(No Model.)

5 Sheets—Sheet 1.

I. N. FORBES.

ROTARY ENGINE.

No. 274,476. Patented Mar. 27, 1883.

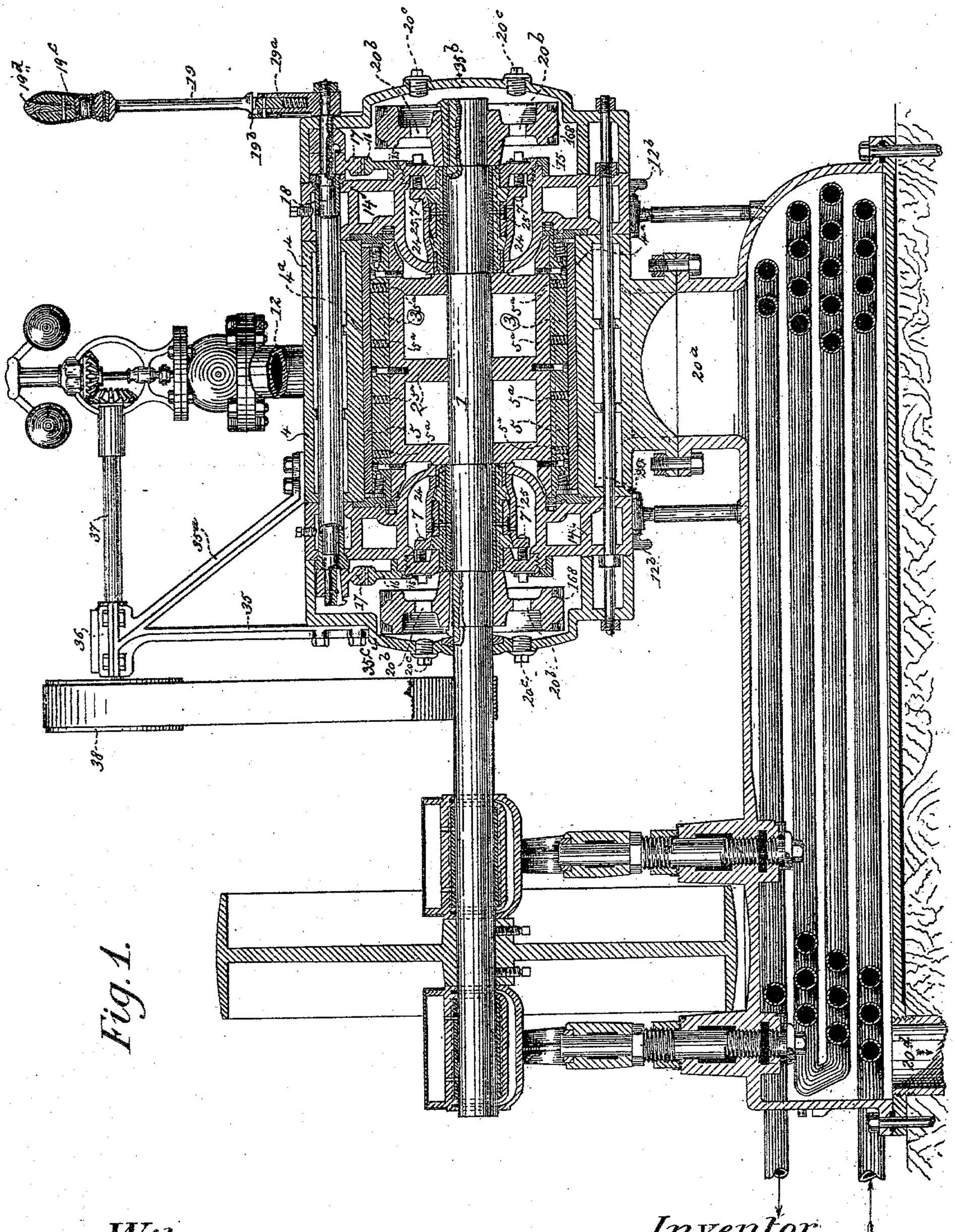


Fig. 1.

Witnesses.

E. Abshagen

Fred. L. Ester

Inventor:

Isaac N. Forbes.

By his Attorneys Knight Bros

(No Model.)

5 Sheets—Sheet 2.

I. N. FORBES.

ROTARY ENGINE.

No. 274,476.

Patented Mar. 27, 1883.

Fig. 2.

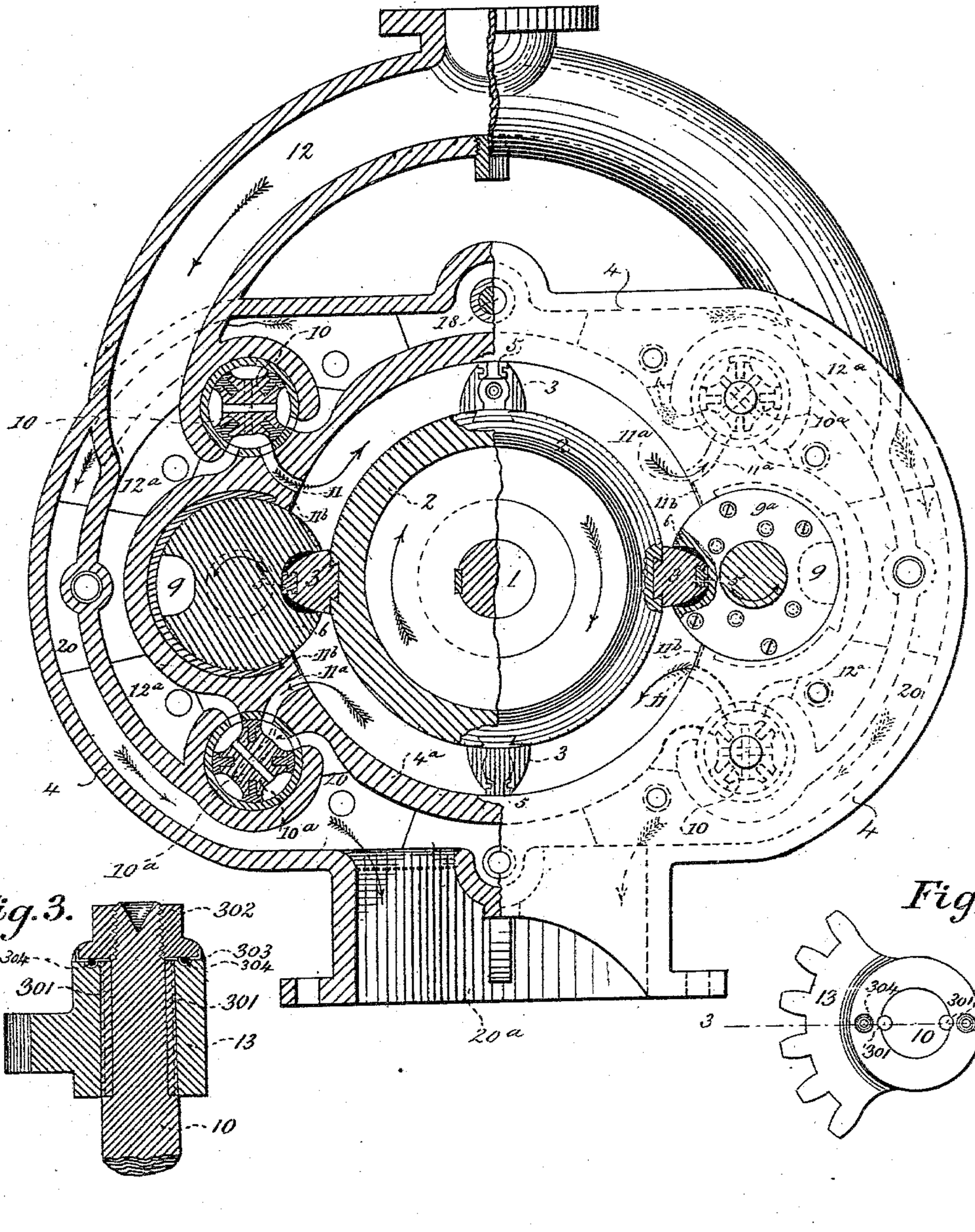


Fig. 3.

Fig. 4.

WITNESSES

E. Abshagen.

Fred. L. Foster.

INVENTOR

Isaac N. Forbes.

By his Attorneys Knight Bros

(No Model.)

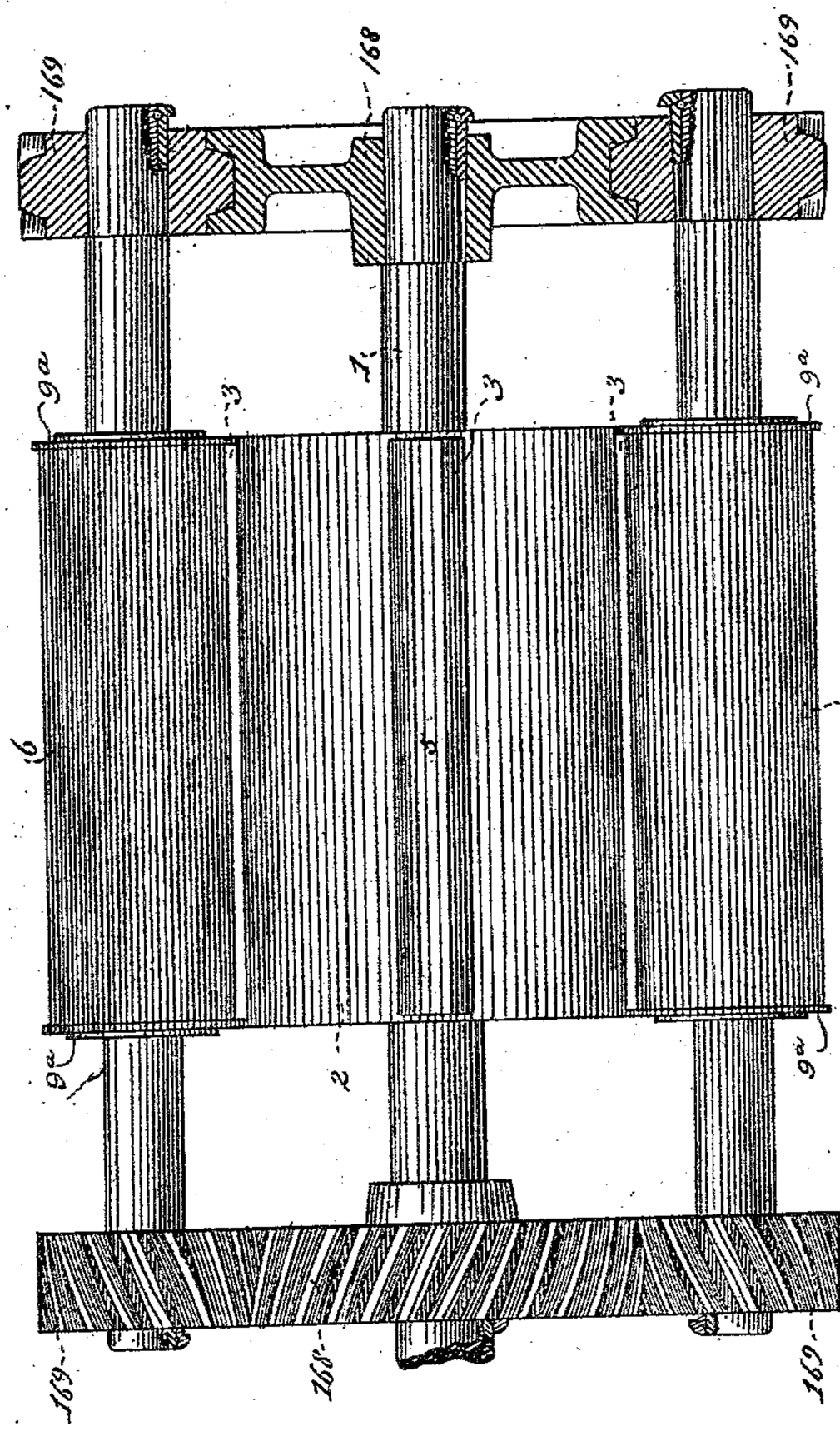
5 Sheets—Sheet 3.

I. N. FORBES.

ROTARY ENGINE.

No. 274,476. Patented Mar. 27, 1883.

Fig. 5.



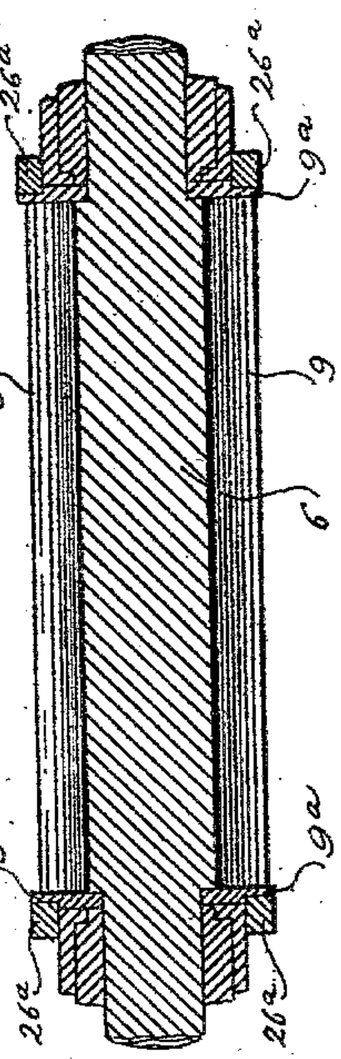
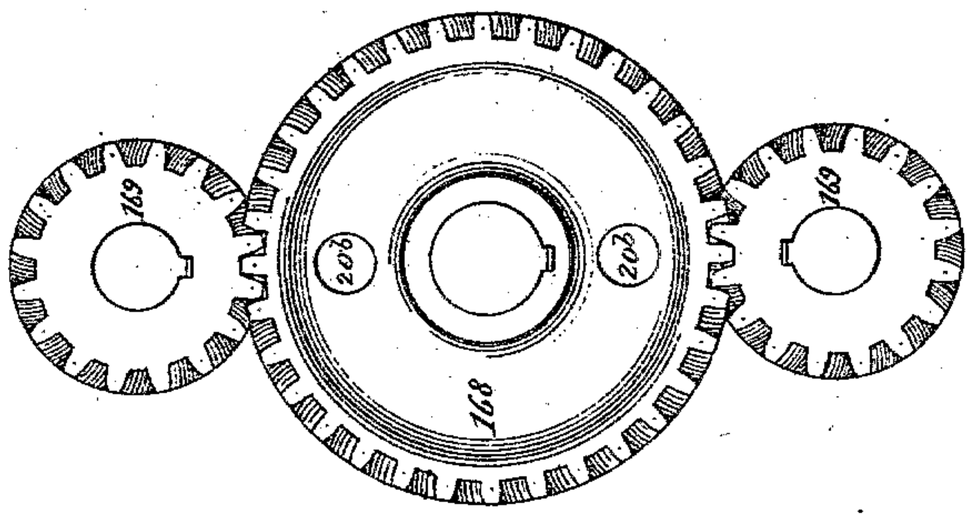


Fig. 5a.

Fig. 6



Witnesses;
Ernest Abshagen
Fred'k L. Foster

Inventor;
Isaac N. Forbes.
By his Attorneys Knight Bros

(No Model.)

5 Sheets—Sheet 4.

I. N. FORBES.

ROTARY ENGINE.

No. 274,476. Patented Mar. 27, 1883.

Fig. 7.

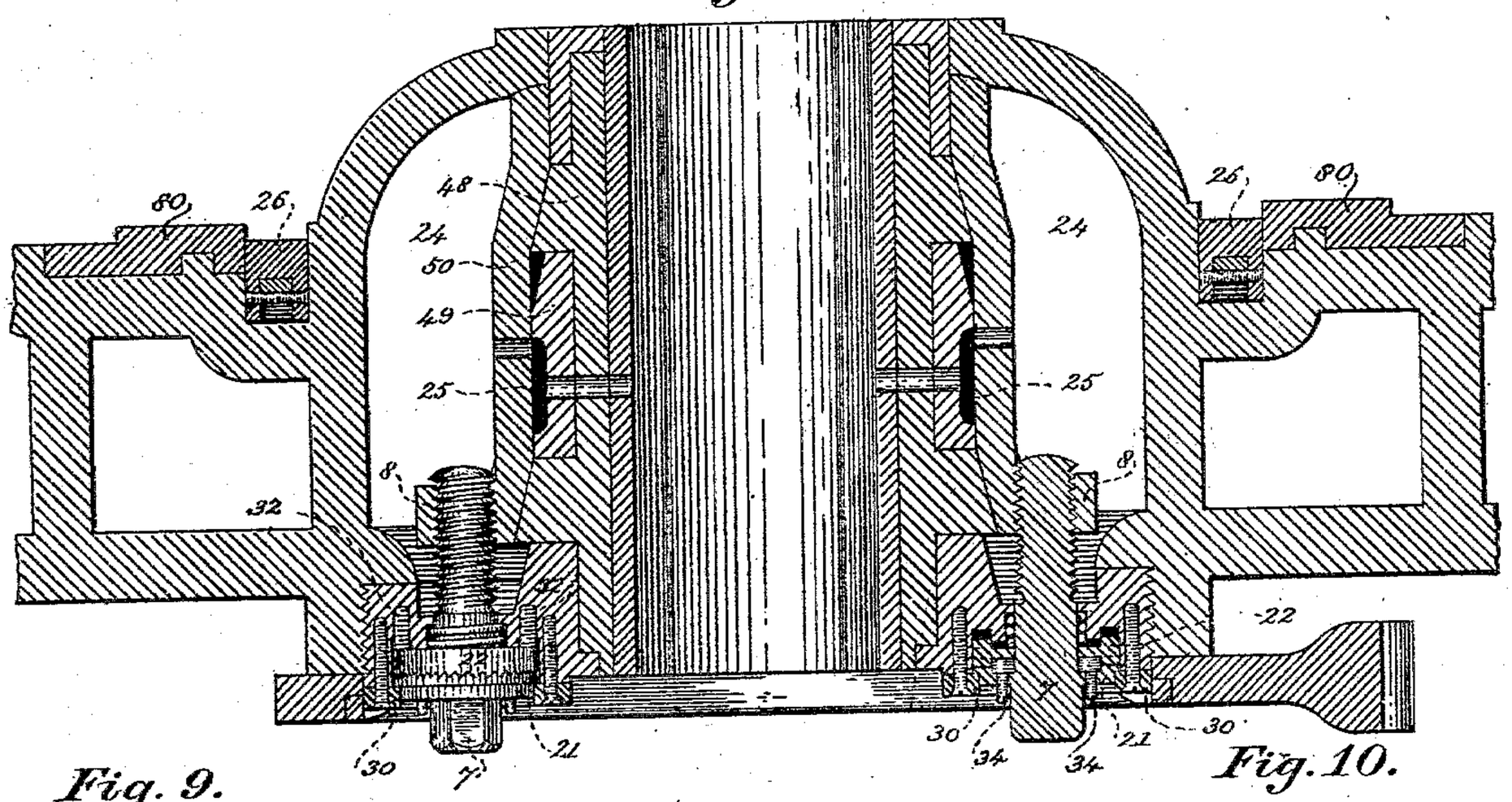


Fig. 9.

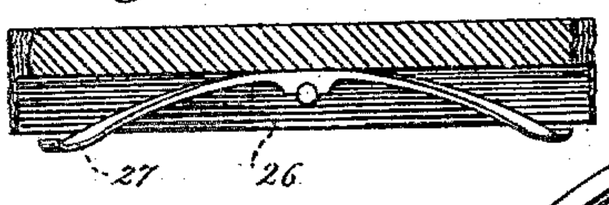


Fig. 8.

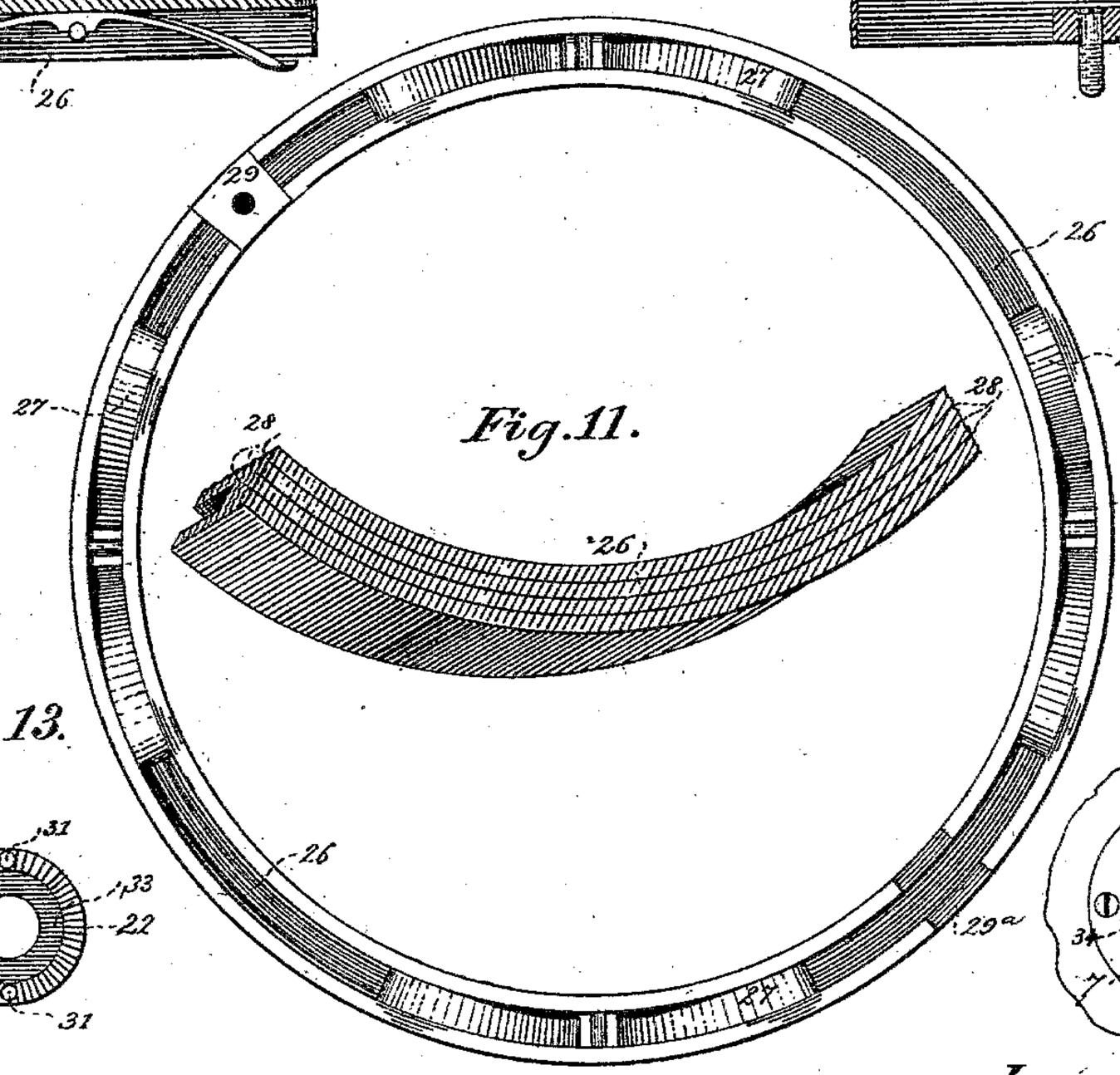


Fig. 10.

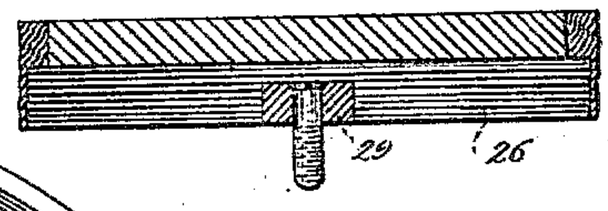
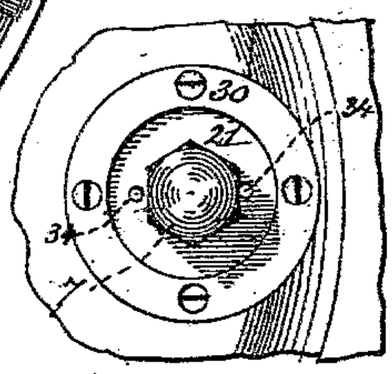


Fig. 11.

Fig. 13.

Fig. 12.



Witnesses.

E. Abshagen.

Fred: L: Foster.

Inventor:

Isaac N. Forbes.

By his Attorneys Knight Bros

(No Model.)

5 Sheets—Sheet 5.

I. N. FORBES.

ROTARY ENGINE.

No. 274,476. Patented Mar. 27, 1883.

Fig. 14.

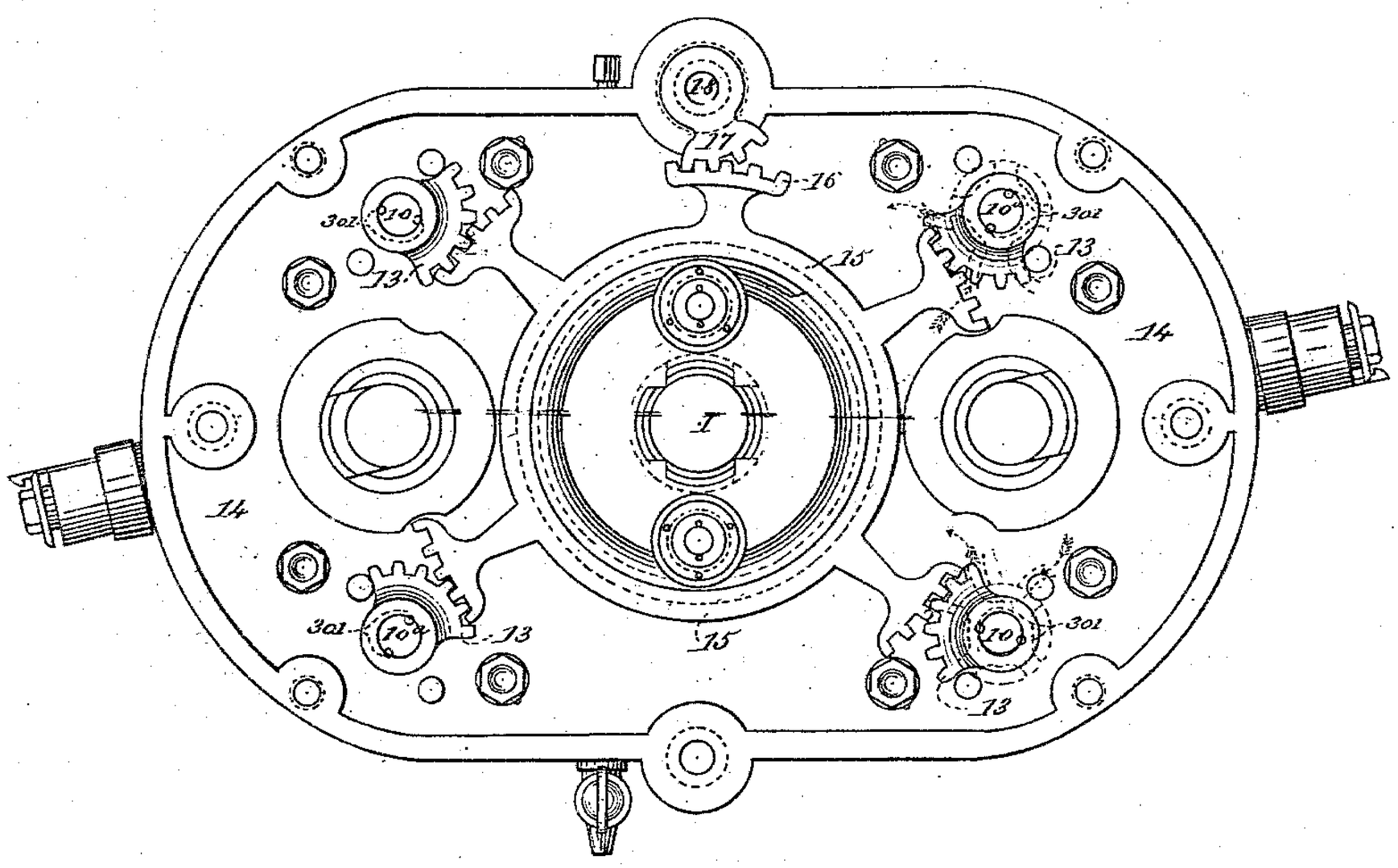


Fig. 15.

Witnesses;
Ernest Abshagen
Fred: L. Foster

Inventor,
Isaac N. Forbes,
By his Attorneys
Knight Bros

UNITED STATES PATENT OFFICE.

ISAAC NEWTON FORBES, OF LAWRENCE COUNTY, DAKOTA TERRITORY.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 274,476, dated March 27, 1883.

Application filed July 26, 1882. (No model.)

To all whom it may concern:

Be it known that I, ISAAC NEWTON FORBES, of Lawrence county, in the Territory of Dakota, temporarily residing at Washington, in the District of Columbia, have invented a new and Improved Trochilic or Rotary Engine, of which the following is a specification.

The cylinder and casing of my engine are provided with ample induction and eduction steam-passages through it without interruption, excepting when closed by the teeth of the piston-wheel in their revolutions. It has one main cylinder for the piston-wheel, two abutment-roller casings, and four valve seats or cylinders. The piston-wheel has four or more piston-teeth upon its surface, standing an equal distance apart, which revolve in the main cylinder in the track of the steam-passage through from the inlet to the exhaust-ports, respectively, and pass by the abutment-rollers in their recesses, which work in connection therewith, the abutment-rollers being geared at each end to the main shaft, and are driven by it so as to rotate in unison therewith without slip between their peripheries and the periphery of the piston-wheel. They may be of the same diameter as the piston-wheel, if preferred, or one-half of that diameter, as shown. The valves are fourfold, and automatic or self-adjusting in becoming steam-tight, and in allowing for contraction and expansion of the engine without binding or leaking, and they are reversible, being connected with the reversing-gear, which, when moved for the purpose, reverses the valves and the current of steam or other motor fluid to the opposite pair of valves for the induction or eduction of steam, as the case may be, and so reversing the motion of the engine. The heads are cast hollow for the reception of oil or other lubricant, and contain all the bearings for the engine proper. The outer covers are secured to the heads, forming casings or housings for the main gear-wheels and reversing-gear. The engine is mounted upon its base, and is secured firmly thereto, the base being secured to the foundation below. The steam is exhausted through this basement. The latter contains a series of connected water-pipes for the purpose of enabling the condensation of exhaust-steam, thus assisting the head-pressure to the extent of condensation. The heat from the exhaust-steam may be thus utilized, and the base, including the pipes, may become a heater, if required.

To enable a better understanding of this engine, I will proceed to describe it with reference to the accompanying drawings, in which—

Figure 1 is a vertical longitudinal central section of an engine complete, mounted upon its base, with governor attached. Fig. 2 is in part a central transverse view and in part a full view of the cylinder and casing, with piston-wheel, abutment-rollers, and valves in position. Fig. 3 is a view of the end of the valve-stem broken, showing the method of securing it to the reversing-gear, and the gear included in section. Fig. 4 is an end view of Fig. 3 with the nut removed. Fig. 5 is a detached longitudinal view of the piston-wheel, abutment-rollers, and helical gear in their positions as when in their respective cylinders. Fig. 5ª is a section of an abutment-roller through the recesses 9, showing end plates, 9ª, and their packing-rings 26ª. Fig. 6 is a face view of the helical gear. Fig. 7 is a central longitudinal section of the main shaft, bearing in the end head, and a portion of the head with all appurtenances enlarged. Fig. 8 is a bottom view of a packing-ring, showing the springs in position and one of the stops. Fig. 9 is a broken sectional portion of the packing-ring, showing the spring in position. Fig. 10 is a view, partly in section, of a piece of the ring, showing the stop for holding the ring from turning. Fig. 11 is a perspective view of part of the ring 8, showing the packing-creases on the outer surface. Fig. 12 is an outside view of the adjusting screw-bolt in a portion of the head. Fig. 13 is a toothed or ratchet ring, in which the toothed part of the adjusting screw-bolt 7 fits to prevent the latter from unscrewing. Fig. 14 is an outside view of the head of the cylinder with the reversing valve-gear attached. Fig. 15 is an outer view of the cover or casing for the cylinder-head or the engine next to the pulley.

Keyed on a shaft, 1, is a piston-wheel, 2, constructed with four teeth, 3, at diametrically-opposite parts and at right angles to each other, and extending nearly the length of the cylinder, on the inner surface of which cylinder the said teeth are made to work steam-tight by packing-strips 5, pressed outward by springs 5ª.

Two abutment-rollers, 6, are arranged opposite each other and at opposite sides of the piston-wheel 2, and connected by helical gearing 168 169, so as to rotate in unison therewith without any slip between their peripheries, forming steam-tight joints. The abutment-rollers 6 are, as in the present illustration, of one-half the diameter of the piston-wheel, and are each provided with two recesses, 9, to permit the passage of the four teeth 3 of the piston-wheel 2. The peripheries of the abutment-rollers and of the piston-wheel are grooved with water-cuts upon their entire surfaces longitudinally, as shown in Figs. 2 and 5, assisting in preventing the passage of steam between their joints.

Four oscillating valves, 10 10 10^a 10^a, each of which is fourfold and similar in construction, are arranged in opposite pairs, one pair of valves, (10 10, for example,) which are opposite each other, being at one time steam-induction valves, while the other pair (10^a 10^a, for example) are for exhaust, the said valves being employed to place either pair of steam-ports (11, for example) in connection with the live-steam passages 12^a and the other pair of ports (11^a, for example) in connection with the exhaust-passages 20. The valves remain at rest during the continuous operation of the engine, being only used for stopping, starting, or reversing the motion. For this purpose a partial rotation is imparted to them all simultaneously by a reversing-lever, 19, through the medium of a rock-shaft, 18, carrying a segment-pinion, 17, gearing with a cogged segment, 16, on the ring 15, from which project toothed segment-gear, one for each valve, gearing with pinions 13 on the stems of the valves 10 10 and 10^a 10^a, as more fully set forth in another application filed by me of even date herewith, designated "Case C." The lever 19 differs from that in the application referred to in the construction of each end, which is composed of two main parts, that which is secured to the rock-shaft 18 and the movable handle in connection therewith, in the present case 19^a, being fixed to the rigid portion of the rock-shaft 18, and bored out for the end of the lever 19 to play in. In the end of the bore, beneath the shank of the lever, is a coil-spring, which throws the catch-pin riveted to the shank of the handle 19 in and out of gear with notches in the rack or bail 19^b by the downward pressure of the hand on the end of the handle. The outer end of the handle is bored out for the reception of a tapered plug, made of some non-conductor of heat, fitted in the end, and secured by a pin running through it and the handle. A recess is cut in the side of plug, and a cord fitted therein, and the plug, being driven in, holds the end fast. This cord is wound around the handle over a non-conducting substance, if preferred, and covers the entire surface of the handle. At the lower part of the handle a tapered hole is bored transversely through the handle, and the cord, passing therein, is held by the recessed plug driven in alongside of it.

The segment-pinions 13 are fixed on the tapered stems of the valves 10 10 10^a 10^a by pins 301, Figs. 3 and 4, and a cap-nut, 302, locked by a flexible disk or washer, 303. Before the nut is applied the washer 303 is punched down into holes 304, formed in the hub of the pinion, and after the nut is screwed home one or more portions of said washer are turned up against the recess in said nut, as shown in Fig. 3.

The supply-pipe 12 and steam-passages 12^a are preferably located, as shown, in the center of the cylinder-casing 4, between the heads thereof, and likewise the exhaust-passages 20 and outlet 20^a; but the supply-pipe 12 may be nearer one end than the other, if desired. Recesses 11^b extend to the rear of the steam-ports 11 and 11^a, within the cylinder, to permit the inlet-steam to pass the ends of the teeth 3, and so behind them as soon as they cover the inlet-ports. The main shaft-bearings within the heads are formed in segments 48, with Babbitt metal on their faces; or they may be composed entirely of any other suitable metal, which may be rebabbitted or replaced by new ones when desired. They have inclined projections on their backs extending through mortises in a case or bearing, 49, in which the assembled bearing-segments are held in their positions for being set up to the shaft as they wear. The bearing-case or housing 49 is surrounded by a movable ring or cylinder, 50, having inclined surfaces corresponding with the inclined projections on the backs of the bearing-segments. The ring or cylinder 50 is drawn endwise to force in the bearing-segments by screw-bolts 7 7, screwing into the flange 8 of the ring. The bolts are turned by means of a key or wrench inserted through the apertures 20^b (shown in Figs. 1 and 6) in the gear-wheel 168, corresponding apertures, 20^c, being provided in the external cover of the cylinder-head. To hold the bolt 7 against unscrewing, it has an annular flange, 21, toothed or serrated on its inner face, and a toothed or serrated disk, 22, which is prevented from turning with the bolt 7 by fixed feathered keys or pins 32, passing through holes 31, (see Fig. 13,) and, permitting a longitudinal but not a rotary movement, is pressed outward by a spiral spring into engagement with the fixed disk or flange 21 on the screw-bolt 7. Longitudinal pins 34 pass through holes in the toothed flange 21, and have heads which move in the annular recess 33 when the bolt is turned, which serve to press the disk 22 out of engagement with the teeth on the flange 21 when pressed inward by the key or wrench. The screw-bolts 7 7 are kept in place by rings 30, fastened to the outer surface of the bearing-case by screws or rivets. The main shell of the head, in which the bearing-case or housing and the adjustable ring are fitted, has an annular chamber, 24, extending completely around the bearing, which also communicates

with the remaining chambers through cored channels, (described more fully in another application of even date herewith, designated "Case D,") forming one main reservoir. Recesses for oil are also formed between the shell and the housing of the bearing-segments, as shown at 25 in Figs. 1 and 7. For packing the joint between the cylinder-heads and the rims or ends of the piston-wheel 2, a ring, 26, is employed at each rim, as shown in section at 26 in Fig. 7, and in under view in Fig. 8, and in detailed broken parts in Figs. 9, 10, and 11. The said ring is pressed out by semi-elliptical springs 27, and is formed with a number of water-packing creases, 28, on its face, as shown in Fig. 11. To secure the said packing-ring against turning in the head, lugs 29 are employed, fitting in corresponding recesses, one of which is shown at 29ª, Fig. 8, and fastened to the head by screws or rivets.

The recessed abutment-rollers are provided with end plates, 9ª, covering the ends of the abutment-roller recesses, for forming tight joints and preventing leakage of steam between the ends of the abutment-rollers and the plates and between the ends of the teeth and the plates, and in connection with packing-rings similar in construction to those hereinbefore described, and shown in enlarged views 7 to 11, inclusive, but made of a breadth and size to fit the end plates, 9ª, of the abutment-rollers.

The hollow base upon which the engine stands, and to which it is bolted, contains a series of connected pipes, through which cold water is forced and around which the exhaust-steam flows in its passage to the exhaust-pipe 20ᵈ.

The engine is provided with a governor of any approved construction, a common form of which is illustrated in Fig. 1. The outer bearing of this horizontal driving-shaft 37 is mounted in a novel manner in a bracket or standard on the end of the cylinder-head cover, supported by a brace, 35ª, extending to the top of the cylinder. The said standard and brace may be made in one or more pieces, as may be preferred. The shaft is driven by a pulley, 38, rotated by a belt from the main shaft 1. Cylinder-cocks 12ᵇ are inserted in the lower portion of the cylinder-heads, both connected with the annular chamber in which the piston-teeth revolve, for the purpose of carrying off the water of condensation, all of which is more fully described in another application for patent filed by me, of even date herewith, designated "Case A.")

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

1. A single reversible trochilic or rotary engine having one main cylinder or engine-casing containing one piston-wheel cylinder, two abutment-roller casings, and four valve-seats, with suitable induction and eduction steam passages, ports, and channels, and a piston-wheel, two abutment-rollers, and four valves, substantially as and for the purpose set forth.

2. In a rotary engine, the combination of cylinder-heads provided with packing-rings, and abutment-rollers provided with removable plate 9ª on its ends, to form packing-joints between the said packing-rings and rollers and surface-bearings for the ends of the piston-teeth, substantially as set forth.

3. A trochilic or rotary engine consisting of a main engine-casing, a piston-wheel, two abutment-rollers, recessed as described, with four reversing-valves, and gear at one or both ends of the engine, two heads, two covers for the heads, and a main shaft, substantially as and for the purpose specified.

4. In a rotary engine, adjustable bolts, with serrated flange 21 and serrated ring 22, stops 32, ring 30 for holding the bolts in position, spring to hold the serrated ring in contact, and headed pins 34, in combination with ring 50 and bearing-pieces 48, as and for the purpose set forth.

5. In a rotary engine, in combination with the head, a packing-ring provided with a recess in its inner surface, as shown, for the reception of springs 27, with stops 29, substantially as specified.

6. The combination of a toothed piston-wheel and recessed abutment-rollers, geared together and grooved or creased longitudinally on their peripheries to adapt them to work together steam-tight, as described.

7. The combination of a toothed piston-wheel, two abutment-rollers on opposite sides of said wheel, recessed for the passage of the teeth thereof, and helical gears at each end, connecting the shaft of the piston-wheel and the abutment-rollers, substantially as and for the purposes set forth.

I. N. FORBES.

In presence of—
ERNEST ABSHAGEN,
FRED. L. FOSTER.