(No Model.)

6 Sheets—Sheet 1.

J. THORNE.

ROTARY ENGINE.

No. 395,722. Patented Jan. 8, 1889.

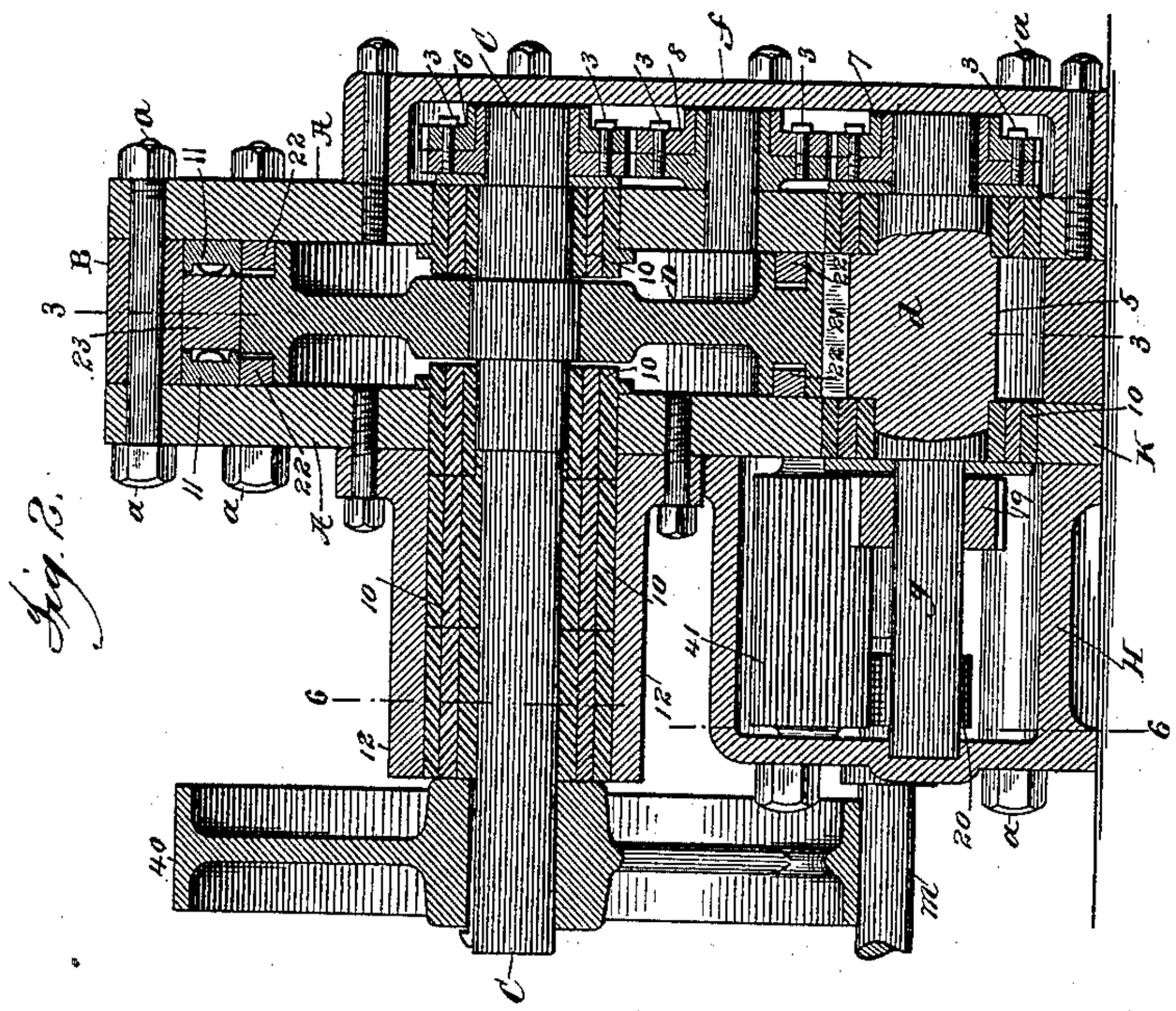

Fig. 2.

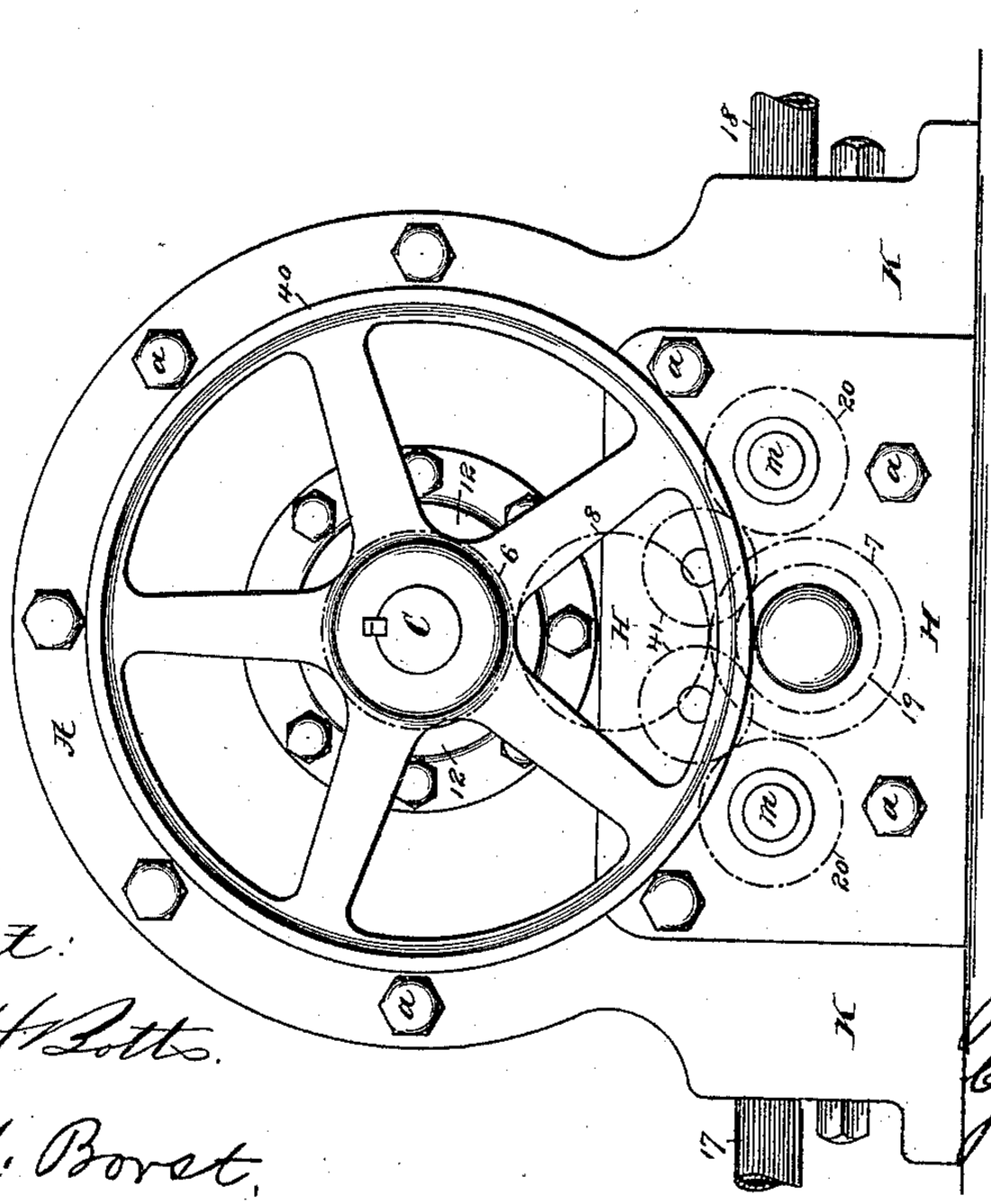

Fig. 1.

Attest:
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G. M. Borst.

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by Philipp Phelps & Hovey
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(No Model.) 6 Sheets—Sheet 2.

J. THORNE.

ROTARY ENGINE.

No. 395,722. Patented Jan. 8, 1889.

Fig. 4.

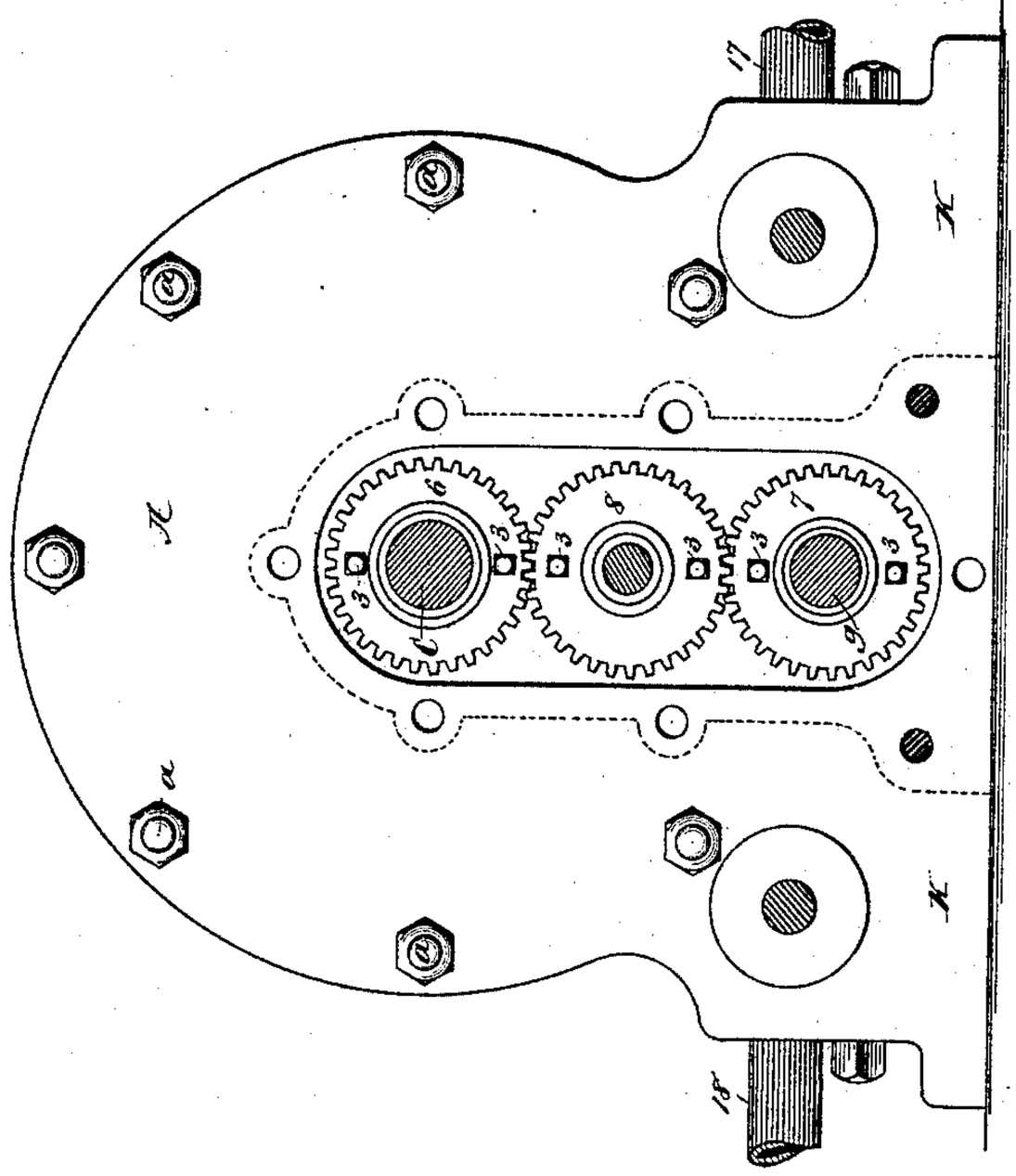
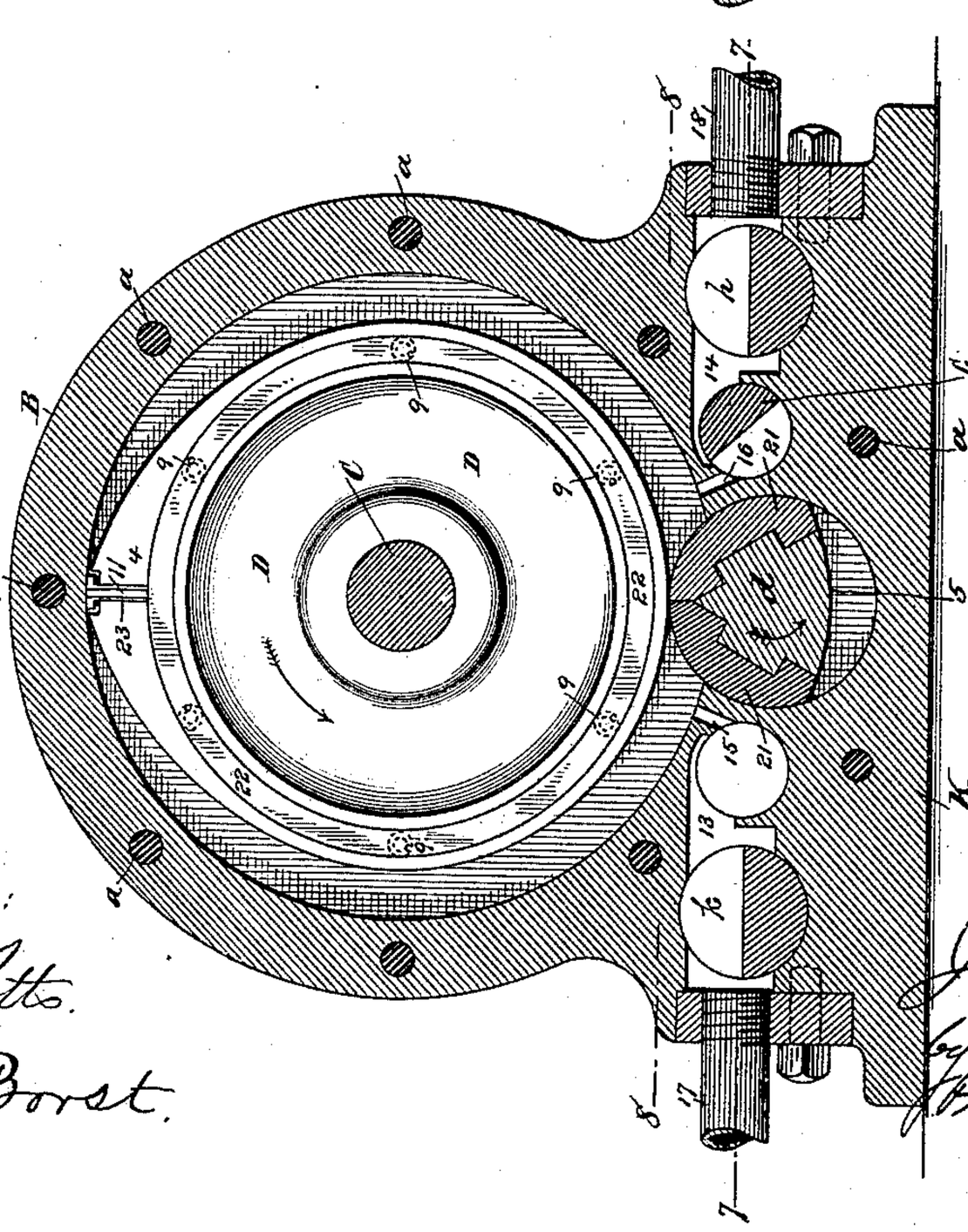


Fig. 3.



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Geo. H. Botts.
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J. THORNE.

ROTARY ENGINE.

No. 395,722. Patented Jan. 8, 1889.

Fig. 5.

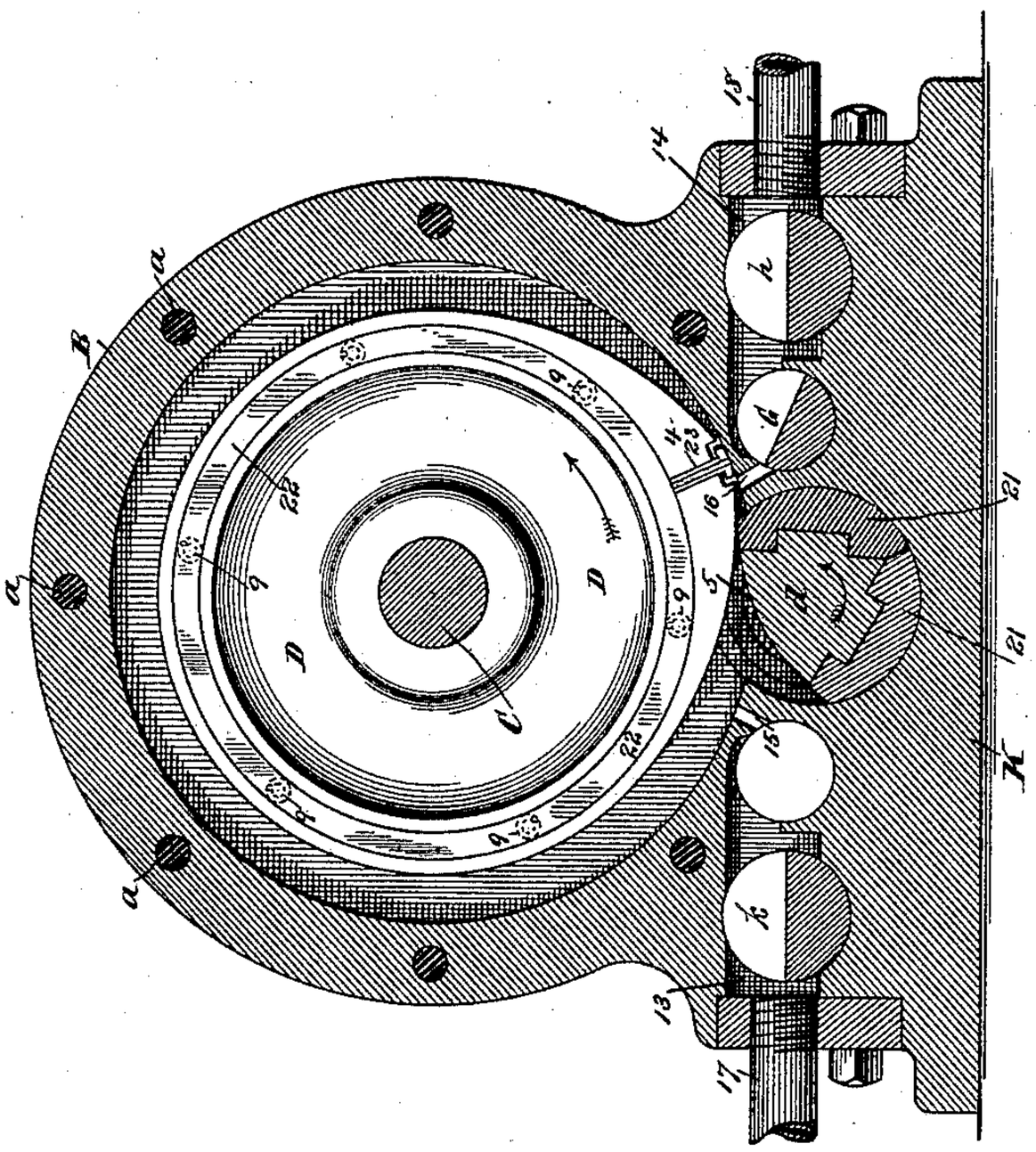
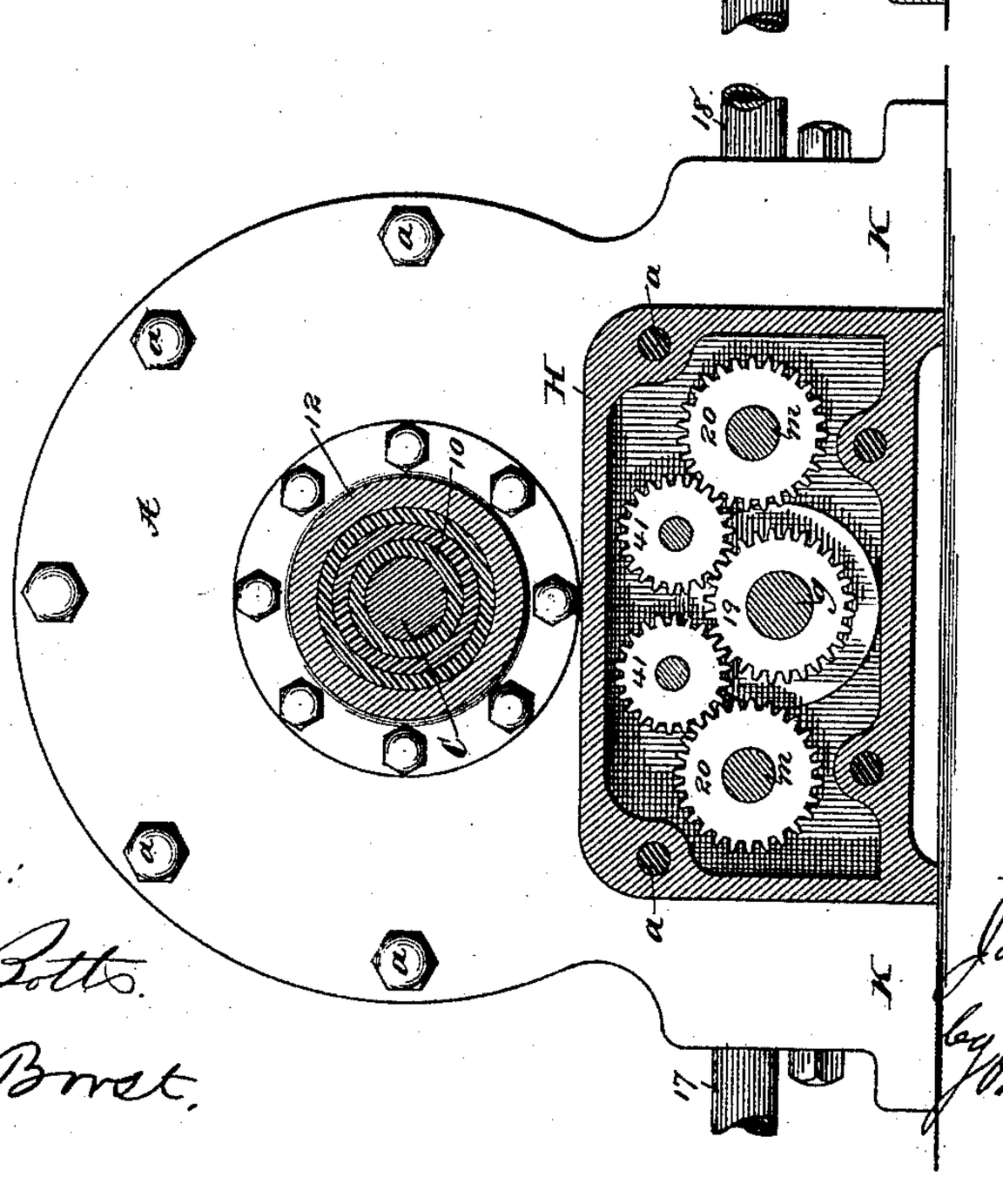


Fig. 6.



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(No Model.) 6 Sheets—Sheet 4.

J. THORNE.

ROTARY ENGINE.

No. 395,722. Patented Jan. 8, 1889.

Fig. 8.

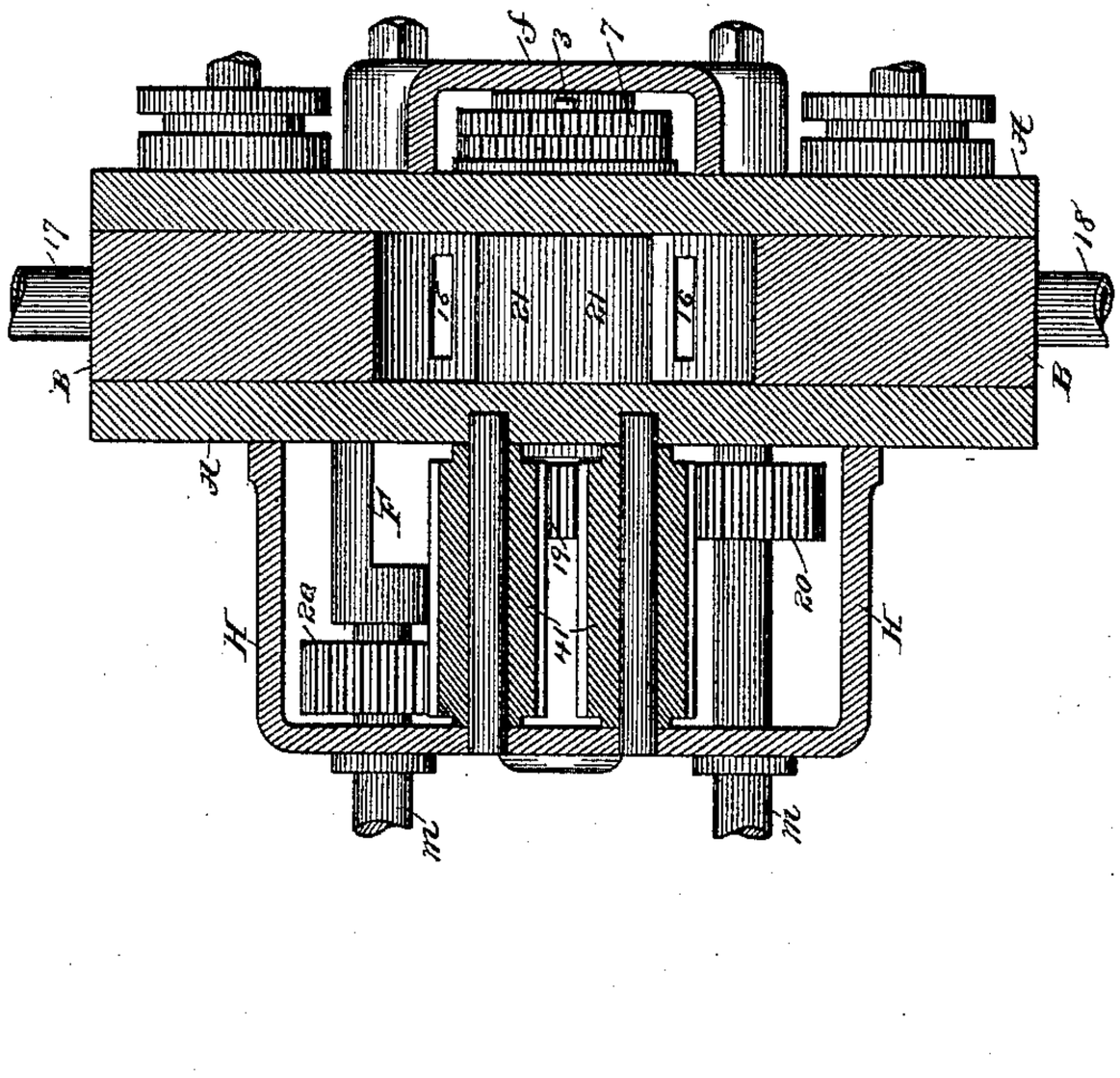
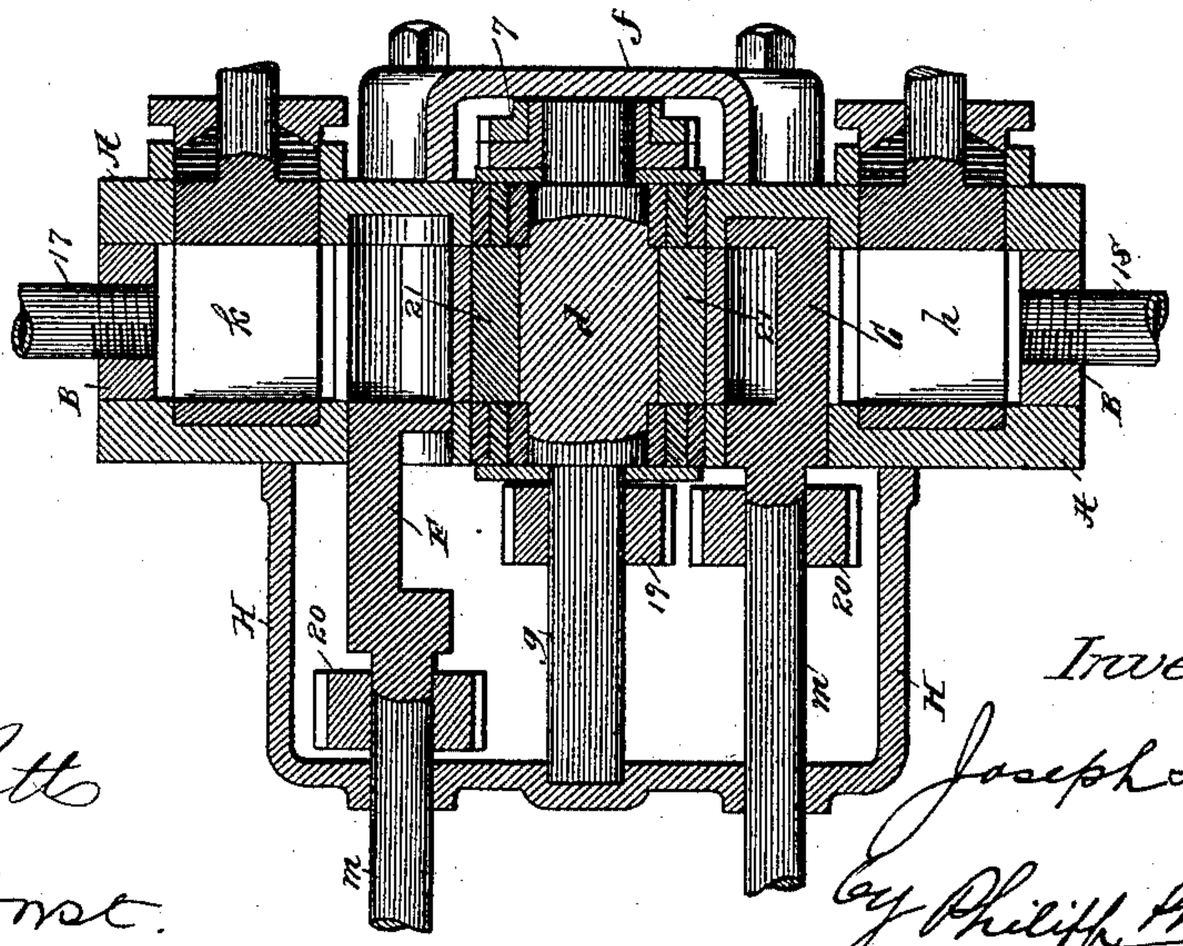


Fig. 7.



Attest:
Geo. H. Bott
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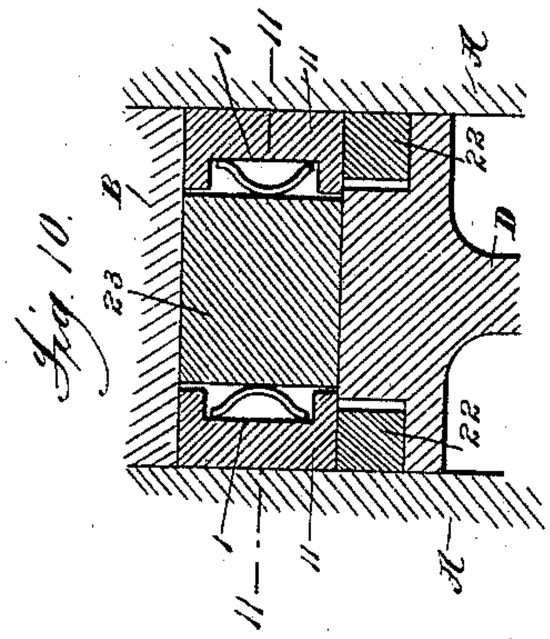
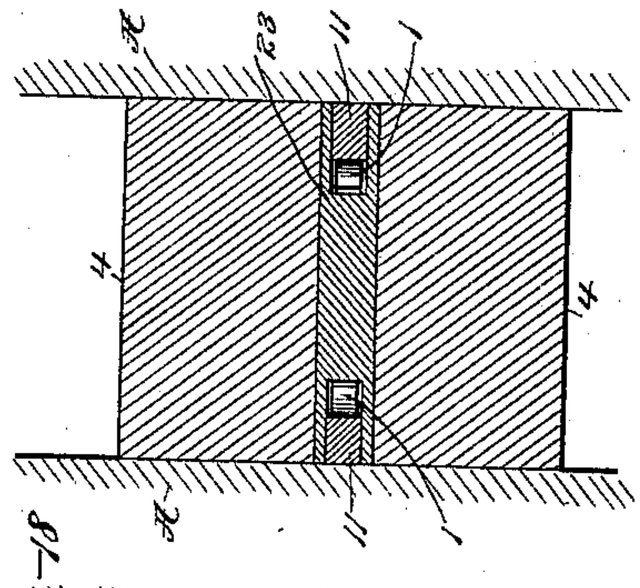
6 Sheets—Sheet 5.

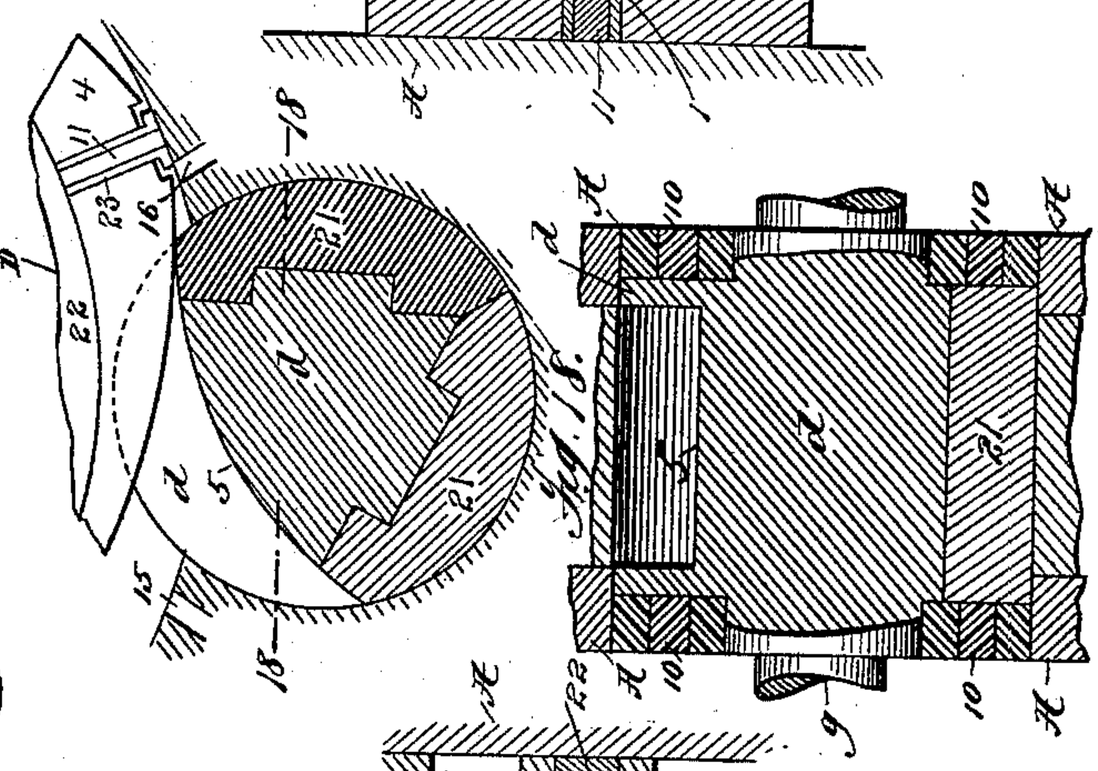
J. THORNE.

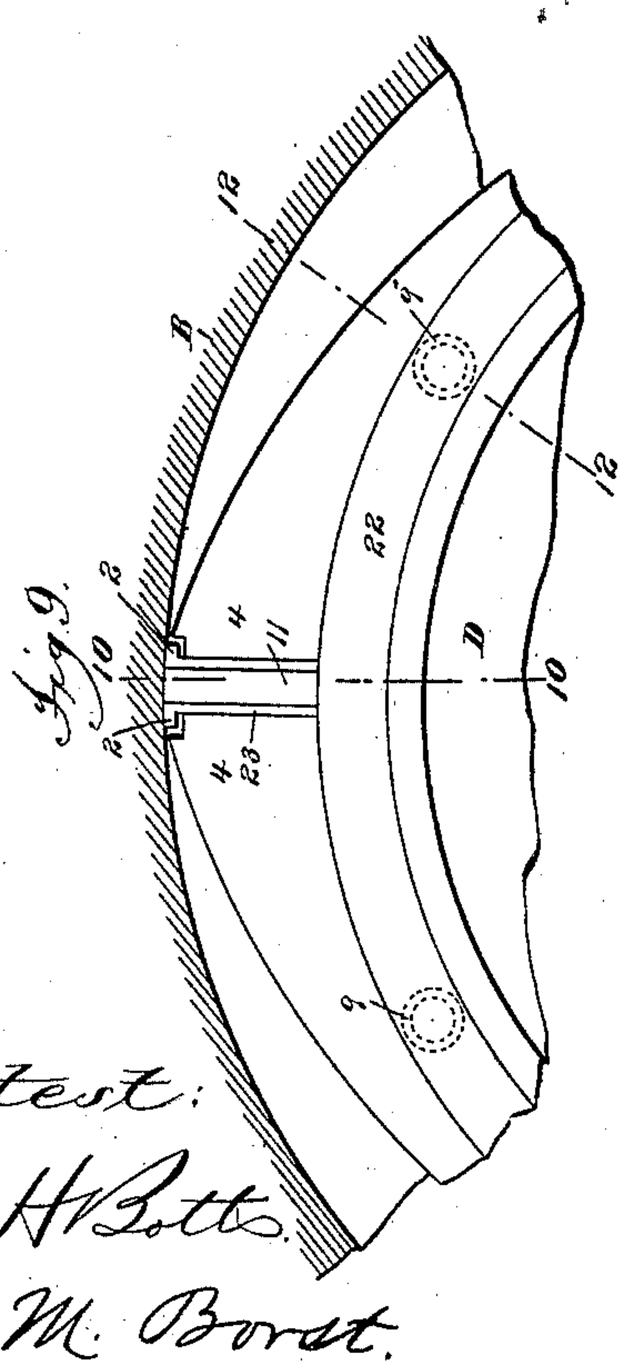
ROTARY ENGINE.

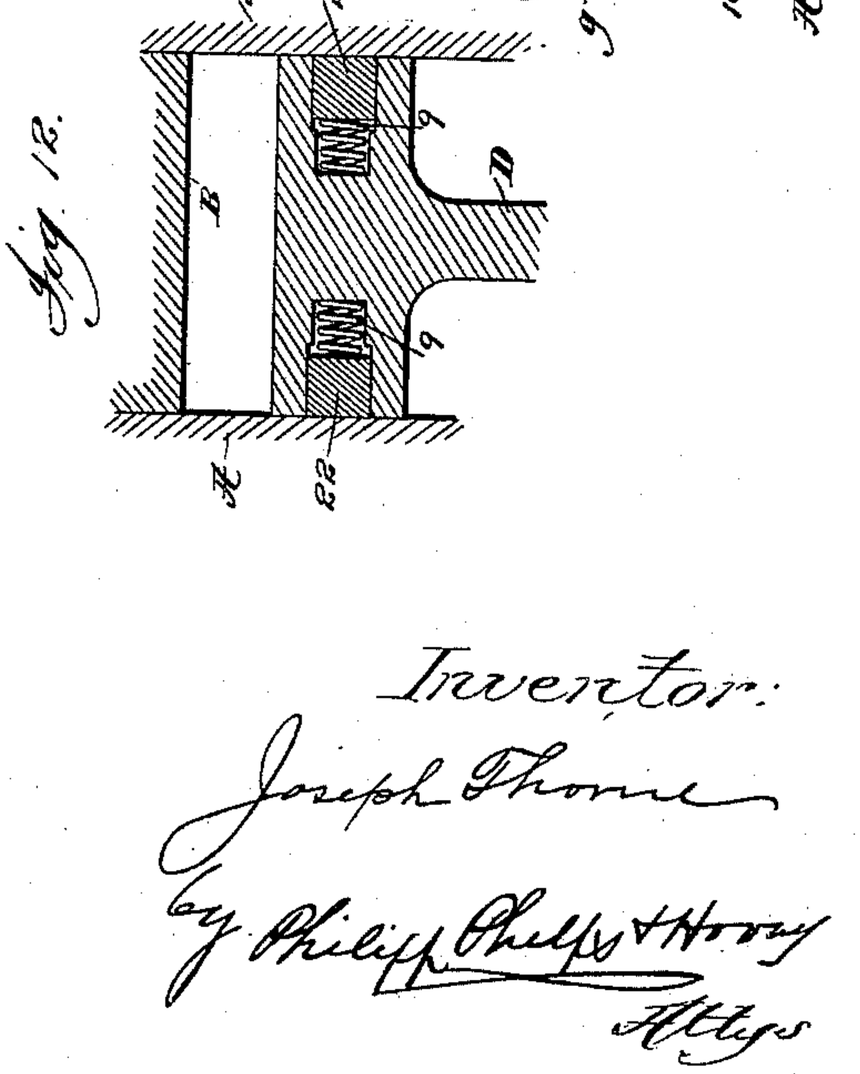
No. 395,722. Patented Jan. 8, 1889.











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(No Model.)

6 Sheets—Sheet 6.

J. THORNE.

ROTARY ENGINE.

No. 395,722. Patented Jan. 8, 1889.

Fig. 14.

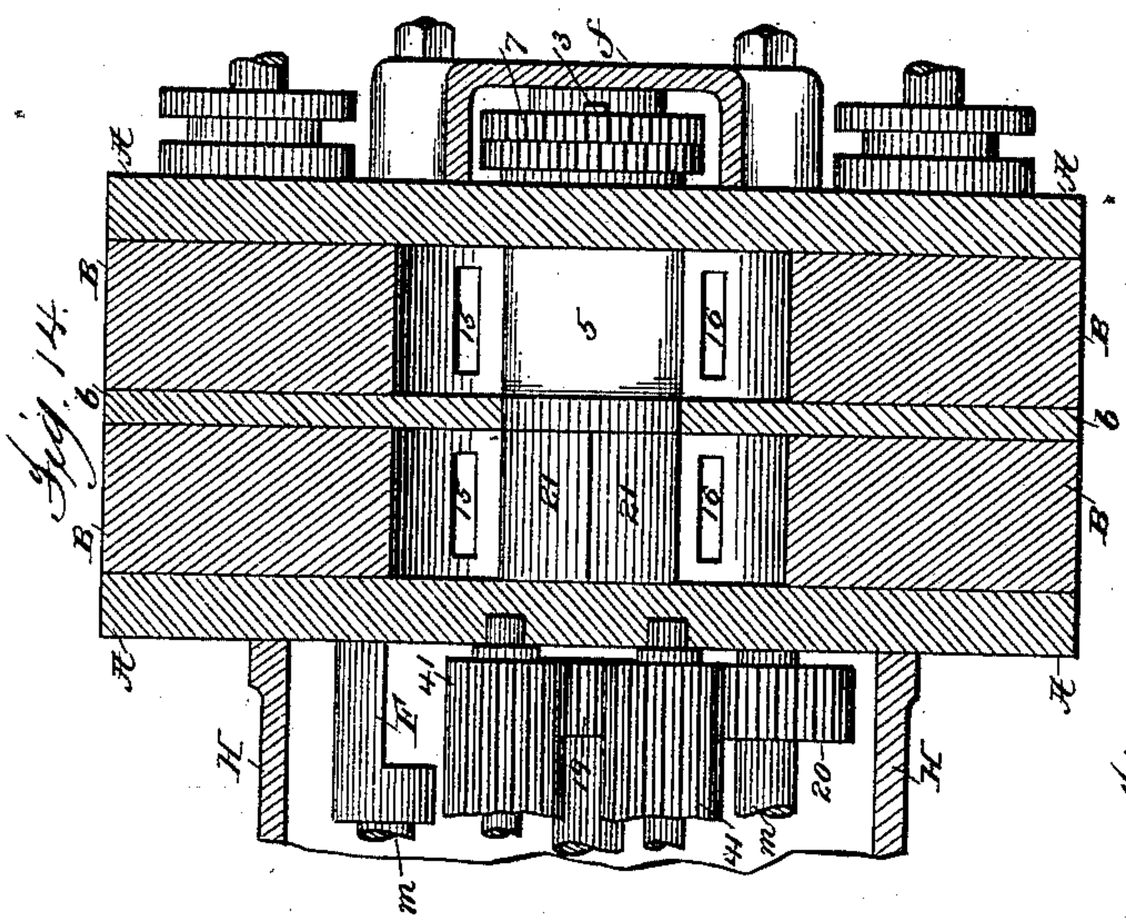


Fig. 15.

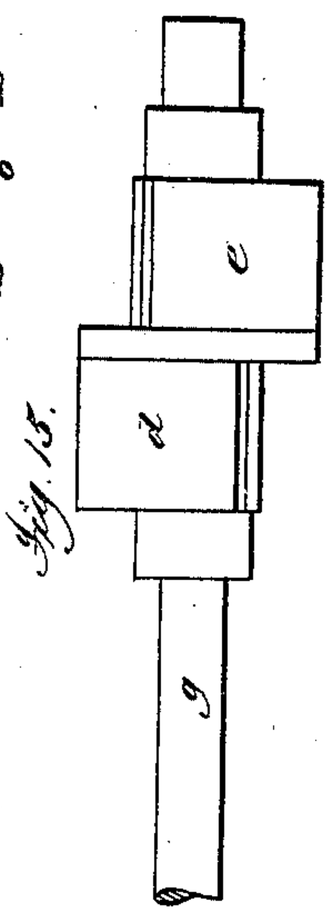


Fig. 16.

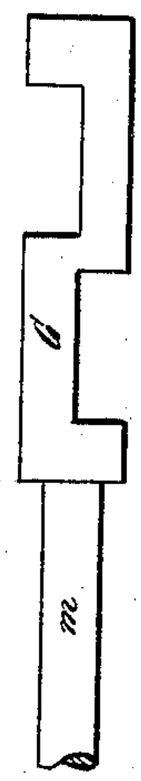
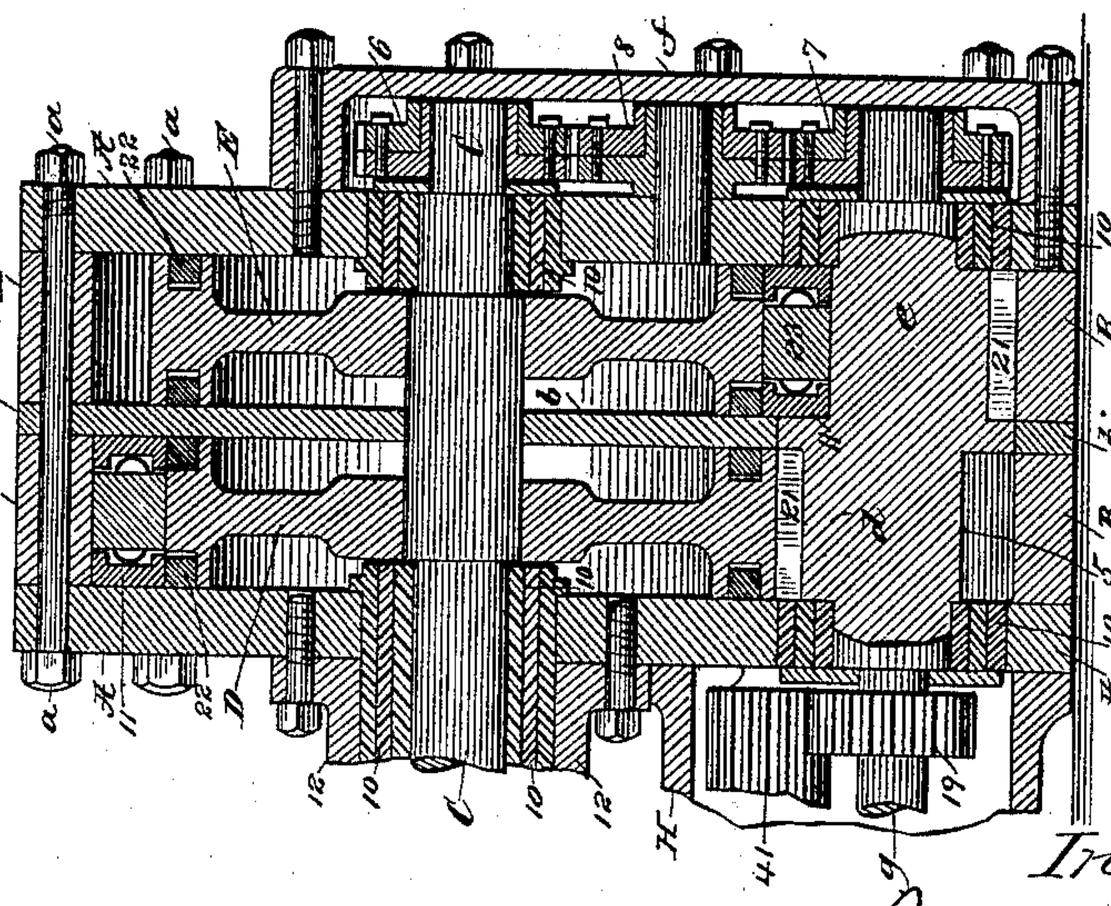


Fig. 13.



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G. M. Brost.

Inventor

Joseph Thorne

by Philip, Philips & Hovey

Attys

UNITED STATES PATENT OFFICE.

JOSEPH THORNE, OF PORT RICHMOND, NEW YORK.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 395,722, dated January 8, 1889.

Application filed January 11, 1888. Serial No. 260,392. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH THORNE, a citizen of the United States, residing at Port Richmond, county of Richmond, and State of New York, have invented certain new and useful Improvements in Rotary Engines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to an engine or motor of that general class known as "rotary" engines, it being the purpose of the invention to provide an engine of this class which will secure economy both in the cost of construction and in the use of steam. These ends I attain by so constructing the engine as to avoid the use of reciprocating parts, which prevent the attainment of high rates of speed and cause loss of power, by causing the abutment and piston to rotate in the same direction, which prevents waste of steam, by dispensing entirely with ordinary stuffing-boxes, which entail expense in the construction and cause great friction and consequent loss of power, and by so constructing and organizing the engine that the pressure of the steam is exerted almost continuously upon the piston.

As a full understanding of the construction and mode of operation of the engine embodying the present invention can only be given by an illustration and a detailed description, all preliminary description of the invention will be omitted and a full description given, reference being had to the accompanying drawings, in which—

Figure 1 is a front elevation of a rotary engine embodying the present invention. Fig. 2 is a central vertical cross-section of the same. Fig. 3 is a section taken upon the line 3 of Fig. 2, the piston being shown in elevation. Fig. 4 is a rear elevation of the engine, the casing for the gearing being removed. Fig. 5 is a view similar to Fig. 3, showing the parts in a different position. Fig. 6 is a vertical section taken on the line 6 of Fig. 2. Fig. 7 is a horizontal section taken upon the line 7 of Fig. 3. Fig. 8 is a similar view taken on the line 8 of the same figure. Fig. 9 is an enlarged view of a part of Fig. 3. Fig. 10 is a section taken on the line 10 of Fig. 9. Fig. 11 is a section taken on the line 11 of Fig. 10. Fig. 12 is a section taken on the line 12 of Fig. 9. Figs. 13 and 14 are views similar to Figs. 2 and 8, illustrating a double engine. Fig. 15 is a view of the rotary following abutments, showing them removed from the engine. Fig. 16 is a similar view of one of the induction-valves. Figs. 17 and 18 illustrate a slight modification, which will be hereinafter explained.

Referring now particularly to Figs. 1 to 12, it is to be understood that the cylinder of the engine is composed of two head-plates, A, of substantially circular form, which rise from a base, K, and are connected by a rim, B, so as to form a circular chamber. The plates A, forming the heads of the cylinder, and the rim B are securely bolted together by bolts *a*, which pass through the heads and the rim, as indicated. Passing through the center of the cylinder and mounted in suitable bearings in the heads A is the main shaft C, upon which is mounted the piston D, which is of a thickness just sufficient to fill the space between the cylinder-heads. The body of the piston D is of circular form, but is provided with a projection or lobe, 4, the sides of which form arcs of two circles described around different centers, and the piston is so set upon the main shaft C that its point or lobe 4 will as the piston revolves maintain close contact with the rim B of the cylinder.

Located in the base K of the cylinder is a circular recess of about one-fourth the diameter of the cylinder, which opens upward into the cylinder. Fitted into this recess is a rotating following abutment, *d*, the body of which is of circular form, but is cut away upon one side, as shown at 5, so that upon being rotated turn for turn with the piston and in the same direction it will always maintain close contact with the periphery of the piston. The portion 5 of the abutment, like the lobe 4 of the piston, forms arcs of two larger circles described about different centers. It will be observed that by reason of this construction all parts of the peripheries of the piston and abutment form parts of true circles. The abutment *d* is mounted upon or made integral with a shaft, *g*, which is supported in bearings in the base K of the

cylinder. The main shaft C and the shaft *g* of the abutment project through the rear head A of the cylinder, and are provided with gears 6 7, which are connected by an intermediate gear, 8, mounted upon a stud projecting from the head. The gears 6 7 8 are of such size that the abutment is caused to make turn for turn with the piston and in the same direction. As before stated, the piston and abutment are so set with relation to each other that as they are thus rotated in unison a close contact will always be maintained between their peripheries—that is to say, they are so set that the projecting lobe 4 of the piston will maintain contact with the depression 5 of the abutment. The gears 6 7 8 (or the gear 8 alone) are made double, as shown, the two parts being secured to each other by bolts 3 and made capable of slight adjustment, so as to compensate for any slight wear or looseness in the gears, and thus prevent backlash. The gears 6 7 8 and the ends of the shafts C *g* are inclosed in a casing, *f*, which is secured to the cylinder-head by means of bolts. The chamber thus formed for the reception of the gears 6 7 8 is kept filled with oil for the lubrication of the gears, the oil being supplied through a suitable duct. The bearings for the shafts C and *g* in the cylinder-heads are provided with double or triple bushings 10, which are lubricated through suitable ducts formed in the cylinder-heads. The end of the shaft C opposite to the gear 6 is extended through the head of the cylinder, and is supported in a long bearing or sleeve, 12, and carries at its end the main driving-pulley 40.

Formed in the base K of the engine, upon each side of the abutment *d*, are chambers 13 14, having ports 15 16, which communicate with the cylinder and pipes 17 18, by which the steam for operating the engine can be admitted through the chamber and port upon either side of the abutment and exhausted through the chamber and port upon the other side, according to the direction in which the engine is to be operated. The ports 15 16 are controlled by rotary valves F G, which are fitted into circular seats formed in the sides and bottoms of the chambers. The valves F G are arranged to make turn for turn with the piston and abutment and in the same direction, and for this purpose the shaft *g* of the abutment, which projects through the cylinder-head, is provided with a gear, 19, which engages, through long intermediates 41, with gears 20, of like diameter, secured to the spindles *m* of the valves. The gears 19 20 41 and the projecting ends of the shaft *g* and spindles *m* are inclosed in a casing, H, secured to the cylinder-head.

The operation of the engine thus constructed and organized is as follows: Assuming that it is desired the piston shall rotate in the direction indicated by the arrows in Figs. 3 and 5, the steam will be admitted through the chamber 14 and port 16 and exhausted through the port 15 and chamber 13, the valve G will be moved inward into its seat, so as to control the admission of the steam through the port 16, and the valve F will be move outward into the casing H, so as to leave the port 15 unobstructed for the exhaust of the steam. When the valve F is in this position, its gear 20 will remain in engagement with the gear 41; but the valve will revolve idly. The steam-connections will be so adjusted that the live steam will enter the chamber 14 through the pipe 18 and that the exhaust-steam can pass off through the pipe 17.

Assuming the engine to be in operation and the parts to be in the position shown in Fig. 5, the steam will pass from the chamber 14 through the port 16 and enter the space in the cylinder between the abutment *d* and the projecting lobe 4 of the piston D and act upon the lobe of the piston, so as to rotate it in the direction indicated by the arrow. As the piston advances from this point the abutment will, through the gears 6 7 8, be correspondingly rotated in the same direction, so as to maintain its contact with the periphery of the piston, and the steam entering the cylinder will continue to act upon the projecting lobe 4 and drive the piston onward, and this will continue until the piston has made about a half-revolution and arrived in the position shown in Fig. 3. At this time the valve G will have completed a corresponding part of a revolution and be in the position shown in said figure, so as to nearly close the induction-port 16. Directly after this the valve G will close the port 16 and cut off the further admission of steam to the cylinder. The steam already in the cylinder will, however, continue to act expansively upon the projecting lobe 4 of the piston, so as to drive the piston onward until said lobe passes the exhaust-port 15 upon the opposite side of the abutment *d*, and as soon as this takes place the steam in the cylinder will be exhausted through the port. It will be observed, however, that before the port 15 is thus opened the piston has nearly completed its revolution, having been acted upon continuously by the steam. After passing the port 15 the piston will be carried onward by the momentum of the parts until it again arrives at the position shown in Fig. 5, at which time the valve G will have arrived in position to again admit steam behind the lobe 4 to drive the piston forward during the next revolution, and so the operation will continue to be repeated. It will be observed that in this operation the piston and abutment rotate in the same direction—that is to say, with their peripheries moving in opposite directions at the point of contact. This is a feature of very marked advantage, as it results in a great saving in the use of steam. If the abutment moved in the opposite direction, a quantity of live steam at full pressure would at each revolution of the abutment be cut out of the cylinder and carried around in the cavity formed by the de-

pressed portion 5 of the abutment, and finally discharged upon the exhaust side of the lobe 4 of the piston, having performed no work and being an entire waste. The amount of steam thus wasted would be considerable. By so constructing and organizing the engine that the abutment moved in the same direction as the piston this waste is entirely avoided, as no live steam is cut out of the cylinder by the abutment.

Another important feature of the invention relates to the means for preventing leakage of steam past the piston and abutment. In order to maintain a tight joint between the cylindrical portion of the abutment and the piston, the periphery of the cylindrical portion of the abutment is made up of a number of loose packing-blocks, 21, which are so formed and secured to the abutment as to be incapable of moving circumferentially around the abutment, and yet be free to be moved outward away from the axis of the abutment by centrifugal force, and thus form a tight joint between the abutment and piston and the abutment and its seat. In the construction shown there are two of these blocks employed, and this number is sufficient; but there may be a greater number employed, if preferred.

As shown in the principal views of the drawings, the packing-blocks 21 and the body of the abutment are only equal in length to the thickness of the piston; but it will usually be preferable to make the body of the abutment and the blocks slightly longer, so that they will enter the openings formed in the head-plates A and have a bearing therein, as shown in Figs. 17 and 18. This will make it impossible for the blocks to become displaced to any such extent as to cause damage.

To maintain a tight joint between the sides of the piston and the heads of the cylinder, the piston is provided on its sides with annular recesses, in which are fitted loose packing-rings 22, which are pressed outward into contact with the cylinder-heads by light springs 9, (see Fig. 12,) seated behind the rings. To maintain a tight joint between the point of the lobe 4 and the rim B of the cylinder and the portion 5 of the abutment, the lobe is provided at its point with a transverse recess in which is seated a loose packing-block, 23, (see Figs. 9, 10, and 11,) which is arranged to be moved outward by centrifugal force, so as to always maintain contact with the rim of the cylinder or the portion 5 of the abutment, as the case may be. The block 23 will preferably be provided with flanges 2, as shown, in which case the piston will be recessed, so as to permit the steam to act upon the inner sides of the flanges, and thus hold the block in contact with the rim of the cylinder. The ends of the block 23 are provided with recesses in which are seated small packing-blocks 11, which are pressed outward laterally by springs 1, so as to form tight joints between the ends of the block 23 and the heads of the cylinder.

To reverse the engine, it is only necessary to withdraw the valve G from its seat, so as to leave the port 16 uncontrolled, and move the valve F inward into its seat, so as to control the port 15, and adjust the steam-connections, so as to permit the live steam for operating the engine to enter the chamber 13 and the exhaust-steam to pass out through the chamber 14. For the purpose of shifting the valves F G to reverse the engine, the spindles *m* of the valves may be provided with any suitable form of operating devices. The point at which the steam is cut off and from which it is allowed to work expansively may be varied to suit different running conditions by so forming the valves F G as to cause the induction-port to be closed earlier or later in the revolution of the piston.

If it is not desired to make the engine reversible, one of the valves F or G will simply be omitted.

It is preferable that the valves F G should rotate in the same direction as the piston and abutment, as shown; but this is not essential. They may rotate in the opposite direction.

The chambers 13 14 or the pipes 17 18 will preferably be provided with valves or cocks *h k*, the stems of which will be connected to any suitable form of speed-governor which will operate the cock or valve on the induction side to vary the quantity of steam admitted, and thus control the speed of the engine.

In the organization which has been described the engine consists of but a single piston and abutment; but in many cases it will be desirable that the engine should consist of a plurality of pistons and abutments, and this can readily be done by duplicating the construction which has been described. Figs. 13 to 16 illustrate a double engine consisting of two pistons and abutments and their auxiliaries. In this case the two pistons D E are mounted side by side upon the main shaft, and the cylinder is divided by a partition, *b*, so as to form a separate cylinder for each piston. The two abutments *d e* are made integral, as shown, and the valves F G are made double, as shown in Fig. 16. The pistons D E are set upon the main shaft with their lobes 4 opposite each other and the abutments and valves are correspondingly arranged, so that the steam is admitted to act in one cylinder at the time it is cut off from the other, and vice versa.

It will readily be understood that the engine may consist of more than two pistons and abutments arranged in the same manner.

In conclusion it is to be remarked that the organization which has been described may be used as a pump or meter, as well as an engine or motor.

What I claim is—

1. The combination, with a rotary piston having a projection or lobe, of a rotary abutment formed to maintain contact with the periphery of the piston and rotating in the

same direction therewith, substantially as described.

2. The combination, with a rotary piston having a projection or lobe, of a rotary abutment formed and arranged to maintain contact with the periphery of the piston, induction and exhaust ports located upon the opposite sides of the abutment, and a rotary valve for controlling the induction-port, substantially as described.

3. The combination, with a rotary piston having a projection or lobe, of a rotary abutment formed to maintain contact with the periphery of the piston and connections between the piston and abutment for rotating the latter turn for turn with the former and in the same direction, substantially as described.

4. The combination, with a rotary piston having a projection or lobe, of a rotary abutment formed to maintain contact with the periphery of the piston, induction and exhaust ports located upon the opposite sides of the abutment, a rotary valve for controlling the induction-port, and connections between the piston, abutment, and valve for causing the abutment and valve to make turn for turn with the piston, substantially as described.

5. The combination, with a rotary piston having a projection or lobe, of a rotary abutment formed to maintain contact with the periphery of the piston and double adjustable gearing connecting the two to cause them to make turn for turn in the same direction without backlash, substantially as described.

6. The combination, with a rotary piston having a projection or lobe, of a rotary abutment formed to maintain contact with the periphery of the piston and rotating in the same direction therewith, induction and exhaust ports located upon the opposite sides of the abutment, and adjustable valves for controlling said ports, whereby the steam can be admitted upon either side of the abutment and exhausted upon the other, substantially as described.

7. The combination, with a rotary piston having a projection or lobe, of a rotary abutment formed to maintain contact with the periphery of the piston, induction and exhaust ports located upon the opposite sides of the abutment, and the rotary valves F G, for controlling said ports, which are geared to the shaft of the abutment and arranged to be inserted and withdrawn to reverse the engine, substantially as described.

8. The combination, with a plurality of rotary pistons having projections or lobes set in different positions with relation to the main shaft, of rotary abutments formed to maintain contact with the peripheries of said pistons and rotating in the same direction therewith, substantially as described.

9. The combination, with a plurality of rotary pistons having projections or lobes set in different positions with relation to the main shaft, of rotary abutments formed to maintain contact with the peripheries of said pistons, induction and exhaust ports located upon the opposite sides of the abutments, and rotary valves for controlling the induction-ports, said pistons, abutments, and valves being connected so as to make turn for turn, substantially as described.

10. The combination, with a rotary piston having a circular body and a lobe, the sides of which form arcs of two circles described about different centers, of a rotary abutment maintaining contact with the periphery of said piston and rotating in the same direction, and having a circular body and a depressed portion formed upon the arcs of two circles described about different centers, substantially as described.

11. The combination, with a rotary piston and the rotary abutment having the gear 19, of the rotary valves F G, arranged to be inserted and withdrawn, and having the gears 20 and the long gears 41, connecting the gears 19 20, substantially as described.

12. The combination, with the rotary piston and the rotary abutment, of the packing-blocks 21, mounted upon the body of the abutment, so as to be permitted to move outward by centrifugal force, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JOSEPH THORNE.

Witnesses:
T. H. PALMER,
J. J. KENNEDY.