No. 755,759. PATENTED MAR. 29, 1904.

F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED DEC. 17, 1903.

NO MODEL. 5 SHEETS—SHEET 1.

Fig. 1.

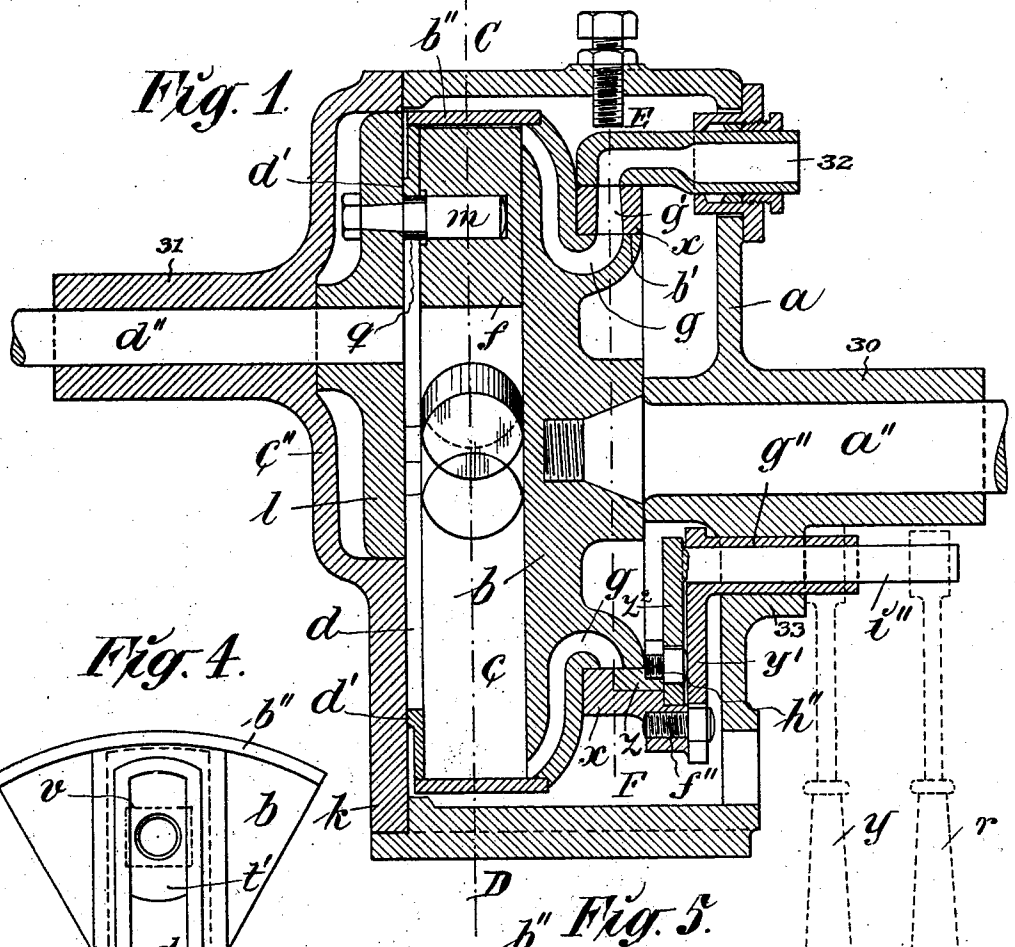


Fig. 4.

Fig. 5.

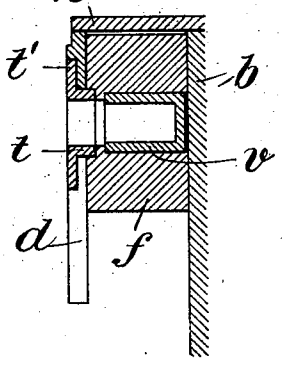
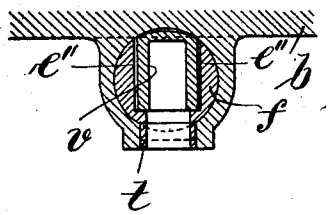


Fig. 6.



Witnesses.

H. L. Amer.

R. F. Lemmer

Inventor.

Frans August Franzén.

by Henry Orth & Sons Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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NO MODEL. 5 SHEETS—SHEET 2.

Fig. 2.

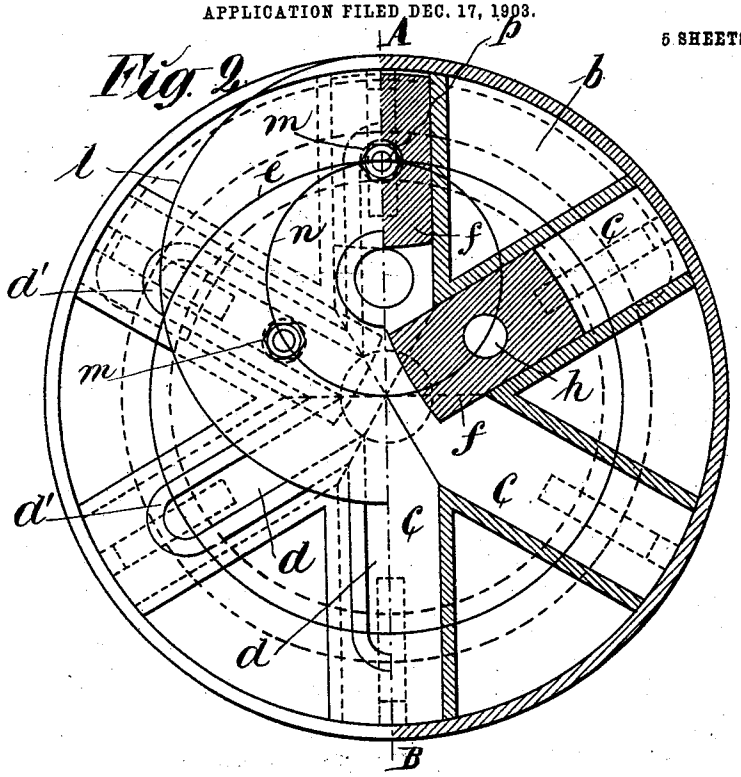
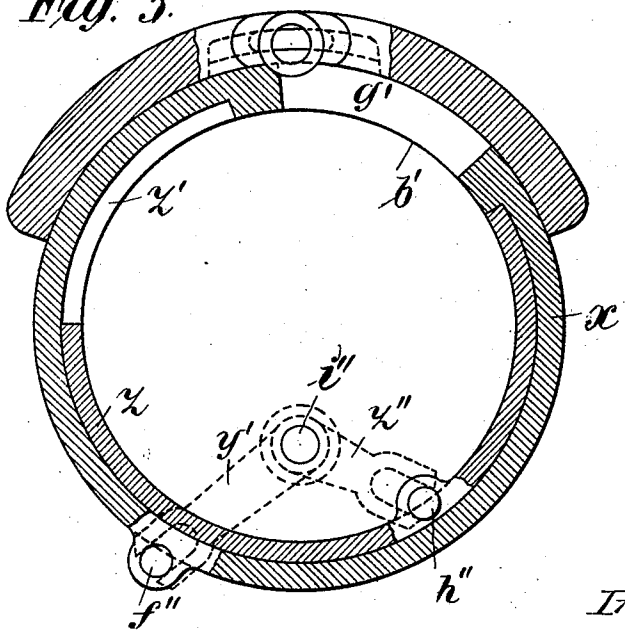


Fig. 3.



Witnesses.

H. L. Amer.

A. Sommers

Inventor.

Frans August Franzén.

by Henry Orth & Son Att'ys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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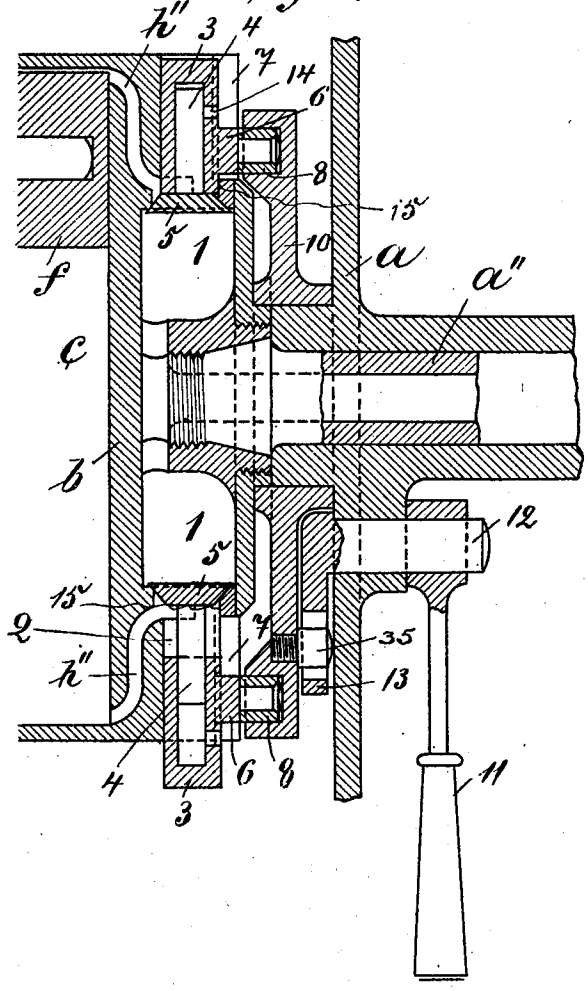
F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED DEC. 17, 1903.

NO MODEL. 5 SHEETS—SHEET 3.

Fig. 7.



Witnesses.

H. L. Ames.

A. Sommer

Inventor.

Franz August Franzén

by Henry Orth & Son attys.

THE NORRIS PETERS CO., PHOTO-LITH., WASHINGTON, D. C.

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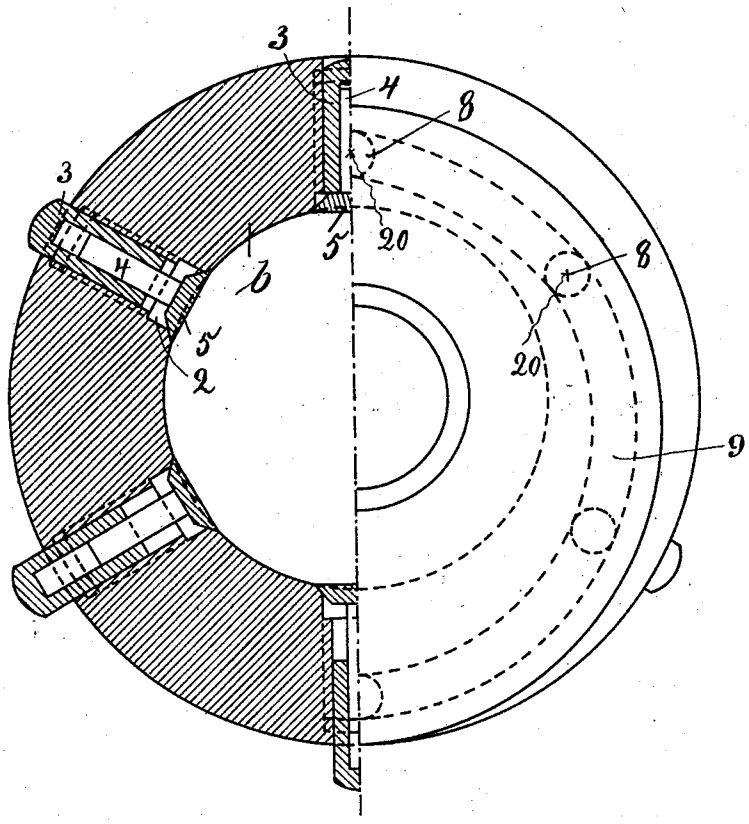
F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED DEC. 17, 1903.

NO MODEL. 5 SHEETS—SHEET 4.

Fig. 8.



Witnesses.
H. L. Amer.
A. Sommers.

Inventor.
Frans August Franzén.
by Munn & Co. atty's.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 755,759. PATENTED MAR. 29, 1904.

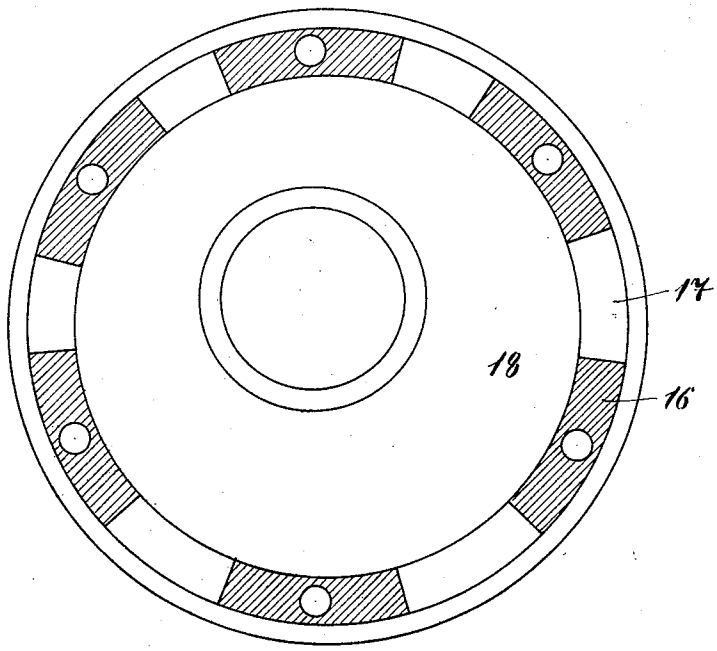
F. A. FRANZÉN.

ROTARY ENGINE.

APPLICATION FILED DEC. 17, 1903.

NO MODEL. 5 SHEETS—SHEET 5.

Fig. 9.



Witnesses,
H. L. Amer.
O. H. Sommers

Inventor.
Frans August Franzén.
by Munn & Co Attys.

THE NORRIS PETERS CO. PHOTO-LITHO. WASHINGTON, D

No. 755,759. Patented March 29, 1904

UNITED STATES PATENT OFFICE.

FRANS AUG. FRANZÉN, OF LUND, SWEDEN, ASSIGNOR OF ONE-HALF TO PONTUS ERLAND FAHLBECK, OF LUND, SWEDEN.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 755,759, dated March 29, 1904.

Application filed December 17, 1903. Serial No. 185,519. (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.

This invention relates to rotary engines, and has for its object a plurality of crossed cylinders having a center common to all of them and a piston in each cylinder traversing the common center at different times, together with details of construction to be hereinafter described and claimed.

Referring to the drawings, in which like parts are similarly designated, Figure 1 is a vertical central section of one form of engine, taken on line A B, Fig. 2. Fig. 2 is a section on line C D, Fig. 1, showing parts of the cylinders in section and parts in elevation. Fig. 3 is a section on line E F, Fig. 1, illustrating the valve mechanism. Figs. 4, 5, and 6 show details of the cylinders. Figs. 7, 8, and 9 show modifications of the steam-distributing devices.

The operative parts are contained within a non-rotary cylindrical casing *a*, provided with a detachable cover or end plate *k*.

Passing through a boss 30 on the casing *a* is the shaft *a''*, on the inner end of which is fixed the rotating wheel *b*, carrying the cylinders. This wheel (shown in Fig. 2 one half in section and the other half in elevation) consists of two parts, the part *b*, having the cylinders *c* and distributing-ports formed therein, and a band *b''*, shrunk on said part *b* and forming the outer closed heads of the cylinders *c*. These cylinders *c* are symmetrically arranged around the wheel, extending diametrically across it, thereby forming a space common to all the cylinders where said cylinders cross one another. There are three cylinders shown, each provided with a piston *f*, organized to travel from end to end of its cylinder and through the space common to all of them at different times during a revolution of the wheel *b*. In a recess or enlargement *c''* on the cover-plate *k* is a crank-disk *l*, secured to a shaft *d''*, journaled in a boss 31, said disk being provided with as many crank-pins symmetrically arranged around its center as there are pistons. In this case there are three crank-pins *m* a hundred and twenty degrees apart, each entering a hole *h* in its respective piston *c*. This crank-disk controls the movement imparted to the pistons by the steam and compels them to move at the proper time and rate of movement. A circle *e*, having for center the center of the wheel *b*, as well as that of the space common to all the cylinders, passes through the center of the pins *m*, where each cylinder is at an end of its stroke. A similar circle *n*, concentric with the shaft *d''*, passes through all of the crank-pins *m*, is tangent to the circle *e* internally at the point *p*, and passes through the center of the wheel *b*. This circle *n* therefore has a diameter equal to the radius of the circle *e*. In order to produce a rectilinear movement by a point on an epicycloid generated by the rolling of one circle on another, the said two circles must have the relative proportions stated. Rectilinear motion is imparted to the pistons by alternately admitting steam to each end of each cylinder, thereby causing a rotation of the crank disk and shaft *d''*, as well as of the cylinders and shaft *a''*.

It is obvious from what has been stated that the crank-pins *m* must pass through the cylinder-walls in order to engage the pistons, and for this purpose each cylinder *c* is provided with a longitudinal slot *d*, through which the pins *m* pass to enter the holes *h* in the pistons and in which they move to and fro with the pistons *f*. In order to prevent the live steam from passing out of the cylinders through these slots, I provide around their edges planed surfaces *d'*, against which the inner

surface of the cover k and of the disk l, which is in the same plane as that of the cover k, have bearing. It is obvious that these surfaces d' may be provided, if so desired, with any suitable packing to more effectually form steam-tight sliding surfaces. Besides the steam-tight joint last described the pins themselves must be packed in the slots to form a steam-tight joint to prevent the steam from passing from one end of the cylinder past the pin m to the other end of the cylinder, and to avoid this I have shown a simple arrangement in Fig. 1, where the pin is shown as having a smaller diameter than the width of the slots where it leaves the pistons c, and around this reduced portion of the pin m is placed a ring q, which yields to the pressure on its outside, and therefore is pressed against the edges of the slot, and one end of the ring abuts against the crank-disk l, the other against the shoulder formed between the reduced portion of the pin and its body. A packing which, perhaps, is more practical is illustrated in Figs. 4, 5, and 6, in which there is shown a sleeve t, having an elongated flange t' flush with the surfaces d'. This flange by reason of its length guides the sleeve from one part of the slot d into the other part past the crossing common to all the cylinders, so that the length of this flange must be such that before one end of it has left the slot d at one side of the common crossing the other end of the flange has already entered that part of the slot on the opposite side of the common crossing, thereby guiding the parts more accurately in a straight line.

Instead of placing the end of the pin directly in the piston f, I place in it a loosely-fitting cup or shell v, between which and the hole to receive it is a space e'', that permits a slight lateral displacement, whereby the breakage of the crank-pins is avoided should they not be exactly fitted. Hence it will not be necessary to observe such great care in fitting the parts when making such an engine.

Steam enters the supply-pipe 32, whose downwardly-directed end has bearing on a ring x, rotatable on the slideway or seat b', formed on the disk b. This ring is provided with a pin f'', on which takes the forked end of a crank-arm y', connected to a hollow shaft g'', having bearing in a boss 33 on the casing, said shaft being rotated by a handle y, by means of which the ring x may be moved between two extreme positions.

In the body of the wheel b there are formed steam-passages g—one to supply steam to each end of each cylinder c and opening in the slideway b'. By turning the ring x the steam-passage g' therethrough may be adjusted in different positions to either side of the point of tangency p, thereby enabling a reversal of the engine and shafts.

Within the ring x and between it and the slideway b' is an arc z, somewhat shorter than the groove z', cut in the inner face of the ring x. This arc z is provided with a pin h'', on which takes the forked end of a crank-arm z'', secured to the end of a shaft i'', journaled within the hollow shaft g'' and operated by a handle r. The space z' permits the release of any steam remaining in the cylinders when the pistons are moving toward their limits and before reaching the position when fresh steam is to be admitted. This space z' must be adjusted with respect to the position of the ring x, so that on reversal of the engine both the arc z and the ring x must be set by their respective handles r and y.

In the modification shown in Figs. 8, 9, and 10 the shaft a'' is made hollow, through which steam is supplied to the chamber 1, formed in the wheel b, and opening into this chamber are radial passages 2, which are connected to the cylinder ends by steam-supply passages h''. There is a longitudinal split or opening 7 leading from each passage 2 through the wall of the wheel b. In each radial passage 2 there is a sleeve 3, closed at its outer end and having an opening 14 through its side. A pin 6 on each cylinder is guided in one of the openings 7 and carries on its end a friction-roller 8, having bearing in an eccentric raceway 9 in the adjustable plate 10. In each cylinder is a pin 4, carrying a valve 5, that seats on and closes the inner end of the passages 2. The disk 10 is adjusted by means of the hand-lever 11, fixed on the shaft 12, journaled in the casing. To the shaft 12 is secured a lever 13, taking on a pin 35. When the cylinder-wheel b rotates, the pins 6, being guided in the raceway 9, impart reciprocation to the sleeves 3. When the pins pass that portion of the raceway nearest the center of the wheel, the sleeves are pushed toward the center, and in doing so the valve-pin 4 closes the opening 14, so that exhaust or spent steam will cushion the sleeve. This sleeve opens the valve 5 to admit live steam from chamber 1 through passages h'' into the cylinders c. The raceway 9 is so formed between the points 20 20, Fig. 8, as to quickly operate the valves. The direction of rotation of the engine will depend upon which side of the point of tangency p the shortest radius of the raceway 9 is situated, and this adjustment is accomplished by turning the plate 10 by means of lever 11. This plate also regulates the quantity of steam supplied to the cylinders by rotating it more or less one way or the other. Steam is exhausted from the cylinders c (see lower part of Fig. 7) through passages h'', the passages 2, and slot 7, the sleeves 3 opening this slot to permit the passage of the steam into the casing a, the slots 7 being cut only to the surface 15. The slot 7 remains closed during the time of admission and expansion of the steam in the cylinders.

For engines of very high speed it is more

advantageous to use sectors 16, Fig. 9, instead of rollers 8. Each sector is provided with a hole in which the pin 6 enters, and they travel in an eccentric groove 17, formed in an adjustable plate 18, thereby providing a structure in which there is but little wear.

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

1. In a rotary steam-engine, the combination with a plurality of cylinders crossing each other in a point common to all of them, of a piston in each cylinder, means to control the movement of each piston in its cylinder and past the common point and means to supply steam to the cylinders, substantially as described.

2. In a rotary steam-engine, the combination with a plurality of cylinders arranged at equal distances from each other and crossing each other in a point common to all of them, of a piston in each cylinder moved from end to end thereof and past the point common to all of them, a single rotating element connected to each piston to control their relative movements and means to supply steam successively to the cylinders, substantially as described.

3. In a rotary engine, the combination with a plurality of cylinders arranged at equal angular distances apart and crossing each other in a point common to all of them; of a piston in each cylinder, a crank-disk, pins therein at equal angular distances apart, each pin connected to a piston, means to admit steam to each end of each cylinder, and means to reverse the engine, substantially as described.

4. In a rotary engine, the combination with a plurality of cylinders arranged at equal angular distances apart and crossing each other in a point common to all of the cylinders; of a piston in each cylinder, a crank-disk, pins on said crank-disk arranged at equal angular distances apart, the circle passing through the centers of said pins having a diameter equal to half the stroke of the pistons and means to admit steam to the cylinders, substantially as described.

5. In a rotary engine, the combination with a plurality of cylinders arranged at equal angular distances apart and a casing for said cylinders, each cylinder provided with a longitudinal slot and crossing each other at a common point, of an end plate for the casing having a recess and coöperating with the cylinders to close the slot therein, a crank-disk in said recess also coöperating with the cylinders to close their slots, crank-pins on the crank, each connected to a piston and passing through the slot in a cylinder, a packing around each pin in the slots, and means to admit steam to the cylinders, substantially as described.

6. In a rotary engine, the combination with a plurality of longitudinally-slotted cylinders crossing each other in a point common to all of them and mounted to rotate; of a casing, a piston in each cylinder, an end plate for the casing having a recess therein, a crank-disk in said recess, both said disk and plate coöperating with the cylinders to close their slots, pins in the crank-disk, each of which passes through a slot and enters a piston, an elongated plate surrounding each pin in each slot and means to admit steam to the cylinders, substantially as described.

7. In a rotary engine, a plurality of cylinders crossing each other in a point common to all of them and arranged to rotate, a ring shrunk around the ends of the cylinders to form their heads, a piston in each cylinder, a rotating element connected to each piston and means to admit steam to the cylinders, substantially as described.

8. In a rotary engine, a wheel, cylinders thereon crossing each other in a point common to all of them, steam-passages between the ends of the cylinders and a slideway formed on the wheel, means to supply steam and a ring between said means and slideway, a piston in each cylinder and means to control the relative movement of the pistons, substantially as described.

9. In a rotary engine, a wheel having cylinders formed thereon, a slideway formed on the wheel and passages connecting said slideway and the ends of the cylinders, a steam-supply, a distributing-ring rotatable on the slideway and having a slot on its under side, an arc in said slot to control the exhaust and means to move said arc, substantially as described.

10. In a rotary engine, a casing, a wheel mounted therein and having cylinders formed thereon, said cylinders crossing each other at a point common to all of them, each of said cylinders having a longitudinal slot extending to about half a piston length of each end, a piston in each cylinder, a bearing-surface formed around each slot, an end plate for the casing and a crank-disk coöperating with the bearing-surfaces to close the slots, crank-pins in the disk, one of which is connected to each piston and passes through the slot of the cylinder, a sleeve having lateral play between each crank-pin and piston, a packing-sleeve surrounding each pin and having an elongated flange guided in the slot, said flange having bearing on the end plate and disk during its movement from end to end of the slot, substantially as described.

11. In a rotary engine, the combination with a wheel having a steam-chamber and a plurality of cylinders formed thereon crossing each other at a point common to all of them, of a hollow shaft on which said wheel is mounted, and valve-controlled passages between the steam-chamber and cylinder ends, substantially as described.

12. In a rotary engine, the combination

with a wheel having a central steam-chamber and a plurality of cylinders formed thereon crossing each other at a point common to all of them, of a hollow shaft to supply steam to the chamber and on which said wheel is mounted, a piston in each cylinder, means to control the relative movement of the pistons and independent valve mechanism at each end of each piston to control the admission of steam from the chamber to the cylinders, 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 AUG. FRANZÉN.

Witnesses:

BENGT EISMAN,

H. HANSSON.