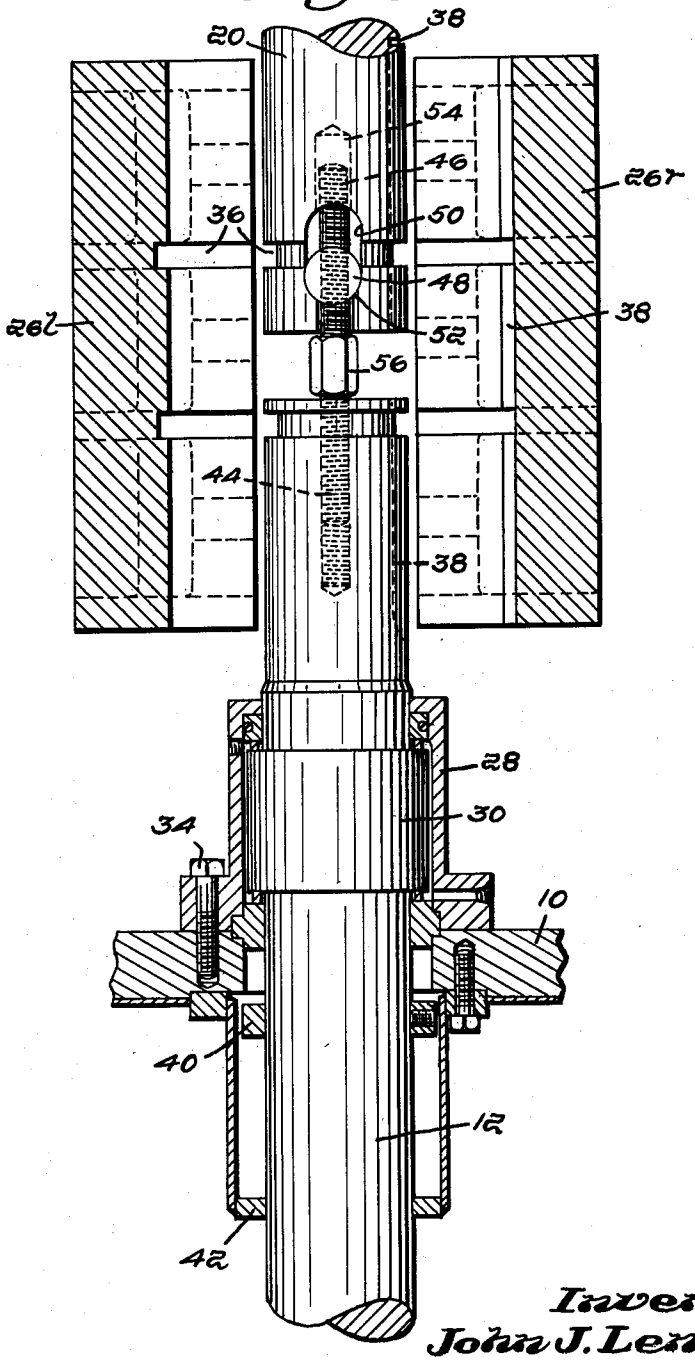
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Fig. 2.



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Fig. 3. Fig. 4. Fig. 5. Fig. 6.

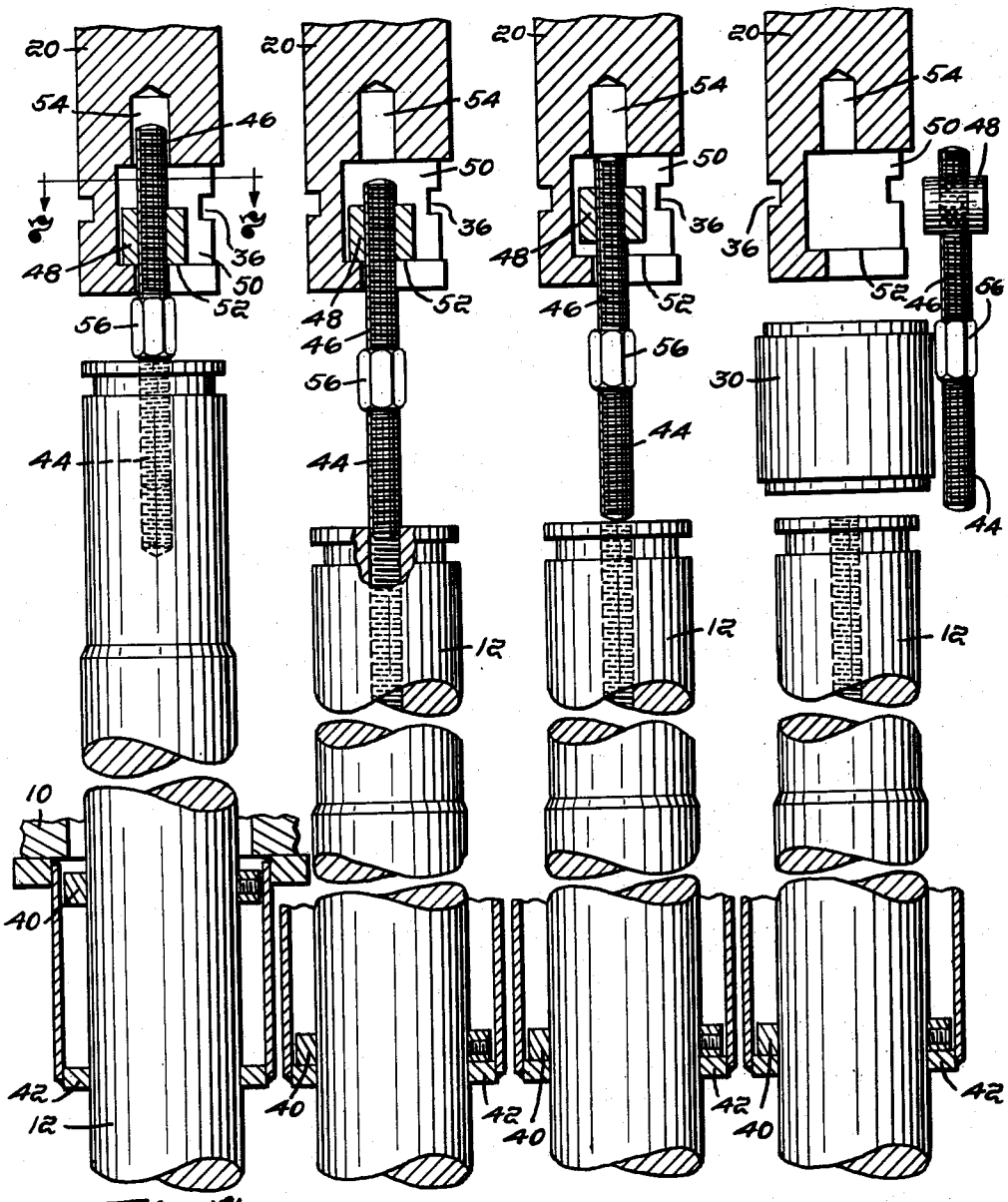
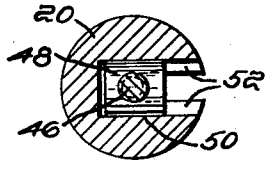


Fig. 7.



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APPARATUS WITH SEALED ROTARY IMPELLER SHAFT

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5 Claims. (Cl. 259—107)

This invention relates to apparatus wherein a rotary impeller operates in a closed container and its shaft is extended externally thereto for driving. An example is an agitator or stirrer for working in liquids or semi-liquids and an exemplary form of such a machine will be here illustrated and described.

The point of entry of the shaft to the container usually must be sealed. It is desirable to use a seal of the "radial" type wherein unbroken rings pertaining to the shaft and the container respectively overlap in joints circumferential to the shaft. Obviously such unbroken rings must be assembled over an end of the cylindrical shaft and in large apparatus this must be done in the field in installation and when the seals require replacement or repair.

The object of the invention is to provide a construction which makes the assembly and disassembly very easy.

The invention will be well understood from the following description of the illustrative embodiment shown by way of example in the accompanying drawings wherein:

FIG. 1 is a part elevation and part section showing container having an impeller therein which impeller is mounted on the end of a depending shaft driven from an aligned power shaft mounted above the container. Most of the container is broken away leaving only portions of the top and bottom which are sectioned;

FIG. 2 shows the adjacent ends of the driving shaft and the impeller shaft in elevation with certain adjacent parts in section and certain parts separated from the shaft and also in section;

FIGS. 3, 4 and 5 are fragmentary views, partially in section, showing successive positions which the shaft sections take when a seal is to be disassembled from or assembled with the impeller shaft. The "inside" of the seal is not shown in the figures. The shafts are displaced 90 degrees from the position of FIG. 2;

FIG. 6 is a similar view showing the connecting and manipulating means between the ends of shafts removed and the seal positioned between them ready to be moved downwardly over the end of the impeller shaft; and

FIG. 7 is a section on the line 7—7 of FIG. 3.

Referring to FIG. 1 of the drawings, I there show in a fragmentary manner the upper portion of a closed tank 8 into which extends from above a shaft 12 (broken away in the figure) carrying at its lower end an impeller 14 in the nature of a fan, pump rotor, turbine wheel or the like, which usually operates near the bottom of the tank. The greater portion of the shaft 12 is broken away. Mounted on the cover plate 10 forming a portion of the top wall of the tank is a frame 16 which supports a casing 18 containing the bearings for the driving shaft 20 (see FIG. 2, not shown in FIG. 1) and the gearing by which it is driven from electric motor 22 carried by bracket 24. The driving shaft 20 is connected to the driven impeller shaft 12 by a coupling 26 of the split sleeve type. The coupling is of conventional form and comprises two parts 26–*l* and 26–*r*, shown separated in FIG. 2. These parts and the shaft have annular grooves 36 to receive sectional locking rings (not shown) to lock together the shaft sections in the axial direction and keyways 38 to receive a longitudinal key (not shown) to provide the driving connection. In the present instance the

longitudinal keyways are located 90 degrees away from the recess 50, hereinafter referred to. This is not necessary but it facilitates the illustration of the separated sections of the coupling in FIG. 2. When the coupling sections are removed as shown in FIG. 2 the opposed ends of the shaft 20 and 12 are exposed with a short distance between them.

Below the coupling, where the shaft 12 enters the tank, a radial seal is provided. The seal is in general of well known construction and it is unnecessary to illustrate in detail the cooperating rings referred to in the second paragraph of this specification and the immediate means for relatively positioning them. It is enough to say that as herein disclosed the seal is a self-contained unit organized within an exterior sleeve 30, the unit being shown in position in FIG. 2 and withdrawn from over the end of shaft section 12 in FIG. 6. The unit when in position is received within a housing element 28, shown in section in FIG. 2, which housing is secured to the container wall as by the screws 34. The internal construction of a radial unit seal such as is herein contemplated is shown in detail in connection with an agitator drive assembly of the kind herein disclosed in FIG. 6 of the Brumagim Patent 2,627,171, of February 3, 1953, and FIG. 3 of the Boutros and Dykman Patent 2,911,240, of April 3, 1959.

Referring to FIG. 2 the shaft 12 may be provided at a point just below the seal, with a shoulder or collar 40, permitting the shaft when freed from the coupling to move downwardly a short distance until this shoulder engages an annular support 42 suspended from the top of the container wall. This arrangement is not new and it prevents the shaft, when freed from its overhead support, from "taking charge," to use the sailor's locution.

However, the shaft and the impeller is a ponderous and unwieldy unit. The construction which will now be described provides for easy handling of the shaft 12 and for opening out a clearance between the same and the lower end of the driving shaft 20 through which the seal may be introduced or withdrawn and longitudinally moved to or from the end of the shaft 12. An important feature of the design is that it requires only a very short distance between the bearings of the driving shaft and the top of the driven impeller shaft, and it is highly desirable to have as little unsupported shaft outward of the bearings as is permissible. It will be understood that, while a portion of the seal is attached to the shaft at its location it is not a bearing in the sense that it lends any substantial support to the shaft.

In FIG. 2 there are shown the sections 26–*l* and 26–*r* of the sleeve coupling 26 separated and moved to one side and in practice they are removed and placed at some convenient, not too distant, location. This exposes the opposed ends of shafts 20 and 12 with a short distance between them. In accordance with the invention a screw is provided, depending from driving shaft 20, tapping into the upper end of the impeller shaft 12 and supporting the latter in its normal raised position when the coupling is removed. This screw and its associated parts provide for the manipulation of the shafts in a manner to be described, so that the upper end of the shaft 12 will be exposed with free space above and around the same to permit the seal to be moved in from one side and telescoped over the end of the shaft, after which the shafts are moved back to their original relative positions, the housing 28 secured at the top wall of the container, and the coupling sections 26 replaced.

Referring particularly to FIGS. 3, 4 and 5, the particular form of screw mechanism illustrated comprises a lower threaded shank 44 tapping into the end of impeller shaft 12 for a distance somewhat greater than the normal distance between the shoulder 40 and the support 42. This screw is suspended from the driving shaft by a swivel-

ing connection permitting its rotation, and also a sliding movement axially of the driving shaft, and the construction herein shown for obtaining this capacity comprises a second threaded shank 46 (the thread of which may be of opposite hand to that of screw 44), which shank 46 traverses a nut 48, herein of cylindrical form, which is received in a recess 50 opening to at least one side of the shaft and of substantially greater axial extent than the depth of the nut, so that the nut is held against rotation but can slide up and down in the recess. The end of the recess has flanges 52 between which the screw 46 passes and which support the nut 48. In other words, when viewed as seen in FIG. 2 the end of the shaft has an undercut groove therein. It might be termed a T-slot, although the word is not particularly happy, because the stem of the T corresponding to the space between the flanges 52 is much shorter than the vertical dimension of the crossbar of the T represented by the larger portion of the recess 50. An axial bore 54 herein extends upwardly from the recess in which under certain circumstances the end of screw 46 could extend. There is no threaded engagement however.

At a suitable point this compound screw 44, 46 is arranged to receive a turning tool such as a wrench and there is herein illustrated a hexagon head 56 which is exposed for manipulation when the sections of the coupling are removed.

Referring now to FIG. 3, this shows the relative positions of the parts after the coupling 26 is removed. A wrench is applied to the head 56 and the screw 44 turned in a direction which tends to unscrew it from shaft 12. This is permitted by the swiveling suspension in the shaft 20. As the shaft 12 is suspended by the screw it descends as the screw is turned. If the companion screw 46 is of the other hand the descent of the shaft for each turn will be the sum of the leads of the two screws and the head 56 will descend half the distance which the shaft descends, assuming that the leads of the two threads are the same.

When the shoulder 40 reaches the support 42 the shaft 12 stops (FIG. 4). On continued rotation in the same direction we have a right and left screw tending when turned to push two elements with which it is engaged apart. As the only easily movable member is the nut 48 that moves upwardly while the screw 44 backs out from the shaft 12 with upward movement of the head 56.

We thus come to the position of FIG. 5 where a space is opened between the ends of the two shafts. If the recess 50 were of sufficient depth the screw 44 could be moved up manually to increase further the clearance beneath its end and the shaft 12 although in the example shown, wherein the turning means 48 increases the diameter of the screw, this movement would be checked when the head 56 reached the bottom of the shaft. Also it is desirable not to make the recess 50 unduly long. Since however in the form shown the recess 50 and the passageway between its flanges 52 are open to one side, the compound screw 44—46, once freed from the shaft 12, and its nut 48, may be simply withdrawn toward the right in FIG. 5, withdrawn as illustrated in FIG. 6, and placed to one side.

In FIG. 6 there is shown in outline the inside 30 of the seal in line between the two shafts showing how it can be inserted laterally and then moved downwardly from the position shown, passing easily onto the reduced upper end of the shaft 12 and the upper portion of the housing 28 thereafter similarly introduced from the side and telescoped over 30. The parts might be so designed as to permit these parts or their equivalents to be inserted as a single unit. The screw mechanism may be then put back and turned to restore the parts to the position of FIG. 3 and the coupling sections 26–*l* and 26–*r* replaced and secured. The mechanism is very simple and compact and operates quickly and easily.

I am aware that the invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and I therefore desire the present embodiment to be considered in all respects as illustrative and not restrictive, as is in fact clear in several matters from the description itself. Reference is to be had to the appended claims to indicate those principles of the invention exemplified by the particular embodiment described and which I desire to secure by Letters Patent.

I claim:

1. An improved drive shaft assembly for an installation wherein an impeller-carrying shaft extends from above into a container and is packed relatively to the wall of the container by a self-contained seal of the radial type and wherein the shaft has a shoulder by means of which it may be supported when lowered from its normal operating position by cooperation of the assembly with a supporting surface, the improved assembly comprising in combination with and cooperation with such impeller-carrying shaft, a relatively fixed driving shaft in spaced vertical alignment with the impeller shaft, a longitudinally divided coupling uniting the shafts, the sections of which are removable laterally, a screw rotatably suspended from the end of the driving shaft and tapping into the opposed end of the impeller shaft, the screw being accessible in the space between the shafts when the coupling is removed to permit it to be rotated to lower by its action the shoulder on the impeller shaft to the supporting surface for the same, the suspension of the screw in the driving shaft including a clearance providing for upward motion of the screw so that it may thereafter be entirely backed out from the impeller shaft and moved as a whole away therefrom to provide a vertical clearance between the two shafts.

2. An assembly as set forth in claim 1 wherein the suspension of the screw in the driving shaft comprises threads of opposite pitch to those in the impeller shaft.

3. An assembly as set forth in claim 1 wherein the suspension of the screw in the driving shaft comprises a captive nut non-rotatable but vertically slidable relative to the shaft and a threaded shank cooperating therewith.

4. An assembly as set forth in claim 1 wherein the suspension of the screw comprises a nut and a recess in the end of the driving shaft having side walls of substantially greater axial extent than the depth of the nut, the walls providing bearings for the sides of the nut preventing rotation of the same while permitting sliding movement, the end of the recess having flanges underriding the end of the nut, the recess being open on at least one side of the driving shaft so that the screw, when released from the impeller shaft may be removed from the driving shaft by a radial movement.

5. An improved drive shaft assembly for an installation wherein an impeller-carrying shaft extends from above into a container and is packed relatively to the wall of the container by a self-contained seal of the radial type and wherein the shaft has a shoulder by means of which it may be supported when lowered from its normal operating position by cooperation of the assembly with a supporting surface, the improved assembly comprising in combination with and cooperation with such impeller-carrying shaft, a relatively fixed driving shaft in spaced vertical alignment with the impeller shaft, a longitudinally divided coupling for uniting the shafts, the sections of which are removable laterally, an undercut groove in the end of the driving shaft opening laterally through at least one side thereof, a normally axially positioned screw projecting through the narrow portion of the groove, an enlargement carried by the screw and normally located in the larger portion of the groove to suspend the screw, the screw being tapped into the end of the impeller shaft for a distance greater than the normal space between the shoulder and the supporting surface, the axial depth of the enlarged portion of the groove being such as to provide a clearance above the screw and the enlargement at least slightly greater than the difference between said distance and space, and

tool engaging means associated with the screw and accessible in the normal space between the shafts for receiving a turning tool.

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