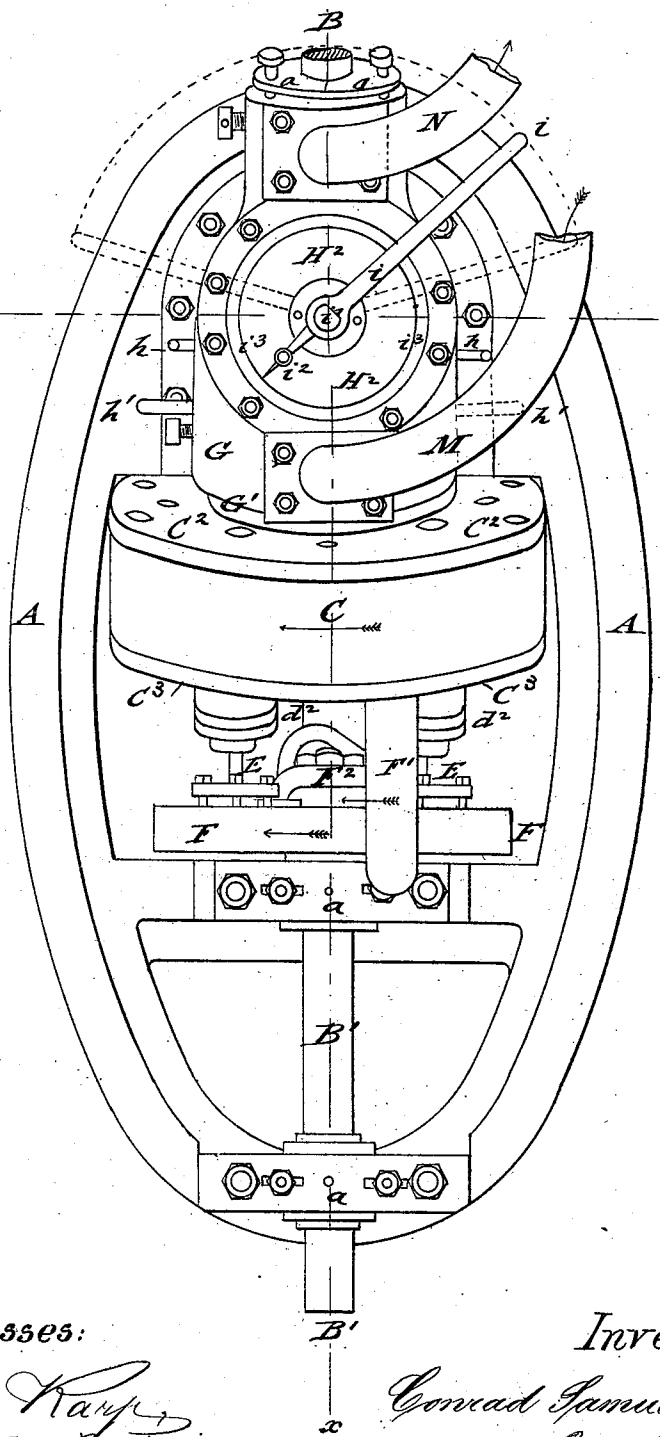
4 Sheets—Sheet 1.

C. S. TEGNANDER.

Rotary-Engine.

No. 227,319. Fig. 1. Patented May 4, 1880.



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4 Sheets—Sheet 2.

C. S. TEGNANDER.

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No. 227,319. Patented May 4, 1880.

Fig: 2.

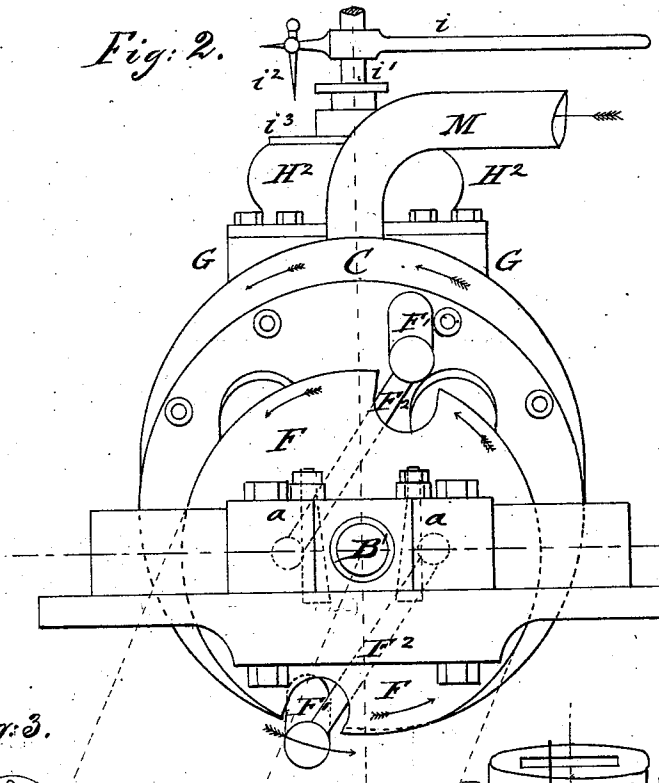


Fig: 3.

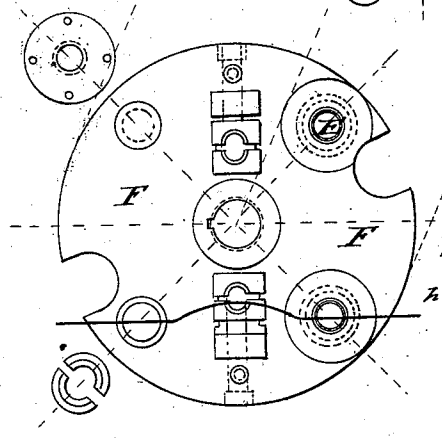
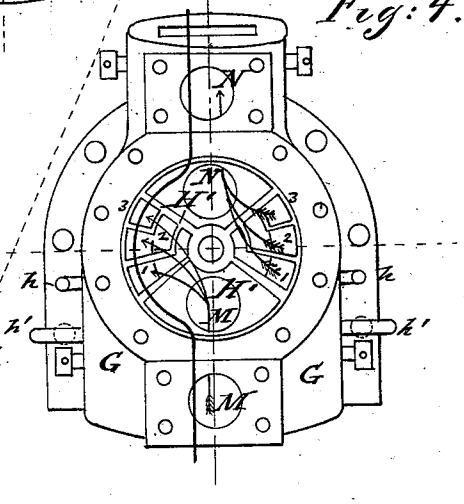


Fig: 4.



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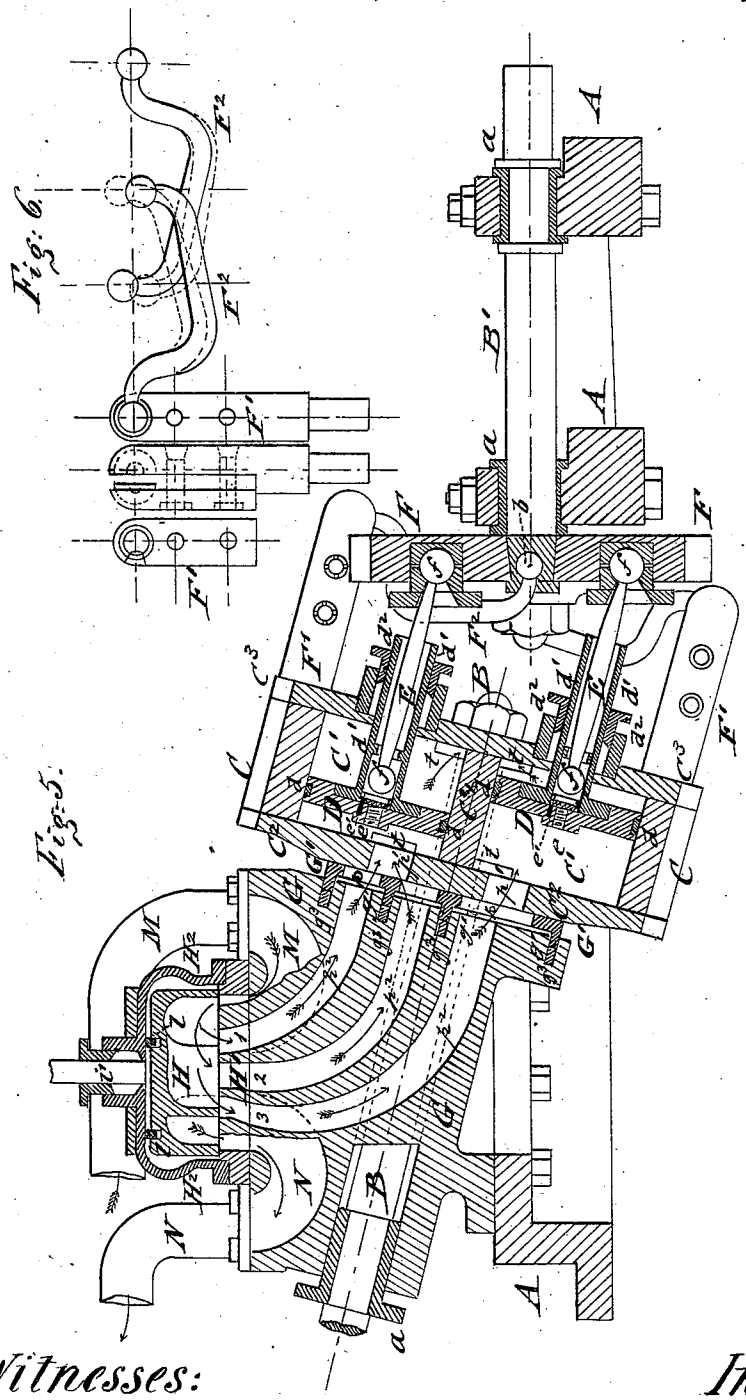
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4 Sheets—Sheet 3.

C. S. TEGNANDER.

Rotary-Engine.

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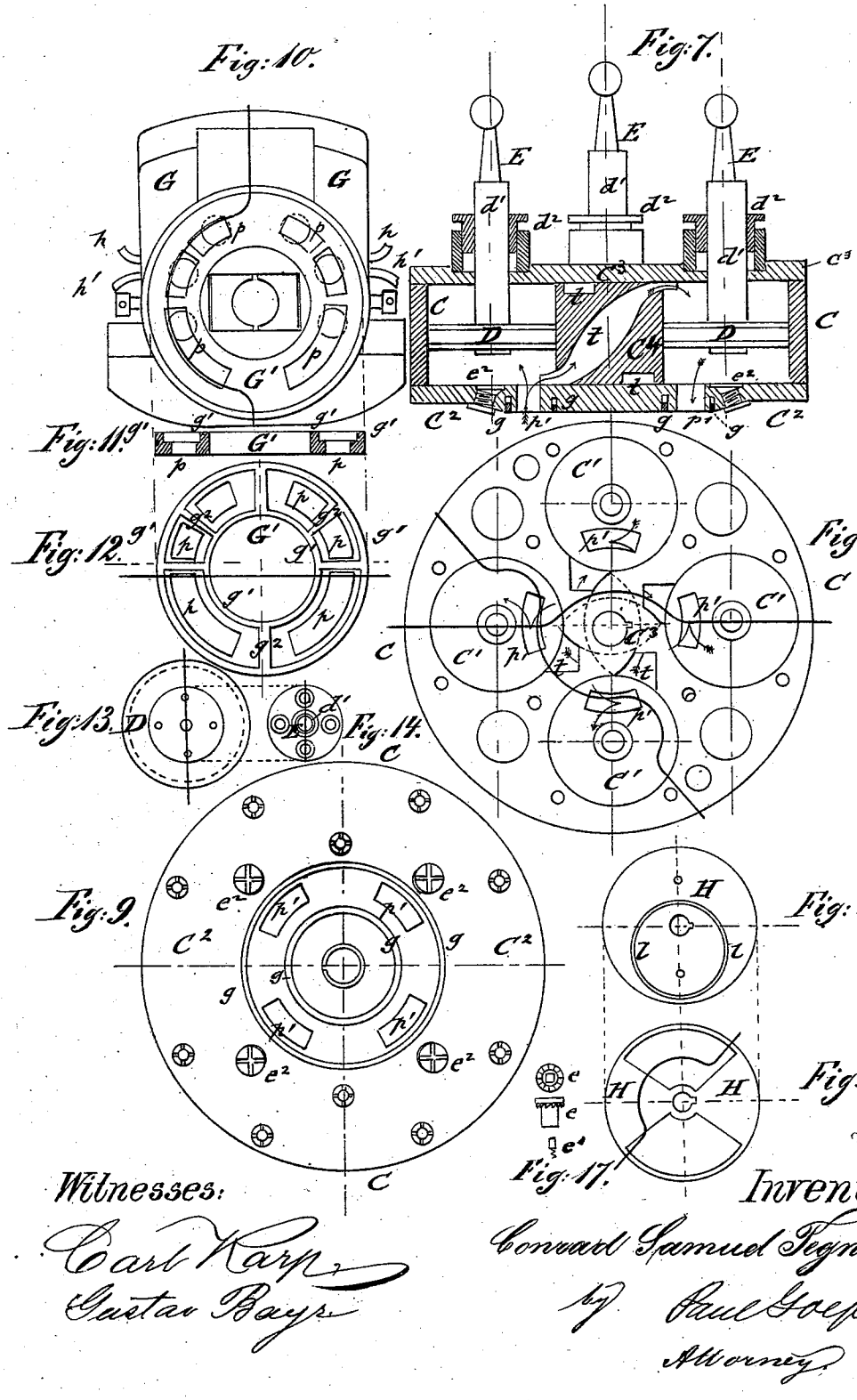
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4 Sheets—Sheet 4

C. S. TEGNANDER.

Rotary-Engine.

No. 227,319. Patented May 4, 1880.



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UNITED STATES PATENT OFFICE.

CONRAD S. TEGNANDER, OF GOTHENBURG, SWEDEN.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 227,319, dated May 4, 1880.

Application filed October 22, 1879. Patented in England June 26, 1879.

To all whom it may concern:

Be it known that I, CONRAD SAMUEL TEGNANDER, of the city of Gothenburg, in the Kingdom of Sweden, have invented certain new and useful Improvements in Rotary Engines, (which have been patented in Great Britain by Letters Patent dated June 26, 1879, No. 2,568,) of which the following is a specification.

This invention relates to a rotary steam-engine of novel construction in which all the parts are arranged symmetrically around the shaft and evenly balanced, so that the engine may be started or stopped in any desired position. The live steam works in positive manner, while the exhaust-steam leaves the engine freely, as the exhaust-ports are always open. The engine may be worked with different degrees of expansion or with full pressure, it being conveniently set to the required position by a very simple regulating mechanism.

The invention consists, essentially, of a cylindrical body having four cylindrical chambers with alternately-working pistons. The pistons are connected by piston-rods and ball-and-socket joints with a revolving disk, to which a horizontal transmitting-shaft is keyed. The disk is coupled by crooked rods and similar ball-and-socket joints to the body of the engine, and imparts rotary motion thereto. The rotary body is held in inclined position by a fixed shaft that turns in bearings at an oblique angle to the horizontal shaft, the upper head of the body revolving in contact with a steam-distributing casing having an intermediate packing-ring. The steam-distributing casing has a number of steam-channels, which communicate with the steam entrance and exhaust ports, and with the steam-ports of the cylinders, and with an axially-adjustable slide-valve, by which the engine may be reversed, or worked expansively or with full pressure, as described.

In the accompanying drawings, Figure 1 represents a plan view of my improved rotary engine; Fig. 2, an end elevation of the same; Fig. 3, a face view of the revolving power-transmitting disk; Fig. 4, a top view of the steam entrance and exhaust ports of the engine; Fig. 5, a vertical longitudinal section of the engine on line *x x*, Fig. 1; Fig. 6, detail views of the crooked coupling-rods and standards that form the connection of the body of the engine with the power-transmitting disk. Figs. 7, 8, and 9 are, respectively, a vertical axial section, a top view with the cover or head removed, and a bottom view of the rotating body. Figs. 10, 11, and 12 represent, respectively, a bottom view, a vertical central section, and a top view of the packing-ring interposed between the rotating body and fixed steam-distributer. Figs. 13 and 14 are a top view of the piston and piston-trunk. Figs. 15 and 16 are top and bottom views of the regulating slide-valve; and Fig. 17 represents detail views of the ratchet-screw of the ball-seats of the pistons.

Similar letters of reference indicate corresponding parts.

A in the drawings represents the supporting-frame of my improved rotary engine. B and B′ are the shafts of the engine, which turn in bearings *a a*. The shafts B B′ revolve in the same vertical plane, but are placed at an obtuse angle toward each other, the shaft B being supported at an oblique angle of inclination to the horizontal plane, its axis intersecting with that of shaft B′ at the point *b*, Fig. 5. To the end of the inclined shaft B is secured the cylindrical body C of the engine. The body C is provided with four cylindrical chambers, C′ C′, which form the cylinders of the engine. In each cylinder reciprocates a piston, D, which pistons rotate with the cylindrical body C, their centers of gravity moving in an elliptical curve. The pistons are provided with elastic packings *d d*, and with tubular trunks *d′ d′*, which extend through the lower head or cover, C^3, of the engine, and slide in tightly-fitting stuffing-boxes d^2 d^2 of the same. The power is transmitted from the pistons, by means of piston-rods E E, to a disk, F, which is rigidly affixed to the end of the horizontal transmitting-shaft B′. The reciprocating motion of the inclined pistons imparts rotary motion to the disk F and shaft B′, this change of motion being accomplished without strain, owing to this connection of the piston-rods by ball-and-socket joints *f f* with the pistons and disk F, as shown clearly in Fig. 5. The ball-and-

socket connection of the pistons and piston-rods takes place at the bottom of the piston-trunks, where the spherical ends of the piston-rods are retained by a collar and end bearing, the latter being capable of adjustment by a screw, *e*, that passes through the center of the piston. The set-screw *e* is provided with ratchet-teeth at the under side, into which a spring-pawl, *e'*, locks, as shown in Figs. 5 and 17. The set-screws *e* are adjusted from the outside of the body C by means of keys, which are inserted through openings e^2 in the upper head of the body, and which fit on the square ends of the set-screws. After the ratchet-screws are adjusted the openings e^2 are closed by screw-plugs.

The rotating disk F is further connected to fixed standards F' of the body C by crooked coupling-rods F^2, which are applied thereto in analogous manner as the piston-rods by universal joints, as shown in detail in Fig. 6. These coupling-rods serve to furnish rotary motion from the disk F to the body C and shaft B, so that thus either shaft B or shaft B' can be employed for transmitting the work of the engine.

The body C revolves, by its upper cover or head, C^2, on the inclined face of a steam-distributer, G, being steam-tightly fitted thereto by means of a packing-ring, G'. The upper head, C^2, has concentric packing-rings *g*, (shown in Fig. 9,) which insure a steam-tight joint between the head and ring G'. That side of the ring G' toward the steam-distributer G is provided at the outer as well as at the inner periphery with circular projecting rims or flanges *g'*, which are radially connected by ribs g^2, as shown in Figs. 11 and 12. These flanges and ribs separate from each other the steam spaces or ports *p p*, of different widths, which ports communicate with equidistant ports *p' p'* in the upper head of the rotating body C.

The rims and ribs of ring G' enter corresponding recesses in the face of the distributer G and form a steam-tight joint therewith by soft interposed packing g^3, that fills up the space between the rims and bottom of the recesses. The ring G' is thus held elastically against the upper head, C^2, of the body C, being enabled to vibrate to some extent thereon, so as to provide for small inaccuracies in the construction of the engine. The elastic cushioning of the ring also equalizes any slight variations in the position of the rotating body C, caused by alterations of temperature, &c., and reduces the wear and tear of the main parts of the engine. As the steam-pressure is the same on both sides of the ring, the same is balanced and free to accommodate itself to the movements of the rotating body C.

The pressure of the upper head, C^2, against the ring can be increased or lessened by means of set-screws at the upper bearing of shaft B, so as to keep up a tight joint at any time.

The required lubricating material is conducted to the ring G', upper head, C^2, and the pistons D by means of pipes *h*, Fig. 10, while a second set of pipes, *h'*, serve for drawing off the water of condensation.

The steam-distributer G is provided with as many curved steam-passages p^2 as there are ports in the packing-ring G'. The live steam is admitted to the passages of the steam-distributer G through a supply pipe and passage, M, and its entrance regulated by a slide-valve, H, which is set to the ports of the valve face-plate H' at the upper horizontal end of the distributer G by a handle, lever, or other mechanism, *i*, secured to the valve-spindle *i'*. The valve H is inclosed by a valve-chest, H^2, through which the valve-spindle extends, the same working in a stuffing-box of the chest. The steam is passed off through an exhaust channel and pipe, N. The relative position of the slide-valve H to its valve-face determines the inlet or outlet of steam, and admits either the reversing of the engine or the working of the same expansively or with full pressure.

To secure the easy working of the valve an elastic packing-ring, *l*, is inserted into a recess at the upper side of the valve H.

The handle *i*, by which the slide-valve is set, may be operated from any desired point, the handle being arranged with an index, i^2, or pointer that moves along a graduated dial, i^3, on the top of the valve-chest, as shown in Figs. 1 and 2.

When the engine is to work to the right, in the direction indicated by the arrows in Fig. 1, and with two-thirds expansion, the valve is so placed that the steam from the supply-pipe M enters the port 1 of the valve-face and passes then through the distributer and the packing-ring to the ports of the cylinder. If the steam is admitted through two ports, the engine works with one-third expansion, while when all the ports are open it works with full pressure throughout. In all these cases the exhaust-ports of the ring and slide-valve are open and communicate with the exhaust-pipe for the unobstructed exit of the steam.

When the engine is to be reversed the handle is turned in such a manner that the former exhaust-ports become the steam-inlet ports, and the former steam-inlet ports the exhaust-ports. If the number of steam-inlet and exhaust ports and passages are increased, other degrees of expansion are obtained with the same facility.

After the steam has acted upon the pistons of the cylinders the same passes in part through diagonal passages *t t* of the solid center portion, C^4, of the body C to the variable spaces between the pistons and the lower head, C^3, assisting thereby in returning the pistons to their former position, ready to be acted upon again by the next supply of steam. The steam, after having done its work, passes back the same way within the rotating body of the engine, and continues its course through the exhaust channels and ports to the exhaust-pipe.

The engine operates as follows: Live steam passes from the inlet-pipe through the slide-valve and the passages of the steam-distributer and the ports of the packing-ring into the cylinders of the body. It operates either with expansion or full pressure, as the case may be, and works successively the pistons, which transmit their motion to the rotating disk, which disk, by the crooked coupling-rods, revolves simultaneously the body C, so as to change continually the relative position of the cylinders and pistons to the ports of the packing-ring and keep up the reciprocal action of the parts. The steam, after having done its work, is returned from the cylinders to the exhaust-passages of the distributer and to the exhaust-pipe, escaping freely therefrom, as the exhaust-ports remain always open. The live steam exerts always a direct action on the symmetrically-arranged parts of the rotating body, which, being exactly balanced on its shaft, secures the even work of the engine in all its positions, and admits the stopping or starting of the same at any moment and with great facility by a simple motion of the handle of the regulating slide-valve.

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

1. The combination of the inclined rotating body C, having fixed standards F′, with coupling-rods F^2, and with a disk, F, rotated by the action of the engine to transmit rotary motion to the body of the engine simultaneously with the revolving of the disk, substantially as set forth.

2. In a rotary engine, the inclined rotating body C, with a steam-discributer, G, having steam-channels p^2, and with a vibrating packing-ring, G′, having ports *p*, and being interposed between the rotating body and steam-distributer, substantially as described.

3. In a rotary engine, the combination of rotating body C, having cylinders C′, pistons D, and diagonal steam-passages *t t*, with a lower head, C^3, an upper head, C^2, having ports *p′*, a packing-ring, G′, a steam-distributer, G, and a steam-regulating slide-valve, H, substantially as and for the purpose specified.

4. In a rotary engine, the combination of the inclined body C, pistons D, having fixed tubular trunks *d′*, and of disk F, with piston-rods E, connected to trunks and disk by ball-and-socket joints, substantially as specified.

5. In a rotary engine, the combination of inclined body C, having fixed standards F′, and of rotating disk F, with the crooked coupling-rods F^2, that are connected to standards and disk by ball-and-socket joints, substantially as set forth.

6. In a rotary engine, the combination of piston D, having fixed tubular trunk *d′*, with the piston-rod E, the trunk having an interior bearing for the piston-rod that is adjustable from the outside of the body, substantially as described.

7. In a rotary engine, the piston D, having a fixed tubular trunk, *d′*, and an interior bearing adjustable by ratchet-screw and pawl *e e′*, substantially as specified.

8. In a rotary engine, the upper head, C^2, of the rotating body C, having screw-plugged openings e^2, for admitting the adjustment of piston-rod bearing from the outside, as and for the purpose specified.

9. In a rotary engine, the combination of the steam-distributer G with a packing-ring, G′, having concentric rims and radial ribs entering recesses of the steam-distributer, and bearing against a packing interposed between the bottom of the recesses and the ring to adapt the latter to varying positions of the rotating body, substantially as specified.

The foregoing specification of my new and useful improvement (Tegnander's steam-engine) signed by me this 15th day of April, 1879.

CONRAD SAMUEL TEGNANDER.

Witnesses:
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CARL CARLSON.