No. 726,896. PATENTED MAY 5, 1903.

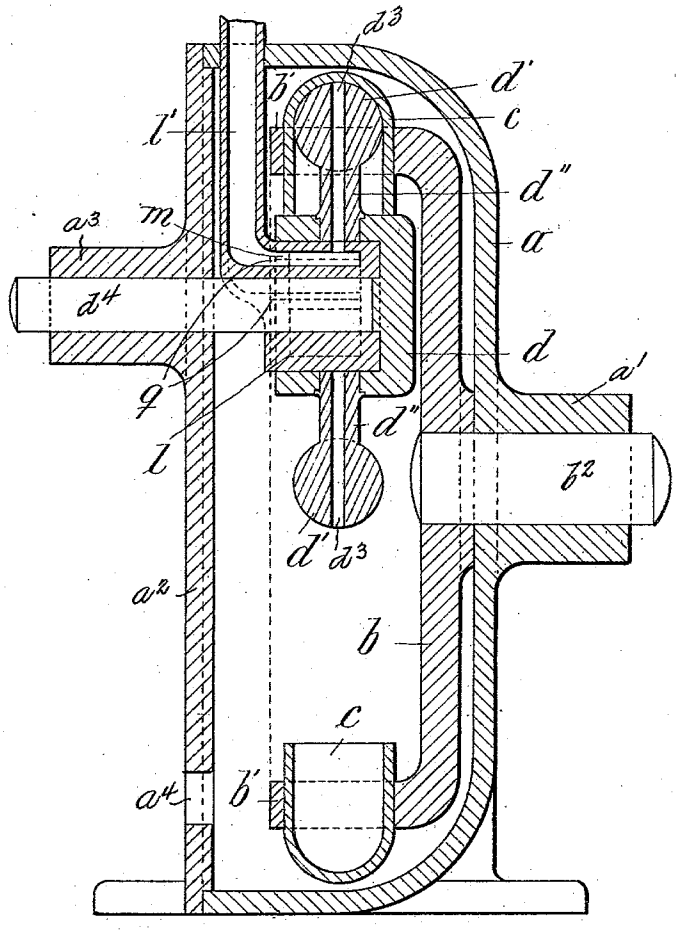
F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED NOV. 23, 1901.

NO MODEL. 6 SHEETS—SHEET 1.

Fig. 1.



Witnesses
C. Abel
B. K. Sommers

Inventor
Frans August Franzen
by Munn Orth & Co
Attys

No. 726,896. PATENTED MAY 5, 1903.

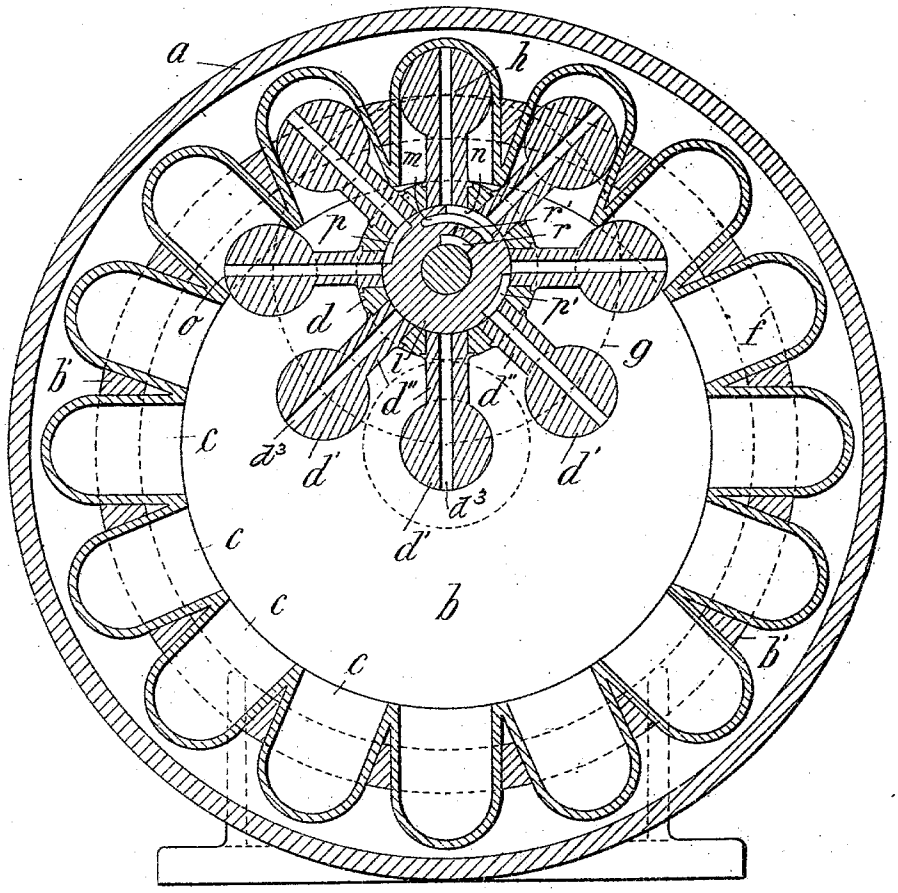
F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED NOV. 23, 1901.

NO MODEL. 6 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
B. F. Hall
B. Sommers

Inventor
Franz August Franzén.
by Munn & Co
Attys.

No. 726,806. PATENTED MAY 5, 1903.

F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED NOV. 23, 1901.

NO MODEL. 6 SHEETS—SHEET 3.

Fig. 3.

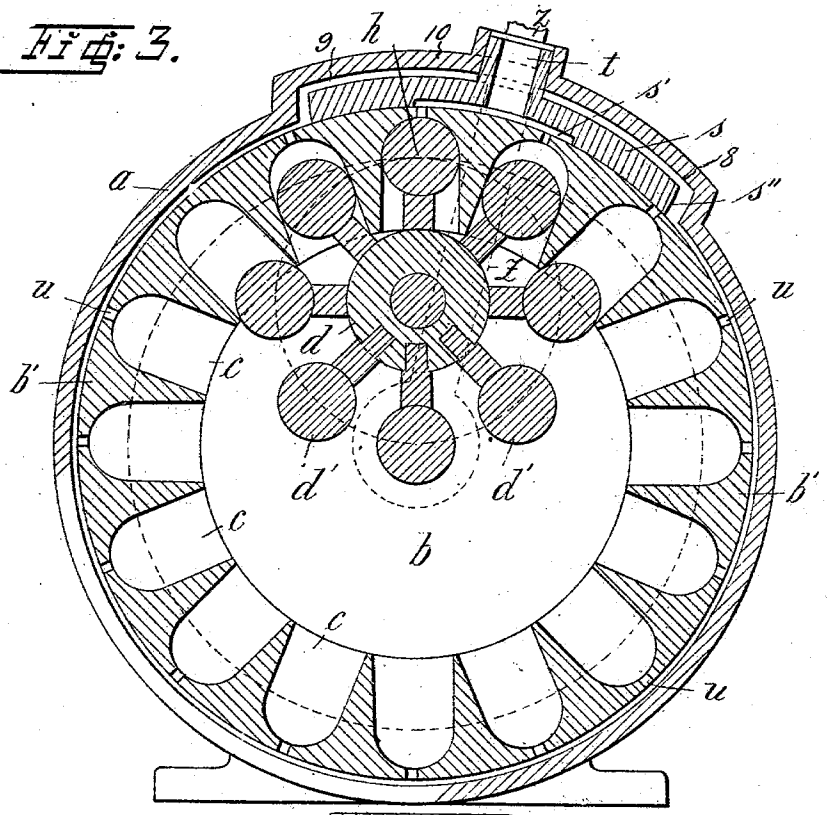
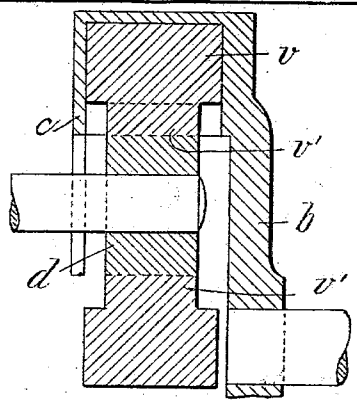


Fig. 4.



Witnesses:
B. Howe
C. B. Sommers

Inventor
Frans August Franzén
by Munn & Co
Attys.

No. 726,896. PATENTED MAY 5, 1903.

F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED NOV. 23, 1901.

NO MODEL. 6 SHEETS—SHEET 4.

Fig. 5.

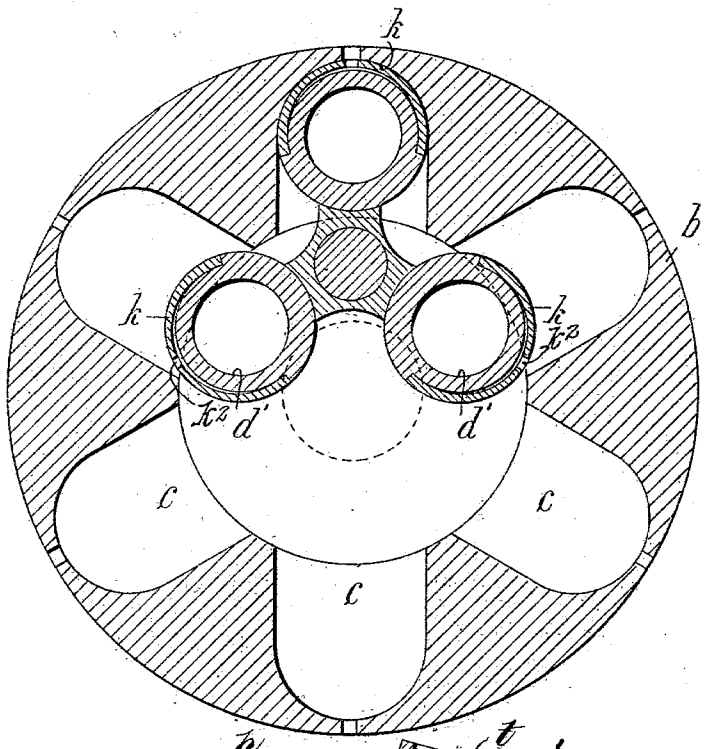
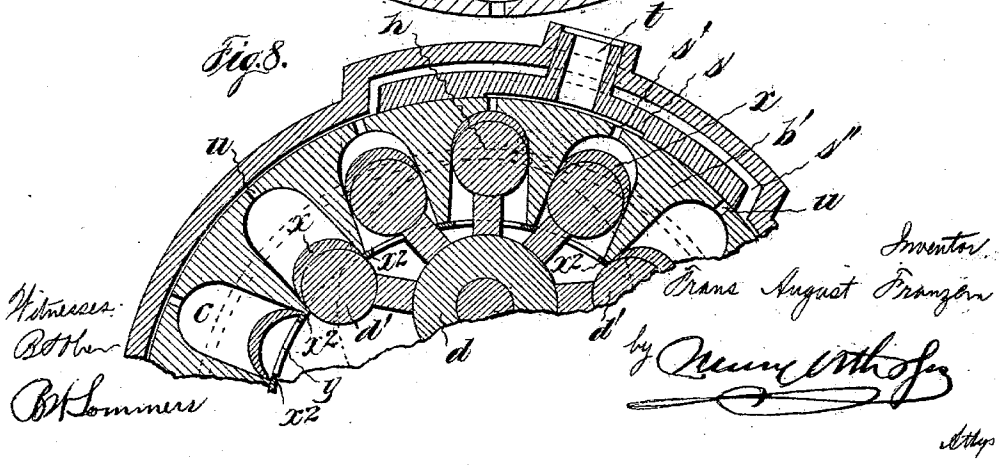


Fig. 8.



Witnesses:
B. F. Hoe
B. F. Sommers

Inventor
Frans August Franzén
by Munn & Co
Attys

No. 726,896. PATENTED MAY 5, 1903.

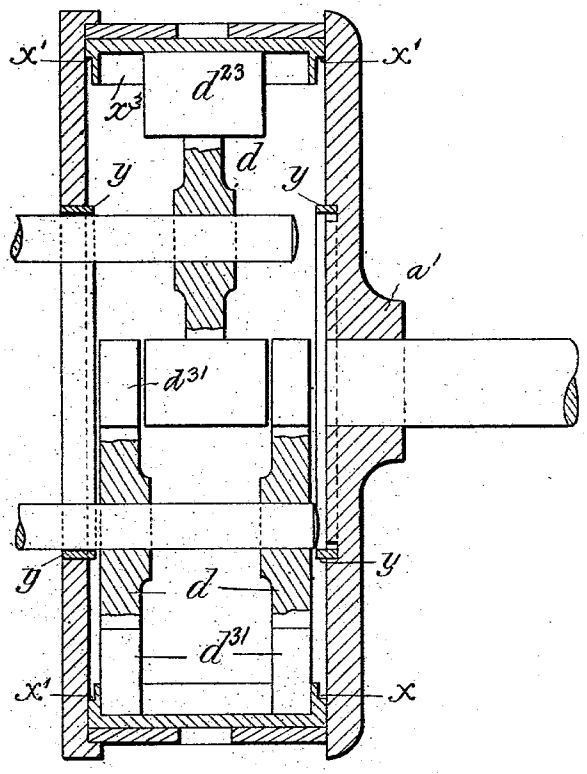
F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED NOV. 23, 1901.

NO MODEL. 6 SHEETS—SHEET 5.

Fig. 6.



Witnesses
[illegible]
[illegible]

Inventor
Franz August Franzen.
by [illegible]
Atty.

No. 726,896. PATENTED MAY 5, 1903.

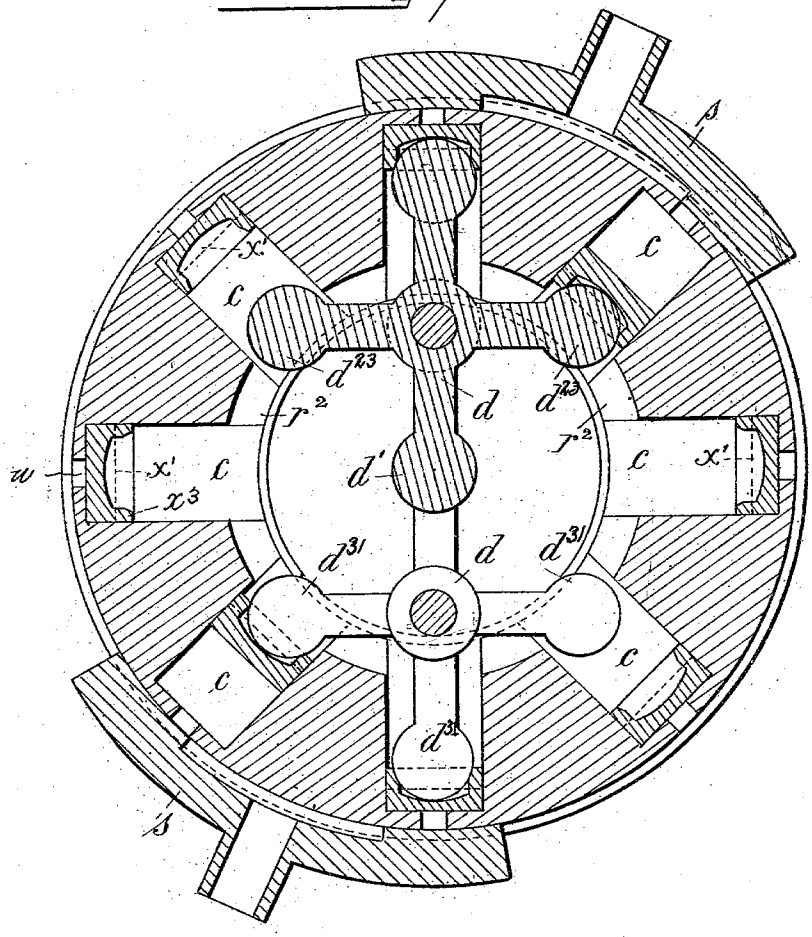
F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED NOV. 23, 1901.

NO MODEL. 6 SHEETS—SHEET 6.

Fig. 7.



Witnesses.
[illegible]
[illegible]

Inventor.
Franz August Franzén.
by [illegible]
Attys

No. 726,896. Patented May 5, 1903.

UNITED STATES PATENT OFFICE.

FRANS AUGUST FRANZÉN, OF LUND, SWEDEN, ASSIGNOR OF ONE-HALF T PONTUS ERLAND FAHLBECK, OF LUND, SWEDEN.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 726,896, dated May 5, 1903.

Application filed November 23, 1901. Serial No. 83,460. (No model.)

To all whom it may concern:

Be it known that I, FRANS AUGUST FRANZÉN, a subject of the King of Sweden and Norway, residing at Lund, Sweden, 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 and figures of reference marked thereon, which form a part of this specification.

The present invention relates to rotary engines, and comprises an outer wheel having a plurality of buckets or cylinders thereon and one or more smaller piston-wheels eccentrically located within the outer wheel, whose pistons successively enter successively-presented buckets or cylinders.

The invention further comprises details of construction fully described in the following specification and particularly pointed out in the claims.

Referring to the drawings, in which like parts are similarly designated, Figure 1 is a cross-section of one form of engine embodying my invention. Fig. 2 is a longitudinal section taken at right angles to Fig. 1. Fig. 3 is a longitudinal section of a modification. Fig. 4 is a fragmentary sectional view showing a modified form of a piston-wheel. Fig. 5 is a view showing three pistons. Fig. 6 is a cross-section, and Fig. 7 a longitudinal section, showing a plurality of piston-wheels capable of coöperating with a single outer wheel; and Fig. 8 is a fragmentary sectional view of a modification showing intermediate packing elements x.

The casing or jacket a, constituting at the same time the frame of the engine, is provided on one side with a central boss a' and preferably, though not necessarily, a flat cover-plate a^2, provided with an eccentrically-located boss a^3 and exhaust-passage a^4.

The bucket or cylinder wheel b is secured to a shaft b^2, journaled in the boss a' of the casing, and rotates in the casing. The rim b' of the wheel b is provided with a number of equally-spaced buckets or cylinders c of any suitable construction and form, either separately secured thereto or cast in one piece with said wheel, as shown in Figs. 3, 5, and 7.

Within the wheel b and eccentric to it is the cog or piston wheel, which consists of a rotatable nave d, to which are secured the cogs or pistons d' in the form of spheres connected by bolts or shanks d'' to the nave. These pistons, as well as their shanks, have a longitudinal perforation or steam-passage d^3.

The shaft d^4 in the boss a^3 supports a valve-ring l, on which the nave of the piston-wheel rotates and through which steam is successively applied to the several pistons as they come into operative position. This ring l contains a segmental annular chamber m, that is connected with the steam-supply pipe l' and preferably formed in one piece with the valve ring or slide. In the valve-ring is an arcuate port n, over which the inner ends of the pistons travel during their rotation to periodically register therewith to admit steam at the required point of their rotation through them to their coöperating cylinders c to one side of the tangent-point h of the pitch-lines of the two wheels.

In order to place the piston-wheel in place, as shown in Fig. 2, three of the pistons are unscrewed from the nave of the wheel and that portion of the wheel turned toward the buckets. The wheel is then rotated to cause the remaining pistons to engage the buckets, whereby the portion which is free of pistons will be turned toward the center of the engine when the missing pistons can be screwed in place.

The relative sizes of the two wheels must be such that the radius of one is a multiple of the radius of the other. For example, the diameter of wheel d must be one-half of that of wheel b, reckoned from the pitch-lines f and g of the respective wheels and the number of pistons preferably one-half of that of the cylinders or buckets.

On turning the wheels the pistons will, owing to their relative proportions, describe straight radial lines toward the center of the wheel b, and the spherical heads of the pistons can thus pass through the entire lengths of the cylinders. Steam enters from the pipe l' to the chamber m in the ring or distributing valve l and passes through the port n and

through the central passage d^3 in that piston that is just to the right of the tangent-point h of the pitch-circles of the two wheels. The steam then acts between the piston and cylinder end and forces the piston outward, at the same time turning the piston-wheel, which in its turn acts on the bucket or cylinder wheel b, causing the engine to rotate toward the right. After the piston leaves its respective cylinder, steam exhausts into the jacket or casing surrounding the engine and is led off either through the port a^4 or a suitable exhaust-pipe. The jacket is thus filled with exhaust-steam, and the pistons to the left of the tangent-point h as they enter the buckets would compress the exhaust-steam in them, and to avoid this I form in the ring l two arcuate exhaust-passages p and p', the former operative when normally direct and the latter when running reversed. These passages have a circumferential length sufficient to allow steam to be forced out of the cylinders during the entrance of the piston therein and are parallel to the axis of the ring and open into the casing at q, Fig. 1.

In order to balance the pressure exerted on the ring-valve l, I provide a recess r under the steam-chamber m and next to the shaft l^4, said recess communicating with the chamber m by a port r'.

In order to diminish the noxious space or clearance to as small an amount as possible, the ring-valve l is placed as far from the center of the wheel as will be permitted by the pistons d'.

In order to reverse the direction of the engine, the ring-valve is turned toward the left, so that it occupies the same relative position on the left of the tangent-point h, in which case the exhaust-passage p' is brought into operative position. To provide for the rotation of the ring-valve, there is a slot in the casing a, through which the pipe l' projects, and covering the same and rigidly connected to the pipe is a slide. (Not shown in the drawings.)

If desired, the pipe can project through the front wall a^2 of the jacket and a suitable arcuate slot made in the wall concentric with the ring-valve. In either case the plate covering the slot fits close to the casing and is of sufficient size to cover the slot whatever the position of the pipe l' is. The amount of steam admitted through the pistons, as well as the amount of expansion, depends upon the relative position of the ring-valve—that is, how far it is turned to one side or the other of the tangent-point h.

Fig. 3 shows a modification of the engine in which the pistons are solid; but the steam instead of being admitted between the cylinder end and piston through the pistons themselves is admitted through the closed ends of the cylinders, thus being admitted from the outside of the wheels instead of from their centers. The bucket-wheel b in this case is made solid and has a circular outer periphery, each cylinder being provided with an inlet-port u in its end. The casing is provided with an offset 8, that has a slot 9, covered by a plate 10. Within the offset is the distributing-valve s, having a steam-chamber s', to which the steam is led through a pipe t, to which the slide 10 is rigidly attached. The cylinders each receive steam through their perforations u while passing under the inlet-valve port s', and the amount of steam admitted and the amount of expansion of the steam will depend upon the length of the port s' on each side of the central inlet-pipe t. The slide s is illustrated as connected to a reversing-lever z, one end of which is supported around a motor-shaft, the object of which is to accurately guide the slide in an arc of a circle. Two such arms may be employed, if desired, or in lieu of this mechanism the slide s may be moved by a suitable bevel-gear operated by any suitable lever mechanism to move the slide along the circumference of the wheel b. This type of motor is convenient for practical use, especially as the clearance is very small. It is of course obvious that the pistons need not be spheres, but may, as shown in Fig. 4, be cylinders v, having their axis parallel with that of the motor-shaft and may be supported by thin plates v'. The cylinders or buckets c must then be square or rectangular in cross-section. A modification of this type of engine consists of providing an intermediate reciprocable packing element between the pistons and ends of the cylinders, whereby a more steam-tight fit is obtained between the coöperating parts, and is intended for engines running at a low speed. In Fig. 8 I have shown three such elements in the form of cups x that increase the tangent-surfaces between the pistons and cylinders and are arranged so as not to leave the cylinders. These cups x are maintained by centrifugal force against the outer ends of the cylinders, except during the passage of the cylinder past the inlet-port s, when they are forced inward by the steam and act on the pistons to rotate the wheels. To prevent the cups from being forced out of the cylinders into the interior of the wheel b by the expansion of the steam and after the pistons have left the cylinders, I provide a thin somewhat springy retaining ring or strip y on the inner ends of the cylinders to form abutting-shoulders x^2, against which the cups may strike. Part of this ring x is shown in Fig. 8. The exhaust from the cylinders b' takes place through the ports u after these ports have passed, during the rotation of the wheel b, the slide s. For this purpose the length of the slide is so adjusted that exhaust will take place a little before the cups x strike their shoulders x^2, there being an exhaust-space s'' between the end of said slide and the interior end wall of the offset. The length of the slide s can be so adjusted that the cups will strike the ring x with little or no force, and the centrifugal force immediately cause them to re-

turn to their operative position in the outer ends of the cylinders.

In Fig. 5 I have shown a piston-wheel provided with three pistons and a packing device threaded on each one. Each packing device consists of a springy socket k, threaded on the pistons d' and provided with a perforation k^2 to admit steam between the packing and piston.

Figs. 6 and 7 show a plurality of piston-wheels coöperating with a single cylinder-wheel. These cylinders c are rectangular in cross-section and contain rectangular packing devices x', having edges x^3 turned toward the center of the wheel. The flanges x^3 on the ends of these packings x' are set in from the edges to enable them to pass the ring y. The diameter of the pitch-line of the piston-wheel is one-half of that of the cylinder or bucket wheel, whereby the pistons will move in a rectilinear direction, and in this case, where two piston-wheels are used, as shown in said Figs. 6 and 7, they are the same diameter, their pitch-lines would be tangent to each other, and in order to enable them to operate the structure shown in Figs. 6 and 7 is adopted, one of the piston-wheels passing between two oppositely-situated parts of the other wheel. As shown, one of the piston-wheels is provided with duplicate pistons d^{31}, between which the cylindrical pistons d^3 of the other wheel can pass. The steam enters in the same manner as in Fig. 3 through two oppositely-arranged valves s, one for each wheel. The packings x' are forced inward, act upon the pistons to rotate the piston-wheels, and are stopped by the ring y, that is set as far in toward the center of the wheel as is permitted by the shafts of the piston-wheels. In order to permit the escape of steam from the cylinders c into the interior of the outer wheel, there are cut-away portions r^2 between adjacent cylinders, the radial height of said recesses or cut-away portions being slightly greater than that of the packings, so that when the latter are seated on the ring y there is sufficient space to allow the escape of steam from the cylinders. Another purpose of this recess r^2 is to provide sufficient space to allow the pistons to enter and withdraw from the cylinders.

Having thus described my said invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In a rotary engine, a casing, an annular wheel journaled therein, buckets or cylinders arranged on its periphery, a piston-head movable in each cylinder and a piston-wheel eccentrically arranged to and coöperating with said annular wheel, and means to admit steam between the heads and cylinders to cause the former to act on and rotate the piston-wheel, substantially as described.

2. In a rotary engine, a casing, an annular wheel journaled therein, buckets or cylinders on the periphery and opening toward the center thereof, a piston-head in each cylinder, means to limit the movement of each piston-head, a piston-wheel journaled eccentrically to the aforementioned one, a plurality of pistons thereon adapted to enter the open ends of the cylinders during rotation, and means to admit steam between the piston-heads and cylinders to cause the former to act on the pistons of said wheel and rotate it, substantially as described.

3. In a rotary engine, a casing, an annular wheel therein, buckets or cylinders arranged on the periphery of said wheel and open toward its center, a plurality of piston-wheels eccentric to and coöperating with the first-mentioned wheel, and means to supply steam between the pistons and cylinders, substantially as described.

4. In a rotary engine, a casing, an annular wheel therein, buckets or cylinders arranged on the periphery of said wheel and open toward its center, a plurality of piston-wheels eccentric to the first-mentioned wheel and coöperating therewith, and means to admit steam on either side of the tangent points of the pitch-lines of said coöperating wheels and between the pistons of the piston-wheels and their coöperating buckets, substantially as described.

5. In a rotary engine, a casing, an annular wheel journaled therein, buckets or cylinders on the periphery of said wheel, a piston-head in each cylinder, a piston-wheel eccentric to the first-mentioned wheel and coöperating therewith, and means to admit steam to the outer ends of the cylinders to cause the piston-heads to act on the piston-wheel, substantially as described.

6. In a rotary engine, a casing, an annular wheel journaled therein, open-ended buckets or cylinders on the periphery thereof, a piston-head in each cylinder, means to prevent said heads from being driven out of their cylinders, a plurality of piston-wheels eccentric to the first-mentioned one and coöperating therewith, and means to admit steam to the outer end of said cylinders to cause the piston-heads to act on said piston-wheels, substantially as described.

7. In a rotary engine, a casing, an annular wheel journaled therein, buckets or cylinders secured to the periphery thereof and having one end open toward the center of said wheel, and steam-ports in their opposite ends, a piston-head in each cylinder, means to prevent the piston-heads from being driven out of their cylinders, two piston-wheels eccentric to the first-mentioned wheel and coöperating therewith, one of said wheels comprising a hub, pistons and a rod connecting the center of each piston with the hub, and the other comprising a hub, pistons and rods to connect the pistons with the hub, the pistons of one wheel capable of passing between pairs of pistons of the other wheel, and means to admit steam to said cylinders to cause the piston-heads to act on the pistons of said piston-wheels, substantially as described.

8. In a rotary engine, a casing, an annular wheel therein, buckets or cylinders opening oward the center of said wheel, a piston-wheel eccentric to and within the first-mentioned wheel and a plurality of spherical pistons on said piston-wheel to successively enter successively-presented buckets, substantially as described.

9. In a rotary engine, a casing, an annular wheel therein, buckets or cylinders opening toward the center of said wheel, a piston-wheel eccentric to and within the first-mentioned wheel, pistons on said piston-wheel, yielding metallic packing elements secured on the working faces of the pistons and means to admit steam between the packing elements and piston ends, substantially as described.

10. In a rotary engine, a casing, an annular wheel therein, buckets or cylinders opening toward the center of said wheel, a piston-wheel eccentric to and within the first-mentioned wheel, spherical pistons on said piston-wheel, and yielding metallic, perforated, packing elements threaded on the spherical pistons, substantially as described.

11. In a rotary engine, an annular wheel having peripheral ports leading to cylinders opening toward the center of the wheel, a part conforming to the periphery of said annular wheel and provided with a chamber communicating with said ports as they successively pass said chamber, means to alter the relative peripheral position of said part and chamber, and means to supply motive fluid, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

FRANS AUGUST FRANZÉN.

Witnesses:
HILVING HESSLER,
ANTON SORENSON.