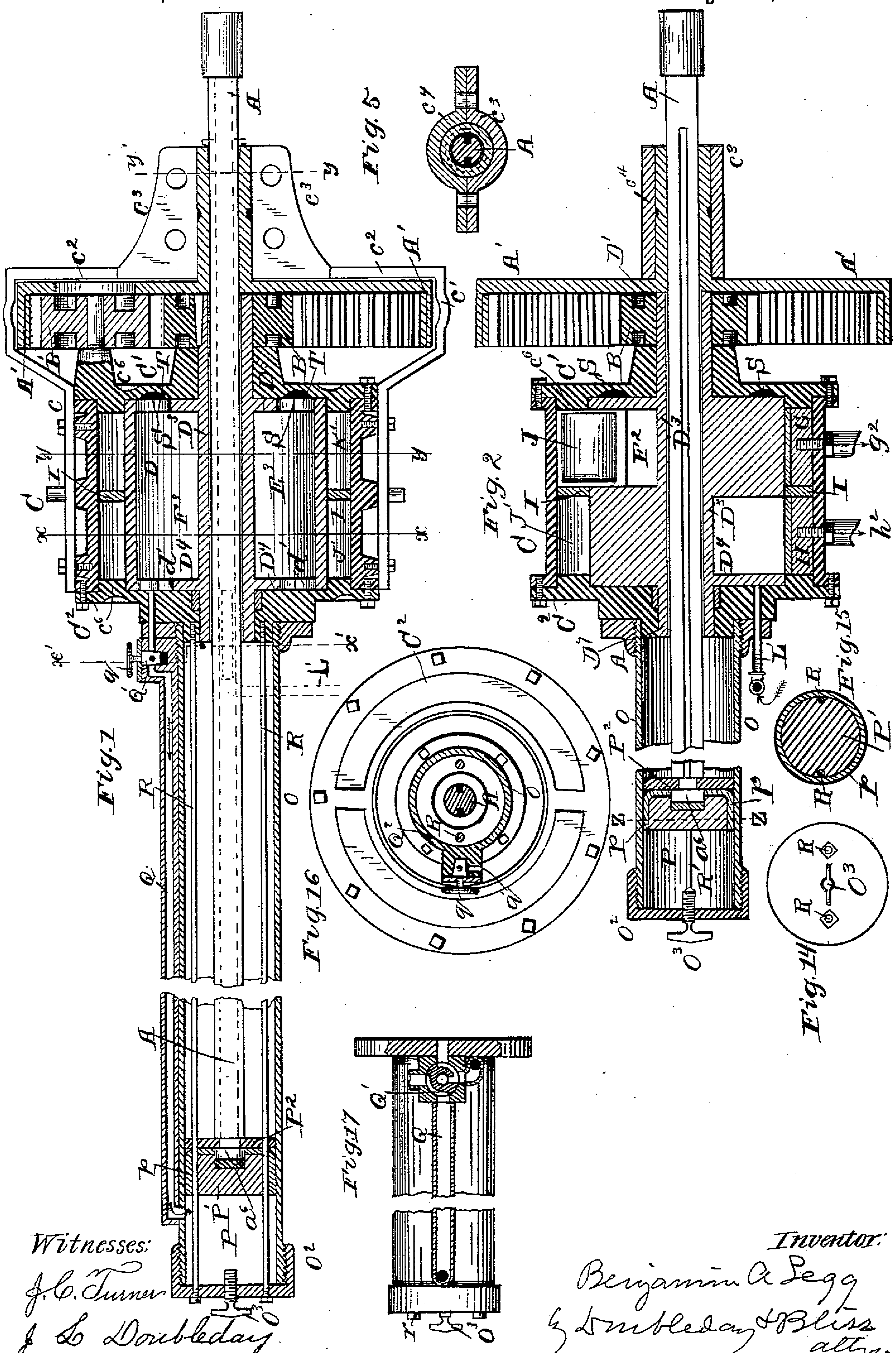
(No Model.) 3 Sheets—Sheet 1.

B. A. LEGG.

ROTARY ENGINE.

No. 560,221. Patented May 19, 1896.



Witnesses:

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J. L. Doubleday

Inventor:

Benjamin A. Legg

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attys.

(No Model.) 3 Sheets—Sheet 2.

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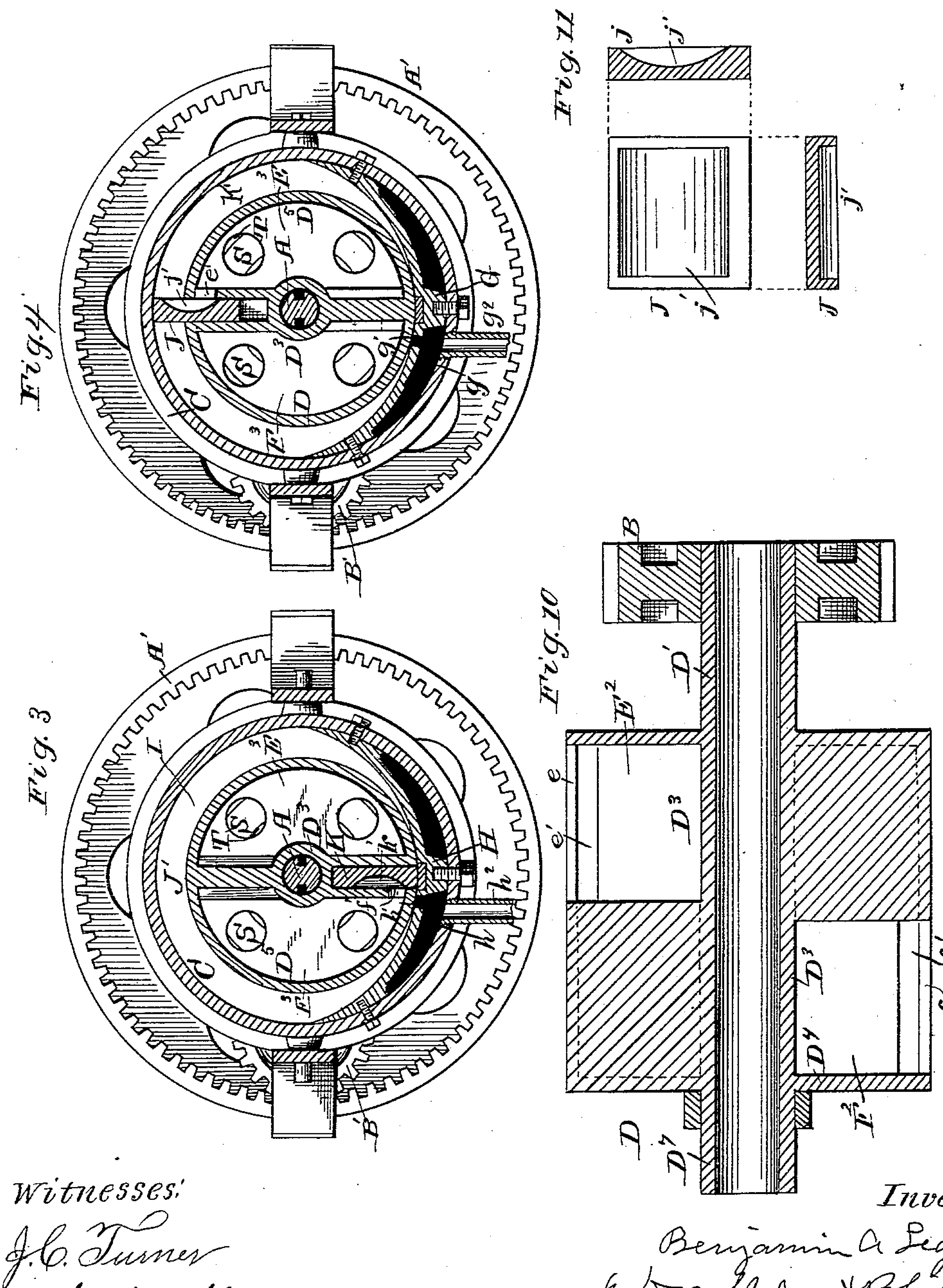

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(No Model.) 3 Sheets—Sheet 3.

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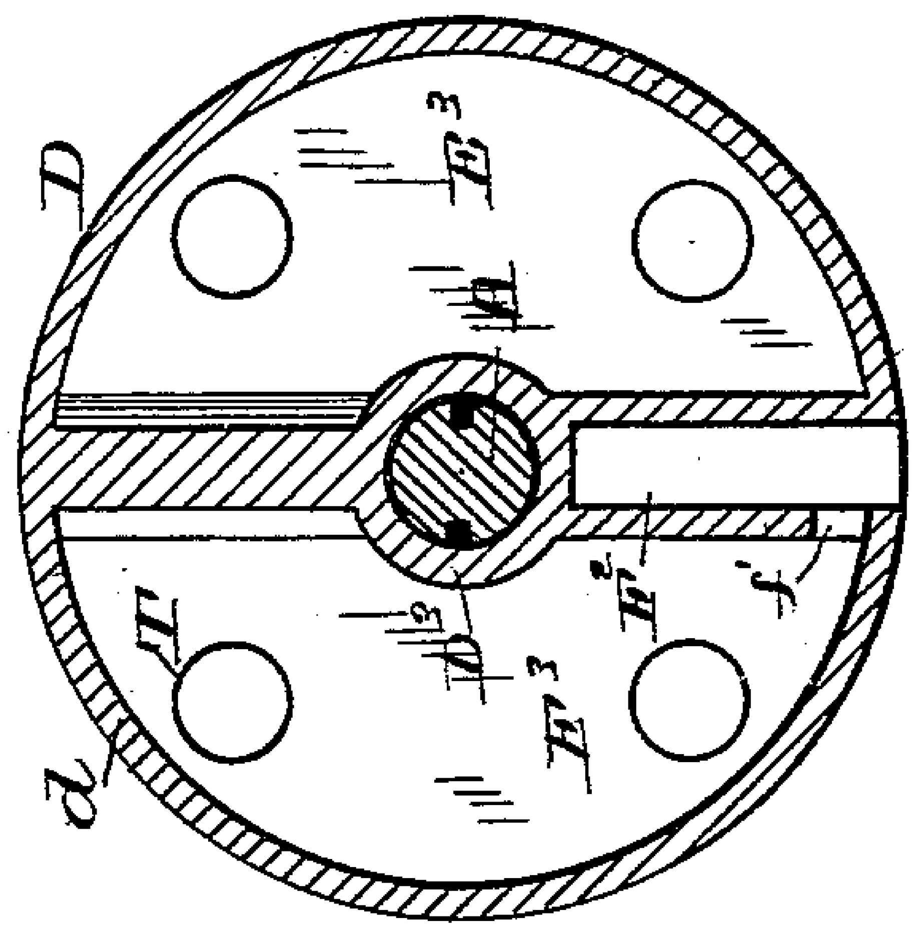

Fig. 12

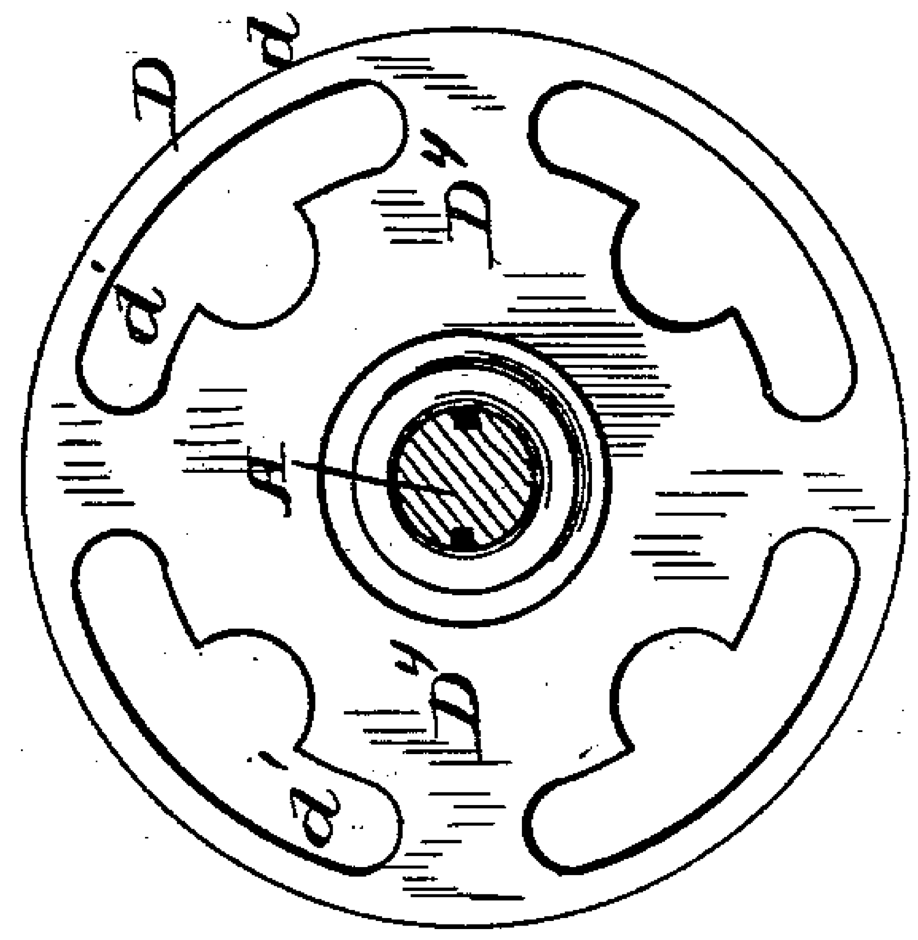

Fig. 13

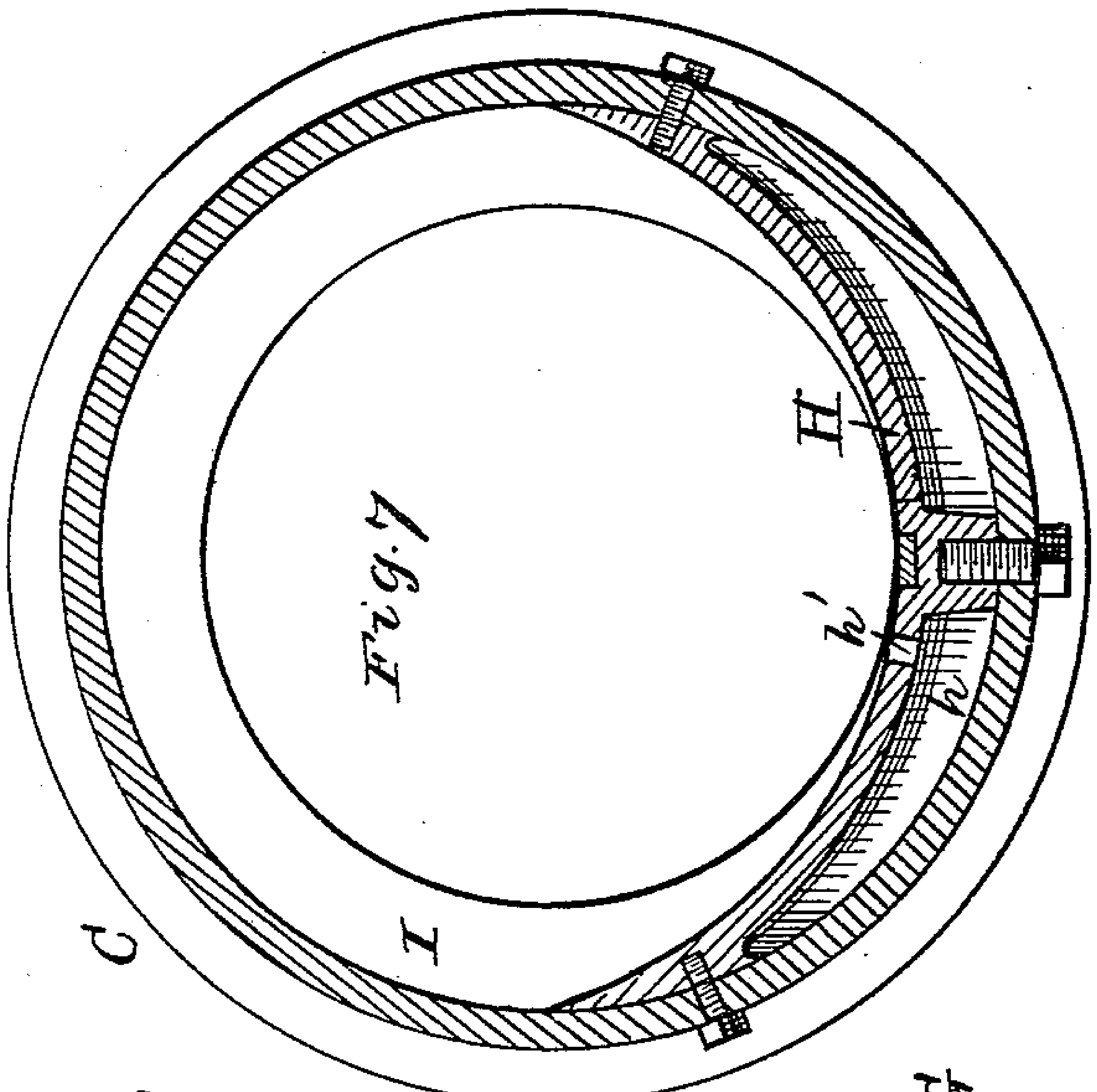

Fig. 7

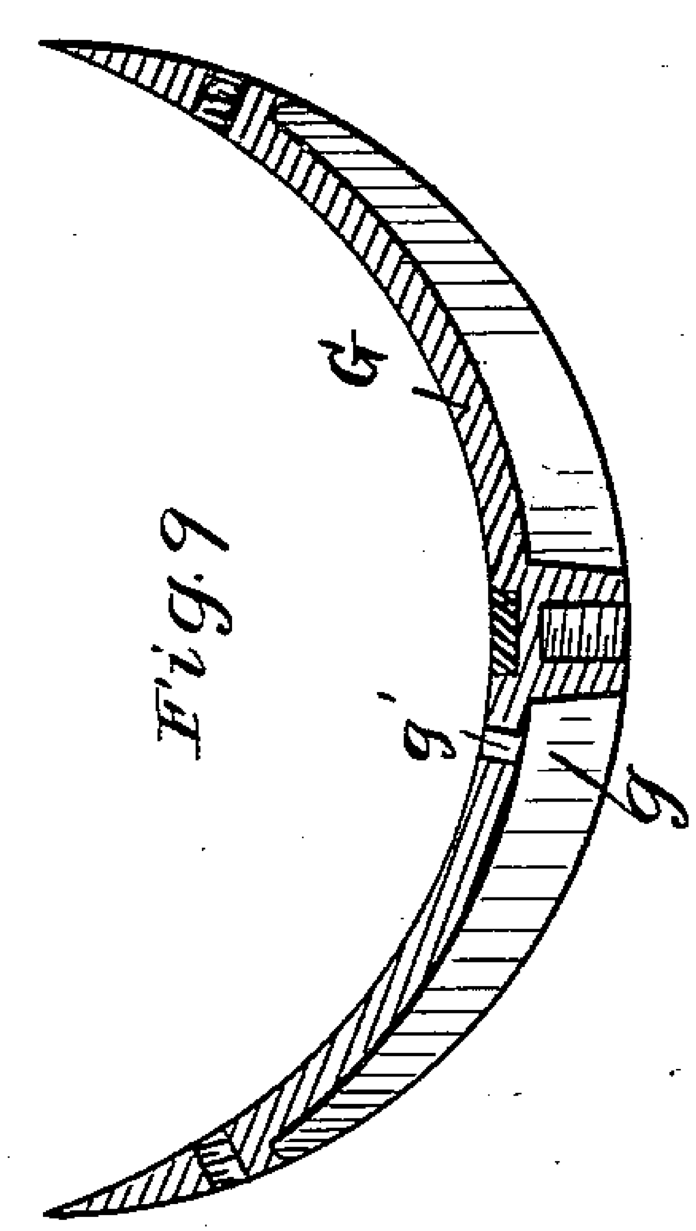

Fig. 9

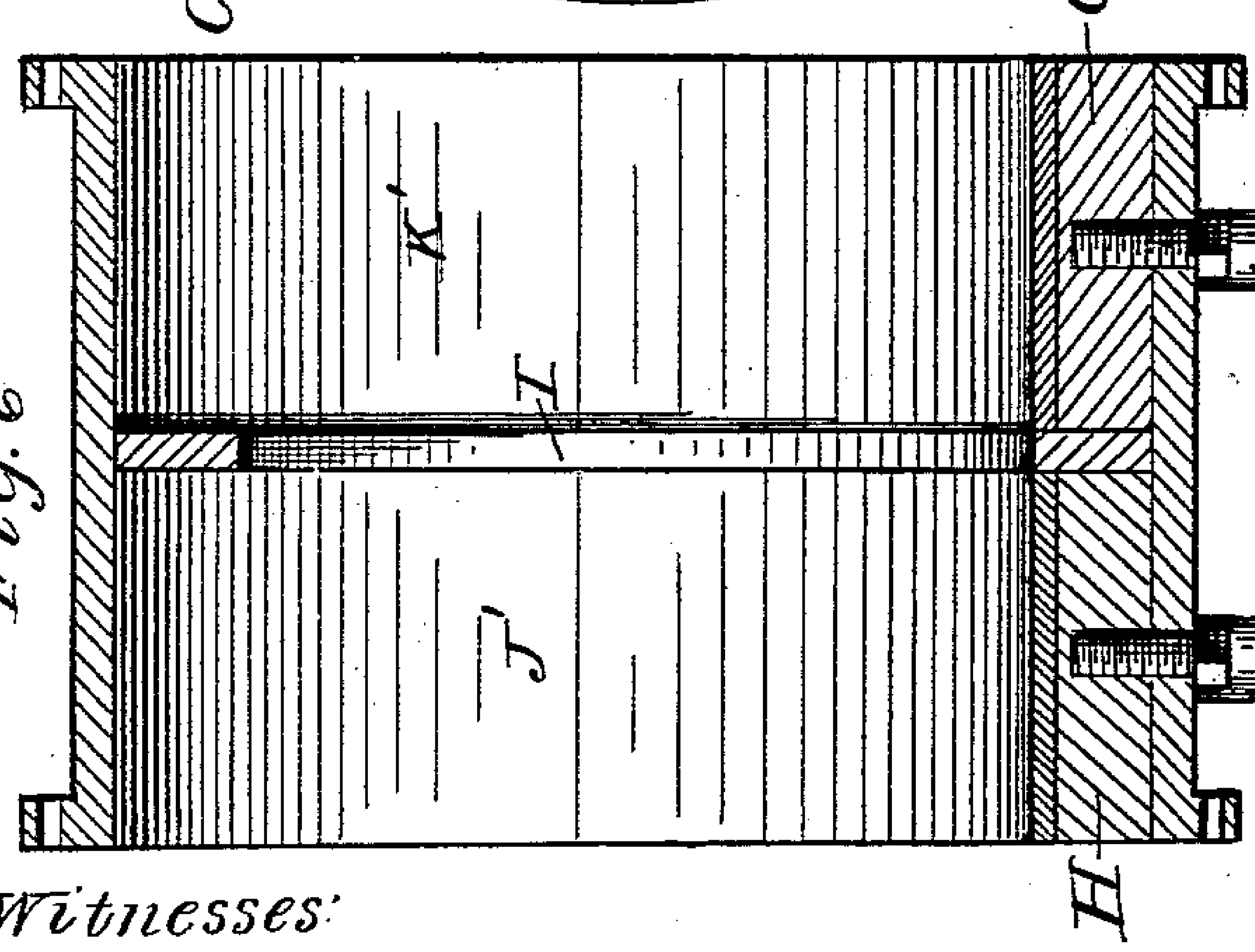

Fig. 6

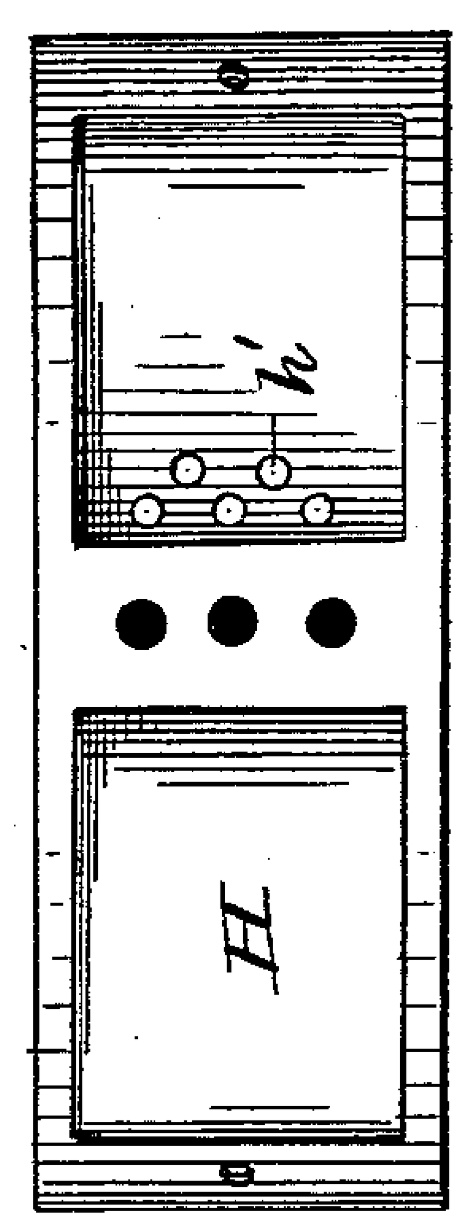

Fig. 8

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UNITED STATES PATENT OFFICE.

BENJAMIN A. LEGG, OF COLUMBUS, OHIO, ASSIGNOR TO THE LECHNER MANUFACTURING COMPANY, OF SAME PLACE.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 560,221, dated May 19, 1896.

Application filed December 9, 1883. Serial No. 221,140. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN A. LEGG, a citizen of the United States, residing at Columbus, in the county of Franklin and State of Ohio, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to improvements in rotary engines—that is to say, engines having initial rotary pistons or initial rotary power-transformers in contradistinction to engines having reciprocating pistons or initial reciprocating power-transformers, whether the power or force utilized be that of heat, as present in steam, or any of the others to-day employed in the arts for producing the mechanical motion of a mass.

I have shown the invention as applicable to rotary engines having the engine-shaft situated on the central axis of the revolving parts of the engine. Moreover, in the construction shown the parts are so constructed and arranged that the engine-shaft can be not only rotated, but moved longitudinally. Such a movement of the engine-shaft is very advantageous when the engine is employed for any of numerous purposes. For the purpose of illustration I have selected a mechanism suitable for operating drills of the character generally employed in boring rock, coal, &c. In most of these respects, however, there can be considerable modification without departing from the essential features of the invention.

Figure 1 is a longitudinal section of a mechanism embodying my improvements. Fig. 2 is a longitudinal section at right angles to that in Fig. 1. Fig. 3 is a cross-section on the line *x x*, Fig. 1, on an enlarged scale. Fig. 4 is a cross-section on the line *y y*, Fig. 1. Fig. 5 is a section on line *y' y'*, Fig. 1. Figs. 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16 show details, Fig. 15 being a section on line *z z*, Fig. 2. Fig. 17 shows a modification of the feed devices.

In the drawings, A represents the engine-shaft. It passes through the piston and the outer cylinder around the rotary piston, and with these parts are combined devices arranged intermediately between the piston and the engine-shaft for carrying the power from the former to the latter. These intermediate devices consist of a spur-pinion B, secured to a tubular shaft formed on and carried with the piston, an idler-pinion B', and a master-wheel A', connected to the shaft. As the piston revolves, rotary motion is carried through the parts B B' and A' to the shaft. The piston is so constructed and arranged that the steam can be carried into the interior thereof and thence conducted into the chamber around it within the outer cylinder to effect the rotation of the piston. To attain this, the cylinder is formed with ducts or chambers running more or less nearly parallel with the axis of the shaft, these lying inside of the circumference of the piston, which circumference is substantially continuous, except at places to be mentioned. An inlet-duct is formed in the outer cylinder adapted to communicate with the aforesaid duct or ducts in the interior of the piston. Preferably this inlet-duct is formed through one of the heads of the outer cylinder, and also by preference said heads C' C^2 of the cylinder are fitted tightly against the ends of the piston.

The piston D as a whole has a circumference substantially circular, and may be longer or shorter, as preference dictates. The above-mentioned ducts or chambers in the interior of the piston are provided by forming it hollow, except that there is a diaphragm extending from one end to the other through the interior, this diaphragm being formed with a continuous tubular part, as at D^3, to surround the shaft, and with chambers E^2 F^2, so arranged that the sliding plates arranged therein can move toward and from the circumference. Each of the chambers E^2 F^2 communicates with one of the aforesaid ducts or larger chambers E^3 F^3 through ports *e' f'*. J K represent the sliding plates, which are fitted snugly and slide in the chambers E^2 F^2, there being apertures in the circumference of the piston D at *e* and *f* to permit the in and out movements of said plates J K.

The plates J K perform to some extent the part of valves in the engine, in so far as they govern the admission and shutting off of the steam, and to some extent the function of the sliding pistons or sliding abutments used in rotary engines. I shall herein refer to them as "sliding plates," although, as said, they are adapted to perform more or less of the above-mentioned functions.

The chamber E^2 and its sliding plate J are situated at one end of the piston, and the chamber F^2 and its sliding plate K are at the other, there being a narrow space on transverse planes between the two valves, so that a diaphragm I can be employed within the outer cylinder to form two chambers J′ K′ around the piston, one of which is of such dimensions that the sliding plate J can revolve therein sufficiently tightly and the other so that the sliding plate K can revolve similarly therein.

By reason of the presence of the diaphragm within the piston the initial steam-chamber is divided, so that the supply to the sliding plate J is separate from that to the sliding plate K, and by reason of the diaphragm I the exhausts from the two parts will be also separated.

In the construction shown the cylinder is provided with abutments G H, these being more or less nearly crescent-shaped, the distance from tip to tip thereof being about equal to the interior diameter of the cylinder, these abutments at the thicker parts being of such thickness that the inner surfaces at the lines of contact are on lines at a distance from the axis of the piston equal to the radius of the latter. The piston therefore revolves with a part thereof in contact with the abutments at the centers of the latter. I prefer to have two of these abutments, one for each end, so that the diaphragm I can be readily made and put in position, this diaphragm being of a width about equal to that of the abutments at their thickest parts. In this respect, however, there can be modification, as the abutments can be made integral and the diaphragm constructed so that its shape shall correspond to the variation in the abutments. Upon each side of the diaphragm and in the abutments G H ports are provided, as at g' h', for the exhaust from the chambers J′ K′, these ports communicating with exhaust-pipes g^2 h^2, there being preferably chambers at g h, formed by recessing the abutments on their under sides.

At the ends of the piston there are webs, as shown at D^4, with apertures. Those at the receiving end of the piston are preferably elongated, as shown at d', so as to allow the steam or air to be admitted substantially continuously to one or the other of the chambers E^3 F^3 in the piston. The webs provide a support for the circumferential wall d of the piston. As shown, the piston is provided with sleeves D′ and D^7, that at D′ being extended out through the head C′ and having the pinion B keyed thereto. That at D^7 extends through the head C^2 of the cylinder, and these together provide the bearings, supplemental rings of soft metal being employed in the bearings, if desired. The heads C′ C^2 are formed with inwardly-projecting flanges, as at c^6, which inclose the extreme ends of the piston and which may be fitted with sufficient tightness to provide support or bearing.

L′ indicates the inlet duct or pipe through which the live steam or air enters, the inner end thereof being in the circle of the elongated apertures d' in the end of the piston.

Each of the sliding plates J K is provided with a recess j' k' on the receiving side—that is to say, on the side toward the port e' f'.

It will now be seen that if steam or air be allowed to pass through the inlet L′ it will enter one or another of the chambers E^3 F^3. If it enters the latter, it will immediately tend to force the sliding plate K outward against the cylinder-wall by reason of the pressure exerted thereon. After the sliding plate moves out sufficiently there is communication from the chamber F^3 to chamber J′ through the passage provided by the cavity k' in the sliding plate K. The steam or air entering the chamber J′ compels the piston to begin rotating, and as this continues the sliding plate K moves to the end of its outer throw and there remains until it comes in contact with the abutment H, which gradually moves it (the sliding plate) inward until it reaches the center of the abutment, where the passage k' is closed. Just as or somewhat before reaching the center of the abutment the sliding plate passes the exhaust-port h'. After this it is ready to begin and to continue another revolution. The sliding plate J, being opposite to that whose movement was just described, will be taking steam at the fullest just as the sliding plate K passes the abutment, the operation of this sliding plate in respect to the passage j' through it, the opening of the exhaust-port g', &c., being similar to that of the one at K.

These rotary engines are advantageous under many circumstances where the engine-shaft or prime shaft is to be not only rotated but moved longitudinally in one direction or the other, or both. To accomplish such a movement, I combine with the engine devices for causing a pressure upon the shaft longitudinally.

O represents a tube or cylinder, within which is placed a piston P. The piston is connected with the engine-shaft loosely, so that the latter can be rotated while moving longitudinally and so that the piston can be held from rotating. With the piston I combine a guide that holds it from revolving, but allows it to move longitudinally. As shown, this guide consists of two rods R R within the tube or cylinder O.

The tube or cylinder O can be mounted in any suitable way. I prefer to bolt it to the stationary part of the engine. It is shown as being fastened to the plate C^2, it being flanged to adapt it to receive the bolts, &c. At the outer end it is provided with a cap O^2, which closes the tube, though it is provided with three apertures, one of which receives a screw O^3, whereby the cylinder-chamber can be opened when necessary, and two are adapted to receive the outer ends of guide-rods R. These rods at their inner ends are screwed into the head C^2 of the engine-cylinder. The engine-shaft is formed with a head a^6, which can be produced by forming a groove in the shaft. In this groove is placed a plate P^2, which is bolted to the head P of the piston, there being a leather or other suitable packing at p, held in place by this plate P^2.

Q represents a duct through which steam or air can be carried to the outer end of the tube O. As shown, it communicates with the steam-chamber in the engine, and there is a three-way valve Q′ inserted at a suitable point, by which the steam may be conducted either to the end of the tube A or may be cut off and that in the tube be allowed to exhaust.

I have represented the master-wheel A′ of the engine as being surrounded by braces or straps c c' c^2, the parts c being bolted to the stationary parts of the cylinder and the parts c^2 carrying the bearing c^3, above which there is a box-cap c^4, this bearing having a bushing, if necessary.

When the piston is rotated in the manner hereinbefore described, it carries with it the pinion B, which in turn revolves the idler B′, interposed between pinion B and the master-wheel A′, the latter having an internal gear meshing with idler B′. The latter is mounted upon a stud-shaft carried by the engine and the engine-frame. As the gear-wheel is splined to the engine-shaft the latter is revolved with it. By varying the diameters of the various gear-wheels the speed of the driven parts relative to the driving parts can be altered. The shaft, preferably, has bearings independently of the piston, so that if they are revolved with different speeds or in different directions there shall not be any undue wear exerted by one upon the other.

By means of the hand-wheel at q the valve Q′ can be so turned as to admit steam or air behind piston P, so that the engine-shaft can be fed forward with a yielding pressure. To return the shaft, a port can be made near the cylinder end of tube A, so that steam or air can be admitted to the tube in front of the piston to cause it to recede. (See Fig. 17.)

At T there are apertures in the end wall of the piston opposite to the end through which the steam is admitted, and in the end wall or head C′ of the cylinder there is formed a groove or recess S at a radial distance from the axis equal to that of the said apertures T. The air or steam can pass through the apertures T and fill the groove or recess S and thus exert a balancing action on the piston. The dimensions of the various parts should be such that the areas of pressure on the sides of the end wall D^5 should be as nearly equal as possible.

Of the numerous features incident to my invention one or more of them can be embodied in a mechanism without necessarily involving the use of all of them. Variations will readily suggest themselves to those acquainted with such matters, and I do not limit myself to all the details of construction or arrangement shown and described, and so far as concerns the hollow axial shaft and the driven shaft passing through it, in combination with the connecting gearing, the rotary piston herein will be understood as representing all such rotary power-transformers.

I am aware of the fact that use has been heretofore made of both single-acting and double-acting rotary engines; but I believe myself to be the first to have provided an engine fulfilling the requirements experienced in certain lines of work. Thus in rock and coal drilling it is necessary to have a compact and simply constructed machine of few parts not liable to breakage, and one which will be light and readily portable. These requirements preclude the use of fly-wheels or other devices for giving a continuous motion or momentum. Such motion I practically insure by providing a double-acting mechanism and at the same time avoid the danger of fracture or impairment by employing strong parts and but few of them.

I am aware of the fact that rotary engines or motors of various styles have been used, both those in which steam or air was the initial agent and each having a cylinder and a rotating piston or body actuated by said air or steam, and also those in which use was made of analogous parts, such as an armature instead of a piston and a field-magnet instead of a cylinder, and therefore I do not broadly claim such parts by themselves considered; but as concerns the mounting of the master-wheel with relation to the piston or initial power part—that is to say, so that it rotates on the axis of such initial power part and has a hub or journal turned outwardly therefrom, with a bearing or support secured to the engine or motor and surrounding the master-wheel—I do not limit myself to the exact details of construction with respect to the piston or its equivalent. This part of the invention can be applied in any case where there is a continuously-rotating initial power part from which the power can be taken first outward and then back to the axis of the initial rotation.

As herein stated, the matters pertaining to the improvements herein relate to rotary engines, irrespective of the use to which they are put. I have found that an engine having the features shown and described is of importance whenever it is desired to have a small light-power device with its parts compactly arranged and so constructed that the power can be applied at one point or another more or less remote from the engine. In the numerous lines of work where such an engine is applicable there are several which present a varying load and resistance to the rotating and longitudinally-movable shaft. The maximum of increase in load is often suddenly felt at the instant when the sliding plate is on the abutment—that is to say, when the steam or air is exerting the least pressure on said plate—and if the increase in load becomes sufficiently severe, as it often does, the engine stops, and in any event has an uneven or pulsating action. When the driven power-shaft is longitudinally stationary and the load is brought toward it, this difficulty is not experienced so much; but with an engine of the kind illustrated the driven shaft is often carried to a distance of from six to ten feet from the engine, and then any sudden increase in load is seriously felt, unless the sliding plate J is where it is taking the full steam. To obviate this I combine with the longitudinally-movable shaft means for reinforcing the sliding plate J—namely, the sliding plate K and its coacting parts—and insure that any sudden increase in load when the driven shaft has been extended to a point remote from the engine shall be taken by the latter devices when the plate J is more or less inactive.

I have in another application, Serial No. 221,014, filed December 8, 1886, shown some of the matters which are herein illustrated and described, but therein make claim only to devices adapted for use in drilling, boring, or otherwise analogously cutting. I herein claim the novel and patentable features shown and described in so far as they relate to engine mechanism or devices for applying or transmitting power.

I am aware that use has been made heretofore, or proposed, of rock-drills, each comprising a rotary engine, a drill-shaft, and a cylinder and piston for advancing the drill-shaft by their pressure while the engine is rotating it. In machines of one sort the drill-stem passed directly through the rotary piston of the engine, there being no bearing interposed for reducing speed, and I entirely disclaim as of my invention any combination of parts in a mechanism comprising as elements of said combination the driven shaft and the rotary piston directly connected together without gearing. In the machines of the other earlier sort above referred to the drill-shaft and its feed-tube were arranged on an axis at right angles to the rotary engine and its piston, so that the power had to be transmitted to beveled wheels which were of equal dimensions, so as to avoid the reduction of speed, and this engine being rigidly secured, after the manner common in rock-drills, to a stiff vertical frame. I also disclaim such mechanisms, the operative parts in mine being mounted universally adjustably and being so arranged to each other that both compactness and the reduction of speed necessary in light portable coal-drills can be obtained. Nor do I herein claim specifically any combination of parts in a machine comprising a driver or an initial-rotation producer other than the piston of an engine adapted to be operated by steam, water, air, or similar substances.

I am aware of the fact that at the date of this patent drilling-machines have been known or proposed as substitutes for the rotary motor herein, (to be actuated by air, steam, or the like material,) engines to be actuated by different agents, such as electricity, said latter engines having parts which in construction and arrangements are more or less similar to and are equivalents of some of the parts of the rotary engine herein—as, for instance, the centrally-perforated piston, the tubular shaft upon which it revolves, and the drill-stem passing such tubular shaft—and while I do not, as beforesaid, make any specific claim to such rotary driving-engine I do not wish to limit the claims herein referring to a "rotary engine" or to a "rotary piston" to exactly the prime motor or to the driving agent herein referred to, although, as I have above set forth, I do not mean to include in any way machines which dispense with gearing between the piston and drill-shaft; nor do I limit myself to the engine combined with a drill, for though I have shown the tool used in connection with the sliding piston as a drill-bit, yet any other kind of a tool could be used as well.

What I claim is—

1. In a rotary engine or motor, the combination of the rotary piston or initial power part, the pinion secured thereto, the master-gear, having a journal or hub turned outward from the engine or motor and situated at the axis of the piston, the support for said journal or hub secured to the engine or motor and extending around the master-wheel, and the gearing between the piston-pinion and the master-gear, substantially as set forth.

2. In a rotary engine or motor, the combination of the rotary piston or initial power part, the pinion secured thereto, the master-gear having its hub arranged at the axis of the piston and extending away from the engine or motor, the bearing or support c^3 for such hub, arms c^2 extending from said bearing across the periphery of the master-gear and connected with the casing of the engine or motor, and gearing between the master-gear and pinion on the initial power part, substantially as set forth.

3. In a rotary engine or motor, the combination of the rotary piston or initial power part, the pinion secured thereto, the internally-toothed master-gear arranged concentric with and in the planes of said pinion and having its hub journaled in a bearing carried by arms

which extend across the periphery of the master-gear and are secured to the engine-casing, and a pinion, mounted on a stud projecting from the engine or motor casing, connecting the pinion on the initial power part with the master-gear, substantially as set forth.

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

BENJAMIN A. LEGG.

Witnesses:
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T. M. LIVESAY.