(No Model.)

3 Sheets—Sheet 1.

A. WATKINS.

ROTARY ENGINE.

No. 599,751. Patented Mar. 1, 1898.

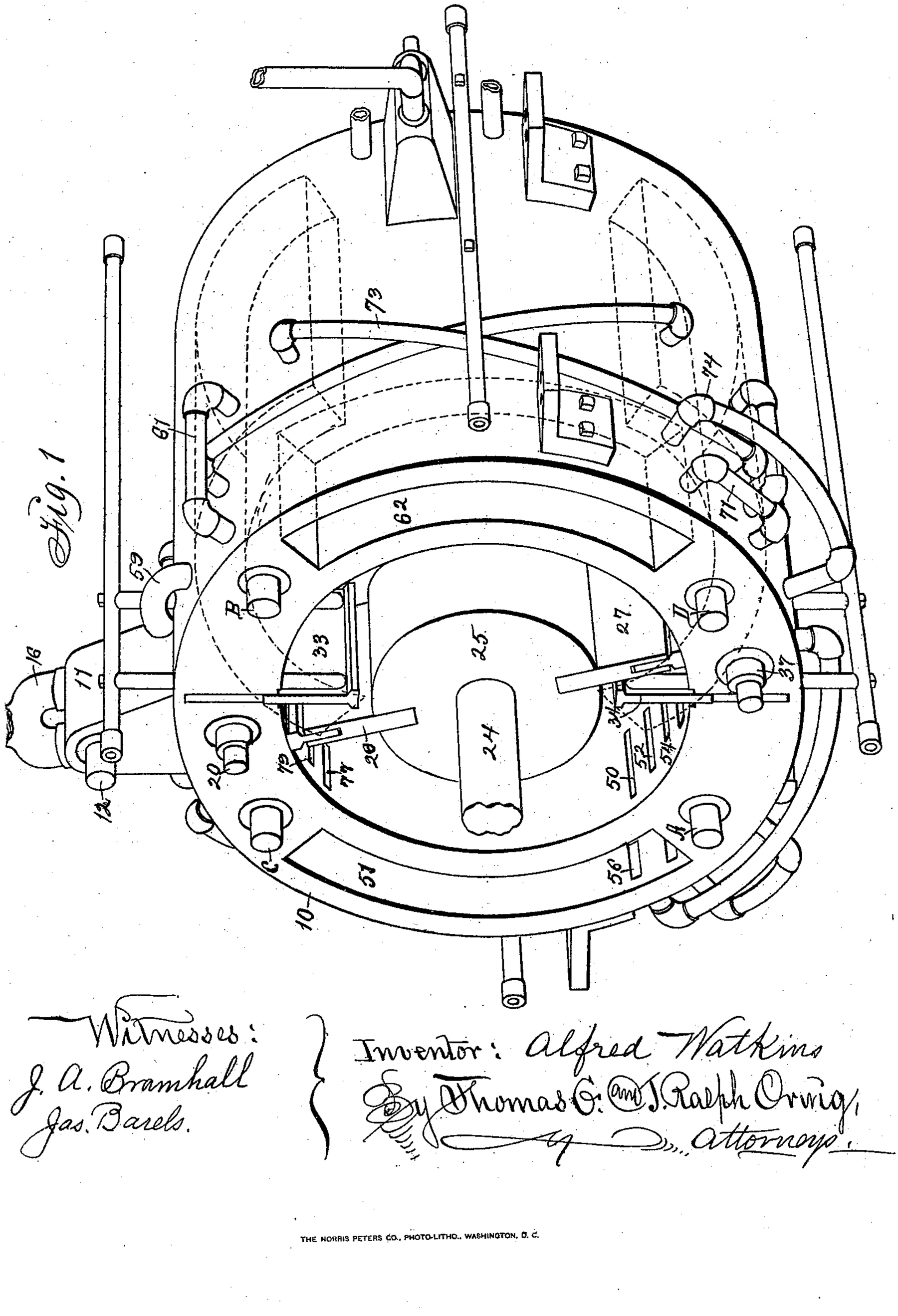

Fig. 1.

Witnesses:
J. A. Bramhall
Jas. Barels.

Inventor: Alfred Watkins
By Thomas G. and J. Ralph Orwig,
Attorneys.

(No Model.)

3 Sheets—Sheet 2.

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Fig. 3

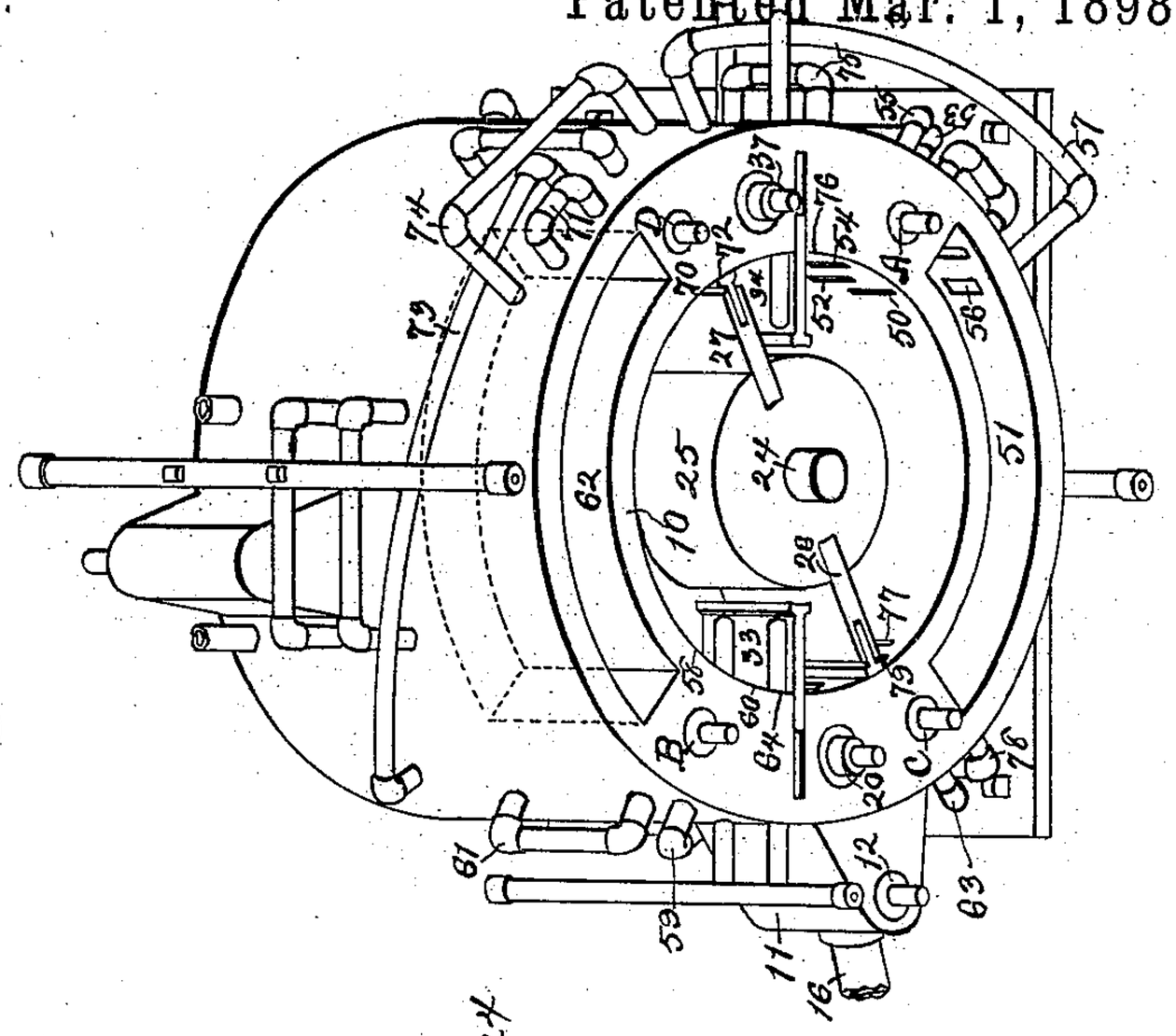
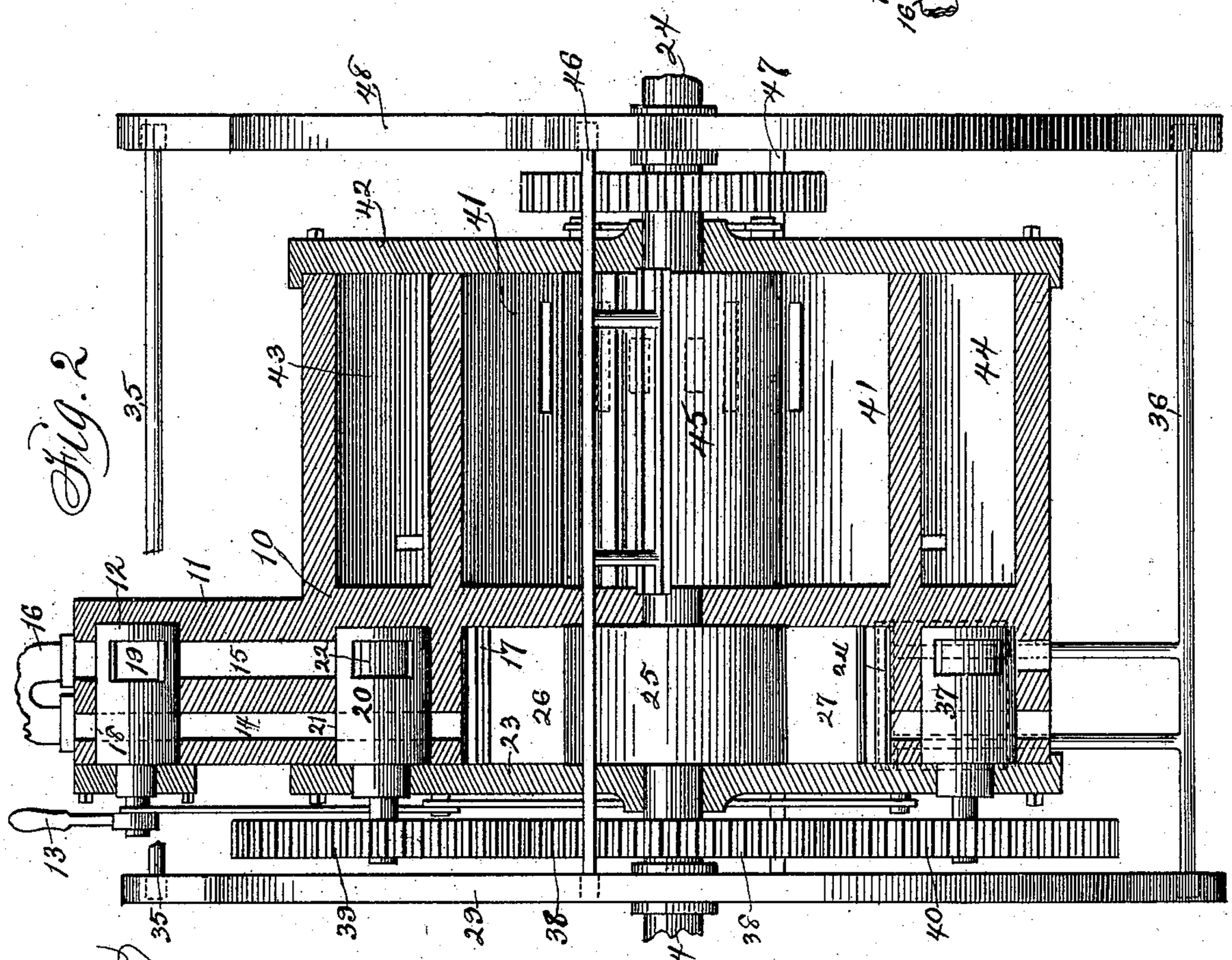


Fig. 2



Witnesses:
J. A. Bramhall
Jas. Barels.

Inventor: Alfred Watkins
By Thomas G. and J. Ralph Orwig,
Attorneys.

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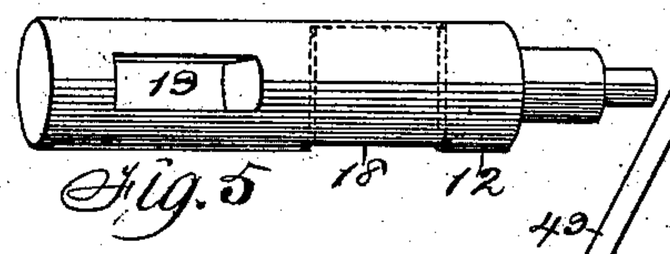


Fig. 5

Fig. 4

Fig. 6

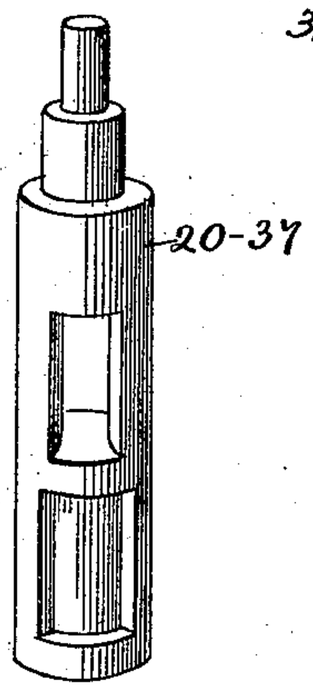
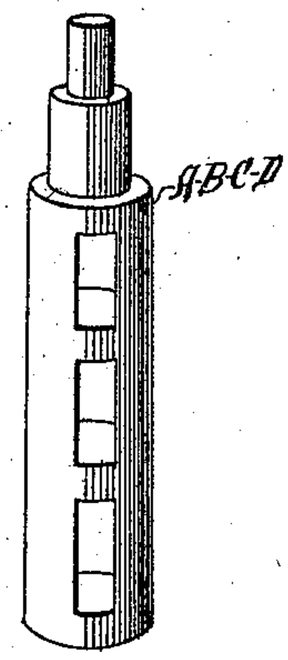


Fig. 7



Witnesses:
J. A. Bramhall
Jas. Bacels

Inventor: Alfred Watkins,
By Thomas G. and J. Ralph Orwig.
Attorneys.

UNITED STATES PATENT OFFICE.

ALFRED WATKINS, OF DES MOINES, IOWA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 599,751, dated March 1, 1898.

Application filed March 1, 1897. Serial No. 625,607. (No model.)

To all whom it may concern:

Be it known that I, ALFRED WATKINS, a citizen of the United States of America, and a resident of Des Moines, in the county of Polk and State of Iowa, have invented a new and useful Rotary Engine, of which the following is a specification.

The object of this invention is to provide improved means to utilize the expansive force of steam in the propulsion of mechanism.

My invention consists in the construction, arrangement, and combination of elements hereinafter set forth, pointed out in my claims, and illustrated by the accompanying drawings, in which—

Figure 1 is a perspective of the engine with a portion of the mechanism at one end of the cylinder removed, the dotted lines indicating a series of chambers surrounding or partially surrounding the cylinders and forming steam-chests therefor. Fig. 2 is a sectional elevation of the engine longitudinally of the main shaft. Fig. 3 is a perspective of the engine similar to Fig. 1. Fig. 4 is an end elevation of the engine, partly in section. Fig. 5 is a perspective of the controlling-valve of the engine. Fig. 6 is a perspective of one of two like valves of the engine. Fig. 7 is a perspective of one of four like valves of the engine.

In the construction and operation of the engine, as shown, a casing 10 is provided with a valve-chamber 11, radially extending from the periphery and near one end thereof, in which valve-chamber is mounted a plug 12, having a hand-lever 13 on its outer end. The valve-chamber 11 has two parallel passages 14 15, connected at their outer ends with a common steam-pipe 16, passing through the valve-chamber and into a steam-cylinder 17 within the casing 10. The plug 12 controls the passages 14 15 and is provided with two ports or passages 18 19, which ports or passages are arranged at right angles to each other and register at times with the passages 14 15, respectively. The plug 12 is a controlling or reversing valve, inasmuch as it controls the entrance of the steam through one or another of two divergent passages 14 15 into the cylinder. At the inner ends of and intersecting the passages 14 15 is located a rotary plug 20, also provided with two transverse ports 21 22 at right angles to each other and arranged to register at times with said passages 14 15, respectively. The inner end portion of the passage 14 communicates directly with the steam-cylinder 17 and is the direct steam-passage to said cylinder, whereas passage 15 diverges and connects with the steam-cylinder at a point removed from the passage 14 and is the reversing steam-passage to the engine. A cap-plate 23 is mounted on the left end of the engine, as shown, and a main shaft 24 is positioned for rotation axially in the cap-plate and casing 10. A disk 25 is mounted rigidly on the main shaft 24 within the steam-cylinder 17 and is provided with diametrically opposite radially-extending pistons or heads 26 27. Each of the pistons comprises a plate radially seated in the periphery of the disk 25 and having a backing or wearing plate 28 yieldingly mounted therein and held by yielding pressure devices in traveling contact with the axial surface of the steam-cylinder 17. A cam-wheel 29 is mounted rigidly on the main shaft 24, at a little distance from the cap-plate 23, and is provided with a cam-groove 30, annular throughout the major portion of its length and having two abrupt short outwardly-extending cam portions 31 32 located on diametrically opposite portions of said cam-wheel. Gates or backing heads 33 34 are mounted slidingly in the casing 10 and extend transversely of the steam-cylinder 17, to which gates are attached cross-heads 35 36, running in the groove 30 and cam portions 31 32 of said groove. A secondary plug 37 is located in the casing 10 diametrically opposite to the primary plug 20 and is of like construction thereto, being shown in detail in Fig. 6 as of the same construction. The secondary plug 37 controls ports or passages leading from one side or portion of the steam-cylinder 17 past one of the gates 33 34 and into the other side or portion of said cylinder. A spur-gear 38 is mounted rigidly on the main shaft 24 between the cap-plate 23 and the cam-wheel 29 and meshes with and drives pinions 39 40 of like size and of like diameter to the spur-gear, which pinions 39 40 are mounted on outer end portions of the primary and secondary plugs 20 27, respectively.

End to end with the steam-cylinder 17 is located a steam-cylinder 41, closed by a cap-plate 42, forming part of the casing 10, which

cylinder 41 is of the same diameter and double the length of the cylinder 17. The steam-cylinder 41 is partially surrounded by segmental steam chests or chambers 43 44 and is supplied with a disk 45, carrying pistons always at right angles to the pistons 26 27, and also provided with gates 33 34. The gates working in the large cylinder 41 are controlled by cross-heads 46 47, traveling in the groove of the cam-wheel 29, and another cam-wheel 48, of like construction to the one designated as 29, is mounted on the main shaft 24 at a little distance from the cap-plate 42 and carrying the right ends of the cross-heads 35 36 46 47, the cross-heads being provided with antifriction-rollers entering the grooves of the cam-wheels. The steam-cylinder 41 also is provided with primary and secondary plugs like unto the plugs 20 37, controlled by a train of gearing from the main shaft on the right end of the engine.

A series of controlling-plugs A B C D are provided and governed by cranks 48 on their outer ends, which cranks are connected with each other and the operating-lever 13 by means of connecting-rods 49. The plugs A B C D are shown in detail in Fig. 7 and are alike in construction.

In the practical operation of this device under a boiler-pressure of one hundred pounds to the square inch live steam enters through the supply-pipe 16, through the controlling or reversing valve 12 and the primary plug 20 and passage 14, into the steam-cylinder 17, between the gate 33 and the piston 26, forcing the piston 26 around to the port 50, at which time one-half of the steam being used exhausts through the port 50 and plug A into the steam-chamber 51, which is of segmental form and extends partially around the cylinder 17 within the casing 10. The piston 26 moves along to a port 52, where one-half of the remainder of the steam passes through a pipe 53 into the steam-chamber 43, from which chamber the steam passes into the cylinder 41 and forces one of the pistons on the disk 45 part way around and exhausts into a stack or condensing-chamber, as desired. The piston 26 passes on to a port 54, where the remainder of the steam exhausts through a pipe 55 into the steam-chamber 44 and is forced out by live steam having entered against the piston 27 after the gates 33 34 have been opened and closed by the offset portions of the cam-grooves in the cam-wheels. Reverting to the steam-chamber 51, we find that it now contains about fifty pounds of steam. The steam leaves the chamber 51 through a port 56 and pipe 57 and passes through the secondary plug 37 into the other half of the cylinder 17, the first exhaust of which passes through a port 58, the plug B, and pipe 59 into the steam-chamber 44. The second and last exhaust is at port 60, through the plug B and pipe 61, into the steam-chamber 43. The steam-chambers 43 44 each being equal in capacity to both chambers 51 and a like chamber 62 opposite thereto, and ports 52 and 58 exhausting at the same time, the steam is equally divided, giving an equal pressure in the chambers 43 and 44 as would be left in the two portions of the cylinder 17. The steam-chambers 43 44 may be united by a pipe, thus equalizing the pressure therein and gaining more power with very little back pressure. Steam is now taken from the chamber 44 and passes into the cylinder 41, and after forcing one of the pistons or heads part way around in said cylinder it exhausts into a stack or condenser, as desired. The steam from the chamber 43 passes into the other half of the steam-cylinder 41 and moves the piston therein part way around and exhausts into a stack or condenser, as desired. While the steam is traveling in this way the plugs A and B are open and the plugs C and D are closed. In reversing, the controlling-valve 12 is turned part way around, opening the port 19 therein and closing the port 18, so that the steam may pass to and through the port 22 of the primary plug 20, and thence through a pipe 63 to the other side of the gate and to a supply-port 64, at which time the steam-chamber 51 becomes void and the steam-chamber 62 performs its function; but the steam-chambers 43 44 remain as heretofore described and perform the same functions. The plugs A and B are closed and the plugs C and D are opened simultaneously with the lever 13. When reverse steam enters from the boiler through the pipe 16, passage 15, port 19 of the controlling-plug 12, port 22 of the primary plug 20, and passes around the gate 33 through the supply-port 64 into the cylinder 17, forcing the piston or head around to a port 70, where fifty per cent. of the pressure exhausts through said port and a pipe 71 into the steam-chamber 62. The piston passes on to an exhaust-port 72, where twelve and one-half pounds of pressure passes through a pipe 73 into the steam-chamber 43, having a back pressure of six and one-fourth pounds, and from here passes on as before. The steam-chamber 62, containing about fifty pounds of steam, which now passes through a pipe 74, passing part way through the secondary plug 37, through a pipe 75, around the gate 34 to a supply-port 76, enters the steam-cylinder 17 and forces the piston or head to the exhaust-port 77, through a pipe 78 to the steam-chamber 44, and on to next and last exhaust 79, through a pipe 63 into the steam-chamber 43, having a back pressure of six and one-fourth pounds. The pipes should be provided with check-valves to prevent the steam returning. The steam is shut off just before the first exhaust in each part of the steam-cylinders and is kept shut off by the primary and secondary plugs until the piston is past all exhausts and next succeeding gates and the gates are closed.

All of the above operation is based upon the proposition that all chambers are empty at the beginning; but now there is an accumu-

lation, as each steam-chamber supplies only one-half of the steam contained therein to the cylinder. Therefore after four or five revolutions of the first piston there is one hundred pounds boiler-pressure on the first piston of the cylinder 17 and a mean average pressure of forty-nine and one-half pounds on the other piston of said cylinder, a mean average pressure of twenty-four pounds and twelve pounds on the pistons in the cylinder 41, which, being twice the area of each piston in the cylinder 17, are equivalent in pressure to about fifty-four pounds on the first piston in the cylinder 17, as the steam is working on both sides of the pistons in the cylinder 41 at the same time with a mean average pressure of thirteen and one-half pounds, providing at least double the power had at the initial movement. By condensation from the steam-chambers 43 44 at a vacuum-pressure of about nine pounds per square inch there is a gain equivalent to thirty-six pounds pressure on the first piston in the cylinder 17 from the one hundred pounds boiler-pressure, the only back pressure being, as shown above, used on the last exhaust from the cylinder 17 and that and the loss by expansion upon the first and last exhausts in the cylinder 17 is overcome by the auxiliary pressure from the cylinders 43 and 44 being set quarterly with the cylinder 17, and therefore supply steam to the cylinder 41 while the cylinder 17 is exhausting into the steam-chambers 43 and 44, therefore giving a greater pressure, as the full pressure from exhausts through the cylinder 17 is kept up half-way of the travel of the pistons in the cylinder 41. In addition to the above there may be added an extra cylinder with twice the capacity of the cylinder 41 and exhausts from the chambers 43 and 44 into it instead of into a stack or condensing-chamber, and then condense from the extra cylinder, which would again add a greater power than condenses from the chambers 43 and 44. The extra cylinder may be applied, if desired, and forms a part of this invention.

In starting the engine or in case of emergency the steam may be let simultaneously into both sides of both cylinders, thus increasing the actual steam at least twice.

A desirable feature of my invention is to be found in the inclosure of the working cylinders within the steam chests or chambers, in this way utilizing to a maximum degree the heat of the steam.

Another desirable feature of my invention is to be found in the provision for avoiding back pressure except in the last exhaust in the steam-cylinders, the supplemental cylinder having twice the capacity of the primary cylinder, thereby reducing the back pressure to a minimum.

Another desirable feature in my invention is to be found in the economical cost of constructing the same for a given horse-power and in the economy with which it may be lubricated, as the oil enters the first cylinder and passes through all of the cylinders and chambers before it can escape in the exhaust.

A further feature of value is to be found in the compactness and lightness of the engine, especially recommending it for marine service, where space and economy of fuel and boiler space, simplicity, and the minimum of attention are material items.

For extra speed it will be necessary to gear the engine up, as the ordinary speed of the main shaft is designed to be about one hundred revolutions per minute.

I claim as my invention—

1. In a rotary engine, a cylindrical casing divided by a transverse partition to produce two steam-cylinders of unequal length and each cylinder provided with two concentric segmental steam-chambers diametrically opposite to each other and communicating with each other and means for regulating the passage of steam from the first or small cylinder into the segmental chambers connected therewith and from said chambers to other half of small steam-cylinder from which it passes to larger segmental chamber and from this to larger steam-cylinder, from which it exhausts or is condensed; thus used for purposes stated.

2. In a rotary engine a valve-chamber having a straight passage communicating direct with a cylinder and a second and parallel passage that diverges at its inner end, and communicates with the cylinder at a point some distance from the termination of the other passage, a rotary plug-valve in the top or outer portion of said chamber having ports in right-angled positions to each other to successively communicate with said passages, a second rotary plug in the lower or inner portion of the valve-chamber having ports in right-angled position to each other, a cylinder having ports at some distance apart and communicating with the passages in the valve-chamber, and means for operating the valves, arranged and combined to operate in the manner set forth for the purposes stated.

3. In a rotary engine a valve, a valve-chamber having a straight passage communicating direct with a cylinder and a second and parallel passage that diverges at its inner end and communicates with the cylinder at a point some distance from the termination of the other passage, a rotary plug-valve in the top or outer portion of said chamber having ports in right-angled positions to each other to successively communicate with said passages, a second rotary plug in the lower or inner portion of the valve-chamber having ports in right-angled positions to each other, a cylinder having ports at some distance apart and communicating with the passages in the valve-chamber, concentric with the first cylinder, each of said cylinders provided with segmental chambers in their cylindrical walls and communicating with each other, and valves for controlling the passage of steam from the first cylinder to its segmental chambers and from said segmental chambers to the second

and larger cylinder, and from said second cylinder to exhaust or condensing chamber, and means for operating the valves, arranged and combined to operate in the manner set forth for the purposes stated.

4. In a rotary engine, two concentric steam-cylinders each having segmental steam-chambers in their walls, a valve-chamber, having passages communicating with one of the cylinders at different points, a valve for controlling the passage of steam from the first steam-cylinder to the second chamber; a hub or disk in each cylinder having radial pistons and fixed to a rotating shaft, and gearing for connecting the said shaft with the said valves arranged and combined to operate in the manner set forth for the purposes stated.

5. In a rotary engine, two steam-cylinders in concentric positions, a valve-chamber having two passages communicating with one of the cylinders at different points, each cylinder having two steam-chambers concentric therewith and passages leading from the first cylinder to the steam-chambers connected therewith, and the second cylinder having corresponding chambers and passages, rotary valves for controlling the passage of steam from the valve-chamber into the said steam-chambers, a reversible valve in the valve-chamber, a reversible valve for controlling the entrance of steam into each of the four steam-chambers, and mechanism for simultaneously operating all of said reversible valves, arranged and combined to operate in the manner set forth for the purposes stated.

ALFRED WATKINS.

Witnesses:
W. H. MOORE,
THOMAS G. ORWIG.