



E. OEHLMANN.

ROTARY ENGINE.

No. 309,734.

Patented Dec. 23, 1884.

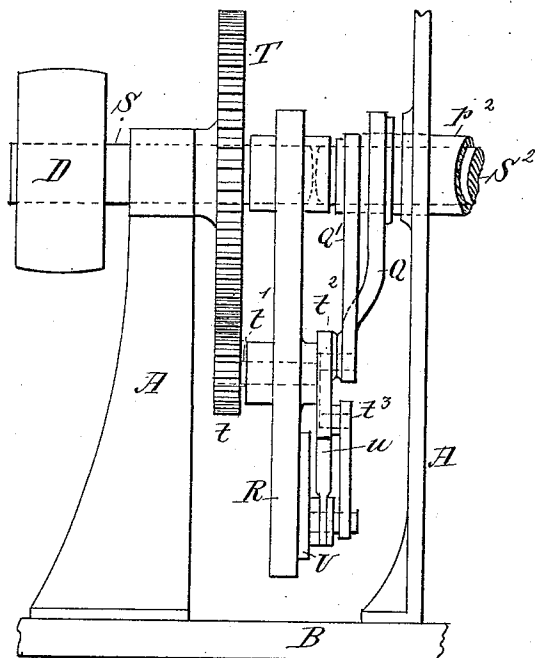


Fig. 9

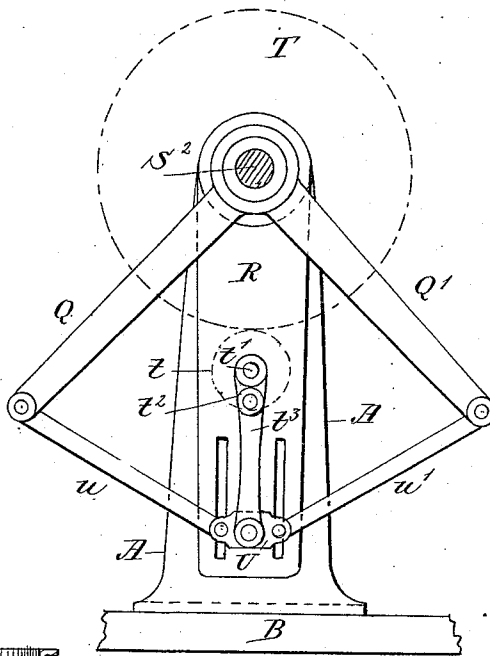


Fig. 10

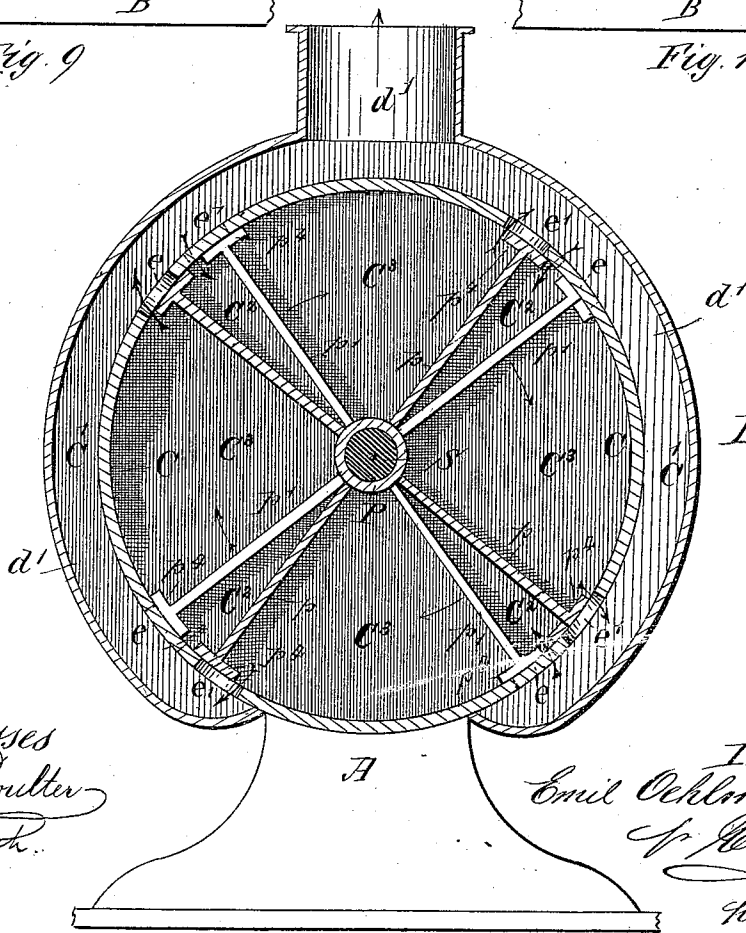


Fig. 2.

Witnesses  
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(No Model.)

4 Sheets—Sheet 3.

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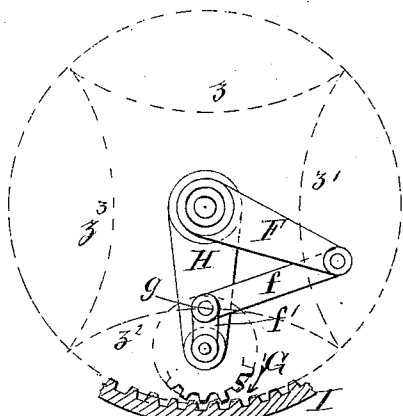


Fig. 5

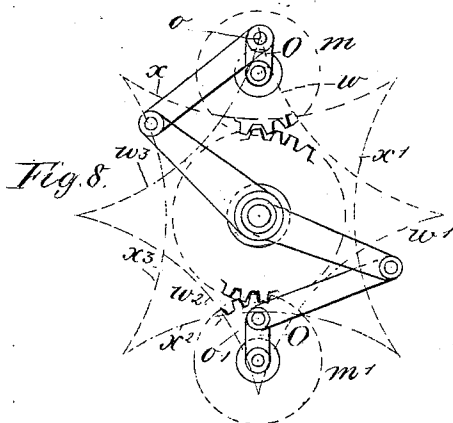
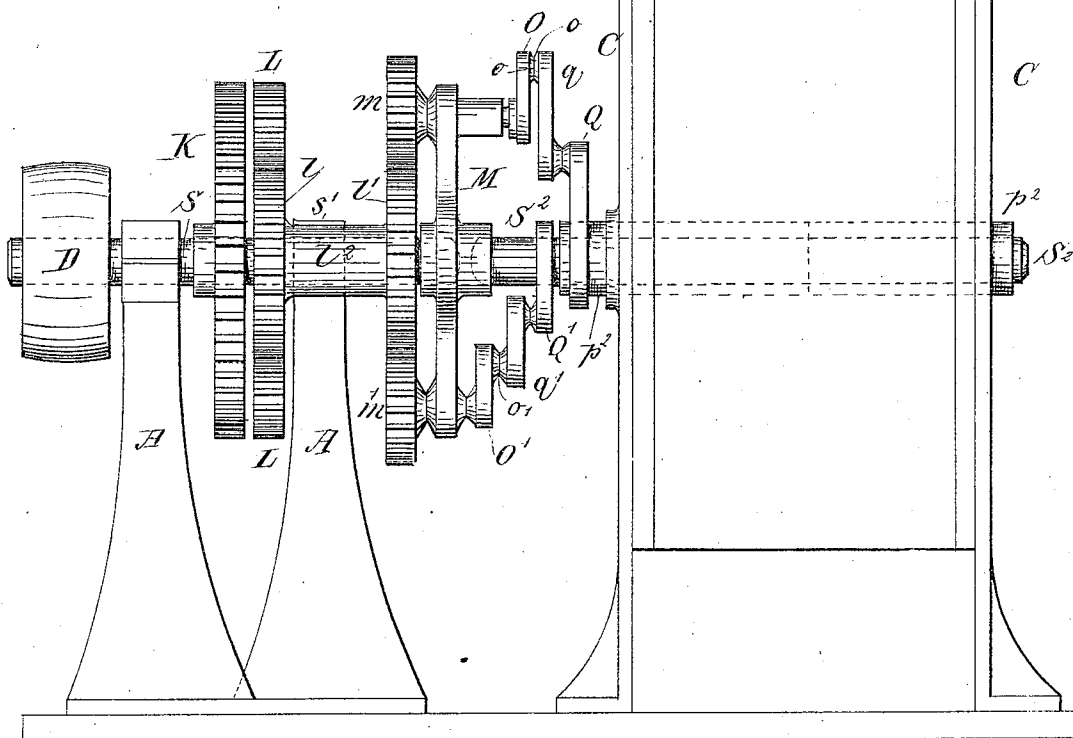


Fig. 6



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(No Model.)

4 Sheets—Sheet 4.

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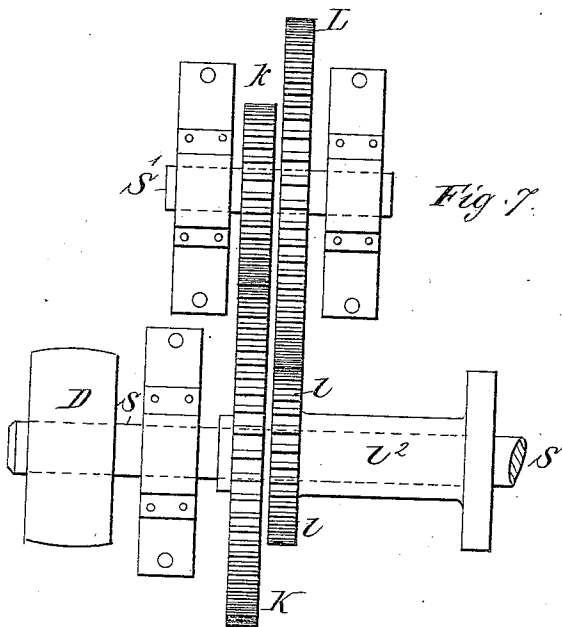


Fig. 7.

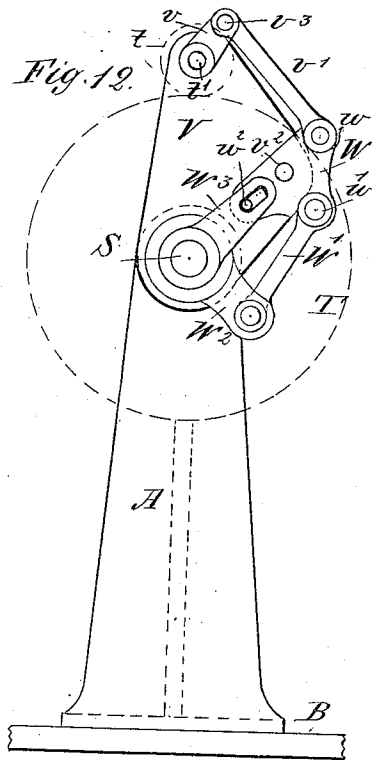


Fig. 12.

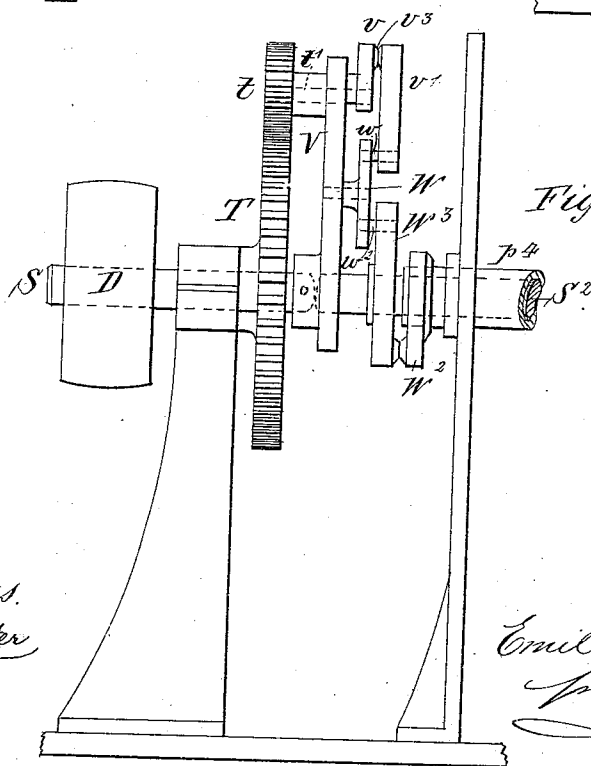


Fig. 11.

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# UNITED STATES PATENT OFFICE.

EMIL OEHLMANN, OF BERLIN, GERMANY.

## ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 309,734, dated December 23, 1884.

Application filed May 24, 1884. (No model.) Patented in Belgium April 26, 1884, No. 64,946; in France April 26, 1884, No. 161,764; in England April 26, 1884, No. 6,867; in Germany April 27, 1884, No. 29,681, and in Italy May 5, 1884, XXXIII, 264; XVIII, 16,804.

*To all whom it may concern:*

Be it known that I, EMIL OEHLMANN, a subject of the King of Prussia, residing at 70 Dresdenerstrasse, Berlin, Prussia, German Empire, have invented certain new and useful Improvements in Rotary Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My invention has relation to improvements in rotary engines, adapted for use as a motor, meter, or pump; and it consists, essentially, in the combination of two co-operating wing-pistons, each having a plurality of wings, said pistons being arranged to rotate at a varying speed within their inclosing-case.

The invention further consists in the combination, in such an engine or apparatus with the described form of co-operating wing-pistons, of mechanism whereby each piston is rotated at a variable speed, and whereby the relative speed of the co-operative pistons is varied, substantially as hereinafter fully described, and shown in the annexed drawings, in which—

Figure 1 is an end elevation of my improved rotary engine. Fig. 2 is a vertical transverse section thereof. Fig. 3 is a detached view of the wing-pistons. Figs. 4 and 5 illustrate the operation of the differential gear. Fig. 6 is an elevation of the engine, showing a modified arrangement of the differential gear, and Fig. 7 is a top plan view of a portion of said gear. Fig. 8 illustrates the operation thereof. Figs. 9 and 11 are end elevations, and Figs. 10 and 12 side elevations, of still further modifications in the arrangement of the differential gear.

The object of this invention is to increase the efficiency of rotary engines, and this I obtain, as above stated, by means of two co-operating wing-pistons having each a plurality of wings, those of one piston moving more rapidly than those of the other piston at

certain points of their rotation within the inclosing-casing.

By imparting a differential motion to the wing-pistons, as described, the spaces or chambers between the wings are contracted and enlarged successively, and as many inlet and discharge ports may be employed as there are piston-wings—that is to say, an inlet and discharge port for each pair of co-operating wings—since the inclosing-casing is perpetually divided by the eight wings of the two pistons (if such are provided with four wings) into four suction and four discharge chambers in the function of the apparatus—for instance, as a pump—so that at each complete revolution of the coacting pistons water is drawn into four chambers and discharged from four chambers, thereby increasing the efficiency of the apparatus very materially.

Referring to Figs. 1 and 2, to a suitable bed-plate, B, are connected standards A, in which is mounted a driving-shaft, S, or driven shaft, according as the apparatus performs the function of a pump or meter, or of a motor. At one or both ends said shaft carries a driving-pulley, D, through which the shaft is driven by any prime motor, or through which or other suitable transmitting mechanism the rotation of the shaft is transmitted. The shaft S rotates freely in a cylindrical casing, C, that has two peripheral passages, *c c'*, on opposite sides of a central peripheral partition, C'. (Shown in dotted lines at Fig. 1.) These passages *c c'* communicate, respectively, on the one hand with an inlet-pipe, *d*, and an outlet-pipe, *d'*, and inlet-ports *e* and outlet-ports *e'*, said ports being arranged on opposite sides of the central partition, C', in pairs, the inlet-ports *e* being slightly in the lead of the outlet-ports *e'*, or the reverse, according to the direction of the motion of the wing-pistons. I have shown, as an example in illustration of my invention, two wing-pistons, P P', loosely mounted upon the shaft S within the casing C. Each of these pistons is provided with four wings, *p p'*, though said pistons may be provided with more or less wings, as desired. Since both pistons are constructed precisely alike, it will be sufficient to de-

scribe one of them in order that the construction of the other may be fully understood.

Referring to Fig. 3 of the accompanying drawings, the piston P is composed of a hub,  $p^2$ , preferably formed on a face-plate,  $p^3$ , from which also project four (more or less) wings,  $p$ , the length of the hub on one side of the face-plate being equal to one-half the length of the wings, so that when both hubs are mounted on the same shaft and in contact at their inner ends their wings will overlap each other and extend from end to end of the inclosing-case and form joint-bearings with their respective face-plates  $p^3$ , or with the cylinder-heads. The outer half of the lower edge of each wing forms an integral part of the hub, while the inner half of the latter forms a joint-bearing with the inner half of the lower edge of the wings of the adjacent piston. The upper edge of each wing forms a segmental head or bearing,  $p^4$ , in contact with the inner periphery of the inclosing-case C. The number of ports, both inlet and outlet, will correspond to the number of wings or of the pistons, one inlet and one outlet port for each pair of wings; hence if each of the pistons has four wings the periphery of the casing C will have four inlet-ports,  $e$ , and four outlet-ports,  $e'$ , arranged as above set forth. Should the pistons have but three wings each, the casing would then have three inlet and three outlet ports; and should the pistons have more than four wings each, then the casing would be provided with as many inlet and outlet ports, respectively, as there are wings on each piston, and the casing will be divided into as many chambers as there are wings on both pistons, each chamber having its inlet and outlet ports. Such an arrangement of ports could not be made available in a rotary engine in which both the wing-pistons are caused to move at a uniform speed, for the reason that the admission of the fluid to and the discharge thereof from the cylinder could not be effected with sufficient rapidity to empty and fill the chambers before the wings of the pistons reach the inlet and outlet ports in their rotation, and for this reason but one inlet and one discharge port have heretofore been used in conjunction with this class of rotary engines. In fact, so far as I am aware, the pistons heretofore used were provided each with one wing only.

As above stated, I have illustrated in the accompanying drawings, as an example of my invention, an engine having two pistons provided each with four wings, and as the function of the engine is not changed by providing such pistons with a greater or less number of wings, provided suitable driving mechanism is employed to impart to said wings the proper differential movement, I will limit the description of the apparatus to four winged pistons, and in its operation as a pump.

As shown in Fig. 2, the piston-wings  $p$   $p'$  of the pistons are in the position they occupy relatively to one another when their speed is

reversed and the piston-heads  $p^4$  of each pair of piston-wings are about to uncover, or have partially uncovered, the admission and exhaust ports, the chambers  $C^2$  being empty and those  $C^3$  full of water. The piston-wings  $p'$  now move rapidly in the direction of the arrows—or from left to right, for instance—while the piston-wings  $p$  move very slowly. The water in the four chambers  $C^3$  is driven out of ports  $e'$  into passage  $C'$  and discharge-pipe  $d'$ , while a partial vacuum is created in chambers  $C^2$ , behind the rapidly-moving piston-wings  $p'$ , and said chambers, gradually becoming enlarged as the piston-wings  $p'$  move away from piston-wings  $p$ , fill with water coming from suction-pipe  $d$  through passage  $c$ . When the piston-wings  $p'$  have so far gained upon the piston-wings  $p$  to again assume the positions shown in Fig. 2 relatively to one another, their speed is reversed, the piston-wings  $p'$  move very slowly, while the piston-wings  $p$  move very rapidly. The chambers  $C^3$  become receiving-chambers, and those  $C^2$  discharging-chambers, and so on continuously. It will thus be seen that the admission of water to and its discharge from the chambers  $C^2$   $C^3$  takes place at each quarter-revolution of the pistons on their shaft, or at each quarter-revolution of the driving-shaft, the pistons being rotated rapidly and slowly alternately at each quarter-revolution of said shaft. This variable or differential movement may be imparted to the pistons in various ways by means of different arrangements of differential gearing or mechanism for producing variable motion. In Fig. 1, for instance, I have shown mechanism connected to each piston whereby said variable motion may be obtained. The piston sleeves or hubs  $p^2$  are made to project outwardly from the face-plates  $p^3$  and through the opposite sides of the inclosing-casing C, and upon each of these projecting ends of the hubs is secured a lever, F, the outer end of which is pivotally connected to the end of a link,  $f$ , the opposite end of which is pivotally connected to a crank-arm,  $f'$ , mounted on the short shaft  $g$  of a pinion, G. A second lever, H, on the driving-shaft S has its upper end connected with said short shaft  $g$  of pinion G, which latter meshes with the toothed inner periphery of a wheel, I, loosely mounted on the driving-shaft S, and rigidly secured to standard A.

I have stated above that each piston is connected with a variable-motion mechanism of the character just described, the relative arrangement thereof being such as to produce the change in the speed of the pistons above described.

The operation of this mechanism is as follows, referring to Figs. 4 and 5: As shown in Fig. 4, the pinion G of the driving mechanism of one piston is at the highest point in its rotation while the corresponding pinion of the other piston is at the lowest point in its rotation, as shown in Fig. 5, the direction of motion being indicated by arrows. When the

lever H is rotated by the shaft S, the short shaft  $g$  of pinion G will be rotated in a reverse direction by said pinion rotating in the toothed rim of wheel I, said lever being mounted on shaft  $g$ , to which latter the pinion is rigidly secured. The axis of the crank-pin  $f^2$ , that connects the crank  $f'$  to the shaft  $g$ , will therefore describe the hypocycloidal curve  $y y' y'' y'''$ , Fig. 4. As the lever F is rotated from the crank  $f'$  through link  $f$ , and as the motion of the crank-pin  $f^2$  corresponds approximately with the circle described by said lever F, it will be readily understood that the rotation of the latter during the first period of the movement is a slow one. If, on the contrary, the crank-pin  $f^2$  is in the position on the hypocycloidal curve  $z z' z'' z'''$  shown in Fig. 5, the lever F is rotated more rapidly. It is therefore obvious that during one half-revolution of the pinion G the movement of the piston is retarded, and during the other half-revolution said movement is accelerated. The degree of variation changes at each point of the revolution of the pinion G, and a uniform periodical variation of the wings of the pistons is obtained, in this example four times, at each revolution of the shaft S. While the crank-pin  $f^2$  is passing over the first half of either of the curves  $y y' y'' y'''$ , the movement of the piston P is retarded, and while passing over the other half said movement is accelerated. The arrangement of the mechanism is such that while the crank-pin  $f^2$  of piston P passes over the first half of one of the curves  $y y' y'' y'''$ , &c., Fig. 4, the corresponding crank-pin of the piston P' is passing over the second half of one of the curves  $z z' z'' z'''$ , &c., Fig. 5, and so on alternately, and from this it will be readily understood why the crank-pin  $f^2$  of piston P is at the beginning of a curve, as in Fig. 4, while the corresponding crank-pin of piston P' is at the center of a curve, as shown in Fig. 5. The diameter of the pinion G is exactly one-fourth that of the inner diameter of wheel I, so that at each rotation of the levers H the pin  $f^2$  of piston P will describe four equal cycloidal curves,  $y y' y'' y'''$ , and that of piston P' four corresponding curves,  $z z' z'' z'''$ , lying in diametrically-opposite planes.

The mechanism for varying the movements of the pistons may be applied on both sides of the casing C to the respective pistons, as shown in Fig. 1, or to one side only, as shown in Figs. 6, 7, and 8. In the latter arrangement a gear-wheel, K, is mounted on and rotated by shaft S, that meshes in a like wheel,  $k$ , the diameter of which is one-half that of wheel K, mounted on a counter-shaft, S', in suitable bearings,  $s'$ , which shaft S' also carries a gear-wheel, L, the diameter of which is twice that of wheel  $k$ , and meshes with a wheel,  $l$ , secured to a sleeve,  $l^2$ , loosely mounted on a shaft, S, which sleeve also carries a gear-wheel,  $l'$ , of the same diameter as wheel  $l$ , said wheels  $l$  and  $l'$  being in this manner rotated twice as fast as their driving-wheel L,

consequently the said wheels  $l$  and  $l'$  rotate four times as fast (in the direction indicated by the arrow, Fig. 5, for example) as the wheel K. This arrangement of variable gear may, however, be varied, so long as the rotation of the wheel  $l'$  relatively to the rotation of the shaft S remains the same. A two-armed lever, M, (or a disk having eccentric pins or studs) secured to shaft S, and rotated thereby, carries at the outer ends of each arm a pinion,  $m$  and  $m'$ , loosely mounted on pins or studs and meshing with the gear  $l$ . The diameter of the wheel  $l$  relatively to the diameter of the pinions  $m$  and  $m'$ , which are of like diameter, is as 1 to 3, so that at each quarter-revolution of the lever M the crank-pin  $o$  of crank O on the stud of pinion  $m$  will describe one of the cycloidal curves,  $w w' w'' w'''$ , and the crank-pin  $o'$  of a crank, O', on the stud of pinion  $m'$ , one of the curves  $x, x', x'',$  or  $x'''$ , Fig. 8. As the crank-pin  $o$  of crank O stands at the beginning of one of the curves—that  $w$ , Fig. 8, for instance—when the pin  $o'$  of crank O' stands at or about at the center of one of the curves—that  $x''$ , Fig. 8, for instance—it is obvious that the above-described differential movement of the pistons is obtained. The movement is transmitted to said pistons as follows: The hub of the lever M is extended on one side, and forms a bearing for a shaft, S<sup>2</sup>, on which both pistons are mounted, the sleeve or hub of one of said pistons—as the piston P', for instance—being rigidly secured to the shaft S<sup>2</sup>, while that of the piston P is loosely mounted on said shaft S<sup>2</sup>, to which is rigidly connected a lever, Q', the outer end of which is connected to a link,  $q'$ , pivoted upon the crank-pin  $o'$  of crank O'. To the hub of piston P is rigidly connected a lever, Q, to the outer end of which is connected a link,  $q$ , pivoted upon the crank-pin  $o$  of crank O.

In Figs. 9 to 12 I have shown other modifications whereby the described differential movement may be imparted to the pistons. As shown in Figs. 9 and 10, the rotation of the driving-shaft S is communicated through a lever, R, that carries a pinion,  $t$ , loosely mounted on a short shaft,  $t'$ , that has its bearing in said lever R, said pinion meshing with a gear-wheel, T, rigidly secured to one of the standards A. To the shaft of pinion  $t$  is pivoted a crank,  $t^2$ , connected by a connecting-rod,  $t^3$ , to a slide-block, U, arranged to slide in guides formed in the lever R, between its outer end and the hub of pinion  $t$ . To the opposite sides of the slide-block U are pivoted two links,  $u$  and  $u'$ , pivotally connected with levers Q and Q', connected to the hub of piston P and to the shaft S<sup>2</sup>, respectively, the piston P being loosely mounted on said shaft and the piston P' rigidly. The crank-pin of crank  $t^2$  here also describes epicycloidal curves, as hereinbefore set forth, to transmit the described variable motion to the pistons. The crank, as will be readily seen, imparts to block U a

complete reciprocating movement to the lever R at each half-revolution of the driving-shaft—that is to say, the block is moved inwardly four times and outwardly four times at each complete revolution of said shaft, whereby the links *u u'* and levers Q Q', and through the latter the hub of piston P and the shaft S<sup>2</sup>, are oscillated and at the same time rotated by the lever R. The wings of the pistons are therefore made to move toward and recede from one another four times in each revolution of the lever R.

In Figs. 11 and 12 the desired result is obtained by means of a stationary toothed wheel, T, with which meshes a pinion, *t*, the shaft *t'* of which is rotatably secured in the outer end of a lever, V, said pinion being, like those hereinbefore, of a diameter equal to one-fourth the diameter of the toothed wheel. To the shaft of pinion *t* is also secured a crank, *v*, connected by link *v'* to an arm, *w*, of a three-armed lever, W, pivoted to a stud, *v*<sup>2</sup>, on lever V. To the arm *w'* of said lever is pivoted a link, W', connected to a lever, W<sup>2</sup>, and to arm *w*<sup>2</sup> of lever W is pivoted the lever W<sup>3</sup>. The crank-pin *v*<sup>3</sup> of crank *v* describes in this case, also, epicycloidal curves, and the movement transmitted to the three-armed lever W, and from the latter to levers W' W<sup>2</sup>, connected, respectively, with piston P and shaft S<sup>2</sup>, is such as to cause the shaft and piston-hub to be oscillated toward V from each other four times at each complete revolution of the lever V, and at the same time rotated by said lever, as described in reference to Figs. 9 and 10.

It is obvious that by varying the diameter of the pinion relatively to the diameter of the wheel from which it is driven, and the length of the levers and links relatively to the diameter of said wheels, the mechanisms described may be applied to impart the described varying movements to pistons having any desired number of wings.

It will also be seen that the apparatus may be employed not only as a pump for pumping fluids, but as a motor by connecting the inlet-passage with any source of motive power—such as steam, compressed air or gases, or a liquid—no valves being required.

As the oscillatory movements of the pistons are in all respects alike, the mechanism employed to move one of the pistons may also serve to move the other pistons, as above set forth, provided means are provided to effect the proper variations in said movements.

Having now described my said invention, what I claim is—

1. In rotary engines, the combination of an inclosing-case and two coacting pistons provided each with a plurality of wings dividing said casing into a corresponding plurality of

chambers, and means for operating said pistons to alternately contract and enlarge said chambers to discharge a fluid therefrom while being contracted, and admit a fluid thereto while being enlarged, substantially as described, and for the purpose specified.

2. In a rotary engine, the combination of two coacting pistons, each provided with a plurality of wings, an inclosing-casing divided by said wings into a corresponding plurality of chambers, each chamber being provided with an inlet and outlet port, an inlet and outlet passage common to the inlet and outlet ports, respectively, of all the chambers, and means for operating the pistons to alternately contract and enlarge said chambers to discharge a fluid therefrom while being contracted, and admit a fluid thereto while being enlarged, substantially as specified.

3. In a rotary engine, the combination of two rotating coacting pistons, each provided with a plurality of wings, an inclosing-case divided by said piston-wings into a corresponding plurality of chambers, inlet and outlet ports for each chamber, an inlet-passage common to the inlet-ports of all the chambers, and mechanism for operating the pistons to discharge a fluid from and admit a fluid to each of the chambers as many times as there are piston-wings at every rotation of said pistons, substantially as described, and for the purpose specified.

4. The combination, in a rotary engine, of two coacting pistons, each provided with a plurality of wings, an inclosing-case divided by said wings into a corresponding plurality of chambers, each chamber being provided with inlet and outlet ports communicating, respectively, with inlet and outlet passages common to the respective ports of all the chambers, and mechanism for imparting a variable rotation to each of said pistons alternately, consisting, essentially, of a driving-shaft, driving-cranks connected by a lever and link to said pistons, and appliances to rotate the crank-pins in cycloidal curves equal in number to the number of wings on the pistons at each revolution of said driving-shaft, for the purpose stated.

5. The combination, with the inclosing-case C, the pistons P P', and the stationary gear-wheel I I, of the pinions G G, levers H H, cranks *f' f'*, links *f f*, and levers F, said parts being arranged for operation substantially as described, and for the purpose specified.

In testimony whereof I affix my signature in presence of two witnesses.

EMIL OEHLMANN.

Witnesses:

A. DEMELIUS,  
B. ROI.