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CENTRIFUGAL PUMP

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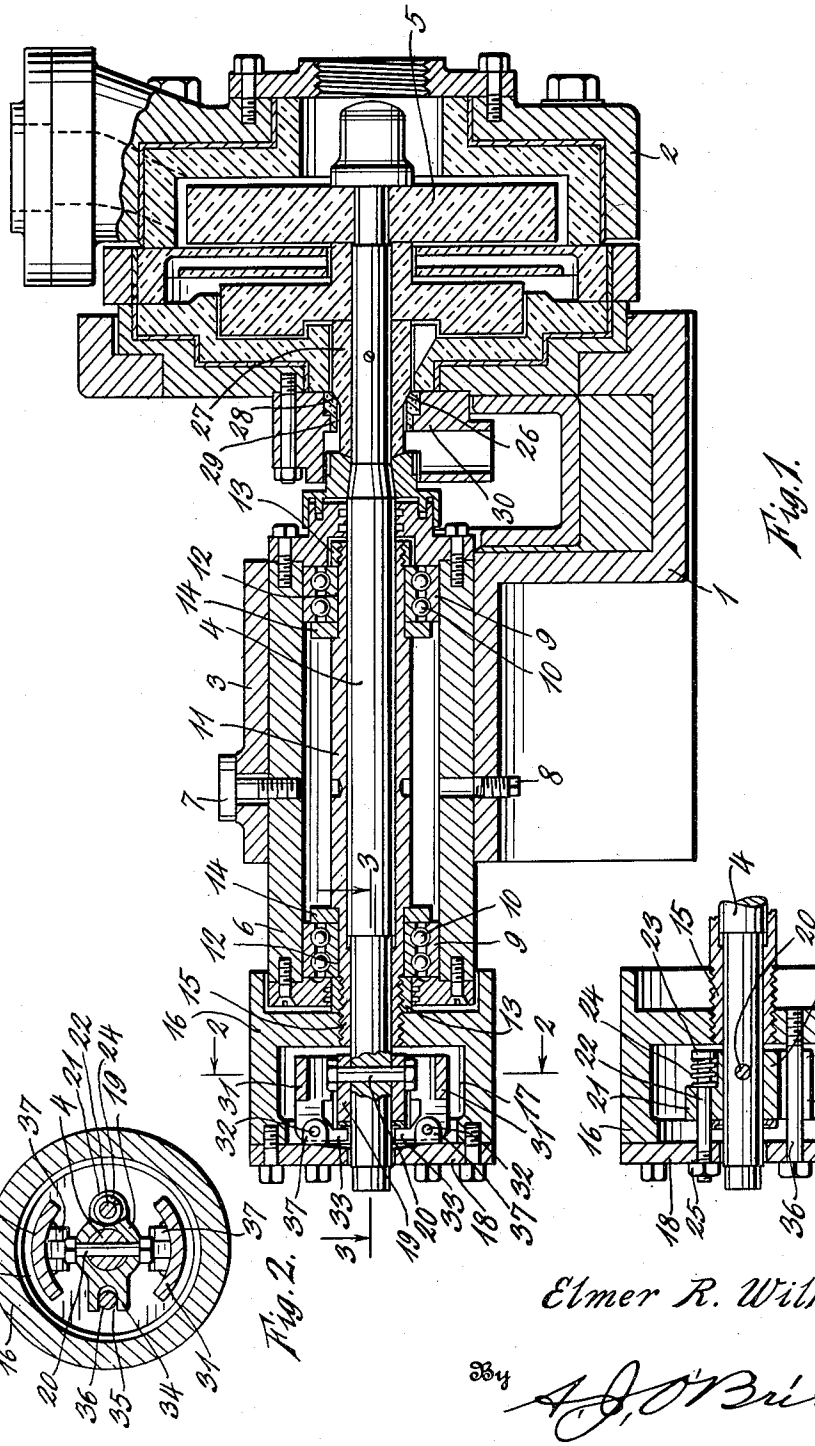


Fig. 1.

Fig. 2.

Fig. 3.

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CENTRIFUGAL PUMP

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This invention relates to improvements in centrifugal pumps of the type employed for pumping acids or other liquid or for pumping water containing sand and grit.

Pumps of this type employ an impeller that is located within an impeller housing and rotated by means of a shaft to which the impeller is attached. In order to prevent excessive wear of the shaft it is necessary that the shaft where it enters the impeller housing shall not be in contact with the surface of the opening through which it passes during operation, and it is equally important that this opening shall be closed as soon as the pumps stop operating as otherwise the liquid contained in the impeller chamber will flow out of the housing.

Pumps of the type referred to have been provided with means for automatically sealing the opening about the impeller shaft when the latter stops rotating and for rendering the sealing means inoperative when the shaft is rotated above a predetermined speed. The sealing means usually takes the form of a movable member controlled by a centrifugal governor operated by the shaft.

Applicant has found that if the opening in the impeller housing wall is provided with a valve seat and the shaft provided with an enlargement which cooperates with the valve seat so as to form a seal when the shaft is in one position that he can employ a centrifugal governor, which is rotated by the shaft, for moving the latter in the direction of its axis and by this means the opening will be automatically sealed when the shaft stops rotating and unsealed when the shaft is rotated above a predetermined speed.

It has been found that when a rotating shaft is reciprocated in its bearings, it requires a greater amount of force to move it than if it were reciprocated in a bearing with respect to which it does not rotate. In order to take advantage of this discovery, applicant mounts the impeller shaft in a tubular member with respect to which it can reciprocate but with respect to which it does not rotate and mounts the tubular member in bearings. The impeller shaft and the tubular member can thus rotate as a unit and the shaft may be reciprocated with the expenditure of the least amount of force.

In order to more clearly describe this invention so that it can be readily understood, reference will now be had to the accompanying drawing wherein one embodiment thereof has been illustrated and in which:

Fig. 1 is a longitudinal vertical section through a centrifugal pump constructed in accordance with the present invention;

Fig. 2 is a section taken on line 2—2, Fig. 1, and shows the construction of the centrifugal means employed for moving the shaft; and

Fig. 3 is a section taken on line 3—3, Fig. 1.

Numeral 1 designates the base of the pump and numeral 2 designates the impeller housing, while numeral 3 represents a tubular portion of the base in which the bearings and parts associated with the impeller shaft are mounted. The impeller shaft has been designated by numeral 4 and has secured to it within the impeller housing a porcelain impeller which has been designated by numeral 5, but which will not be described in detail for the reason that the particular type of impeller is immaterial.

Located within the part 3 is a cylindrical member 6 that is held in place and prevented from longitudinal movement within member 3 by means of screws 7 and 8. Located within member 6 near each end thereof, are ball races 9 that form part of a ball bearing, the balls of which have been indicated by numeral 10. A tubular member 11 has its ends provided with ball races 12 that cooperate with the balls 10 and the ball races 9 to form bearings in which the tubular member 11 rotates. The ball races 12 are held in place by means of threaded collars 13, which are secured to the ends of the tubular member 11 and serve to force the ball races against the rings 14 that form an abutment for the inner ends of the ball races. The outer end of tubular member 11 is provided with a threaded extension 15, to which a cylindrical housing or pulley 16 is attached in the manner shown in Figure 1. This housing has a central chamber 17 and has its outer end closed by means of a plate 18, that is secured in place by means of bolts. The shaft 4 extends entirely through the inte-

rior of member 16 and terminates outside of plate 18 in the manner shown in Figure 1. Secured to the shaft 4 is sleeve 19 that is held against longitudinal and rotary movement with respect to the shaft by means of pin 20. Sleeve 19 is provided on one side with a lug 21, which is perforated for the reception of a bolt 22. This bolt is provided with a head 23 and carries a spring 24 that is located between the head 23 and the lug 21 in the manner shown in Figure 3. The bolt extends through an opening in plate 18 and is provided with a nut 25. This nut is adusted so as to compress the spring 24 to such an extent that it will normally move the shaft 4 towards the left so that the conical shoulder 26 on the porcelain member 27 that is attached to the shaft will engage the correspondingly inclined conical surface 28 of the carbon member 29 that is secured in the ring 30 in the manner shown in Figure 1. When the shaft is in this position, the opening between surfaces 26 and 28 will be sealed and this is the position that the parts occupy when the pump is stationary. When the pump starts rotating and begins to function as a pump, it is necessary to move the shaft towards the right so as to separate the surfaces 26 and 28 and this is accomplished by means of a centrifugal device which comprises two weights 31, that are pivoted at 32, and are each provided with an arm 33 that extends towards the shaft and engages the end of the sleeve 19 so that the centrifugal force exerted by these weights when the shaft rotates exerts a force which moves the shaft towards the right with respect to tubular member 11 and this opens the valve formed by surfaces 26 and 28.

For the purpose of preventing relative rotation between tubular member 11 and shaft 4, sleeve 19 has been provided with a lug 34 that extends from the side opposite from lug 21 and this lug is provided with a slot 35 for the reception of bolt 36. Bolt 36 passes through an opening in plate 18 and has a threaded connection with the flange of the pulley 16 in the manner shown in Figure 3 and therefore prevents the shaft from rotating in tubular member 11 as above intimated.

In the drawing the pivots 32 have been shown as secured to inwardly extending ears 37 carried by the plate 18 but they may be pivotally attached to the material of part 16 if desired.

Let is now assume that the parts are in the position shown in Fig. 1 and that the shaft 4 is rotated by means of a proper source of power until it attains a speed approximately that which is required for successful operation. In the beginning the conical surface 26 rests against the corresponding surface 28 and forms a seal but as the parts increase their speed of rotation, the force exerted by the weights 31 move the shaft 4 towards the right, thereby separating surfaces 26 and 28, which will remain in separated or spaced relation until the pump stops. When the speed of the pump is reduced the force exerted by the centrifugal weights will, of course, be correspondingly reduced and the action of spring 24 will move the shaft 4 towards the left so as to bring surface 26 against surface 28 and seal the impeller chamber.

It has been pointed out above that when an attempt is made to move an impeller shaft like shaft 4 in the bearings in which it rotates, that a much larger amount of force is required than when the same shaft is moved in a tubular member with which it is nonrotatably connected. It is to this construction therefore that this invention more particularly relates and it is applicant's intention to claim specifically the construction comprising a tubular member rotatably secured to a stationary base member and having a shaft extending longitudinally therethrough and held against relative rotation, but free to move longitudinally and means for normally holding it in a predetermined position, together with means for moving it away from the normal position when it rotates and to claim broadly the construction for opening and closing the opening by reciprocating the impeller shaft, either in its bearings or in a tubular member, as illustrated, although a centrifugal governor has been shown as the means for reciprocating the shaft, this is merely illustrative, as any other suitable means may be employed.

Ring 28 has been described as being made of carbon and attention is called at this place to the important part played by this material. When the pump is stationary the adjacent surfaces of members 27 and 28 are in contact so as to form a seal, and they remain in contact until the shaft has attained sufficient speed to make the centrifugal governor, or other means, effective for the purpose of moving the impeller shaft. During the initial rotation, a large amount of friction would be developed between the adjacent surfaces of this seal, unless they were separated by a film of lubricating material or were made of such materials that have a small coefficient of friction. Carbon and porcelain have been found to develop only a small amount of friction due, perhaps, to the lubricating qualities of the carbon which may be in the amorphous form, such as graphite. Carbon is also resistant to the action of acids and therefore it is of great importance in pumps used for this purpose as ordinary lubricants cannot be employed owing to the action of the acids that spoil their lubricating properties. The use of a carbon member as one part of the seal is considered to form an important part of this invention, as well as the combination of carbon and porcelain in a pump used in connection with acids or other liquid that

have a deleterious effect on metals and on ordinary lubricants.

Having described the invention what is claimed as new is:

1. In a device of the class described, a support, a tubular member rotatably secured to the support, a shaft slidably mounted in the tubular member, means for preventing relative rotation between the shaft and tubular member, resilient means for exerting a force tending to move the shaft longitudinally with respect to the tubular member and a centrifugal device for moving the shaft longitudinally against the force of the resilient means.

2. In a device of the class described, in combination, a stationary supporting member, a tubular member rotatably secured to the stationary member, a shaft slidably mounted in the tubular member, means for preventing relative rotation between the shaft and the tubular member, means comprising a spring for exerting a force tending to move the shaft longitudinally with respect to the tubular member, said stationary member having a portion provided with an opening through which one end of the shaft extends, the shaft having an enlarged portion adapted to engage the sides of the opening to form a seal, means for normally holding the shaft with the enlarged portion in engagement with the side of the opening and means for moving the shaft longitudinally in the opposite direction when it is rotated.

3. In a centrifugal pump comprising a casing having a runner chamber provided with an opening for the reception of an impeller shaft, said shaft being smaller than the opening, an impeller carried by the shaft and means carried by the shaft for closing the opening when the shaft is in one position, a supporting member rigidly connected with the casing, a tubular member rotatably connected with the supporting member, said shaft extending through the tubular member, the shaft and tubular member being relatively movable in the direction of their axes, means for preventing relative rotation between the shaft and the tubular member, means comprising a spring for moving the shaft into opening closing position and means comprising a centrifugal device for moving the shaft away from opening closing position whenever the speed of rotation attains a predetermined value.

4. In a device of the class described, in combination, a stationary supporting member, a tubular member rotatably secured to the same, a shaft slidably connected with the tubular member, means for preventing the shaft from rotating relative to the tubular member, a casing connected with the stationary member, said casing having an opening through which the shaft passes, said opening being larger than the shaft, said shaft having an enlarged portion adapted when in one position to seal the opening through which the shaft passes, means for moving the shaft longitudinally to sealing position when the shaft is stationary and means for automatically moving the shaft to unsealing position when it attains a predetermined speed of rotation.

5. In a device for shifting the position of a shaft while it is rotating, comprising a stationary member, a tubular member rotatably secured to the stationary member, a shaft located within the tubular member, a housing secured to the end of the tubular member, a sleeve secured to the end of the shaft, a plurality of governor weights pivotally secured to the housing, each of said weights having an arm in engagement with the sleeve, means for rigidly attaching the sleeve to the shaft, means for preventing relative rotation between the shaft and the sleeve and means comprising a spring for normally holding the shaft in a predetermined position while permitting it to be moved by the action of the governor, a casing having an opening through which the shaft passes, said shaft being smaller than the opening and an enlarged portion secured to the shaft, said enlarged portion sealing the opening when the shaft is in normal position.

6. A centrifugal pump comprising a base member having a housing provided with an impeller chamber, said housing having an opening, a tubular member mounted for rotation on the base, said tubular member being axially aligned with the opening, a shaft extending through the tubular member, said shaft being smaller than the opening in the housing and extending through the same whereby a space is formed between the side of the opening and the shaft, means carried by the shaft for sealing the opening when the shaft is in one position, means comprising a spring for normally holding the shaft in sealing position and means for sliding the shaft axially in the tubular member from sealing to unsealing position.

In testimony whereof I affix my signature.

ELMER R. WILFLEY.