Nov. 17, 1936. R. DE STOUTZ 2,061,144

PISTON SPINNING PUMP

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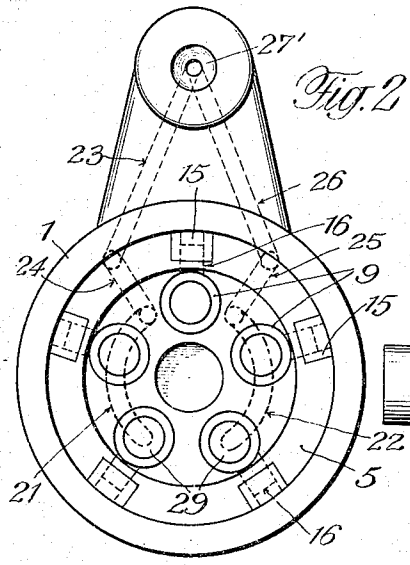


Fig. 2

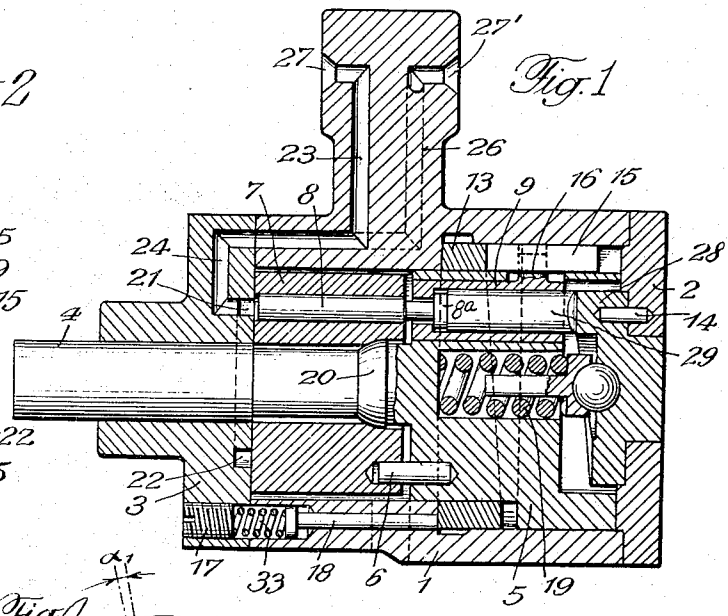


Fig. 1

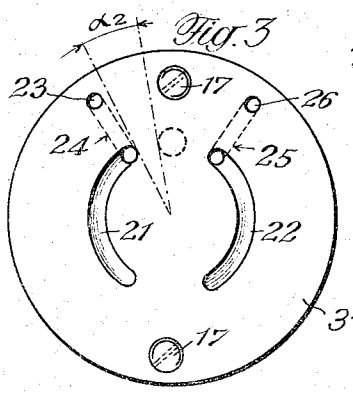


Fig. 3

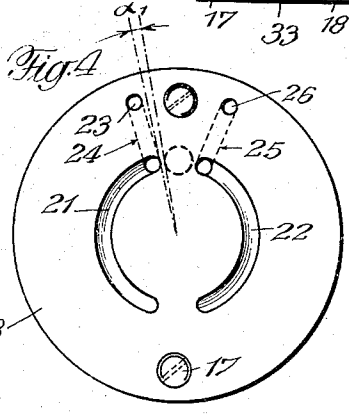


Fig. 4

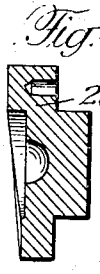


Fig. 5a

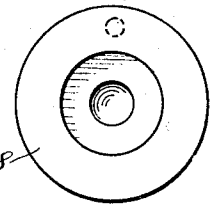


Fig. 5

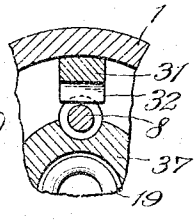


Fig. 9

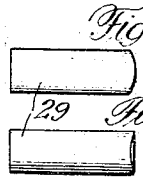


Fig. 7

Fig. 7a

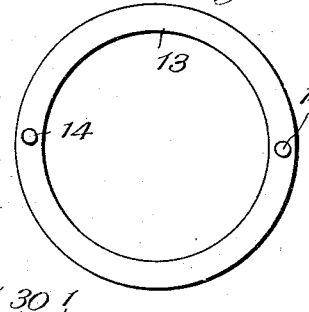


Fig. 6

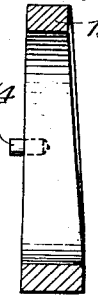


Fig. 6a

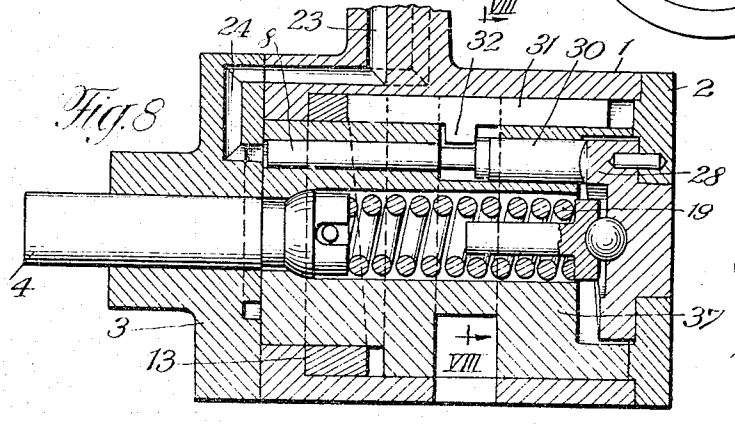


Fig. 8

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PISTON SPINNING PUMP

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Fig. 1

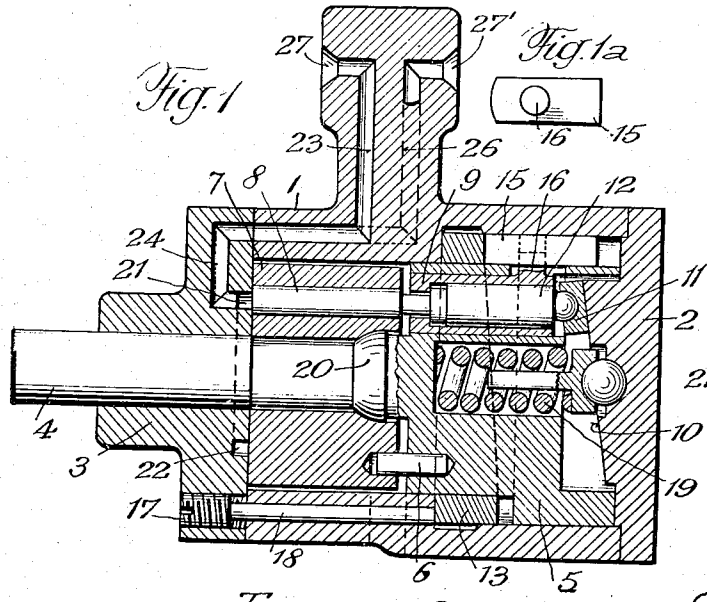


Fig. 1a

Fig. 2

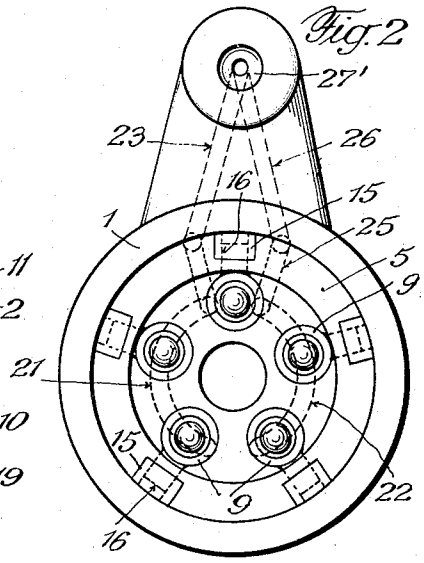


Fig. 10

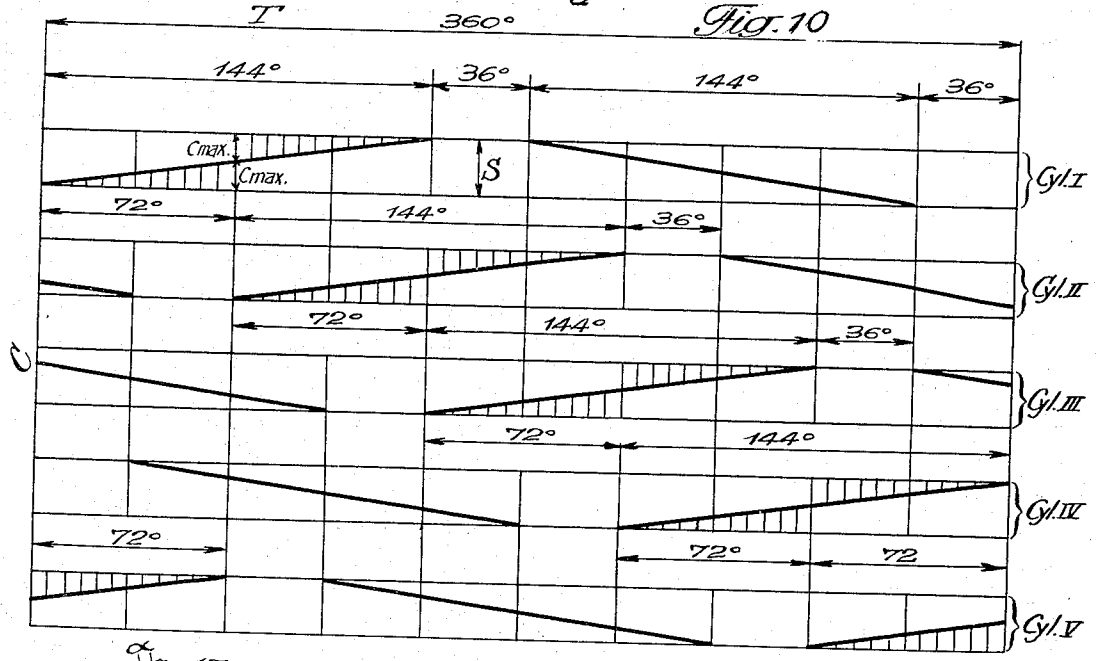


Fig. 3

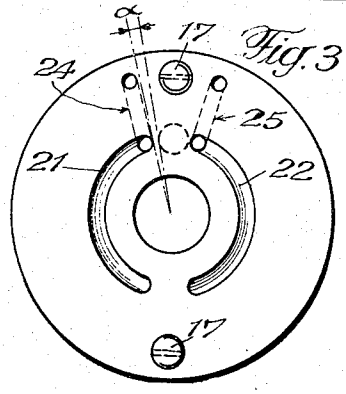


Fig. 4

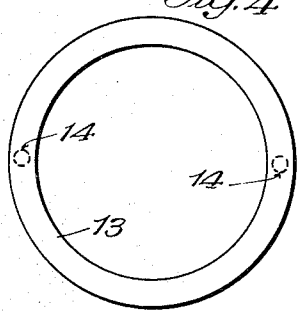
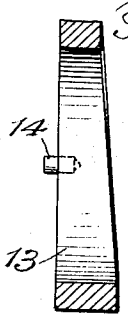


Fig. 4a



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UNITED STATES PATENT OFFICE

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PISTON SPINNING PUMP

Robert de Stoutz, Zurich, Switzerland

Application April 5, 1933, Serial No. 664,645
In Switzerland April 12, 1932

4 Claims. (Cl. 103—162)

This invention relates to piston operated viscose spinning pumps comprising a rotor which is rotatably arranged in a casing and which includes a plurality of working bores for the pistons in parallel disposition to the axis of rotation of the rotor which is adapted to act in the manner of a rotary valve.

In piston pumps of this type the pistons are actuated by means of a traverse disc with a plane end face obliquely disposed to the axis of the disc, or a similar traverse member, thus being imparted a versed sine movement, the speed curve of which is represented by a sine curve.

In the pump according to the present invention traverse cams are used instead of a traverse disk with a plane end face obliquely disposed to the axis of the disk for effecting the suction and pressure stroke. Hereinafter the traverse cams will be briefly referred to as suction cam member and pressure cam member, respectively.

With the known spinning pumps including pistons having a sine movement imparted thereto, the pressure stroke follows the suction stroke without intermission, i. e. each piston is at rest only in the dead centre positions of its traverses during the changes of direction of the movement. Consequently it is necessary that each working bore for the pistons is connected with the pressure side immediately on the piston leaving the suction side, in order to avoid substantial fluctuations in the output of the pump. In practice this is however, impossible as a certain spare area on the port face of the slide valve gear must be provided between the pressure and suction control passages respectively and the working bores in the central position of the latter between these passages, in order to prevent working fluid from escaping from the pressure side of the pump to the suction side thereof by way of the working bores or vice versa. The amount of spare area must, however, be reduced to a minimum (for spinning pumps to 1 millimeter at the most), with a view to avoiding substantial fluctuations in the output.

Thus, the slide valve gear of pumps of this type affords but poor obturation, as the allowable spare area between the working bores of the pistons and the valve control passages is too small. This fact represents one of the most serious objections to spinning pumps with a versed sine piston motion.

This disadvantage can be completely eliminated, according to the invention, by using a cam disc having a lateral traversing guide track with axially projecting cam portions for effecting the suction stroke, for the reason that with this arrangement the pressure cam member can be given any shape, for example in such a manner, that the piston is imparted a uniformly accelerated and a uniformly retarded movement. The speed curve for the piston movement is thus transformed into a straight line inclined to the axis on which the time is plotted and the curve illustrating the movement of the piston assumes a parabolic shape.

In a pump having five pistons, for example, two pistons act in the sense of compressing the working fluid at all times, whereas two pistons draw in and the remaining piston is at standstill. Each piston is thereby uniformly accelerated during a period corresponding to a rotational displacement of the drive shaft of 72° and uniformly retarded during a period of the same duration.

The sum of the speeds of the two pistons simultaneously compressing the working fluid is constant at all times, so that the output of the pumps is maintained constant. Thus, the pressure periods as well as the suction periods have a duration corresponding to an angle at the centre of the drive shaft of 144° which provides, between the end of each pressure stroke and the beginning of the next following suction stroke and vice versa, a spare area of port face that corresponds to an angle at the centre of 36° minus the cross sectional area of the working bore. During the rotation of the drive shaft through these angles of 36° the pistons are at rest. The thus formed considerable spare area of port face renders the slide valve gear fluid-tight in a high degree, as compared to pumps with a versed sine piston motion in which the pistons are continually moving, so that the spare area of port face to be provided between the pressure and suction strokes must be cut down to a minimum, in order to avoid substantial fluctuations in the output.

The allowable spare area between the ends of the pressure and suction control passages may be still increased by shortening the suction curve which can be readily done, as the length of this curve, i. e. the duration of the suction period has no influence on the uniformity of the output of the pumps. For carrying this feature into effect, the lateral traversing guide track on the traverse cam member, as provided for according to the invention, can be simply provided with recesses of any desired length between the axially projecting cam portions thereof.

Moreover, the use of a traverse cam member adapted to impart to the pistons a uniformly accelerated and retarded motion has the further

great advantage over the pumps with a versed sine motion of the pistons of attaining a theoretically and practically perfectly uniform output. It is a known fact that with pumps having a versed sine piston movement a satisfactory uniformity of output can be attained only by providing a greater number of pistons with their strokes offset relatively to each other, so as to produce an equalizing effect. However, even with provisions of this kind the theoretical degree of disuniformity of, for example a five piston pump, amounts to minimum 5.00% of the normal output. Actually this value is always greater. In order to obtain a perfect uniformity, a pump of this type should be equipped with an infinitely great number of pistons and no spare area of port face should be provided at all.

In contradistinction, thereto, the application of a traverse cam member having a lateral traversing guide track with axially projecting cam portions, as provided according to the invention, for imparting to the pistons a uniform acceleration and retardation, permits of obtaining a perfect uniformity of output.

Pumps of this type can be equipped with any number of pistons, except that at least three pistons must be provided. The construction of these pumps is, however, only feasible, when for the return movement of the pistons, i. e. for effecting the suction stroke thereof, a traverse cam member having a lateral guide track with axially projecting cam portions is provided.

In realizing the above-mentioned advantages the following measures have already been proposed together with applying cam disks with circumferential guide tracks.

(1) Uniform acceleration—uniform speed—uniform deceleration, thus without an intervening standstill of the pistons at the dead centers.

Spinning pumps that were compelled to operate on this principle of movement were unfit for use alone for this reason that the pistons are kept moving up to the dead center similarly as explained above in connection with the ordinary versed sine pumps.

(2) Speed 0—uniform acceleration—uniform speed—uniform deceleration—speed 0.

In this case admittedly the pistons come at rest at the dead centers, but nevertheless such pumps are unfit for use as spinning pumps, as for effecting the uniform speed, on the respective traverse cam a relatively long stretch of constant inclination must be provided. On this stretch the slide block contacts with the cam always at the same point of the block in consequence of which a flattened portion will be formed at this point, due to wear, and thus considerable irregularities in the output ensue during changing over from the uniform acceleration to the uniform speed. The surface curvature to be adopted for the slide blocks depends in a high degree on the shape of the curve and must remain unaltered.

According to this invention the inclination of the traverse cam changes continually, so that the point of contact travels about the surface of the slide block without intermission. Experience has shown that here the curvature of the slide blocks remains practically unaltered even if the general wear is considerable.

In the pumps, according to the present invention, it is necessary that at least at the end of the suction stroke the pistons are guided between the two traverse cam members without any axial play, so that the pistons are compelled to perform the full traverse without any deviations. For this reason the pistons must be positively driven for avoiding seizing of the same by coagulated viscose. While it is required that the pistons or the slide blocks thereof respectively must bear on the pressure cam member during the entire pressure stroke, for the suction stroke, spring means may be applied for compensating an unavoidable slight play of these parts between the pressure and suction cam members in such manner that these spring means are adapted to ensure a tight bearing engagement between the pistons and the pressure cam member at the end of the suction stroke, whereby the major portion of the suction stroke is positively controlled. The actuating sliding members for the control of the pistons, must be jammed, together with the pistons and the slide blocks thereof, in between the two cam members without allowing any play, at least at the end of the suction stroke.

In the pump according to the present invention the rotor may consist of one part only actuated by means of a shaft and carrying the pistons and their actuating sliding means or it may consist of two parts revolving together in the casing, one of which parts is a rotatable guide member actuated by means of a shaft and containing the actuating sliding means of the pistons and the other part being a rotor-shaped piston carrier centered on the shaft and actuated by an intervening pin, both parts taken together being hereinafter referred to as rotor.

In spinning pumps all the transverse forces acting on the pistons and favoring wear of the cylinders should be completely eliminated. The conversion of a rotary motion into a rectilinear sliding motion is practically impossible without producing tranverse forces directed vertically to the sliding motion. According to the invention the component forces due to the inclination of the cam track are taken up by sliding means guided in the rotor and which are independent of the pistons, the piston heads being only jammed in between these sliding means and having lateral play between them, whereby transverse pressure on the pistons and thus the wear of the latter in the cylinders is prevented.

In the accompanying drawings constructional forms of the invention are illustrated by way of example only, in which

Fig. 1 shows a longitudinal section of a constructional form of the pump according to the invention;

Fig. 2 shows an elevation, as seen from the right in Fig. 1, with the rear cylinder cover removed;

Fig. 3 illustrates an elevation of the front cylinder cover showing the port face thereof;

Fig. 4 depicts a modification of Fig. 3;

Fig. 5 shows a side section of a cam disc for controlling the pressure stroke of the piston;

Fig. 5*a* shows an elevation of Fig. 5;

Fig. 6 shows an elevation of a correlated cam disc for controlling the suction stroke of the piston;

Fig. 6*a* is a cross section of Fig. 6.

Figs. 7 and 7*a* are two different views of a slide block;

Fig. 8 shows a longitudinal section of another constructional form of the pump according to the invention;

Fig. 9 shows a fragmentary section on the line XIII—XIII in Fig. 8, looking from the left, and

Fig. 10 illustrates a diagram showing the individual piston speeds for a five-piston pump according to the invention.

Referring particularly to the Figs. 1 to 3 and 5 to 6a of the drawings, which illustrate a first constructional form of the pump according to the invention, the pump casing 1 is provided with two covers 2 and 3 screwed or otherwise connected thereto, the latter comprising a bearing for the driving shaft 4 of the pump and control passages 22 to 25. In the casing 1 a rotor is mounted consisting of a rotatable member 5 actuated by means of shaft 4 and a rotor-shaped piston carrier 7 which is centered on the shaft and actuated by an intervening pin 6.

In cylindrical working bores of the piston carrier 7, which bores extend parallel to the axis of rotation of the latter, pistons 8, in the present case five in number, are displaceably arranged which are provided with cylindrical heads 8a for engagement with actuating members 9 guided in the rotatable guide member 5. Slide blocks 29 are displaceably guided in the bored actuating members 9. The rear cover 2 of the casing is provided with a traverse cam member 28 having a lateral annular guide track with axially projecting cam portions for the presure stroke such as shown in Figs. 5 and 5a, the annular guide track being in sliding engagement by a line bearing contact with the slide block members 29 as shown in Figs. 7 and 7a in two views taken at right angles to each other. Between the regulating screws 17 and the pins 18 compression springs 33 are inverted for compensating a slight amount of unavoidable play arising between the cam members and the slide blocks at the end of the suction stroke.

The return movement, viz. the suction stroke of the pistons is effected by an annular cam member 13 having a lateral traversing guide track with axially projecting cam portions (Figs. 6 and 6a) the throw of which is equal to that of the traverse cam member 28 and which is secured on the casing 1 against distortion by pins 14.

On this suction cam member the ends of pegs 15 are sliding which are displaceably arranged in grooves of the rotatable guide member 5 for driving the actuating members 9, the latter being provided with noses 16 which project into holes of the sliding pegs 15. Consequently, the suction cam member 13 urges the pistons during the suction stroke onto the slide block members 29, by means of the displaceable pegs 15 and the actuating members 9, whereby the slide block members 29 in turn are urged against the pressure cam member 28. By these means axial play between the pistons and the pressure cam members is avoided. The suction cam member 13 is adapted to be axially adjusted relatively to the pressure cam member 28 by means of regulating screws 17 and pins 18, in order to compensate for wear.

The component forces due to the inclination of the cam track are taken up by the sliding pegs 15 and the actuating members 9 which are guided in the rotatable member 5 and which are independent of the pistons, the piston heads being freely held in between the actuating members 9 and the slide block members 29 and having lateral play between them, whereby transverse pressure on the pistons and thus the wear of the latter in the cylinders is prevented.

The shaft 4 is provided with a spherical enlargement 20 which is urged on the piston carrier 7 by means of a spring 19, the piston carrier in turn being pressed on the port face of the cover 3, whereas the other end of the spring 19 abuts against the cover 2 by means of a spring plate forming a guide and an intervening thrust ball. The port face of the cover 2 comprises a suction control passage 21 and a pressure control passage 22, these control pasasges being adapted to alternately communicate with the individual working bores of the piston carrier during the rotation of the same. The piston carrier 7 is thus adapted to operate at the same time in the manner of a slide valve.

The working liquid enters the pump at 27 and flows through the pasasges 23 and 24 into the suction control passage and from thence into the working bores of the pistons. It is then pressed into the pressure control passage, by action of the pistons, to leave the pump at 27' via the passages 25 and 26.

In the constructional form as per the Figs. 8 and 9, the actuation of the pistons is effected by means of slide block members 30 and sliding pegs 31 which are guided in the rotor 37, the rotatable guide member 5, as used in the previous constructional form, thus being dispensed with and the rotor consisting of one part only. The sliding pegs 31 are provided with noses 32 for directly pressing the heads of the pistons on the slide block members 30 which in turn are urged on the pressure cam member 28. In this constructional form of the invention the actuating members 9 of Fig. 1 are dispensed with and the piston heads are freely held in between the noses 32 of the sliding pegs 31 and the sliding block members 30 which are guided in the rotor 37 and take up the component forces due to the inclination of the cam track. Otherwise the construction and operation of this pump are similar as shown and explained in connection with the previous constructional form of the invention.

In the Figs. 3, and 4, the spare area of port face, i. e. the distance between the working bore of the pistons and the ends of the adjacent control passages, in the central position of the bore between these passages, is indicated by the angles α_2 and α_1 respectively. With a pump comprising a traverse disc having a plane end face obliquely disposed to its axis that imparts to the pistons a versed sine movement, this spare area must be reduced to a minimum, in order to avoid fluctuations in the output. This is represented by the angle α in Fig. 4.

When on the other hand the traverse cam member is designed to impart to the pistons a uniformly accelerated and retarded motion, so that the curve illustrating the movements of the piston assumes a parabolic shape, the allowable spare area is far greater, viz. 18° for a pump with five pistons, so that much better obturation is obtained. With such a design for the traverse cam member having a lateral annular guide track with axially projecting cam portions, a positively guided piston movement in both directions is, however, only feasible, when also for the return movement of the pistons a traverse cam member having a lateral annular guide track with axially projecting cam portions, as shown in the Figs. 6 and 6a is used.

If, in a known manner, the return movement of the pistons is effected with the aid of springs, i. e. resiliently, the same effect were obtained, less the disadvantages offered by springs, that is a complete uniformity of output. This is due to the fact that on the one hand the working cycle of the pistons as such is perfectly uniform, as will be seen in the diagram shown in Fig. 10, in which C represents the speed, T the time, and s the stroke of the pistons, and on the other hand that

each piston bore is already connected with the pressure control passage at the moment of the beginning of the pressure stroke and not only after a certain time from the beginning of this stroke.

It has been assumed for all the constructional forms of the invention that the suction cam member is adjustable relatively to the pressure cam member, viz. that the pressure cam member is fixed to the casing so as to be the determining factor for the piston movement.

Alternately, the suction cam member may be fixed if desired and the pressure cam member adjustably arranged instead, it being only necessary that one of the two cam members is fixed to the casing as a base for determining the piston movement.

Furthermore, the control passages for the working fluid may, in a known manner, be provided on the inner circumference of the casing instead of on the inner sides of the covers thereof.

I do not limit myself to the particular size shape, number or arrangement of parts as shown and described, all of which may be varied without going beyond the scope of my invention as shown, described and claimed.

What I claim is:

1. In a spinning pump in combination a casing, a rotor mounted for rotation in said casing and having piston bores therein, means for rotating said rotor, pump pistons reciprocably arranged in the working bores of said rotor, said casing having control passages for the working fluid formed therein for cooperation with said working bores of said rotor, a traverse cam member effecting the pressure stroke of the pistons, said cam member having a track the development of which comprises a straight line perpendicular to the piston axis followed by a curve equidistant to a parabola, immediately followed by a curve equidistant to the same but inversed parabola followed by a straight line perpendicular to the piston axis, said traverse cam member imparting to each of said pistons a uniformly accelerated movement immediately followed by a uniformly retarded movement during the pressure stroke thereof and a period of dwell at both ends of the stroke.

2. In a spinning pump in combination a casing, a rotor mounted for rotation in said casing and having piston bores therein, means for rotating said rotor, pump pistons reciprocably arranged in the working bores of said rotor, said casing having control passages for the working fluid disposed therein for cooperation with said working bores in said rotor, a traverse cam member for effecting the pressure stroke of the pistons, slide blocks loosely connected to the pistons, means for longitudinally guiding said slide blocks in the rotor, said pressure cam member actuating said slide blocks for effecting the pressure stroke of the pistons, a traverse cam member for effecting the suction stroke of the pistons, sliding pegs loosely connected to the pistons, means for longitudinally guiding said other sliding members in the rotor, said suction traverse cam member actuating said sliding pegs and eliminating longitudinal play of said pistons between said traverse cam members and said blocks and sliding pegs at the end of the suction stroke, adjusting screws provided in said casing for axially displacing said suction traverse cam member, spring means inserted between said adjusting screws and said suction traverse cam member to compensate for wear, said sliding blocks and sliding pegs taking up the transverse component forces due to the inclination of the cam tracks, thus avoiding wear of said pistons and working bores.

3. In a spinning pump in combination a casing, a rotor mounted for rotation in said casing and having piston bores formed therein, means for rotating said rotor, pump pistons reciprocably arranged in the working bores of said rotor, said casing having control passages for the working fluid disposed therein for cooperation with said working bores in said rotor, a head on each piston, a suction cam member having a lateral annular guide track with axially projecting cam portions, a pressure cam member having a lateral annular guide track with axially projecting cam portions, a sliding peg for each piston loosely connected to said piston and cooperating with said suction cam member, longitudinal guides in said rotor for said sliding pegs, a slide block for each piston, loosely connected to the piston and cooperating with said pressure cam member, said rotor having longitudinal guiding bores for said slide blocks, said sliding pegs being in positive cooperation with said suction cam member to urge said piston heads against said slide blocks, whereby said slide blocks in turn are urged against said pressure cam member at the end of the suction stroke.

4. In a spinning pump in combination a casing, a rotor mounted for rotation in said casing and having piston bores formed therein, means for actuating said rotor, pump pistons reciprocably arranged in the working bores of said rotor, said casing having control passages for the working fluid disposed therein for cooperation with said working bores of said rotor, a head on each piston, a bored actuating member for each piston loosely connected to said piston heads, a suction cam member having a lateral annular guide track with an axially projecting cam portion, a pressure cam member having a lateral annular guide track with an axially projecting cam portion, a sliding peg for each piston connected to said actuating member and cooperating with said suction cam member, said rotor having longitudinal guides for said sliding pegs and longitudinal guide bores for said actuating members, a slide block for each piston loosely connected to the piston and longitudinally displaceable in the bore of its corresponding actuating member and cooperating with said pressure cam member, said sliding pegs being in positive cooperation with said suction cam members to urge said actuating members against said piston heads whereby said piston heads are urged against said slide blocks which in turn are urged against said pressure cam member at the end of the auction stroke.

ROBERT DE STOUTZ.