No. 688,271. Patented Dec. 3, 1901.

F. G. TEES.

ROTARY ENGINE.

(Application filed Apr. 9, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 2.

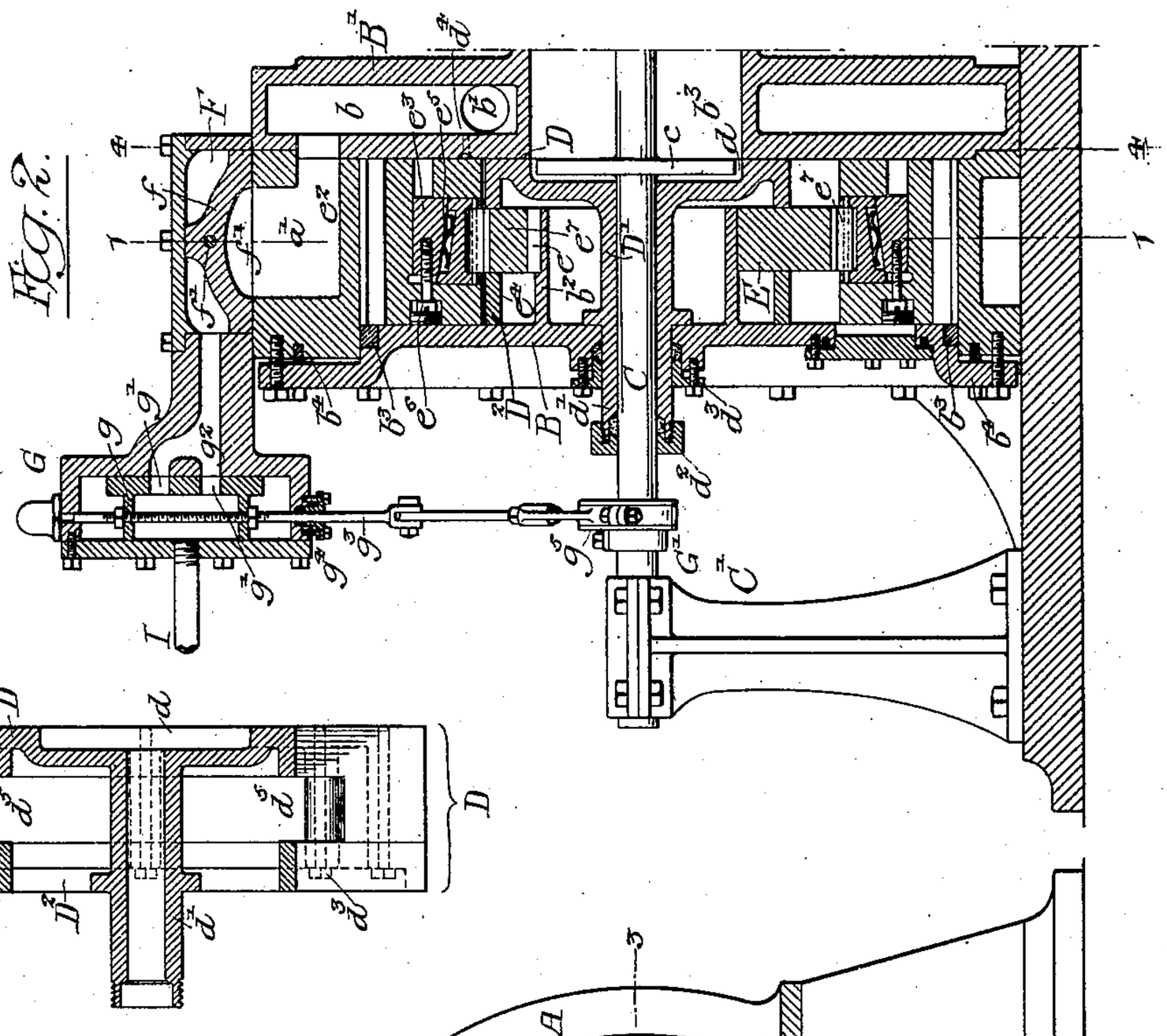


Fig. 3.

Fig. 1.

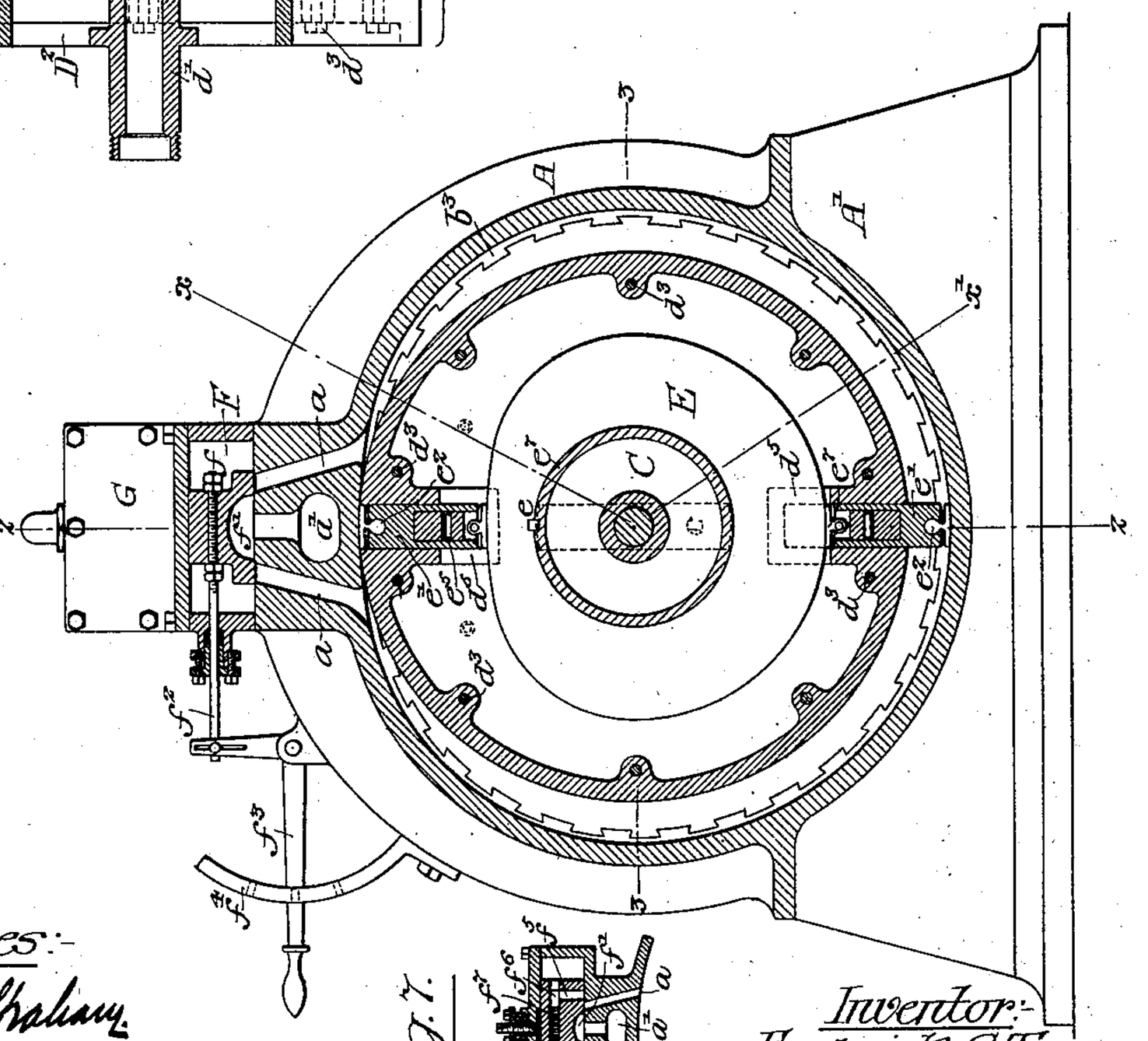
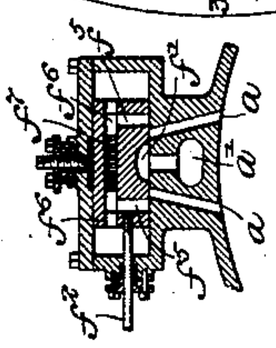


Fig. 4.



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Louis M. V. Whitehead

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Fig. 4.

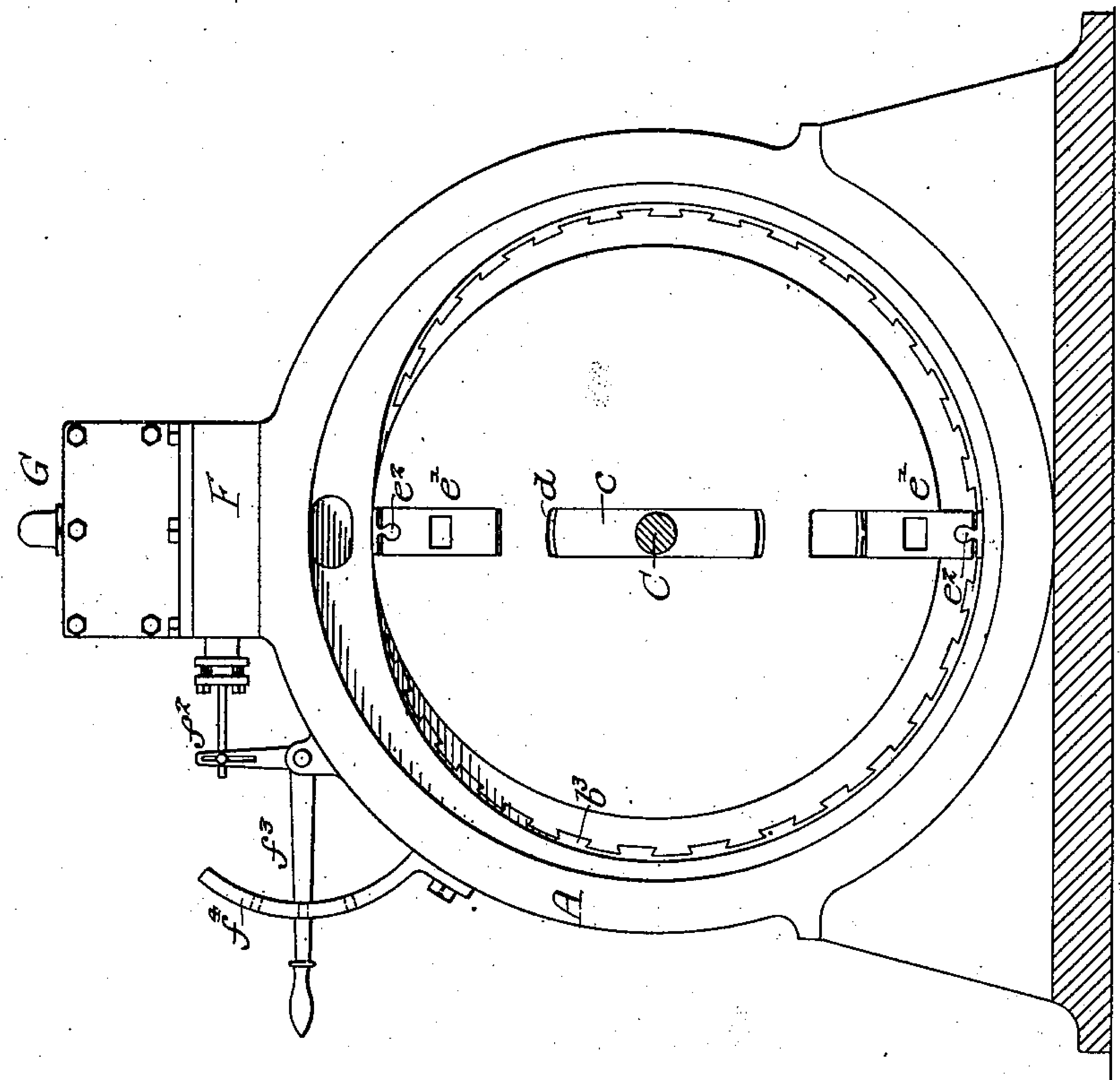
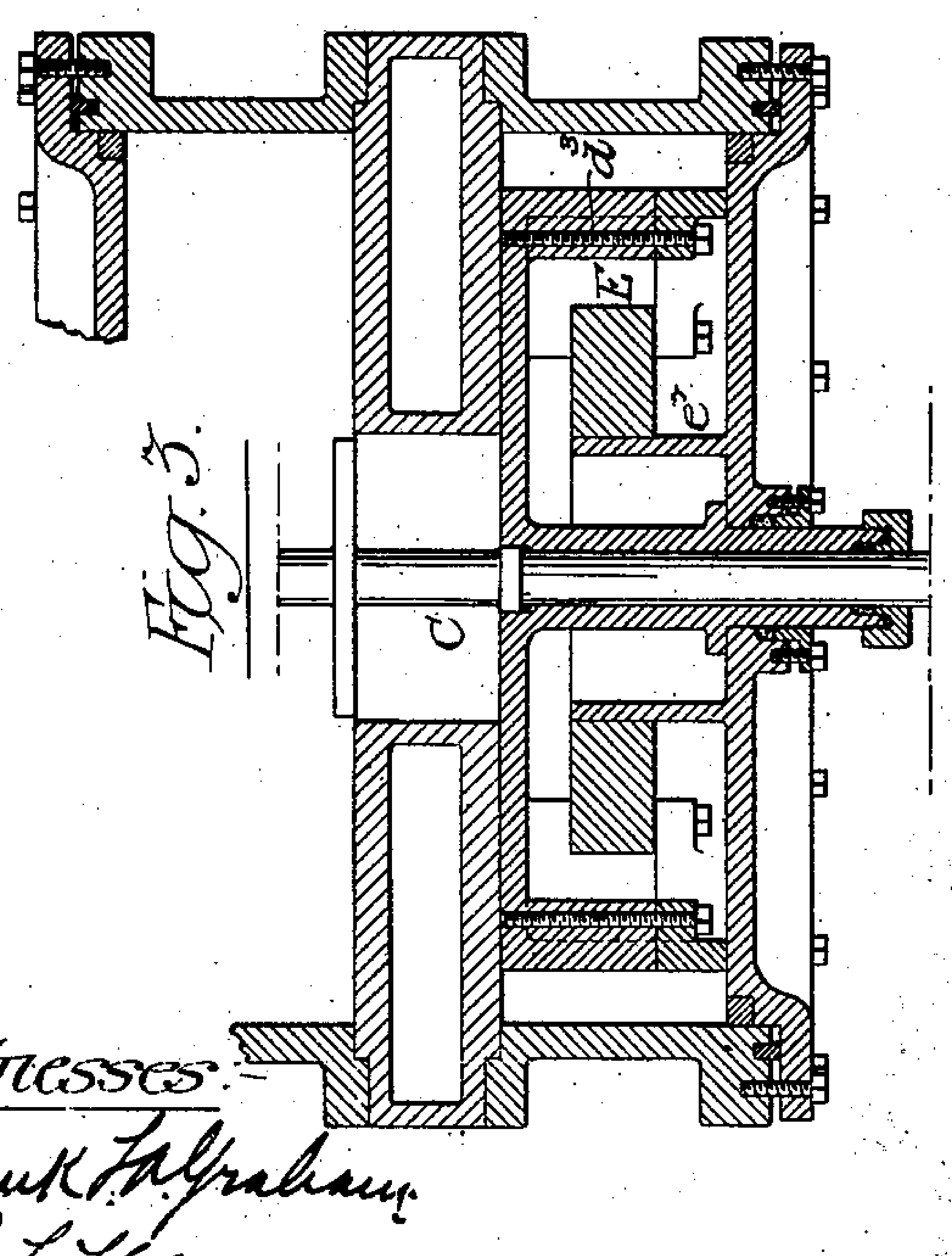


Fig. 3.



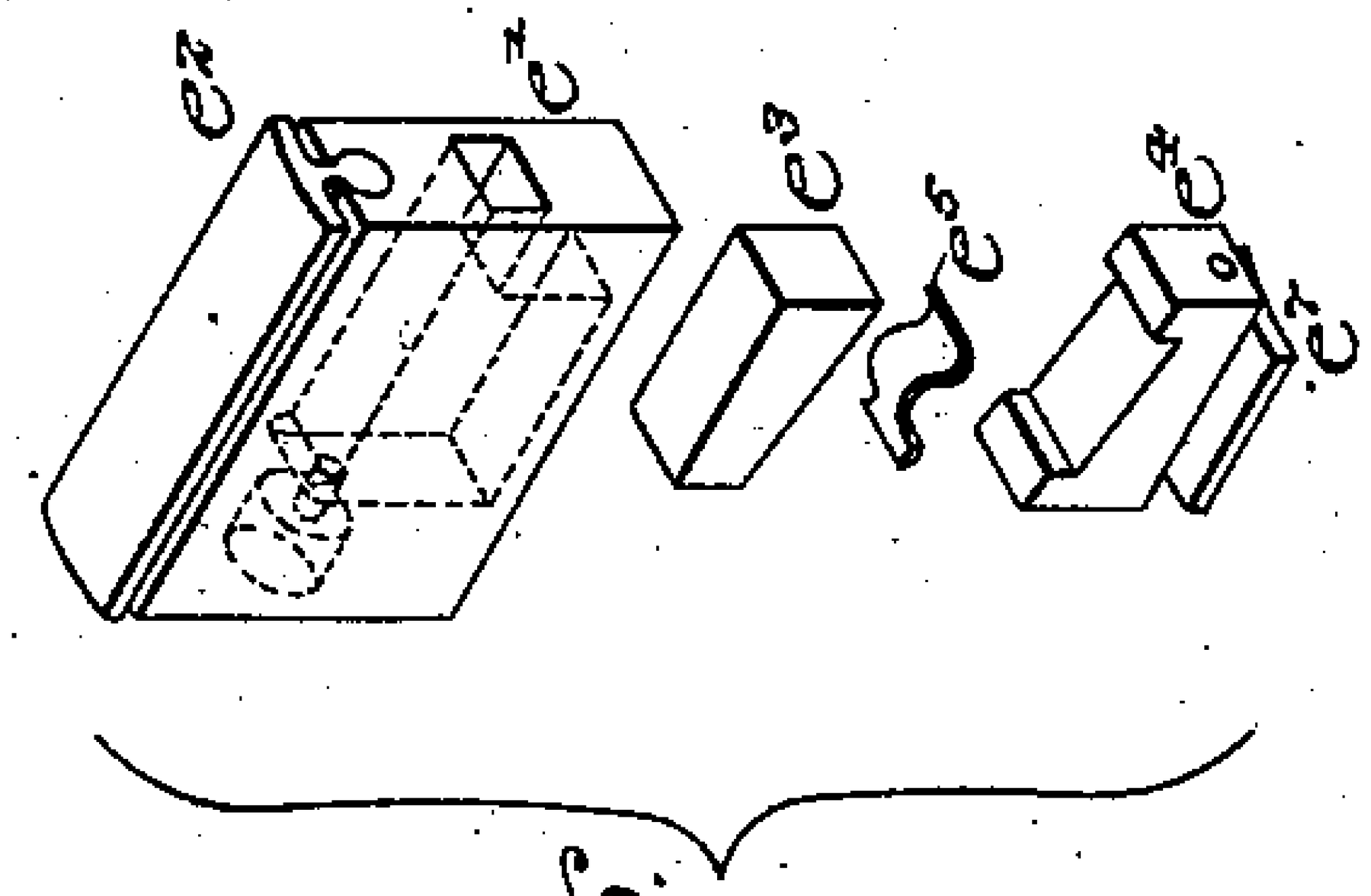


Fig. 6.

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

UNITED STATES PATENT OFFICE.

FREDERICK G. TEES, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO JOHN H. SORDEN, OF PHILADELPHIA, PENNSYLVANIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 688,271, dated December 3, 1901.

Application filed April 9, 1901. Serial No. 55,025. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK G. TEES, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Rotary Engines, of which the following is a specification.

My invention relates to certain improvements in rotary engines, and more particularly to improvements in the engine for which a patent was granted to me on December 25, 1900, No. 664,509.

The objects of my invention are to construct a rotary engine which shall be economical in operation and which while having its parts so that they may be easily adjusted to compensate for wear yet shall not be complicated nor costly to build. These objects I attain as hereinafter set forth, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical sectional view on the line 1 1, Fig. 2. Fig. 2 is a sectional view on the line 2 2, Fig. 1. Fig. 3 is a sectional view on the line 3 3, Fig. 1. Fig. 4 is a sectional view on the line 4 4, Fig. 2. Fig. 5 is a vertical sectional view of the piston with the cover removed. Fig. 6 is a detached perspective view of one of the blades, and Fig. 7 is a sectional view of a modified form of reversing-valve to be used with my improved engine.

A is a casing mounted on the base A'. Secured to each end of the casing are suitable heads B B', forming with the casing A a steam-chamber in which the piston revolves. The head B' may form the partition between two engine-casings, as shown in Fig. 3, when it is desired to drive a shaft by two rotary engines placed in line. The head B' has a large opening b^2 at the center for the passage of the shaft. This head B' is preferably made hollow, as shown in Figs. 2 and 3, so as to form an exhaust-chamber b, connecting with the exhaust-port of the engine and having an opening b', through which the exhaust may pass to the atmosphere, to a condenser, or to the admission-valve chamber of another engine. In the casing A are two steam-inlet ports a a and a central exhaust-port a', communicating with the exhaust-chamber b.

The head B is preferably dished in form and extends within the steam-chamber, as shown in Fig. 2, the surface thereof which comes in contact with the inside of the said chamber being provided with a soft-metal ring b^3, as shown. This ring extends into dovetailed slots in the head B. The ring coming flush with the inside face of the head is faced off and provides a bearing-surface for the ends of the sliding shoes attached to the piston and to be hereinafter described. There is also a packing-ring b^4 set in a recess in the edge of the casing, by means of which a steam-tight joint is obtained between the head B and the said casing.

A shaft C, supported in bearings C', only one of which is shown in the drawings, passes through the center of the steam-chamber. Loosely mounted on the shaft C is a piston D, made in two parts D' and D^2. In the piston are one or more recesses d, and on the shaft in the present instance are two arms c c, which rest in the recesses in the said piston and through which the shaft is turned.

It will be noted that the piston D has an extended hub d' passing through the head B, there preferably being a stuffing-box d^2 provided to prevent the possible escape along the shaft of steam or oil from the space within cylindrical section b^2, said steam and oil having been found to pass between the piston and the head B' and to accumulate in said space. There is also a stuffing-box in the head B itself to prevent leakage of steam from the steam-chamber around the projection d' of the rotary piston. This piston is cylindrical in form and in the present instance is made in two parts D' and D^2 in order that a cam E of the shape shown may be operatively placed within it. The said cam is held by a key e to an inwardly-projecting cylindrical section b^2 of the head B, the part D' of the piston being recessed to retain said cam without having its rotation in any way interfered with thereby. The parts of the piston are rigidly held together by bolts d^3, there being suitable lugs provided for them. In the piston shown there are two recesses extending inwardly from the surface and placed one hundred and eighty degrees apart, having in them reciprocating slides e' e' of the shape shown in Figs. 1, 2, and 6. The inwardly-

projecting sections of the piston which form the recesses are cut away at d^5 on account of the eccentricity of the cam E, this latter not coming in contact with any part of the said piston at any point of its revolution. The said reciprocating slides, Fig. 6, are the full width of the piston and have in their outer faces a recess, preferably cylindrical, in which fits loosely a shoe e^2. This consists of a curved bearing-section adapted to slide upon the inside surface of the steam-chamber and a cylindrical head fitting the recess, the two being connected by a neck of such proportions that it holds the bearing-section far enough away from the body of the slide to allow of said bearing-section being inclined from one side to the other as it follows the curved inside surface of the steam-chamber.

There is a hollow space within each slide, preferably rectangular in section, in which are placed a wedge-block e^3 and a recessed wedge-block e^4, there being a spring e^5 between the blocks, as shown. In order that the pressure exerted by the spring upon the block e^4 may be varied, a screw e^6 is provided, this being within a countersunk opening in the slide and extending into the wedge-shaped block e^3. Within the inner face of the piece e^4 is journaled a shoe e^7, similar in shape to the shoe e^2, it being of the same width as and bearing upon the edge of the cam e, this latter being similar in outline to that of the interior of the steam-chamber.

Secured to the upper part of the casing A in any suitable manner is a reversing-valve chest F, and carried by an extension of this chest is an admission-valve chest G. Within the chest G is a slide-valve g, having in the present instance two passages g', communicating with the two ports g^2, connecting with the passage leading to the valve-chest F, as shown in Fig. 2. On the rear of the valve g are two lugs through which passes the screw-threaded valve-stem g^3, having nuts by which the valve can be adjusted on the stem. This latter is guided at both ends and passes through a stuffing-box g^4. On the shaft C is an eccentric G', having a strap g^5, connected to the valve-rod g^3, as shown.

I is the steam-inlet pipe communicating with the chest G.

By the construction of valve shown I am enabled to admit a quantity of steam to the engine during a short stroke of the valve. The valve f in the chest F is not only a reversing-valve, but may also be used as a stop-valve when shifted to the position shown in Fig. 1. It is of the type known as a D slide-valve, having a recess f' communicating at all times with the exhaust-port a'.

Adjustably secured to the valve f is a rod f^2, which extends through a stuffing-box in the casing F and is connected to one arm of a lever f^3, pivoted to the casing A. The other arm has a suitable operating-handle which may be secured in any position to a quadrant f^4. By shifting the valve f the direction of rotation of the piston D may be reversed, or the piston may be brought to a stop by shifting the valve to a central position, as in Fig. 1.

I may modify the construction of the reversing-valve. For instance, in Fig. 7 I have shown a D-valve having a steam-inlet passage f^5 at each end, which may register with the steam-inlet ports a. The passages f^5 communicate with a longitudinal passage f^6. Side passages f^7 extend from this longitudinal passage f^6 to the sides of the valve, so that the valve is balanced. The valve may be held to its seat by a screw, as shown in Fig. 7.

Holes d^4 d^4 are formed through the side of the head B', (shown in dotted lines in Fig. 2,) through which any steam possibly accumulating within the hollow of the piston may blow off into the exhaust-passage b when the slide-recesses of the piston pass said holes.

In operation steam passes from the admission-valve C through the passage g^2 to the reversing-valve F, and this is moved by hand so as to open communication between the steam-space inside of the valve-chest F and the interior of the steam-chamber, the direction of rotation of the engine depending upon which of the passages a is connected to the steam-space of the valve-chest. The admission-valve g is so set that steam enters the steam-chamber when one of the slides e' has reached a position indicated by the dotted lines x. Owing to the pressure on the slide the piston D begins to revolve, the said slide forming a steam-tight joint with the inside surface of the steam-chamber and the outside edge of the fixed cam E. The shoes e^2 and e^7 follow the curvatures of the cam and of the inside of the chamber, the spring e^5 continually acting to force these shoes apart and form tight joints. The steam is cut off when the slide has reached the position indicated at x', from which point it expands until the second one of the slides uncovers the port a, connected with the exhaust, when the steam escapes through this to the condenser or other engine. This cycle of operations is repeated by said second slide. When for any reason it is desired to alter the pressure of the shoes upon their bearing-surfaces, the screw e^6 is operated, thereby moving the wedge e^3 in or out. This can be accomplished without dismantling the engine, as a capped opening is provided in the head B.

It will be understood by those skilled in the art that I may operate the cut-off valve G in connection with any desired form of governor, by which means the amount and time of opening of said valve, and consequently the amount of steam admitted, is varied according to the load on the engine.

When two engines are used in line, as shown in Fig. 3, I prefer to place the driving-arms c of one engine ninety degrees in advance of the arms c of the other engine. Both engines may be used as high-pressure engines or may be compounded, as desired.

It will be understood that while I have referred to steam as the driving fluid any fluid under pressure may be used.

The piston D is not necessarily made in two parts, as I may place the cam within the same and retain it in position by means of guides bolted to the piston itself, the said cam being held stationary by the cylindrical projection b^3 of the head B, as above explained.

I claim as my invention—

1. The combination in a rotary engine, of a casing having in it a steam-chamber, a shaft extending through the same carrying a piston, a cam supported by a projection from the casing and slides within the piston extending between the cam and the curved inside surface of the steam-chamber, there being shoes loosely mounted in the ends of each slide and means on each slide for varying, at will, the pressure of the shoes upon the cam and upon the curved surface of the chamber, substantially as described.

2. The combination in a rotary engine of the character described, of a piston having radially-placed movable slides, the same consisting of a piece carrying a bearing-shoe on each end, a spring acting against one of said shoes, and a wedge within said piece, the said wedge being adjustable as to position, the pressure of the spring upon the shoe being thereby variable, substantially as described.

3. The combination in a rotary engine, of a casing having in it a steam-chamber, a piston in the same having within it a cam, recesses in the piston and slides therein, bearing upon the cam and upon the inside of the curved surface of the steam-chamber, each of said slides having two parts, one of the parts having a width equal to that of the piston and bearing upon the surface of the steam-chamber, the other part being less in width and bearing upon the cam, with an adjustable device between said two parts whereby the pressure upon their respective bearing-surfaces may be varied, substantially as described.

4. In a rotary engine, the combination of a casing having in it a steam-chamber, a steam-chest on said casing and ports extending from the said chest to the chamber, an exhaust-passage also leading from the steam-chest, a valve controlling the admission and exhaust of steam to the chamber, a removable head to the said chamber extending into the same, and a packing-ring fixed to the said inwardly-extending part whereby a steam-tight joint is secured between the said head and the chamber, substantially as described.

5. The combination in a rotary engine, of a casing inclosing a chamber, a shaft extending therethrough, a piston on the shaft, slides carried thereby bearing on the curved inside surfaces of the steam-chamber, a head secured to the casing extending into the chamber and having a packing-ring fixed to said inwardly-extending part, the upper ends of the said slides also bearing upon the side of the packing-ring, substantially as described.

6. The combination in a rotary engine, of a casing and two heads forming a chamber, a piston within the chamber, inlet and outlet ports, a valve controlling the admission of motive fluid to the chamber, one of said heads having an exhaust-chamber therein, said exhaust-chamber communicating with the exhaust-port, substantially as described.

7. The combination in a rotary engine, of two engines arranged side by side in line, a hollow division-head situated between the casings of the two engines and communicating with the exhaust-port of one or both engines, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

FREDERICK G. TEES.

Witnesses:

WILLIAM E. BRADLEY,

JOS. H. KLEIN.