

Patented July 14, 1914.

1,103,053.

Fig. 4.

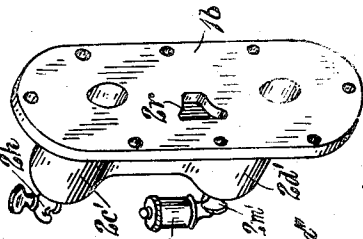


Fig. 2.

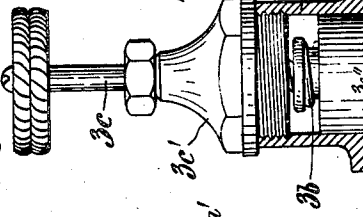


Fig. 3.

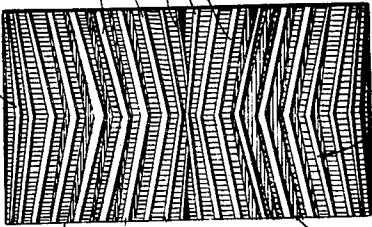


Fig. 1.

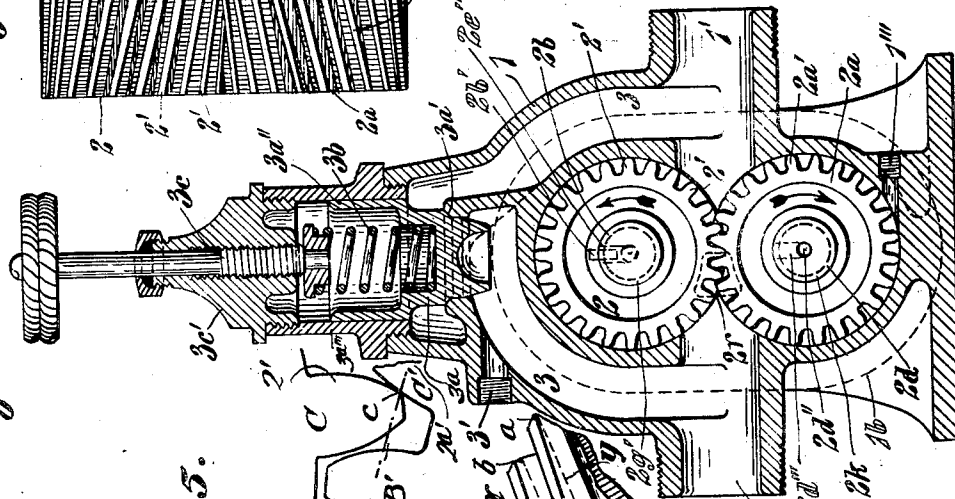


Fig. 5.

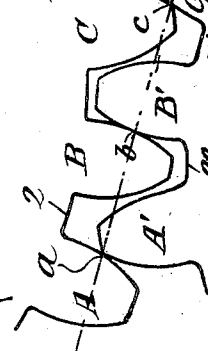
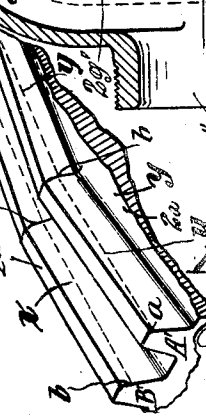


Fig. 6.



Witnesses:

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KARL KIEFER, OF CINCINNATI, OHIO.

FLUID PUMP OR MOTOR.

1,103,053.

Specification of Letters Patent.

Patented July 14, 1914.

Application filed January 9, 1911. Serial No. 601,599.

To all whom it may concern:

Be it known that I, KARL KIEFER, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented a new and useful Improvement in Fluid Pumps or Motors, of which the following is a specification.

My invention relates to double-piston rotary pumps or motors, and the object is to provide a device of this character of simple construction that will be highly efficient, and steady and quiet in its operation.

My invention consists in the parts and details of construction and arrangement of parts, as will be hereinafter more fully described and claimed.

In the drawings: Figure 1 is a vertical section taken through the middle of a pump longitudinally of the inlet and outlet. Fig. 2 is a vertical cross section taken through the middle of the pump longitudinally of the shafts. Fig. 3 is a detailed side elevation of the rotors or pistons of the pump. Fig. 4 is a detailed perspective view of one of the ends of the casing, better illustrating its inside formation. Fig. 5 is a diagrammatic view to illustrate the operation of the teeth of the rotors or pistons. Fig. 6 is a detailed perspective view of a part of one of the pistons to further illustrate the operation of the teeth thereof.

The casing 1 of the pump has a horizontally disposed inlet 1' and a similarly disposed outlet 1'' on the opposite side from the inlet, and the ends 1^a and 1^b of the casing support the rotors or pistons 2 and 2^a with their centers or axes equidistant above and below; respectively, the center line of the inlet and outlet. These rotors or pistons 2 and 2^a have helical teeth 2' and 2^a' which mesh together between the inlet 1' and the outlet 1'', and the teeth are so arranged, and of such proportion and of such number that a substantially fluid-tight contact is made thereby between said inlet and outlet, as will hereinafter be more fully set forth. Except where they enter the inlet and outlet passages, the pistons 2 and 2^a are inclosed by the walls of the casing 1 so that the teeth 2' and 2^a' are closely adjacent to the inner concave sides of the walls, and the pistons running in the directions indicated by the arrows, the liquid entering at the inlet 1' will be carried around in the spaces between the teeth to the outlet 1'', where it

is forced from between said spaces by the intermeshing of the teeth 2' and 2^a' of the pistons.

A by-pass 3 leads from the outlet 1'' interiorly of the wall of the casing 1, over the upper piston 2 and down to the inlet 1', and is closed by the valve 3^a located vertically above the pistons, which is unseated upward, and is normally held down by a spring 3^b adjusted by a screw 3^c; thus this valve 3^a may be adjusted to maintain any desired pressure at the outlet 1'', and to allow the excess fluid to pass back to the inlet through the by-pass 3.

The two rotors or pistons 2 and 2^a preferably have their teeth designed theoretically correct so that they constitute a pair of intermeshing gears, and the upper piston or gear 2 is adapted to drive the lower piston or gear 2^a. Accordingly, it is possible to avoid the use of an objectionable number of stuffing boxes or glands around the shafts of the pistons or gears. As illustrated, it is necessary to have a gland around the driving shaft 2^b of the upper piston or gear 2 only, the stud 2^c which supports said gear 2 being rigidly mounted in the casing, as is also the shaft 2^d of the lower gear 2^a. The upper gear 2 has a central bore, into part of which extends the stud 2^c for said gear to turn loosely on, and the remaining part of said bore receives the inner end of the driving shaft 2^b, which has a key 2^b' rigidly securing it to the gear 2. The part of the driving shaft 2^b outside of the casing may be provided with any suitable means for driving the pump, which it is not deemed necessary to herein illustrate or describe. The lower gear 2^a turns loosely on the shaft 2^d.

As will be seen, the ends of the casing have extensions 2^a' to receive and surround the ends of the shaft 2^a, and the end 1^b has similar extension 2^c', which receives and surrounds the end of the stud 2^c. The bearing 2^e for the shaft 2^b has a stuffing box or gland 2^e' around the shaft and between this gland and the gear 2 there is an annular recess 2^e'' with which a suitable grease cup 2^f communicates, controlled by a plug 2^f'. Leading from the annular recess 2^e'' interiorly of the shaft 2^b to its inner end is a passage 2^e''', and the ends of said shaft 2^b and of the stud 2^c inside the gear 2 are left some distance apart so that a space 2^g is left to receive the lubricant and act as a reservoir therefor in-

side the gear 2. The stud 2^c has a spiral groove 2^s on its convex surface that communicates between the space 2^s and an interior passage $2^{s'}$ inside the stud 2^c that leads from the end of said spiral groove 2^s , inside the gear 2, to the end of the stud 2^c inside the extension 2^c , which is provided with an outlet controlled by a plug 2^h . The shaft 2^d has an interior passage $2^{d'}$ leading from one end to the inside of the gear 2^a , and there communicates with one end of the spiral groove 2^s , the other end of which communicates with another interior passage $2^{d''}$, in the shaft 2^d , leading to the other end of the shaft inside of the other extension 2^c , one of said extensions being provided with a grease cup 2^m controlled by a plug $2^{m'}$, and the other extension having an outlet controlled by the plug 2^n . It will therefore be seen that the lubricant can be supplied to the gears 2 and 2^a by opening the plugs 2^h and $2^{m'}$, respectively, while that which has been used may be allowed to escape by opening the plugs 2^h and 2^n , respectively. When these plugs are closed and the stuffing box 2^e is properly packed, no lubricant can escape from the pump to the outside. For confining the lubricant around the shafts, the gears are provided on their ends with annular packing rings or gaskets 2^p , which bear against the inner sides of the ends 1^a and 1^b of the casing, so that the lubricant can not mingle with the fluid being moved by the pump.

It will be noted that the valve 3^a in the bypass 3 has a conical seat $3^{a'}$, but that the opening below this seat has parallel sides while the valve 3^a is shaped accordingly, so that it may have considerable vertical movement before the valve will be permitted to vibrate, as it would if only held in alignment by its spring 3^b . Also, this valve 3^a has an upper cylindrical extension $3^{a''}$ that fits closely in a cylinder $3^{a'''}$ that forms part of the valve casing; with the plug 3^c , which carries the screw 3^d , screwed into the upper end of this cylinder $3^{a'''}$, the cylindrical extension $3^{a''}$ of the valve 3^a confines a certain amount of air inside the cylinder $3^{a''}$, so that the arrangement performs the function of a dash-pot with a steadying effect on the operation of the pump.

The pressure gage may be applied to the pump in the threaded opening $3'$ leading to the bypass 3, and the lower part of the casing 1 has an opening $1'''$ in which a drain cock may be applied to the pump.

The teeth $2'$ and 2^a of the pistons or gears 2 and 2^a respectively, are, on each gear, inversely directed from the ends of the gear toward the middle thereof, meeting in the middle at an angle so that they are of what is known as "herring bone" formation, and of course, as is necessary in helical gears, the

teeth of corresponding sides of the different gears are inversely directed around the gears, so that when the two gears are brought together in the pump, these "herring bone" teeth intermesh and make rolling contact with each other, as is required in well designed gears. The number of the teeth in the gears is of importance. It is not sufficient merely to have the teeth of the two gears intermesh so that one will drive the other, even though the teeth be theoretically correct; it is necessary that there always be teeth of the respective gears making continuous contact from end to end of the gears, so as to maintain the substantially fluid-restricting means between the inlet and outlet, the absence of which so seriously lowers the efficiency. With the use of the helical gear teeth, this continuous line of contact from end to end of the gear is of shorter duration than with simple spur gears, and it is necessary to provide the teeth in such a manner that before any two teeth begin to recede from each other near one end of the gear, and thus destroy the continuous line of contact, the next two teeth will have completed their continuous line of contact from end to end of the gear.

The above will be understood upon inspection of Figs. 5 and 6 of the drawing. In Fig. 5 the tooth A of one gear and the tooth A' of the other gear are making contact at a . Now, let it be understood that each half-length of a tooth, from the angle in the middle of the "herring-bone" gear to either end, is to be considered as a complete tooth for the purpose of the following explanation. Also let it be assumed, for instance, that, as illustrated in Fig. 3, the pitch of the helical teeth is such that a tooth advances a distance equal to the circular pitch of the gear. Thus, the other end of the tooth A will be coincident with this end of the tooth B; and the point of contact at that other end will be coincident with the point of contact seen at b between the teeth B and B' in Fig. 5, which, of course, shows this end only. The line of contact made by the tooth A' along the side of the tooth A will be projected along the line x , as seen in Figs. 5 and 6.

The same relation exists between the teeth B and B', which, as seen in Fig. 5, make contact at b at their near ends; at their other ends the point of contact will be coincident with the point of contact c of the next pair of engaging teeth C and C' at this end. The line of contact made by the tooth B' along the side of the tooth B will be projected along the line y , as seen in Figs. 5 and 6.

From the above it will be understood that, in their advanced regions, coincident with the point c , the teeth B and B' are about to break the continuity of their line of contact

α , but the teeth A and A' are completing their continuous line of contact γ at α , where the teeth end at the sides of the gears, as above explained. Thus, the teeth A and A' are complementary to the teeth B and B' in maintaining constant fluid-restricting contact.

Consideration of the above circumstances will make it apparent that such operation of the teeth as above described is dependent upon the relation of the length of the gear to the helical pitch and the circular pitch of the teeth. For example, with such a rotor or piston of length approximating its diameter, it is necessary to have from 20 to 30 teeth thereon, each advancing around the piston a distance about equal to the circular pitch of the teeth. By thus assuring a constant closed joint between the intermeshing teeth, the helical teeth are made just as efficient as any other form of impeller, with respect to leakage of the pump, and the full advantage attained by the use of helical teeth is afforded in the operation of the pump. This advantage consists in the ejection of the fluid from the spaces between the teeth, by the intermeshing of the teeth, in direction toward the end of the gear. By providing the teeth of each gear pitched in both directions and meeting at an angle in the middle of the gear, or of "herring bone" formation, the fluid thus passes to both ends of the gears and escapes into the outlet 1" through the recesses 2" in the inner sides of the ends 1^a and 1^b of the casing. It will of course be understood that some of the fluid will be displaced over the tops of the teeth when they intermesh, but the endwise means of escape afforded for the fluid greatly increases the smoothness of operation of the pump, and practically eliminates all vibration, which has been a very objectionable feature in pumps of this character heretofore produced, in pumping liquids.

From the foregoing description it will be understood that the continuity of fluid restricting contact is attained by properly proportioning the angular duration of continuous contact between the respective teeth to the angle of helical advance of the teeth; and this advantage is not dependent upon coincidence of overlapping tooth-ends, it only being necessary that the helical advance be less than the angle of rotation during which the respective gears have the continuous contact. However, an important advantage is attained in connection with this continuity of fluid restricting contact by making the overlapping tooth-ends coincident as shown. By thus having the end of a tooth at one end of the gear, or at the angle in the middle of the gear, coincident with the beginning of a following tooth, at the other end, the full advantage of the helical

gear in producing steady delivery of fluid without pulsation is attained; for without such coincidence the gear has more of the character of a plain spur gear with teeth running parallel to the axis. With such a plain spur gear, or with a helical or "herring-bone" gear without the coincidence of tooth-ends above alluded to, there is a variation of condition in the region where the teeth emerge from the inclosing concave casing walls. With the plain spur gear, at one instant a complete tooth-top will be presented, and at the next instant a complete interdental space will be presented; and with any kind of helical gear not having the tooth-ends coincident, these tops and spaces will be varyingly presented with less degree of completeness across the gear, but yet with a large degree of irregularity of condition in these regions. With the tooth-ends coincident, there will be no instant when there is a complete tooth-top presented or when there is a complete interdental space presented, while, in addition, the proportion of top and space presented will always be the same, and the conditions in this region will be uniform; so that by this means not only is the advantage attained over the plain spur gear, but this advantage of the helical or herring-bone gear is completely attained. Since freely open interdental space in this region permits free escape of fluid, and a tooth-top in this region prevents escape, it will be seen that a constant proportion of these two will result in elimination of alternate increase and decrease, or pulsation, of delivered fluid. Such uniformity of condition in these regions where the fluid escapes from between the teeth will, however, be of little significance without the continuity of fluid restricting contact between the intermeshing teeth, because leakage back between the teeth, in addition to being a source of waste, is also a cause of irregularity of delivery of fluid and also causes pulsations where permitted. It is, therefore, by the combination of these provisions that my object is attained most completely.

While the above provisions eliminate pulsation in the delivery of a pump, the operation of a motor constructed as above described will be steadier, on account of the uniform rate of inflow of fluid between the teeth where they enter behind the concave walls of the casing, and because of the elimination of leakage between the teeth of the two gears where they intermesh.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a pump or motor pistons consisting of intermeshed helical gears, respective teeth of which have continuous contact from end to end during rotation thereof through a

certain angle, and each of which teeth advances, from end to end, through an angle not exceeding the aforementioned angle.

2. In a pump or motor, pistons consisting of intermeshed gears, each with teeth advancing helically thereon, respective teeth of which have continuous contact from end to end of the helical advance of the respective teeth during rotation of each gear through a certain angle, and said helical advance of each tooth being through an angle not exceeding said angle of rotation.

3. In a pump or motor having an inlet and an outlet, pistons consisting of intermeshed gears, each with teeth advancing helically thereon, respective teeth of which have continuous contact from end to end of the helical advance of the respective teeth during rotation of each gear through a certain angle, and said helical advance of each tooth being through an angle not exceeding said angle of rotation, the outlet means having communication at the ends of the gears with the spaces between the teeth where the gears mesh.

4. In a pump or motor pistons consisting of intermeshed gears, each having inversely arranged helical teeth forming angles midway of the length of the gear, the respective teeth of said gears having continuous contact from end to end during revolution thereof through a certain angle, and the angle of advance of each tooth, from the end of the gear to its angle midway of the length of the gear, being not in excess of the aforementioned angle.

5. In a pump or motor, pistons consisting of intermeshed gears, each with teeth advancing helically thereon inversely and forming angles intermediate of the length of the gear, respective teeth of the gears having continuous contact from end to end of the helical advance of the respective teeth during rotation of each gear through a certain angle, and said helical advance of each tooth being through an angle not exceeding said angle of rotation.

6. In a pump or motor having a casing with an inlet and an outlet, pistons therein consisting of intermeshed gears, each with

teeth advancing helically thereon inversely and forming angles intermediate of the length of the gear, the respective teeth of said gears having continuous contact from end to end of the helical advance of the respective teeth during rotation of each gear through a certain angle, and said helical advance of each tooth being through an angle not exceeding said angle of rotation, and the casing adjacent to the ends of the gears having spaces communicating with the spaces between the teeth where the gears mesh, and with said outlet.

7. In a pump or motor, pistons consisting of intermeshed gears, each with teeth advancing helically thereon, respective teeth of which have continuous contact from end to end of the helical advance of the respective teeth during rotation of each gear through a certain angle, said helical advance of each tooth being through an angle not exceeding said angle of rotation, and each of the teeth being, at the end of its helical advance, coincident with the beginning of helical advance of another tooth on the respective gear.

8. In a pump or motor, pistons consisting of intermeshed gears, each with teeth advancing helically thereon inversely and forming angles intermediate of the length of the gear, respective teeth of the gears having continuous contact from end to end of the helical advance of the respective teeth during rotation of each gear through a certain angle, said helical advance of each tooth being through an angle not exceeding said angle of rotation, and each tooth, where its helical advance ends at the angle intermediate of the length of the gear, being coincident with the beginning of the helical advance of other inversely helically advancing teeth on the gear.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses, this 5th day of January, 1911.

KARL KIEFER.

Witnesses:

ERNEST E. FINCH,
CLARENCE PERDEW.

It is hereby certified that in Letters Patent No. 1,103,053, granted July 14, 1914, upon the application of Karl Kiefer, of Cincinnati, Ohio, for an improvement in "Fluid Pumps or Motors," errors appear in the printed specification requiring correction as follows: Page 2, line 115, for the reference-letter "*x*" read *y*; same page, line 125, for the reference-letter "*y*" read *x*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of October, A. D., 1914.

[SEAL.]

J. T. NEWTON,
Acting Commissioner of Patents.