No. 627,922. Patented June 27, 1899.

M. A. GREEN.

ROTARY ENGINE.

(Application filed Oct. 20, 1898.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.

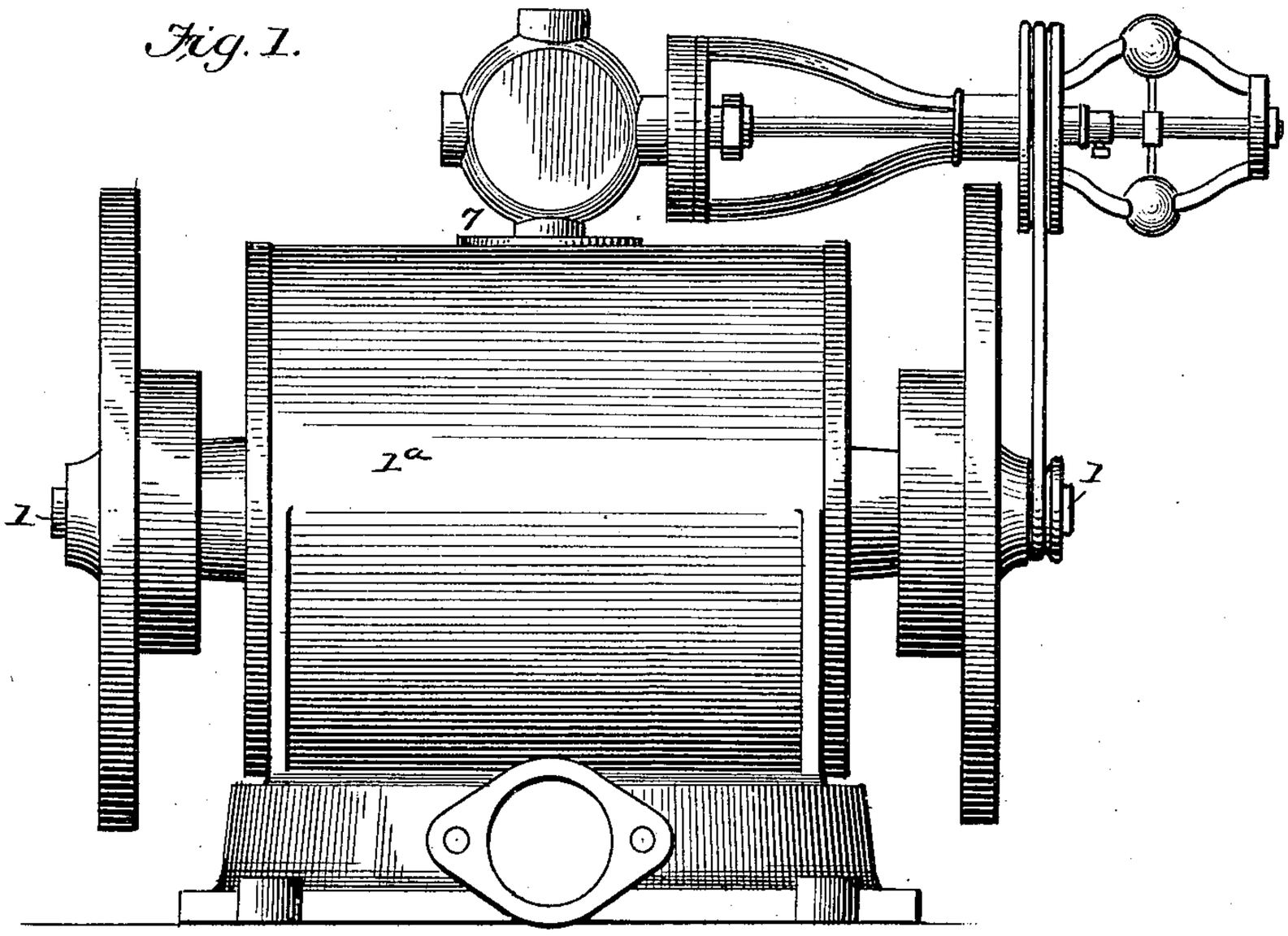
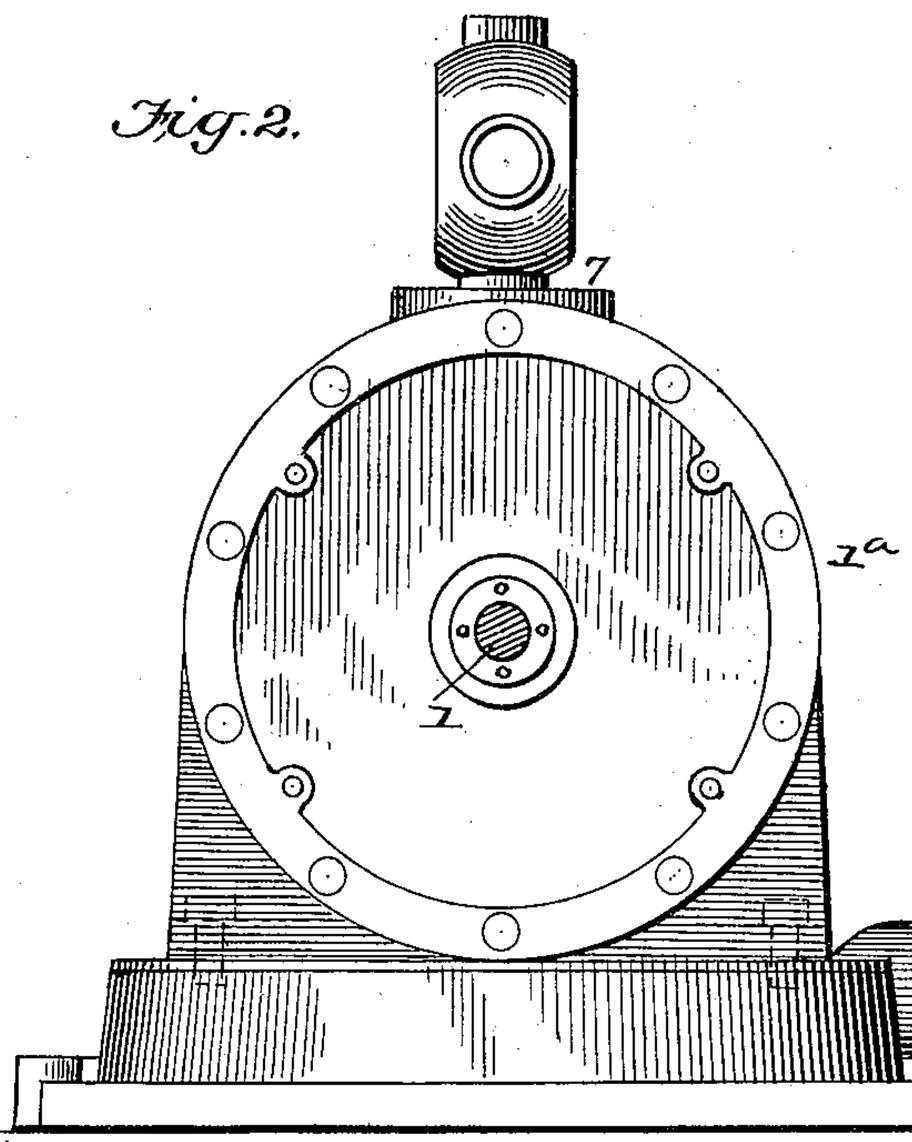


Fig. 2.



WITNESSES:
Jos. A. Ryan.
M. L. Blondel

INVENTOR
Martin A. Green.
BY Munn & Co.
ATTORNEYS.

No. 627,922.

Patented June 27, 1899.

M. A. GREEN.

ROTARY ENGINE.

(Application filed Oct. 20, 1898.)

(No Model.)

5 Sheets—Sheet 2.

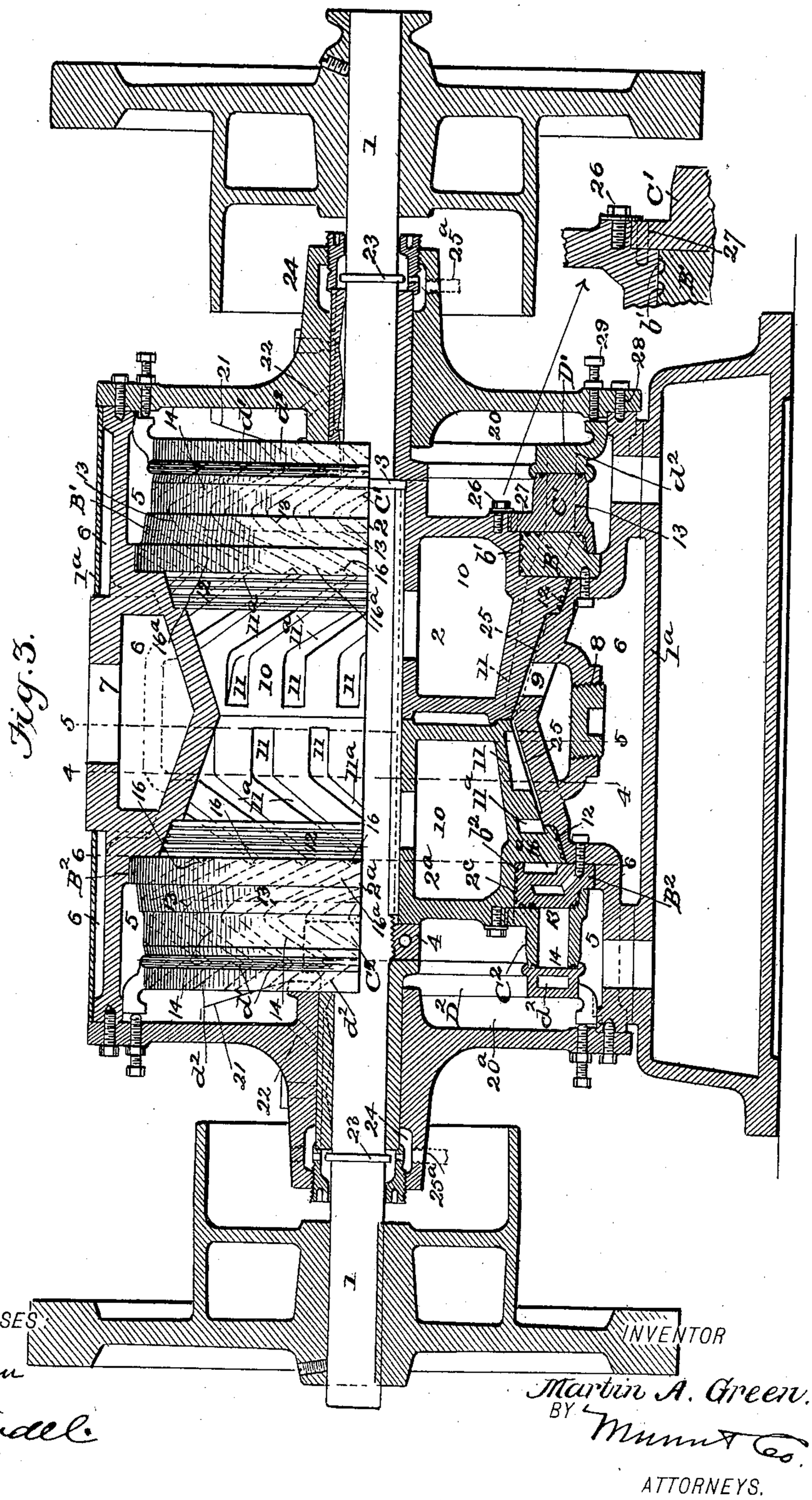


Fig. 3.

WITNESSES:

Jos. A. Ryan

W. D. Blondell.

INVENTOR

Martin A. Green.

BY Munn & Co.

ATTORNEYS.

No. 627,922. Patented June 27, 1899.

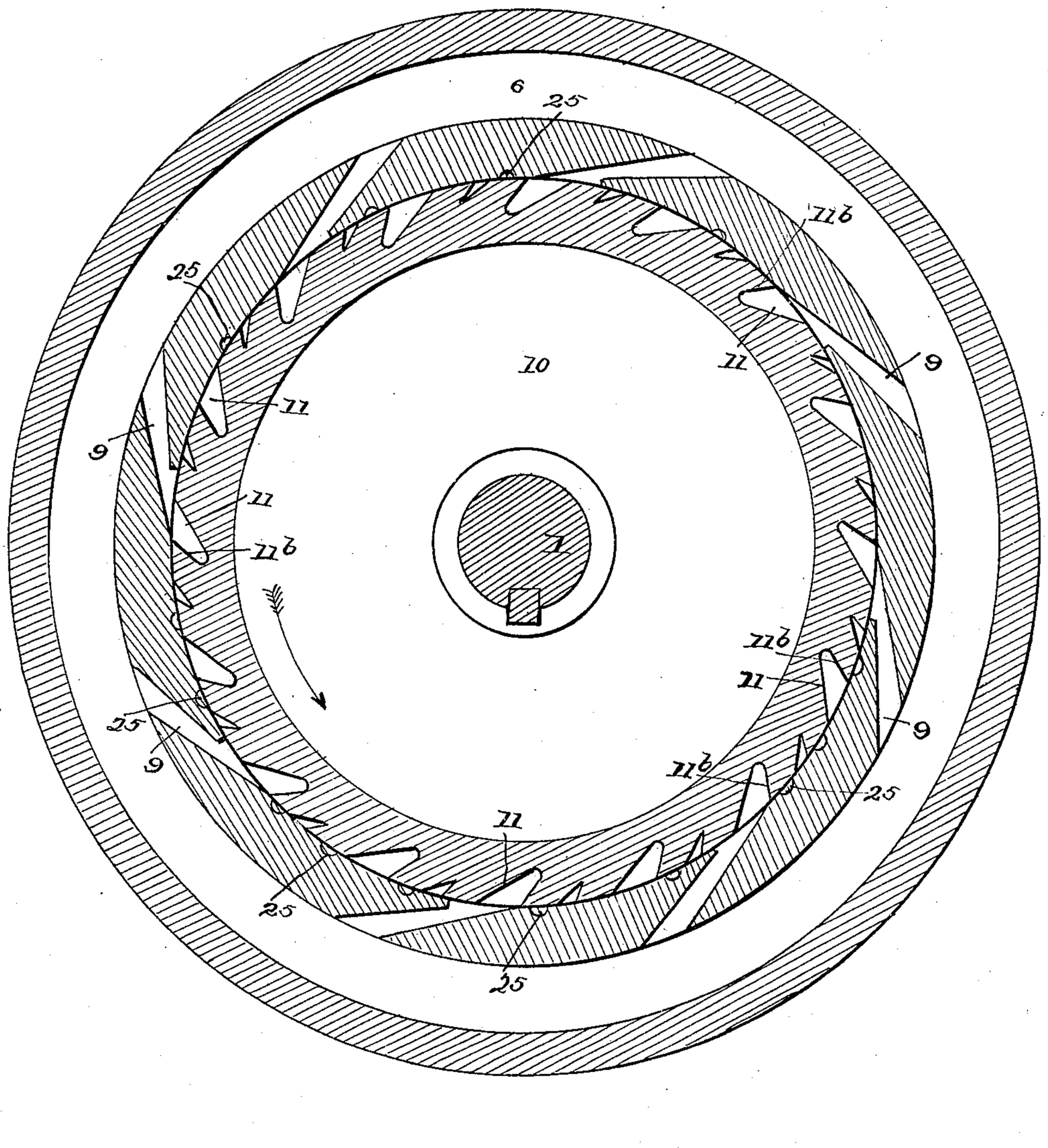
M. A. GREEN.

ROTARY ENGINE.

(Application filed Oct. 20, 1898.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 4.



WITNESSES:

Jos. A. Ryan

M. S. Blondel.

INVENTOR

Martin A. Green.

BY Munn & Co.

ATTORNEYS.

No. 627,922. Patented June 27, 1899.

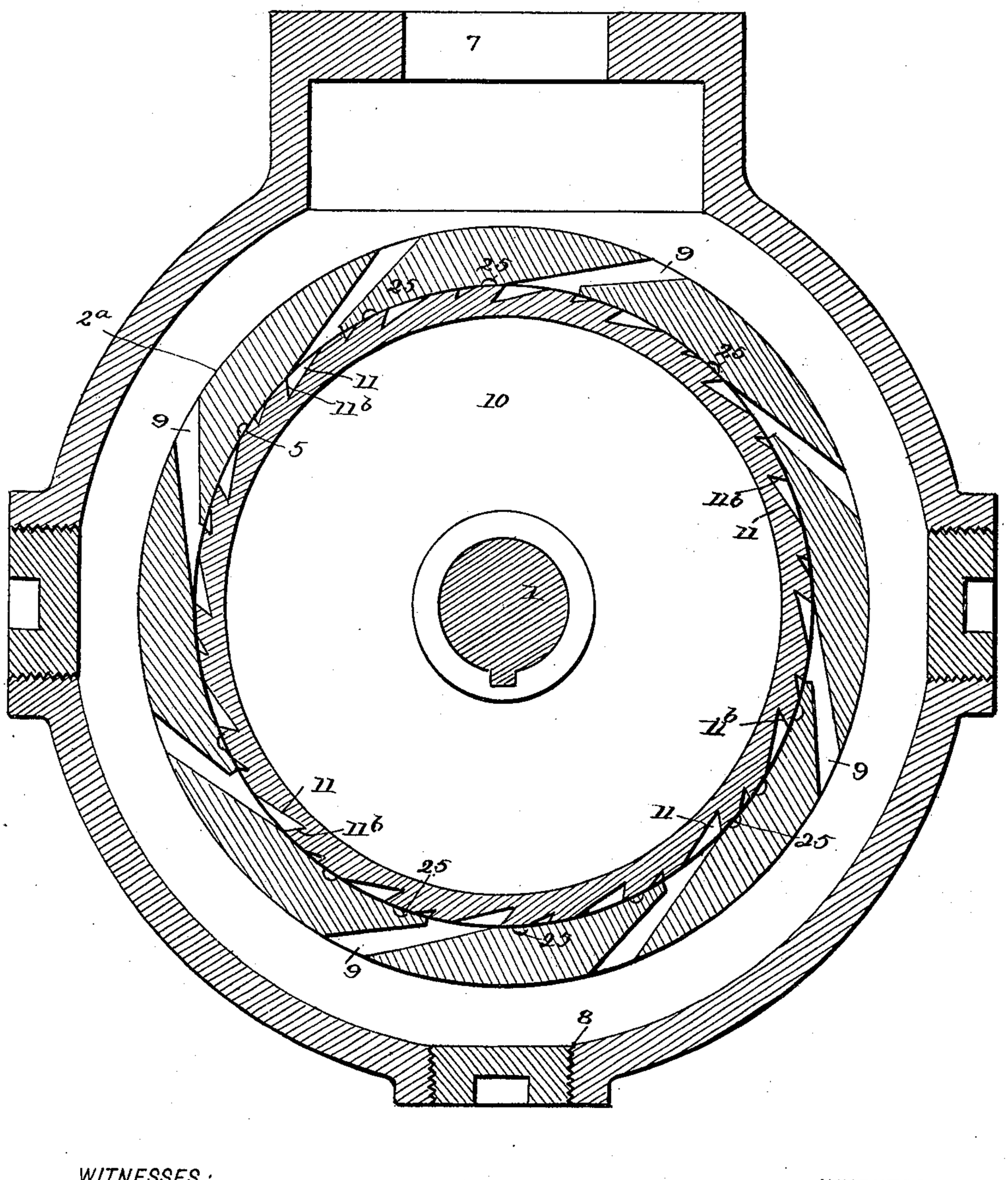
M. A. GREEN.

ROTARY ENGINE.

(Application filed Oct. 20, 1898.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 5.



WITNESSES:
Jos. A. Ryan
M. S. Blondell.

INVENTOR
Martin A. Green.
BY Munn & Co.
ATTORNEYS.

No. 627,922. Patented June 27, 1899.

M. A. GREEN.

ROTARY ENGINE.

(Application filed Oct. 20, 1898.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 6a

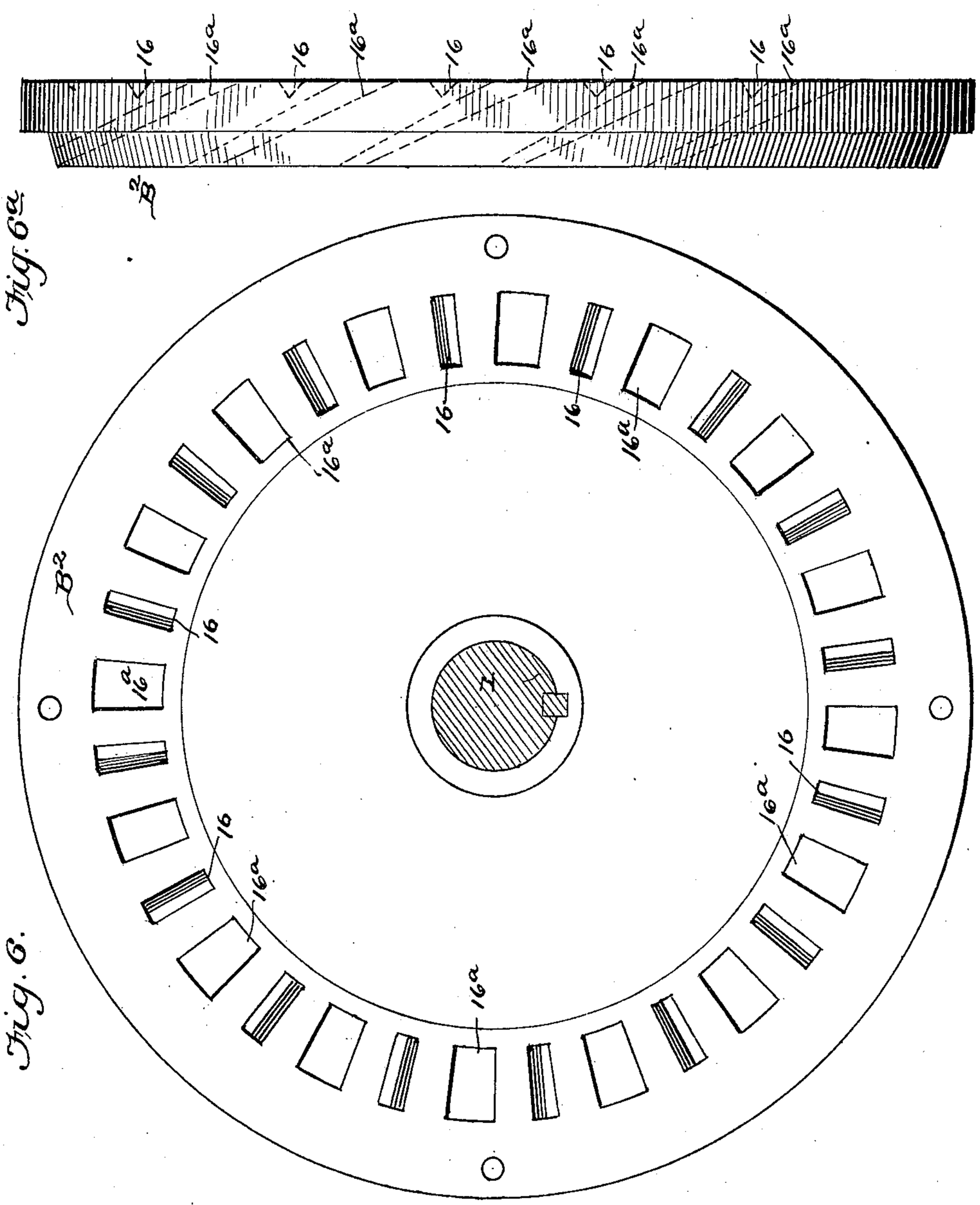


Fig. 6.

WITNESSES:

Jos. A. Ryan

W. D. Blondell

INVENTOR

Martin A. Green.

BY Munn & Co.

ATTORNEYS.

UNITED STATES PATENT OFFICE.

MARTIN A. GREEN, OF PHILADELPHIA, PENNSYLVANIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 627,922, dated June 27, 1899.

Application filed October 20, 1898. Serial No. 694,063. (No model.)

To all whom it may concern:

Be it known that I, MARTIN A. GREEN, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and Improved Rotary Engine, of which the following is a specification.

This invention, while relating generally to the class of rotary engines, more specifically is in the nature of a turbine engine capable of being operated by fluid or vapor force; and such invention primarily has for its object to provide a stable but simple construction of engine of the character noted, having the several parts arranged to effect a double compound action which will run better and more economically than a piston-engine without the loss of power from dead-centers or reciprocating parts, and by reason of its non dead-centers or reciprocating parts can be readily adjusted to run at very high speeds, so balanced and freed of crank or other jerky motions as to require no special foundations or anchoring means.

This invention also comprehends a novel construction of engine including a peculiar arrangement of rotary piston and fixed steam inlets and abutments, whereby the steam or water force can be used with admission or direct action and also with an expansion action without the aid of drop-valves or other pivotal or movable parts commonly used in the class or rotary engines having concentric pistons.

Another object of this invention is to provide a rotary or turbine engine particularly flexible as to power and economy of construction and operation, and in which as many series of concentric piston or turbine wheels can be readily placed on one drive-shaft within a single casing or shell as may be found necessary to give the desired power, and whereby to compound the use of the same with water force to produce a proper economy in running.

Furthermore, the invention comprehends such correlation of detachable and adjustable parts which can be conveniently set the same as valves of other engines, whereby to increase or diminish the openings of the leads or inlet-ports and render the engine one of substantial practicability, receiving steam or water, using its force, cutting it off, and expanding it in all parts similar to that of the reciprocating-piston engine without the aid of reciprocating or other movable parts other than that of the rotary drive-wheel or piston members secured on the drive-shaft.

In its subordinate features this invention embodies certain details of construction and peculiar combination of parts, as will be first described in detail and then be specifically pointed out in the appended claims, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of an engine constructed in accordance with my invention, the same being equipped with a suitable governor mechanism for regulating the supply to the inlet-port. Fig. 2 is an end elevation of the same. Fig. 3 is a vertical longitudinal section of my improved engine, parts of the internal mechanism being shown in side elevation. Fig. 4 is a transverse section of the same, taken practically on the line 4 4 of Fig. 3, looking in the direction of the arrow. Fig. 5 is a transverse section taken practically on the line 5 5 of Fig. 3, looking in the direction of the arrow. Fig. 6 is a transverse section taken on the line 6 6 of Fig. 3. Fig. 6^a is an edge view of the valve B^2. (Shown in Fig. 6.)

In its practical construction my improvement comprises a cylindrical casting or shell bored out true and having certain ports or openings, hereinafter specifically referred to, and also heads and bearing members to receive the horizontally-disposed drive-shaft 1, upon which is mounted a pair of concentric pistons or what I shall hereinafter term the "turbine" wheels 2 2^a, which are keyed to the shaft 1, the collar 3 being part of the shaft at one end and forming an abutment or stop for the wheel 2, which is held secured in its proper position by reason of the wheel 2^a, held clamped up tight against the wheels 2 by means of the split clamp-nut 4.

The wheels 2 2^a have a conical shape and are held on the shaft with their apices or reduced ends abutting their peripheral faces, traveling in the chamber 5, having corresponding shape, as clearly shown in Fig. 3, the purpose of such double conical shape being to bring the direct or admission impact of the water or steam force toward the center of the turbine, consisting of the compound disk

wheels 2 2^a, whereby to concentrate such direct water or steam force as much as possible centrally of the engine to produce a more uniform and regular revolution of the shaft through the medium of the sectional turbine wheel or piston than could possibly be obtained by disseminating the direct-impulse steam or water force over the entire surface of said wheel.

The shell or casing 1^a has an angular steam-space 6 surrounding the wheel-chamber 5, it having a feed-port or lead 7 at the top, a plug-drip or outlet-port 8 at the bottom, and a series of ports 9 communicating with the chamber 5, said ports being equidistantly and radially arranged and extended through the wheel 10 at an angle, whereby to deliver the steam into the chamber 5 at a tangent, the reason of which will presently appear.

The wheel-sections 2 2^a have a series of equidistantly-arranged pockets 11 in their peripheral faces disposed near their abutment or inner ends, which pockets extend outward parallel with the longitudinal axis of the drive-shaft and terminate in shallow external annular channels 11^a, gradually decreasing in width and depth from their entrant to their exit end, such channels extending to the extreme outer end of the wheel-sections, their extremities passing under fluid packing-rings 12, which form a part of the wheel-sections 2 2^a, as best shown in Fig. 3.

By referring now more particularly to Fig. 4 it will be observed the pockets 11 and channels 11^a have a triangular shape in cross-section and also have their short or straight walls 11^b opposing the tangential line or feed of the ports 9, whereby such walls 11^b form abutments to receive the full force of the direct steam impact as it passes through the ports 9 in the pockets 11 and also the full expansive force of the steam as it passes from the pockets 11 into the channels 11^a, it being obvious that by gradually increasing the area of the said channels 11^a from their entrant to their exit ends a maximum power of the expansive steam force is obtainable.

In the practical construction of my engine the pockets 11 and the ports 9 are so arranged that when the wheel-sections 2 2^a have moved a certain distance the live steam is intermittently cut off, which permits the steam or fluid volume within the pockets 11 to exhaust through the channels 11^a, which expand against the wheel of the chamber 5 and materially assist in obtaining a rotary action of the wheel-sections 2 2^a and the drive-shaft, and to obtain a maximum power and speed the two sections 2 2^a are mounted on a shaft to operate alternately—*i. e.*, their pockets and channels have a staggered relation—so that as one wheel is receiving a direct steam impulse force in its pockets 11 the other section is being carried forward under an expansive steam force in its channel 11^a, such compound rotary action on the shaft greatly accelerating its speed and positively avoiding any jerky or irregular rotation so common in rotary engines having cut-off pistons, drop-valves, or other pivotal or reciprocating parts.

So far as described it will be observed that the live steam entering the inlet passes through the ports 9 against the wheel-pockets 11 and force the turbine wheel and the shaft in the direction indicated by the arrow in Fig. 4, the wheel acting intermittently on each wheel-section; yet owing to the peculiar arrangement of the two sections 2 2^a the shaft will at all times be receiving a direct live-steam impulse as well as a compound direct and exhaust steam force.

The steam or water volume which exhausts through the channels 11^a escapes from the same by abutment-valves B' B^2 in the nature of annular rims fixedly secured to the shell or casting 1, as clearly shown in Fig. 3, by reference to which it will also be seen the wheel-sections 2 2^a have annular bearing portions 2^c, which travel on the internal faces of the valve-rims B' B^2, which faces have fluid packing-grooves b' b^2, as shown. The fixedly-held valves B' B^2 have a series of radially-arranged pockets 16, which alternate with the series of exhaust-ports 16^a, which extend angularly in the direction opposite to that of the channels 11^a and also are of gradually-decreasing nature from their entrant to their exit end.

It should be stated that the correlation of the pockets 16 in the valves B' B^2 and the steam-ports 9 is such that as the ports 9 are cut off and the steam in pockets 11 is exhausting its expansive force in its channels 11^a such channels 11^a will be moving in line with the pockets 16, discharge in a direct manner against the abutment-walls of the said pockets 16, and effect a second impetus to the wheel-sections 2 2^a by direct steam force and then move in line with the exhausts 16^a to permit the steam within the channels 11^a to pass out of same, it being manifest that after the channels 11^a pass the pockets 16 the fluid contained therein forms a packing between the wheel-heads and the rims B' B^2. The opening distance between each pair of pockets 11 and each pair of exhausts 16^a is such that the steam within the channels 11^a will discharge into the said pockets 16 and then into the exhaust-ports during the passing of one pocket 11 from one inlet 9 to another inlet 9, and the spaces between the pockets 11 and the ports 16^a are such that while the pockets 11 are receiving live steam the ends of the channel 11^a, forming parts of the said pockets 11, will be passing over the spaces between the pockets 16 and exhaust-ports 16^a, and in consequence will be held closed. Thus it will be seen by the construction so far described the drive-shaft in operation under one charge of live steam in the pockets 11 receives a direct maximum force of live steam, a continued movement by the expansive force of such charge within the channels 11^a, a second direct force by reason of the impact of the steam in the channels 11^a

against the pockets 16, thereby providing, as it were, a triple force of the said steam charge, which force is, however, in this construction of engine further augmented by a second reuse of the exhaustive force of the steam charge as it passes through the valves B′ B², which is effected as follows: The steam charges as they pass into the exhaust-ports 16ª escape into a series of radial ports 13 and in annular rims C′ C², which are attached to and form part of the wheel-sections 2 2ª, such ports 13 being so arranged that after the wheels 2 2ª and the rims C′ C², forming a part thereof, have traveled a certain distance steam is cut off from the ports 16ª in the valves B′ B² and the charge is then exhausted into the ports 13, having angular veins or channels 14, which channels extend out at a different angle to the ports 13 and have their gradually-decreasing exhaust-faces exhaust against the second set of fixedly-held valve-rims D′ D², which are provided with pockets *d* and exhausts *d*², arranged similar to the pockets and exhausts in the valves B′ B², thereby obtaining, as it were, a third impulse or force of the steam charge as the same exhausts through the veins or channels 14 and engages the valves D′ D² with a direct force by reason of discharging into the abutment-pockets *d*′, after which the said steam charge or charges escape through the ports *d*² into collecting-chambers, presently again referred to. Thus the complete operation of a single charge of live steam into the collecting-pocket 11 has a compound triple action. First, at direct impulse on pocket 11 it exerts its maximum force to drive the wheel-section forward; second, by its expansive force within the channel 11ª it continues the forward rotary movement of the wheel and, as the steam passes under the packing-rings 12, discharges against the pockets 16 and the valves B′ B², the same creating a reactionary impact or second direct force to carry the wheel forward in a regular and even manner, such operation being also acquired for the reason that there are the same number of angular ports in the valve-rims B′ B² as there are channels and pockets in the wheel-section. Thus by the time the wheel-sections have cut off the steam carried from the ports 9 the ends of the channels 11ª will have traveled to the ports 16ª and exhausts therein, the same driving action of the steam charge taking place in the wheel-sections C′ C² by reason of the steam contact with the pockets *d*′ in the valve-rims D′ D², from whence the same escapes into the chambers 20 20ª.

By the arrangement and construction of the several parts, as described and shown, a triple compound direct impulse of force is obtained, which force is obtained from each charge of live steam, and which force I claim will run an engine with greater economy than could be effected by the use of valve-equipped disks. The same can be applied at a much less cost than the ordinary piston or swinging-valve engine, is void of dead-centers and reciprocating parts, and can be run at an unlimited speed, the motion being so regular as to require no special foundation to take up jars, the wheel-sections being thoroughly balanced on the shaft, and, furthermore, the concentration of the initial or maximim force being at a point centrally of the engine torsional or twist strain on the shaft or its bearings is practically entirely eliminated.

To still further increase the force of each charge against the wheel-sections 2 2ª, a few grooves or veins 25 are cut in the outer casting or wall 10 in opposite direction to the angle of the channels 11ª in the said wheel-sections, said grooves extending from the center of the casting to within about one-half inch of the packing-rings 12, the purpose of such grooves being to catch the steam and add friction against the wall or casting 11 as the steam passes down or around the channels 11ª. To produce a greater pressure on the lower side of said wheel, a greater number of the grooves 25 are placed at the bottom than at the top, so as to carry up the weight of the wheels by the pressure of the steam and reducing the friction and wear on the bottom of the channels of the shaft.

It is obvious there can be as many series of the wheel-sections 2 2ª placed on one shaft of the same casing as may be found necessary to give the required power and to compound the steam or vapor sufficiently often to give the proper economy.

In the complete arrangement of my engine one lubricating attachment to the main steam or inlet pipe will serve to lubricate the entire engine, including the bearings.

It will be noticed the main heads have angle-pieces 21, which center above the main bearing on either side and form a water and oil pocket to catch the surplus oil and water that comes from the steam, which then passes down through the channel 22, thoroughly lubricates the bearing and the ring 23, and catches the surplus oil and throws it off into the reservoir 24, from which it can be drawn through the drop-pipe 25ª.

By angling the peripheral faces of the two wheel-sections in the different directions, as stated, the end thrust that would naturally exist were only one wheel used is reduced to a minimum.

By the use of two wheels and holding them together on the shaft by means of a split nut 4 the thrust outward that now exists on the wheels is absorbed on the shaft, simply forming a slight tensile strain.

The wheels C′ C², as above stated, are separated from the sections 2 2ª, but are made fast to travel therewith by means of clamp-bolts 26 and dowels 27, as clearly shown in Fig. 3.

By making the members C′ C² detachable the same can be readily adjusted to match the parts in the valves B′ B². The valve-rings D′ D² are also adjustably held within the casing by suitable dowels 28 and clamp-bolts 29.

By making the members C′ C² and D′ D² adjustable, as stated, the ports can be set the same as the valve on any other engine and adjusted to increase or diminish the openings of the lead. This enables me to provide a thoroughly-practical engine adapted to receive the steam, use its force, cut it off, and expand it in all parts similar to that of an ordinary piston-engine without the cut-off, reciprocating, or moving ports.

In its complete form my engine also has a suitable governor mechanism for governing the feed through the inlet, which mechanism is of a horizontal type and driven from a suitable V-pulley on the fly-wheel, as shown in Fig. 1.

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

1. An engine of the character described; comprising a suitable shell or casing having an internal chamber provided with tangentially-discharging feed-ports; a turbine piston rotatable in the internal chamber, having a series of peripheral pockets, said pockets terminating in lateral escape-grooves; a valve fixedly held in the end of the internal chamber, having exhausts and also having portions thereof adapted to receive the direct impact force of the exhaust from the piston escape-grooves before the exhausts from the said piston communicate with the exhausts in the valve, whereby the said piston will receive a supplemental forward thrust independent of the live-steam pressure entering against the piston, as set forth.

2. A turbine engine having a piston consisting of two wheel-sections fixedly held on the shaft; radially-disposed alternate impact-pockets and exhausts in the end walls of the piston-chamber, said wheel-sections having impact-pockets terminating in effluent grooves, having their ends movable over the exhausts and pockets in the chamber end walls; and feed-ports in the wall of the piston-chamber discharging against the impact-pockets of the piston-wall section, as specified.

3. A turbine engine having a piston fixedly held on the shaft; an annular ring or abutment having radially-alternate impact-pockets, said piston projecting through such ring and having an abutment movable therewith, provided with ports traversing the exhausts of the ring abutments; a second fixedly-held abutment having impact-pockets and exhausts arranged to be traversed by the discharge end of the ports in the movable abutment, the said piston-wheel having impact-pockets terminating in effluent grooves having their ends movable over the exhausts and pockets of the fixed ring or abutment, and feed-ports in the wall of the piston-chamber discharging against the impact-pockets of the piston-wheel as specified.

4. A turbine engine having a piston formed of two conical sections fixedly held on the shaft with their apices in close contact; a piston-chamber having a like contour, said chamber having radially-disposed alternately-arranged exhaust and impact-pockets in the end walls thereof; the piston-wall section having peripheral impact-pockets in their inner ends terminating in lateral effluent grooves, the ends of which traverse the alternately-arranged impact-pockets and exhausts in the piston-chamber; and feed-ports discharging tangentially on the piston-wheels against their impact-pockets, as set forth.

5. In a turbine engine, comprising a turbine piston-wheel fixedly mounted on a shaft, said wheel having a central portion provided with peripheral impact-pockets terminating in lateral effluent grooves; fixedly-held abutments at each end of the central portion of the wheel, having alternately-disposed impact-pockets and exhausts, over which the ends of the effluent grooves pass as the wheel is rotated; an abutment-valve adjustably secured on each end of the central portion of the piston-wheel, having escape-ports; a second set of fixedly-held abutments having alternate impact-pockets and exhausts over which the discharge ends of the ports in the adjustable abutment-valve pass; and tangentially-arranged steam-inlets discharging against the impact-pockets of the central portion of the piston-wheel, all being arranged substantially as shown and for the purposes described.

6. In a turbine engine of the character described; the combination with the turbine wheel having impact-pockets and effluent grooves; the feed-ports discharging against the impact-pockets of the wheel and the fixedly-held abutment-rings adjustably mounted on the ends of the piston-wheel having ports adapted to communicate with the ports in the ring-held abutments, substantially as shown and for the purposes described.

7. In a turbine engine of the character described, the combination of the piston-chamber having its end walls provided with alternate impact-pockets and escape-ports and having the annular wall of the piston-chamber provided with the tangentially-arranged inlet-ports; of a piston consisting of two turbine-wheel sections having each a peripherally-arranged series of impact-pockets at their inner ends, the two series of impact-pockets being staggeredly arranged, whereby to be moved alternately in line with the feed-ports, said pockets having lateral angularly-effluent grooves adapted to discharge against the alternately-disposed impact-pockets and exhausts of the end-wall abutment, substantially as shown and described.

8. The combination with the casing, the shaft and the fixedly-held abutment-rings, said abutment-rings having alternately-arranged impact-pockets and exhausts; and a second set of fixedly or detachably held abutment-rings having impact-pockets and exhausts; of a turbine piston having at the center a double set of peripherally-arranged im-

pact-pockets terminating in laterally-extending effluent grooves, the discharge ends of which traverse the impact-pockets, said wheel-section having bearing portions engaging the said inner abutment; the valve or abutment-ring adjustably and detachably fitted on the outer end; of each piston-wheel section having escape-ports adapted to communicate with the exhaust-ports in the inner and outer sets of fixedly-held abutment-rings and tangentially-arranged feed-ports discharging into the impact-pockets of the piston-wheel section, as specified.

9. The combination in a rotary engine of the character described with a shell or casing; the drive-shaft and the end abutment having impact-pockets and exhausts; of a piston-wheel having peripheral impact-pockets terminating in lateral effluent grooves discharging against the end abutment in line with their impact-pockets and exhausts; inlet-ports discharging against the pockets of the piston-wheel, said piston-wheel pockets and inlet-ports being arranged to concentrate the force of the propelling means centrally of the engine, as and for the purposes described.

10. In a rotary engine of the character described; the combination with the casing and the drive-shaft, said casing having a series of annularly-arranged steam packing-grooves, a greater number of such packing-grooves being arranged on the lower face of the casing than on the upper face; of a piston having peripheral impact-pockets near the center thereof, said pockets terminating in laterally-extending angular effluent grooves; end abutments having exhaust-ports and inlet-ports discharging against the impact-pockets of the wheel, substantially as shown and described.

11. In an engine of the character described; the combination of the casing and the drive-shaft, the end abutment having exhausts, said casing having an internal piston-chamber having packing-ring depressions at the extreme ends, the annular wall of such chamber being tangentially arranged in the ports of the piston-wheel having a series of peripheral impact-pockets terminating in laterally-extending effluent grooves; and packing-rings fitting over the outer ends of the piston and traveling within the packing depressions in the ends of the piston-chamber and against the end abutment as shown and described.

12. The combination of the casing having suitable end bearings; a shaft having a fixed collar abutting the bearings at one end; a piston formed of two sections fixedly held on the shaft; a split nut for holding the two sections securely in position on the shaft with one section abutting the fixed collar on the shaft, said pistons having impact-pockets and terminating in laterally-extending escape-grooves traversing the abutment-exhausts and the inlets arranged to discharge against the impact-pockets of the piston, said casing having means for collecting and discharging the condensations substantially as shown and for the purposes described.

MARTIN A. GREEN.

Witnesses:
MARIAN G. WHITNEY,
ROBERT W. KILPATRICK.