L. P. STOREY.

ROTARY PISTON PUMP.

APPLICATION FILED MAY 2, 1921.

1,407,496.

Patented Feb. 21, 1922.

2 SHEETS—SHEET 1.

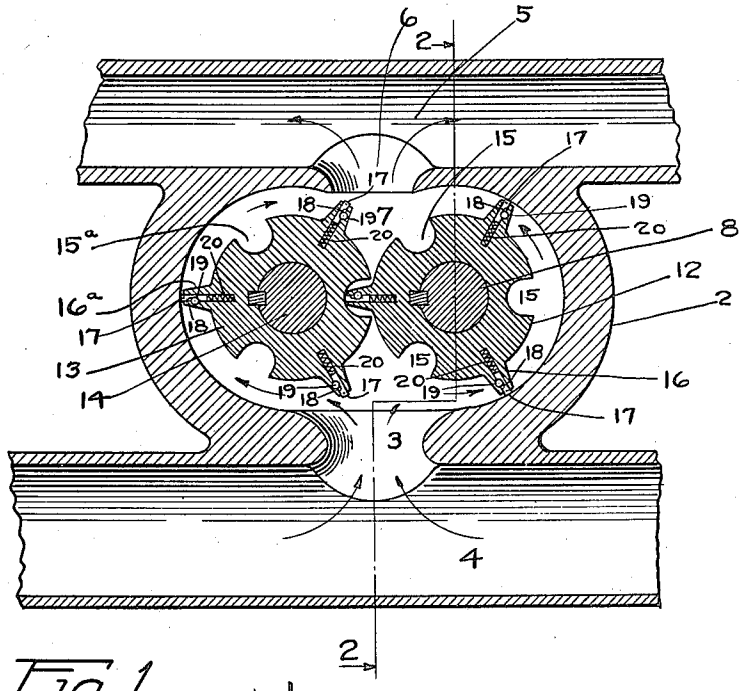


Fig 1

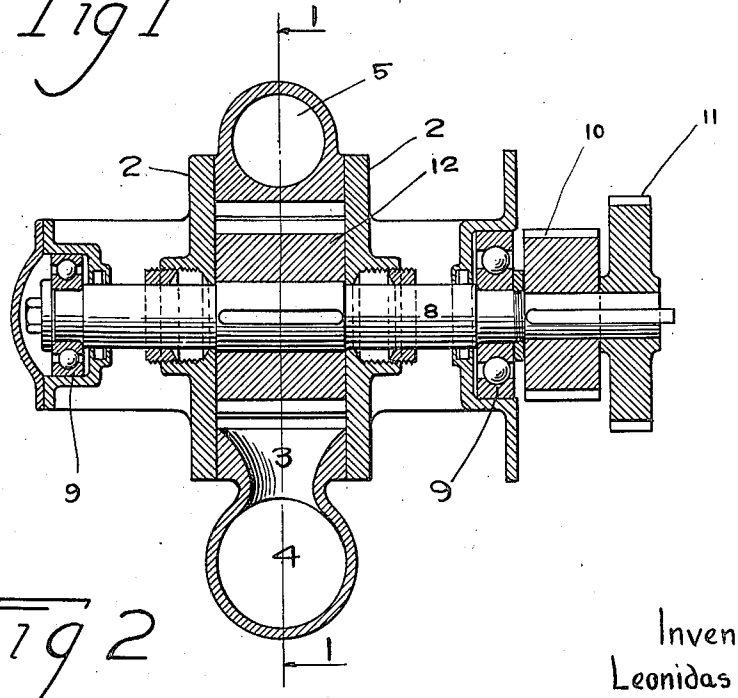


Fig 2

Inventor
Leonidas P. Storey
By Paul & Paul
His Attorneys

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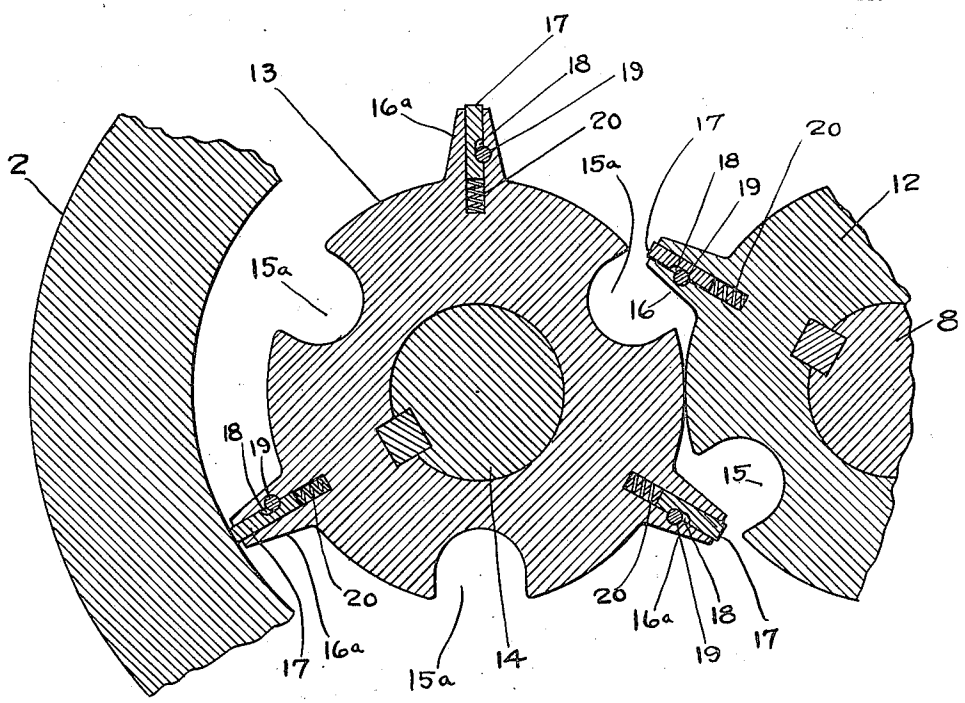


Fig. 3

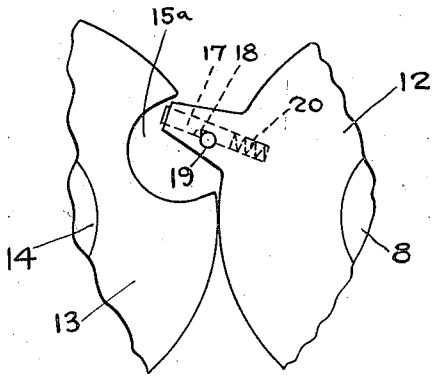


Fig. 4

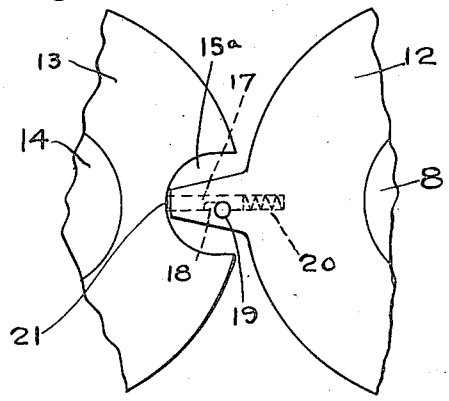


Fig. 5

Inventor
Leonidas P. Storey
By Paul & Paul
His Attorneys

UNITED STATES PATENT OFFICE.

LEONIDAS P. STOREY, OF ST. PAUL, MINNESOTA, ASSIGNOR TO WATEROUS FIRE ENGINE COMPANY, OF ST. PAUL, MINNESOTA, A CORPORATION OF MINNESOTA.

ROTARY PISTON PUMP.

1,407,496. Specification of Letters Patent. Patented Feb. 21, 1922.

Application filed May 2, 1921. Serial No. 466,008.

To all whom it may concern:

Be it known that I, LEONIDAS P. STOREY, a citizen of the United States, resident of St. Paul, county of Ramsey, State of Minnesota, have invented certain new and useful Improvements in Rotary Piston Pumps, of which the following is a specification.

The object of my invention is to provide a rotary piston pump wherein there will be a uniform flow for the intake and discharge.

A further object is to provide a pump composed of parts which can be easily assembled without extreme precision of fitting or adjustment, and in which the relative exact synchronization of the piston with respect to its driving gear and its companion piston element is not essential. The first cost of manufacture and maintenance is thus greatly reduced.

A further object is to provide a pump of the class described which will be efficient in operation and in which the non-adjustable contacting parts will be reduced to a minimum, with provision for adjustment at all wearing points.

Other objects of the invention will appear from the following detailed description.

The invention consists generally in various constructions and combinations, all as hereinafter described and particularly pointed out in the claims.

In the accompanying drawings forming part of this specification,

Figure 1 is a sectional view through a rotary piston embodying my invention,

Figure 2 is a sectional view on the line 2—2 of Figure 1,

Figure 3 is an enlarged sectional view showing the relative arrangement of the pistons and the position of the teeth or webs and recesses therein,

Figure 4 is a detail view showing one position of the pistons with a tooth entering a recess.

Figure 5 is a similar view showing another position of the pistons.

In the drawing, 2 represents the housing or casing of the pump, communicating at 3 with the water supply passage 4 that is connected with the hydrant or other suitable means for supplying the fluid to the pump. 2 are piston heads securely attached to the housing or casing of the pump.

A fluid passage 5 communicates with a port 6 that leads to the piston chamber 7 on the other side of the pistons from the port 3. A shaft 8 is journaled in bearings 9 and has gears 10 and 11 mounted thereon. The gear 11 serves as a drive for the shaft, being connected with some suitable source of power, not shown. A rotary piston 12 is keyed on the shaft 8 and a corresponding piston 13 is keyed on the shaft 14 which is driven from the adjacent gear 10. These pistons are provided with peripheral recesses 15 and 15ª arranged at intervals in the peripheral surfaces, there being preferably three of the recesses in each piston, although a greater or lesser number of recesses and teeth may be employed. Alternating with these recesses on the peripheral surfaces of the pistons, I provide a series of teeth 16 and 16ª, said teeth being wedge-shaped substantially in cross section and adapted to enter the recesses of the pistons as they are revolved. The teeth are considerably smaller than the recesses which they enter as the pistons revolve, my object being to provide for a minimum displacement of the water by these teeth as they enter the recesses and thus prevent acceleration in the flow of water through the pump, which I have found will necessarily follow if the teeth substantially fill the recesses. I have found by actual test that where the teeth are of sufficient size to substantially fill the recesses in the piston, the displacement of the water by these teeth or webs will destroy the uniform flow in both suction and discharge, increasing it temporarily at the time when a tooth is passing into the recess of the abutting piston. This variation in the flow is of course objectionable. It not only produces vibration, but interferes seriously with the smoothness of operation of the mechanism and causes a rise and fall in volume of discharge from the pump that interferes with its efficiency.

In a positive displacement pump, such as the type herein shown, where measured volumes of water are discharged at given intervals, it is necessary for uniform intake

and discharge flows that there be no slacking up or cessation as well as no undue acceleration of flow, such as would be caused by a sudden increase in displacement by reason of teeth or webs on one piston positioned to enter correspondingly shaped and sized recesses in the adjacent piston. When a tooth formed to fit a recess snugly enters the recess through the rolling action of the piston, it is evident that the sudden displacement of the water therein will temporarily increase the flow and when the tooth has fully invaded the recess this temporary acceleration would cease, thereby causing fluctuations in the volume of discharge from the pump. The slender taper tooth shown herein eliminates these objections. The teeth are preferably wedge-shaped and the recesses are substantially semi-circular with ample spaces between the walls of the recesses and the side walls of the teeth, so that the displacement of water by the teeth is insufficient to cause any appreciable acceleration in the flow when the teeth enter the recesses. This will be clearly shown from an examination of Figures 3 and 4, where the teeth are shown as comparatively small in cross section with respect to the diameter or size of the recesses, and hence only a small volume of water will be displaced, insufficient to disturb the uniformity of flow.

When a tooth is passing through the spaces in the adjoining piston, I prefer to seal the gap between the point of the tooth and the wall of the recess by providing blades 17 mounted to slide in recesses in the wedge-shaped teeth and having slots 18 to receive pins 19 mounted in said teeth for the purpose of limiting the movement of the blades in both directions. Springs 20 are positioned to normally force the blades to the limit of their outward movement, where their outer edges will project slightly beyond the corresponding faces of the teeth in position to contact with the wall in the bottom of the recess and yield slightly under the pressure thereon. These blades are so positioned with respect to the walls of the recesses that they contact only at 21 as they pass the center, sufficient space being provided between the blades and the walls of the recesses at the entrance to prevent metallic contact between the recess walls and the side walls of the teeth. Wear and noise in the operation of the pump are thus eliminated.

When the blades are passing the center, as indicated in Figure 5, there will be light contact with the base of the recess sufficient to close the gap and prevent the flow of water between the pistons. The slots in the blades are of sufficient length to allow them to slide back and forth, the pins limiting the movement of the blades in both directions, allowing sufficient freedom, however, of such movement to permit action of the springs and allow the blades to adapt themselves to the wall at the bottom of the recess with which they come in contact. The blades 17 also function in contact with the casing of the pump to close all openings between the ends of the teeth and the cylindrical portion of the pump casing.

I have found that pump pistons made in this way can be assembled much more rapidly, as accurate fitting of parts is unnecessary. Thereby considerable saving in machine work and labor is effected. Where pumps of this type are provided, with recesses and cams or like devices accurately fitting therein, it is evident that the parts must be carefully adjusted when assembled and otherwise alignment of the working elements is necessary, but where a comparatively large recess is provided to receive a comparatively small tooth or web, contacting therewith only at one point, it is evident that not only close preliminary machining and fitting but also subsequent adjusting and readjusting is entirely avoided. It it not even necessary to synchronize the moving parts closely, considerable latitude being allowed because of the wide spaces between the teeth or webs and the walls of the recesses.

From the foregoing description it will be noted that a pump of this type will cause a uniform flow of intake and discharge, there will be no metallic noise at high pressure and high speed resulting from torsional and radial deflection of the piston shafts, wear of driving gears, wear of bearings and distortion of the pump when under internal stress. Its efficiency will not become impaired through long use for the parts can be readily adjusted at all points of wear. It will also be noted that the normal contact between the pistons is a true rolling contact. Furthermore, inaccuracy of the driving gears will not reduce hydraulic efficiency and will permit of periodical fluctuations in the angular velocity relatively between the two pistons. It is also evident even though the relative position of the parts change from that indicated in a static position there can be no mechanical vibration and noise caused by such uneven synchronization.

It will be understood, of course, that a pump of this type is preferable to one where the pistons are cam shaped or in the form of gear teeth and are actuated by external gears, where it is imperative that the piston teeth have continuous flanking contact to prevent leakage of the fluid. It is therefore readily apparent that with the external driving gears transmitting power and motion to the pistons the alignment between the flanks of the driving gears and the flanks of the piston teeth must be absolutely

exact. In operation, these parts are distorted relatively, due to torsional and radial deflection of the shafts, wear of gears and wear of bearings, resulting in excessive friction and loss in efficiency. The pump herein shown avoids these difficulties and will run smoothly and uniformly mechanically, and efficiently and smoothly hydraulically.

I claim as my invention:

1. A rotary piston pump comprising a casing having a piston chamber provided with intake and discharge openings, rotary pistons mounted in said chamber, said pistons having peripheral teeth and recesses alternately formed therein, the teeth of one piston being adapted to enter the recess of the adjacent piston as they are revolved and said teeth being comparatively thin and occupying only a portion of the space in said recess, the pistons being in continuous peripheral contact except just before, while and just after the teeth pass the center, at which time only the teeth are in contact with the wall of the recess, whereby only a small volume of the water in said recess will be displaced, for the purpose specified.

2. A rotary piston pump comprising a casing having a piston chamber provided with intake and discharge openings, rotary pistons mounted in said chamber, said pistons having peripheral teeth and recesses alternately formed therein, the teeth of one piston being adapted to enter the recesses of the adjacent piston as they are revolved and said teeth being comparatively thin and contacting only at their outer edges with the walls of said recess as the teeth pass the center, whereby flanking contact of the teeth with said walls will be prevented.

3. A rotary piston pump comprising a casing having a piston chamber provided with intake and discharge openings, rotary pistons mounted in said chamber, said pistons having peripheral teeth and recesses alternately formed therein, the teeth of one piston being adapted to enter the recesses of the adjacent piston as they are revolved and said teeth being comparatively thin and occupying only a portion of the space in said recess, whereby only a small volume of the water in said recess will be displaced, and blades yieldingly mounted in said teeth and being of such relative lengths as to contact with the bottoms of said recesses only as the teeth pass the center line of the pistons.

4. A rotary piston pump comprising a casing having piston chambers provided with intake and discharge openings, rotary pistons mounted to revolve therein, said pistons having comparatively large peripheral recesses and thin wedge-shaped teeth alternating therewith and rolling contact peripheral surfaces on the pitch circles of said pistons between said recesses and said teeth, said teeth contacting with the walls of said recesses only in the bottoms thereof and said peripheral surfaces being in contact only just before, during, and just after the engagement of said teeth with the bottoms of said recesses, whereby a continuous seal is provided between the suction and discharge sides of the pump.

5. A rotary piston pump comprising a casing having a piston chamber provided with intake and discharge openings, pistons mounted to revolve in said chamber and provided with comparatively small peripheral teeth and comparatively large peripheral recesses alternating therewith, each piston having curved peripheral surfaces on its pitch circle between its teeth and recesses, for rolling contact with the corresponding surfaces of the other piston, means yieldingly mounted in the ends of said teeth for contact with the bottoms of said recesses, the rolling contacting surfaces of said pistons forming a seal between the suction and discharge sides of said pump when said teeth are entering and leaving said recesses and out of contact with the walls of the recesses, whereby flanking contact of said teeth with the walls of the recesses is avoided.

6. A rotary piston pump comprising a casing having a piston chamber provided with intake and discharge openings, pistons mounted to revolve within said chamber and provided with alternately arranged peripheral teeth and recesses and said pistons having curved peripheral surfaces for rolling contact on the pitch circle between said teeth and recesses, said recesses being comparatively large and said teeth comparatively small and arranged to contact with the walls of said recesses only while said teeth are approaching the center of said recesses and are on said center and leaving it, whereby flanking contact of said teeth with the walls of said recesses is prevented, the rolling contact of said piston surfaces sealing the passage between the suction and discharge sides of said pump when said teeth are entering or leaving said recesses and are out of contact with the walls of the recesses.

7. A rotary piston pump comprising a casing having a piston chamber provided with intake and discharge openings, pistons mounted to revolve in said chamber and provided with comparatively small peripheral teeth and comparatively large peripheral recesses alternating therewith, each piston having curved peripheral surfaces on its pitch circle between its teeth, and recesses for rolling contact with the corresponding surfaces of the other piston, blades yieldingly mounted in the ends of

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said teeth for contact with the bottoms of said recesses, said rolling surfaces being in contact only when a tooth is entering its recess and passing out of contact with each other only when said teeth are in contact with the bottoms of said recesses and passing though the center thereof and said rolling surfaces coming into contact again when said teeth move out of contact with the bottoms of said recesses, whereby a continuous water seal is formed between the suction and discharge sides of said pump.

In witness whereof, I have hereunto set my hand this 15th day of April, 1921.

LEONIDAS P. STOREY.