

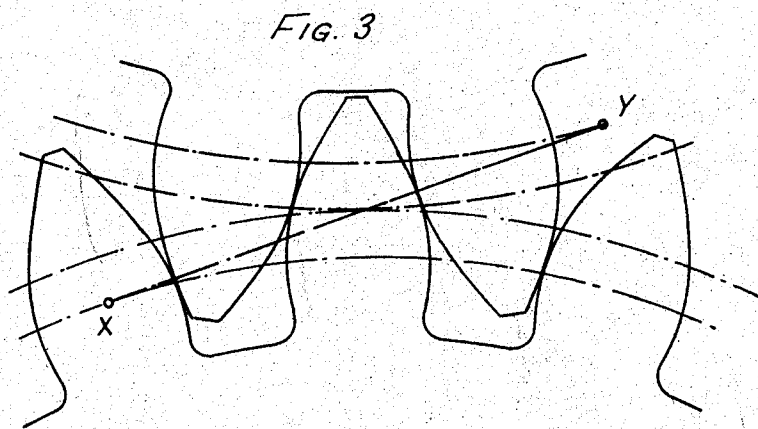
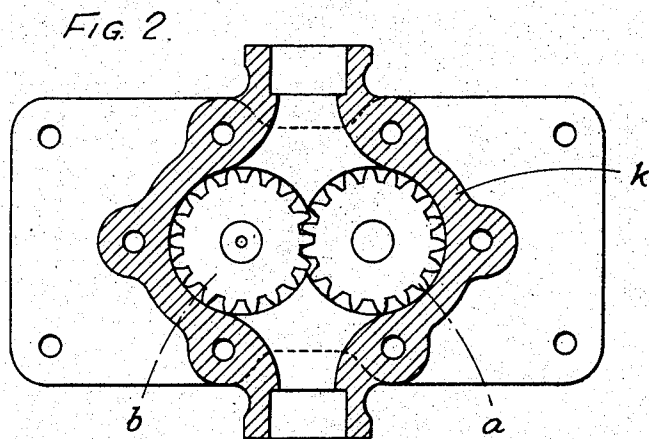
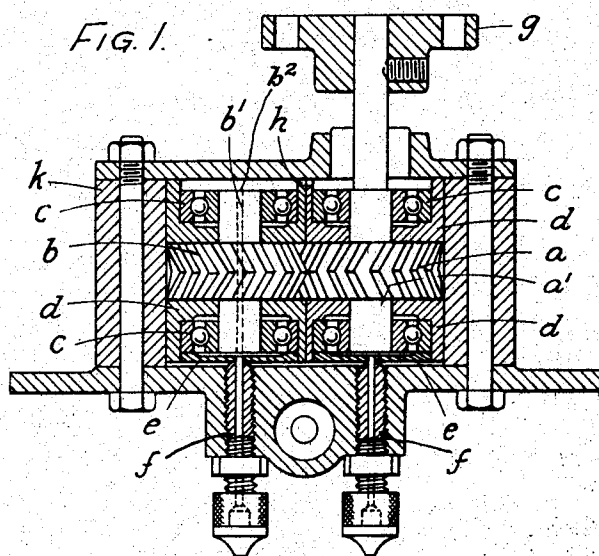
May 12, 1936.

R. J. McLEOD

2,040,754

ROTARY FLUID PUMP

Filed Dec. 23, 1932



INVENTOR
Robert J. McLeod
By *Amos L. Norris*
ATTORNEY

UNITED STATES PATENT OFFICE

2,040,754

ROTARY FLUID PUMP

Robert James McLeod, London, England

Application December 23, 1932, Serial No. 648,678
In Great Britain September 30, 1932

2 Claims. (Cl. 103—126)

This invention relates to rotary pumps of the type employing gear wheels as rotors. It is frequently necessary for such pump to have compactness and portability in a handy form and at the same time arrange for high rotational speeds and high volumetric efficiency. Now, in employing gear wheels of the spur and helical type, certain well-known disadvantages arise. In the former type pulsation of the fluid is caused by the action of a tooth on the one wheel entering the fluid filled space between the teeth on the other wheel and effecting a bulk and almost instantaneous displacement of this fluid.

This effect is, particularly in high speed pumps, undesirable and results in objectionable noise and vibration.

In order to overcome this pulsation, one common expedient, which has been adopted is to cut a channel at each end in the side or end plates or bearing housings and allow a slight leakage back to the suction side, thus reducing the volumetric efficiency of the pump.

In the case of double helical gears objection has always been raised on the ground that the fluid would partially run back into the suction side unless the spiral angle was small.

The well known quality of helical gear rotors that tooth engagement is such that all phases of tooth contact take place simultaneously enables a pump to be constructed which is practically free from pulsation with its accompanying disadvantages.

It is well known that in order to preserve the quality of helical gears, that all phases of tooth engagement take place simultaneously, that the width of the tooth face must have a certain minimum value depending on the number of teeth on a given rotor and the spiral angle. It has been stated that in known constructions an increase in spiral angle is considered undesirable. It, therefore, remains that if the face width is varied, the number of teeth must be varied. If the gear rotors of a fluid pump are constructed with teeth of normal proportions, they are liable to have the serious disadvantage that the face width is such that an open passage is formed between the inlet and outlet sides of the pump. If the face width is reduced so that this passage is prevented, from the above statement it will be seen that with teeth of normal proportions the number of teeth must be increased if continuity of phase engagement is to be retained. Such increase, however, involves fresh difficulties both in manufacture and in the design of an efficient pump.

In order to avoid the difficulties caused by an increase in the number of teeth and of alteration of the spiral angle when the face width is reduced, according to the invention a fluid rotary pump of the kind referred to is provided with double helical toothed rotors which are provided with teeth, the addenda of which are increased in radial direction and are greater than the value given by the reciprocal of the diametral pitch and the dedenda greater than the value 1.1 divided by the diametral pitch, the rotors intermeshing in normal manner, that is according to Brown and Sharpe's standards or values agreeing closely with said standards, with simultaneous engagement of the teeth in all phases of tooth engagement, the total face width of each double helical tooth (i. e. the total face width of the rotor) being shorter than the distance given by one quarter the product of the pitch diameter of the gear by π .

A pump constructed according to the invention is capable of rotating at very high speeds, for example 3000 to 9000 revolutions per minute without pulsation.

In consequence of such high speeds, the volumetric capacity of the pump is high in proportion to its size, the dimensions of the teeth, of course, forming a factor in the obtaining of such volumetric efficiency.

The number of teeth always in engagement shall not be less than two and may be three. The teeth may be designed to conform approximately to the following formula:

$$N = \frac{\sqrt{Rp^2 - rp^2} + \sqrt{Rw^2 - rw^2} - \sin PA \times C}{\cos PA \times CP}$$

Where C=center distance of wheel and pinion.
N=average number of teeth in continuous engagement.

Rp=blank radius of pinion.

rp=base circle radius of pinion.

Rw=blank radius of wheel.

rw=base circle radius wheel.

PA=pressure angle.

CP=circular pitch.

Applying the above formula to a pair of pump rotors as actually used, wherein the values are as follows:—

Pitch.	16 DP. equal to 0.1963 CP.	
Pressure angle	degrees	18
Center distance	inches	1.25
Blank diameter	do	1.4135
Root diameter	do	1.1888

To find number of pairs of teeth in continuous engagement:—

$$N = \frac{\sqrt{.7067^2 - .5944^2} - \sqrt{.7067^2 - .5944^2} - \sin 18 \times 1.25}{.1963 \times \cos 18}$$

Since wheel and pinion are identical, the formula becomes:

$$N = \frac{2 \times \sqrt{.4994 - .3533} - .309 \times 1.25}{.1963 \times .951}$$

$$N = \frac{2 \times .382 - .387}{.1866}$$

$$N = \frac{.764 - .387}{.1866}$$

$$N = 2.02$$

In the above example 30 degrees spiral angle and .5" face width are used. To obtain "cover" with standard teeth, the face width would have to be .7852".

In the accompanying drawing, which illustrates one construction of a pump embodying the invention—

Fig. 1 is a vertical section of the pump, partly in elevation.

Fig. 2 is a sectional plan.

Fig. 3 illustrates the contour of the teeth with the extended zone of engagement represented by the line X—Y.

In Figs. 1 and 2 the driving and driven double helical toothed rotors *a* and *b* respectively are carried on or made solid with their spindles *a*₁, *b*₁. The spindles are carried in bearings *c*, *c*, preferably of the ball or roller type, but which may also be of the journal type. Each of the bearings is mounted in separate housings *d*, *d*, *d*, which are made a tight push fit in the bores of the pump body *k*. On the lower ends, as shown, of the bearing housings remote from the driving coupling *g* are fitted plates or solid washers *e*, *e*. Adjusting screws *f*, *f* provided with suitable lock nuts carried in the body *k* engage with the washers *e*, *e* and may be set to adjust the clearances between the bearing housings *d*, *d* and the sides

of the pump rotors *a*, *b* to very fine limits in order to reduce leakages to a minimum.

The adjusting screws *f*, *f* are made hollow and fitted with grease nipples. A small hole *b*₂ drilled through the spindle *b*₁ of the driven rotor *b* connects with an open passage *h* between the ends of the top bearings and allows the top bearing of the driving rotor *a* to be lubricated from the same point as the two bearings of the driven rotor *b*. The bottom bearing of the driving rotor *a* is lubricated separately from the nipple attached to its own adjusting screw. The body end plates and the safety valve are of usual construction.

The inlet side which is determined by the direction of rotation may be at either side of the pump, the rotors entering mutual engagement at the delivery side.

I claim:—

1. A fluid rotary pump comprising a casing, an inlet and an outlet therefor, double helical toothed rotors, meshing one with the other, means for driving said rotors, the addenda of the teeth on the rotors being greater than the value given by the reciprocal of the diametral pitch, and the dedenda greater than the value 1.1 divided by the diametral pitch, the rotors intermeshing in normal manner with simultaneous engagement of the teeth in all phases of tooth engagement, the total face width of each double helical tooth (i. e. the total face width of the rotor) being shorter than the distance given by one quarter the product of the pitch diameter of the gear by π , whereby the teeth at the point of intermesh and around the peripheries of the rotors inhibit passage of fluid from outlet to inlet.

2. A fluid rotary pump as claimed in claim 1, comprising housings in said casing, bearings supported in said housings for carrying said rotors, screws supported in said casing and co-operating with said housings for adjusting the position of said housings in relation to said rotors.

ROBERT JAMES McLEOD.