Feb. 1, 1938. B. A. SWENNES 2,107,090

WATER PUMP

Filed Jan. 10, 1935

Fig. 1

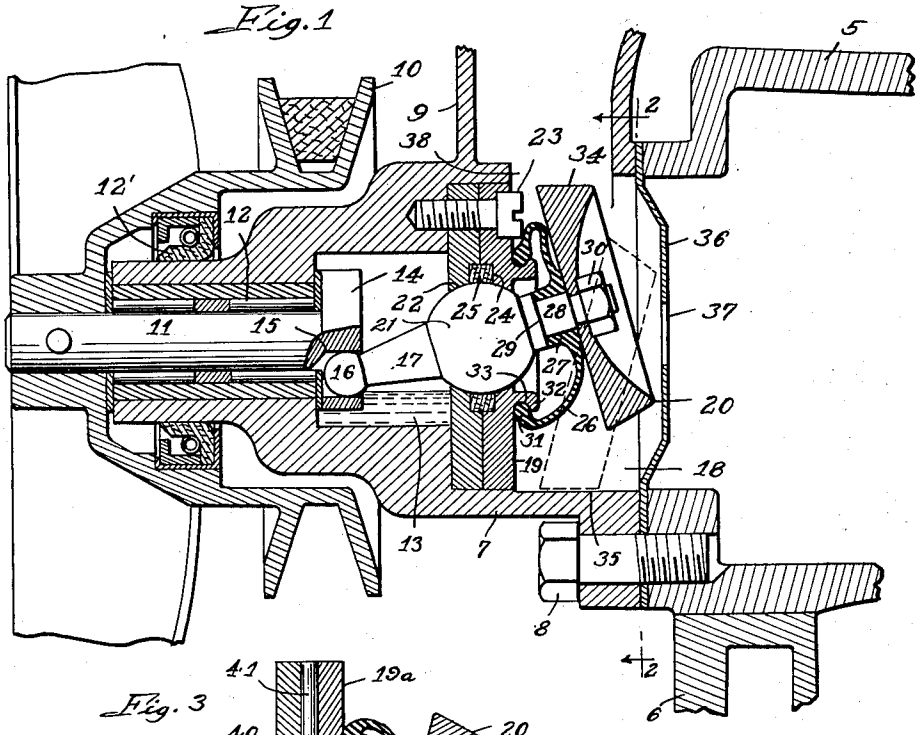


Fig. 3

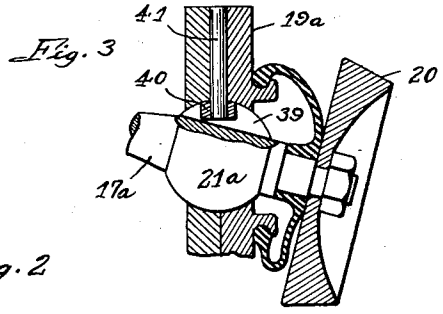


Fig. 4

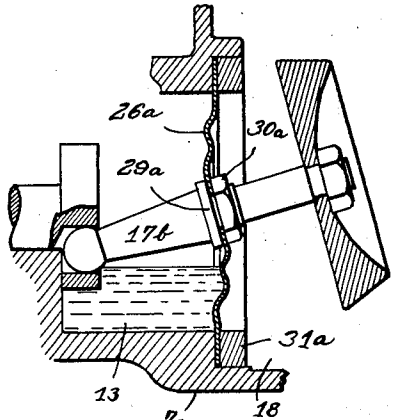
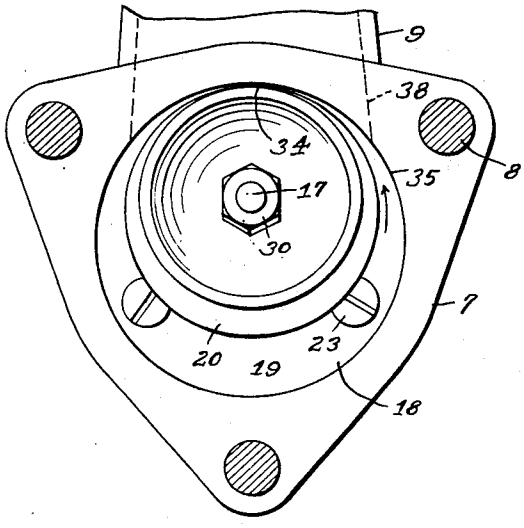


Fig. 2



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2,107,090

WATER PUMP

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Application January 10, 1935, Serial No. 1,195

23 Claims. (Cl. 103—111)

This invention relates to pumps generally and more particularly a water pump for automobile engines.

In my earlier application, Serial No. 675,376, I disclosed a packingless water pump in which a partition wall provides a bearing for a non-rotating wobble shaft or nutator, and a boot or diaphragm cooperates with the partition and shaft to prevent water leakage. In that construction, however, an impeller rotatably mounted in the impeller chamber is operated through a driving connection with the end of the nutator. It is the principal object of my present invention to provide a pump of the same general type but which operates more easily and, consequently, with much less wear, by reason of the mounting of the impeller directly upon the end of the nutator, thus eliminating the impeller bearing and the bearing connecting the nutator and impeller, and correspondingly reducing power consumption and wear of parts.

The pump impeller in accordance with the present invention is in the form of a frusto-conical swash plate of the proper diameter in relation to the diameter of the impeller chamber that is concentric with the axis of nutation of the impeller, so that very little clearance is left between the impeller and the walls of the chamber in operation, experiment having shown a decided increase in output with reduction in the clearance. The outlet from the impeller chamber can be radial but the inlet is preferably in front of the impeller and on the axis of nutation.

The invention is illustrated in the accompanying drawing, in which—

Fig. 1 is a vertical section through a portion of an automobile engine block showing a pump thereon made in accordance with my invention;

Fig. 2 is a cross-section on the line 2—2 of Figure 1 looking toward the impeller as indicated by the arrows;

Fig. 3 is a fragmentary sectional detail of the nutator bearing showing a modified or alternative construction, and

Fig. 4 is a section corresponding to a portion of Figure 1 but showing a further modification in the nutator mounting.

Similar reference numerals are applied to corresponding parts throughout these views.

Referring to Figs. 1 and 2, the numeral 5 designates a head on an engine block 6 having a pump housing 7 bolted on the front end thereof as at 8. The pump housing has a radial, upwardly extending neck 9 for discharge of water adapted for connection in the usual way with the automobile radiator. Now, in accordance with the disclosure in my earlier application, the fan pulley 10 is mounted on a stub shaft 11 received in a bearing 12 provided in the outer end of the housing 7 in communication with the oil chamber 13, and a drive disk 14 provided on the inner end of the shaft 11 has a hole 15 provided therein to receive the ball-shaped end 16 of the non-rotatable wobble shaft or nutator 17. In other words, the shaft 11 instead of extending through a suitable stuffing box into the impeller chamber 18 to operate an impeller therein terminates in the oil chamber 13 where it is operatively connected with the front end of the nutator 17, and the latter extends through a partition 19 into the impeller chamber 18 to operate the impeller 20. Any lubricant finding its way along the shaft 11 through the bearing 12 from the oil chamber 13 is trapped by the retainer 12' which is mounted snugly on the cylindrical end of the pump housing, as shown. In that way loss of lubricant is reduced to a minimum and the oil chamber when partially filled at the time of assembly should not require any refilling, although, of course, an oil filler plug or cup may be provided on the housing directly behind the fan pulley if so desired. The nutator 17 has a ball-shaped enlargement 21 intermediate its ends universally fulcrumed in a socket or bearing 22 at the center of the partition 19. The latter separates the oil chamber from the impeller chamber and is made in two parts arranged to be assembled on the ball portion 21 from opposite sides and to be fastened by screws, as at 23, in the housing 7. Recesses 24 are provided in the two halves of the partition to accommodate a leather or felt washer 25 to retain lubricant and thus protect the boot 26 from too free contact with the oil while also assuring lubrication of the ball portion 21 by the lubricant retained in the washer, even though the oil level in the chamber 13 might be low. The boot or sleeve 26 is preferably, though not necessarily, molded in one piece of rubber, and more particularly a synthetic thermo-plastic rubber material such as thiokol, derived from the inter-action of compounds of olefins with soluble polysulfide, which is unaffected by oil and does not suffer any ill effects if subjected to the action of hot water and anti-freeze solutions. However, any other flexible material suitable for the present purpose may be employed. The boot constitutes a seal to prevent access of water from the impeller chamber 18 to the bearing 22. The boot 26 is made small enough at one end 27 to fit tightly on the reduced portion 28 of the nutator, and is arranged

to be compressed against the shoulder 29 on the nutator when the nut 30 threaded on the end of the nutator is tightened to clamp the impeller 20 in place. The other end of the boot is of larger diameter and has an enlarged rim 31 arranged to be stretched to pass over the neck 32 to fit in the annular recess 33 thereon and provide a water-tight joint. A small boot is preferred to a larger diaphragm because it can be provided at much lower cost, and offers less resistance to the motion of the nutator.

In operation, assuming that the pulley 10 has a fan belt working thereon, the rotation of the disk 14 causes the nutator 17 to have circular oscillation or what is known as nutating motion, that is, the forward end of the nutator moves in a circle, and this circular motion results in a corresponding circular motion of the rear end of the nutator. The nutator merely fulcrums universally intermediate its ends in the bearing 22; it does not revolve. Consequently, the problem of preventing leakage is greatly simplified; the boot 26 need only hug the nutator and the partition 19 tightly enough to provide a static seal as distinguished from the old rotary type shaft seals. The seal is not only simpler to make but much more effective and really positive. When the oil chamber 13 is filled to the level of the lower portion of the bearing 12 there is ample lubrication for the shaft 11 and nutator 17 for smooth and quiet operation with minimum wear.

The impeller 20 is in the form of a frusto-conical swash plate, the periphery 34 of which remains parallel with the inside wall 35 of the impeller chamber 18 in the nutating motion of the impeller, as indicated in dotted lines in Figure 1. Very little clearance is left between the periphery of the impeller and the inside wall of the chamber. Experiment showed a decided increase in the pump's output upon reduction in the clearance. For example, whereas one gallon per minute was secured with a $\frac{1}{8}$" clearance, 2.86 gallons per minute was secured with a .015" clearance. The impeller chamber 18 has a partition 19 as its front wall and a plate 36 as its back wall, the plate being fastened in place between the cylinder head 5 and pump housing 7 as shown. A center hole 37 provided in the plate 36 serves as a water inlet for the chamber 18. The hole is preferably small in relation to the diameter of the circle described by the impeller. For example, a 1" diameter was found to give the good results above referred to with a pump in which the impeller described a circle of a $1\frac{3}{4}$" diameter. When the diameter of the hole 37 was reduced to a 15/16" diameter, less water was pumped, and on the other hand, when the diameter was increased to $1\frac{3}{4}$", very little output was secured as compared with the output stated above. The output of 2.86 gallons per minute compares very favorably with the output of pumps in common use today and operated at similar speeds; one of the most widely used pumps has an output of only .468 gallon per minute. In the event the output of the present pump is more than is desired, it is obvious that one may regulate its performance by simply changing to a different sized hole at 37. Thus the same pump may be used on different engines having different requirements as to pump ratings, by merely employing different plates 36 with the proper sized holes 37. While I have shown an offset in the plate 36 to provide operating clearance for the impeller 20, it should be understood that a plain plate may be employed by simply setting the bearing 22 farther forward relative to the plate.

The operation of the special impeller herein disclosed is not understood well enough to make it proper to offer a definite theory of operation. Apparently when the impeller 20 is in the uppermost position shown in Figs. 1 and 2, in which it more or less seals off the outlet 38 in the neck 9, there is a crescent-shaped slug of water below the impeller which in the nutating motion of the impeller, in which it describes a circle, moving in the direction of the arrow in Fig. 2, is displaced in the direction of the arrow from the impeller chamber 18 into the neck 9, more water being at the same time drawn in continuously through the inlet 37 to take the place of the water displaced. There is no perceptible pulsation but instead a fairly steady flow in the operation of the pump at substantially constant speed.

The construction disclosed in Fig. 3 shows a partition 19—*a* in connection with a nutator 17—*a* in which a longitudinal slot or keyway 39 is provided in the ball portion 21—*a* for reception of a roller 40 carried on a radial pin 41 mounted between the halves of the partition 19—*a*. This is to positively prevent turning of the nutator. I have found, however, that there is actually little or no tendency for the nutator to turn, whatever turning moment is given by reason of friction of the ball 16 in the hole 15 is counteracted apparently by an opposite moment given the impeller 20 by the skin friction of the water in the impeller chamber 18 against the periphery of the impeller.

In Fig. 4 a diaphragm 26—*a* is shown in lieu of the partition 19 and boot 26 serving both as a support for the nutator 17—*b* and as a seal, the diaphragm being clamped at its center on a shoulder 29—*a* on the nutator as at 30—*a* for a water-tight seal, and being clamped at its periphery in the housing 7—*a* of the pump by means of a ring 31—*a* for another water-tight seal. The diaphragm may be of rubber, leather, or metal—in fact, any flexible material suitable for the purpose.

It is believed the foregoing description conveys a good understanding of all of the objects and advantages of my invention. While reference has been made to the special adaptability of my invention to use on automobile engines, it will, of course, be understood that the same is applicable to pumps generally, whether it be for the pumping of water or any other liquid or fluid medium. The appended claims have, therefore, been drawn so as to cover all legitimate modifications and adaptations.

I claim:

1. In an automobile engine water circulating pump, means providing an impeller chamber, means providing an oil chamber for lubricating oil, a drive shaft extending into the oil chamber through a bearing communicating therewith for lubrication, a partition separating the two chambers and having a bearing supplied with lubricant from the oil chamber, a wabble shaft universally fulcrumed intermediate its ends in the bearing on the partition and pivotally connected at one end to said drive shaft at a certain radius relative to the axis of rotation of the latter whereby movement is arranged to be communicated to that end of said shaft in a circle to produce corresponding movement of the other end, and an impeller on the other end of said shaft in the impeller chamber, the circular movement of

such other end of the shaft imparting a planetary movement to said impeller.

2. In a water circulating pump for an automobile engine, the combination of a fan pulley shaft supported in spaced relation to a water circulating passage of the engine, a vibratory spindle extending from the fan shaft to said passage and disposed at an angle to the axis of the shaft and pivotally connected at one end to said shaft at a certain radius measured from the axis of the latter, an impeller in the water circulating passage carried on the other end of said spindle, means supporting the spindle intermediate its ends for universal fulcrum motion, said other end of the spindle imparting a planetary movement to said impeller.

3. In a water circulating pump for an automobile engine, the combination with the water circulating passage of the engine, of a housing adapted to be secured to the engine in communication with said passage, a fan pulley shaft supported in said housing, a partition in said housing between the shaft and the passage, said partition having a central bearing, a wabble shaft universally fulcrumed intermediate its ends in said bearing and extending rearwardly from the partition and forwardly from the partition to the fan shaft and pivotally connected thereto for vibratory motion circlewise at both ends, and an impeller on the rear end of said wabble shaft and adapted to be planetated by said wabble shaft coincidental with such circle-wise motion.

4. In a pump, the combination of an impeller chamber, a rotary driven shaft outside the impeller chamber, a supporting bearing for said shaft, a partition between the bearing and impeller chamber, a non-rotating wabble member universally fulcrumed on the partition intermediate its ends and swiveled at its forward end on the drive shaft at a predetermined radius with respect to its axis of rotation, and a fluid impeller mounted on the other end of said wabble member at a predetermined radius with respect to the aforesaid axis of rotation, said impeller being planetated in a circular path about such axis incident to rotation of said shaft.

5. In a device of the class described, a housing having an outer bearing, an impeller chamber, a partition between the impeller chamber and the outer bearing in said housing forming an oil chamber therein, said partition having a second bearing coaxial with but axially spaced from the outer bearing, a pulley shaft received in the outer bearing and carrying a drive pulley on the outer end and a drive member on the inner end, an impeller disposed in the impeller chamber, a wabble shaft mounted for circular oscillation in the second bearing and projecting into the oil chamber for pivotal connection with the drive member and into the impeller chamber for support of the impeller directly thereon, whereby to planetate said impeller in a circular path.

6. A device as set forth in claim 5 including means for preventing rotation of the wabble shaft relative to the partition in the circular oscillation thereof.

7. In a pump, the combination of an impeller chamber and a lubricating chamber, a driving shaft supported in a bearing communicating with the lubricating chamber for lubrication of said bearing, an impeller in the impeller chamber, a non-rotating wabble member disposed at an angle to the driving shaft and pivotally connected therewith at a predetermined radius with respect to the axis of rotation thereof at one end, said shaft causing circular oscillation of the ends of said wabble member incident to rotation of said shaft, said impeller being mounted directly on the other end of said wabble member and given a circular planetary movement by the wabble member while said member is oscillating.

8. In an automobile construction, the combination with an engine head having a water circulating passage therein and an impeller chamber communicating therewith, a rotary pulley shaft supported in axially spaced relation with respect to the impeller chamber, a non-rotating nutating element supported for circular oscillation at a point between the impeller chamber and shaft and connected at one end with said shaft whereby to have circular oscillation without turning, and an impeller mounted directly upon the other end of said member in the impeller chamber, said impeller being given a planetary movement by said member during such oscillation of the member.

9. In a pump, a housing having a substantially circular impeller chamber therein, a nutating shaft projecting into the impeller chamber substantially from the center of one end and arranged to be operated so that the inner end describes a circle in the housing, and an impeller carried on the end of said shaft for planetary motion in the housing, said housing having an inlet for admission of fluid to the other end of said chamber substantially centrally thereof, and an outlet for fluid in the side wall of said chamber.

10. In a pump, a housing having a substantially circular impeller chamber therein, a pump shaft projecting into the impeller chamber substantially from the center of one end and arranged to be operated so that the inner end describes a circle in the housing, and a frusto-conical impeller secured substantially centrally thereof on the inner end of said shaft and adapted to be planetated thereby in the path of such circle, said impeller being of such diameter with relation to the diameter of the circle described by said shaft so that the periphery thereof moves in close relation to the side walls of the impeller chamber, said housing having an inlet for admission of fluid to the other end of said chamber substantially centrally thereof, and an outlet for fluid in the side wall of said chamber.

11. A pump as set forth in claim 10 wherein the impeller is tapered so as to have the full periphery thereof disposed substantially parallel to the side walls of the impeller chamber in all positions occupied by said impeller in the normal operation thereof.

12. In a pump, a housing having a substantially circular impeller chamber therein, a pump shaft projecting into the impeller chamber substantially from the center of one end and arranged to be operated so that the inner end describes a circle in the housing, an impeller carried on the end of said shaft for planetary motion in the housing, and a flexible seal member having a fluid-tight connection at one point with the shaft between the impeller and the end wall of said chamber and having a fluid-tight connection at another point with said end wall to prevent loss of fluid from the impeller chamber while allowing freedom of circular movement of said shaft, said housing having an inlet for admission of fluid to the other end of said chamber substantially centrally thereof, and an outlet for fluid in the side wall of said chamber.

13. A pump comprising a fluid circulating chamber having opposed spaced apart walls, one

of said walls having a fluid intake opening therein and the other of said walls having a bearing socket therein in registry with such opening, an elongated nutating member having a spherical section universally articulated in said socket and end sections disposed respectively interiorly and exteriorly of said chamber, a tiltable disk-like impeller member having a central section connected with the interior end section, said disk-like impeller being in a plane at substantially right angles to the longitudinal axis of said nutating member, and means for imparting force to the exterior end of said nutating member to cause circular vibration of each of the end sections thereof and tilting movement of said impeller member.

14. A pump comprising a fluid circulating chamber having an intake opening, a support member having an anchorage spaced axially of said opening interiorly of said chamber, a vibrating member having a section secured in such anchorage and an end section extending in the general direction of the chamber opening, said anchorage permitting of said vibrator member being vibrated with said end section describing a closed path about the perpendicular axis of the opening, a tiltable disk-like member having a central section secured to the end of said vibrator member and disposed in a plane substantially perpendicular to a line defined by said central section and the anchorage in said support member, and means energizable to cause vibration of said vibrator member and tilting movement of the disk-like member thereon.

15. A pump comprising a fluid circulating chamber having an intake opening, a vibrator stem anchored at a point substantially coincident with the perpendicular axis of said opening interiorly of said chamber, said stem having an end extending in the general direction of such opening from said anchorage and said anchorage permitting of vibration of said stem in a manner pursuant to which the end thereof describes a closed path about the axis of the opening while the anchored section thereof remains substantially coincident with such axis, a tiltable, disk-like impeller member upon the end of said stem and having a central section in operative connection therewith, the disk-like member being disposed in a plane substantially perpendicular to the stem, and means energizable to cause such vibration of the stem and tilting movement of the impeller connected therewith.

16. A pump comprising a fluid circulating chamber having a wall with an intake opening therein, a disk-like impeller member in said chamber, and means for imparting a bodily motion to said disk in a closed path circumscribing the axis of said opening and in a plane parallel to said wall concurrently to tilting said member whereby said member is carried about the interior of the chamber in a manner causing adjacent peripheral edge sections to be successively displaced a maximum distance from said wall and at a maximum distance radially from the axis of such opening while diametrically opposite edge sections are successively carried to a minimum distance from said wall and a minimum distance radially from said axis.

17. A pump having an axis and comprising a fluid circulating chamber having an intake opening registering with such axis, a disk-like impeller member in said chamber, said member being disposed with its center spaced from the pump axis and angularly thereto so that the principal axis of said impeller intersects the pump axis at a point more distant from the intake than the impeller, and means for moving said impeller about the pump axis while constantly tilting said impeller so that the axis thereof continually coincides with such point on the pump axis.

18. A pump comprising a fluid circulating chamber having a cylindrical side wall and an end wall having a central intake opening, a disk-like impeller in said chamber, said impeller having a bevelled peripheral edge and being disposed with its center spaced laterally from the longitudinal axis of said chamber and tilted so that the principal axis of the impeller intersects the chamber axis at a point more removed from the intake opening inwardly of the chamber than said impeller, and means for moving said impeller bodily in a closed path about the opening axis while constantly changing the tilting angle of the impeller in a manner causing the principal axis thereof to continually intersect said point of the chamber axis, and the bevel at the edge of the impeller being at such an angle that the overchanging edge section nearest the cylindrical wall is in parallelism with such wall.

19. A pump comprising a fluid circulating chamber having an axis, side walls extending in general parallelism with such axis and an end wall containing an intake opening in substantial registry with such axis, a substantially flat impeller member in said chamber, said impeller being disposed eccentrically of said chamber axis and angularly thereto, said impeller having a normal axis, the impeller being disposed at such an angle to the chamber axis as to cause the impeller axis to intersect the chamber axis at a point more removed from the intake opening inwardly of said chamber than the impeller, and means for planetating said impeller about the chamber axis while changing the angularity of the impeller to said chamber axis in a manner causing the impeller axis to continually coincide with said point on the chamber axis, said planetating means further causing adjacent peripheral edge sections of said impeller to be brought successively into close proximity with the chamber side walls during such planetary movement.

20. A pump comprising a fluid circulating chamber having an axis and a fluid intake passage in substantial alinement with such axis, a substantially flat impeller member disposed in said chamber eccentrically of such axis, a face of said impeller being dished and exposed in the general direction of such intake passage, said impeller having an axis normal thereto and being disposed angularly to the chamber axis in a manner causing the impeller axis to intersect the chamber axis at a point inwardly of said chamber with respect to the intake passage, and nutating means operable to effect a planetary movement to said impeller about the chamber axis while maintaining the intersection of such axes at said point.

21. In a centrifugal pump, a planetary impeller comprising a substantially flat member, and means for planetating said member to impart rotary movement to fluid in said pump, such planetation being through a closed path within a plane disposed at a slight angle with respect to said flat member and said means serving also to constantly wabble said member in a manner substantially preserving the size of such angle.

22. In a pump, a pump housing having a wall containing an intake opening, an impeller in said housing, said impeller being free of fluid passages

therein, said impeller having a face disposed opposite to said opening and inclined with respect to the axis thereof, and means for planetating said member in a closed path about such axis while constantly tilting said impeller to preserve the inclined relation thereof with respect to such axis.

23. In a centrifugal pump, a fluid passage, a planetary impeller having a face disposed at a slight angle to a plane extending transversely of the side walls of such passage, said impeller being mounted in a manner permitting passage of fluid between its edge and said side walls, and means for planetating said impeller in such plane while constantly tilting said impeller to maintain an angle between such face and such plane.

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