J. H. HARRISON.

ROTARY ENGINE.

APPLICATION FILED JAN. 14, 1909.

945,525.

Patented Jan. 4, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

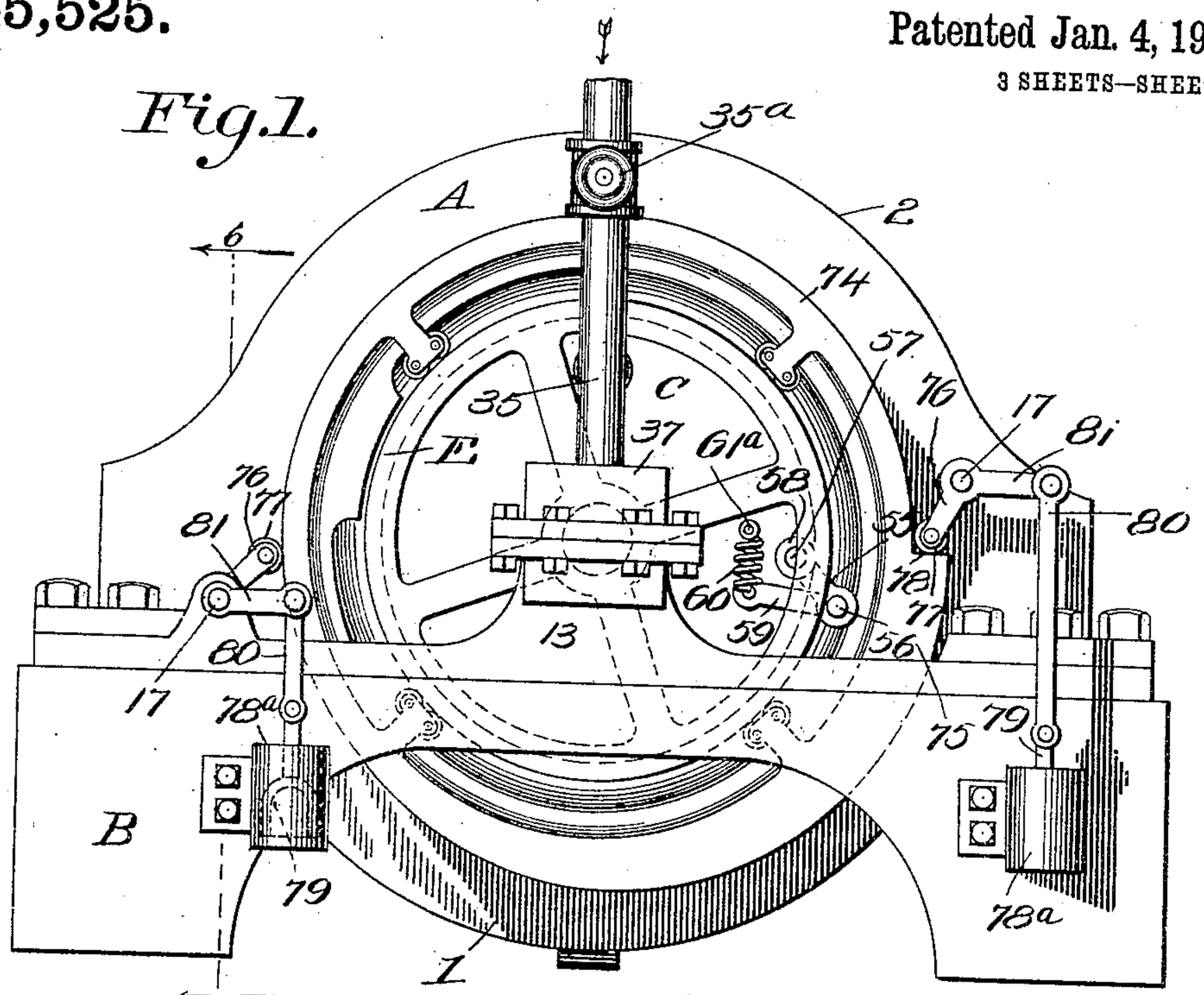
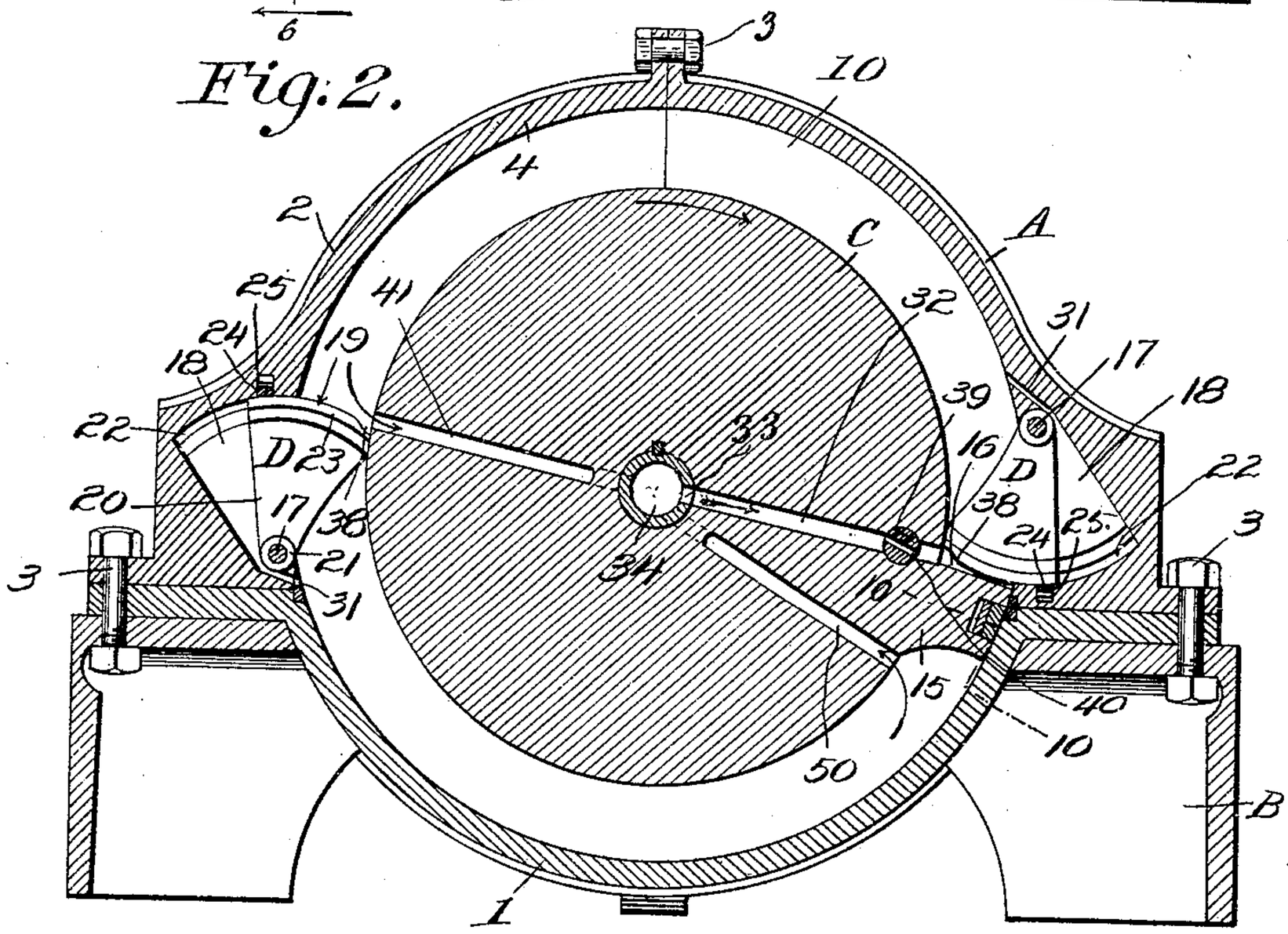


Fig. 2.



Witnesses

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3 SHEETS—SHEET 2.

Fig. 3.

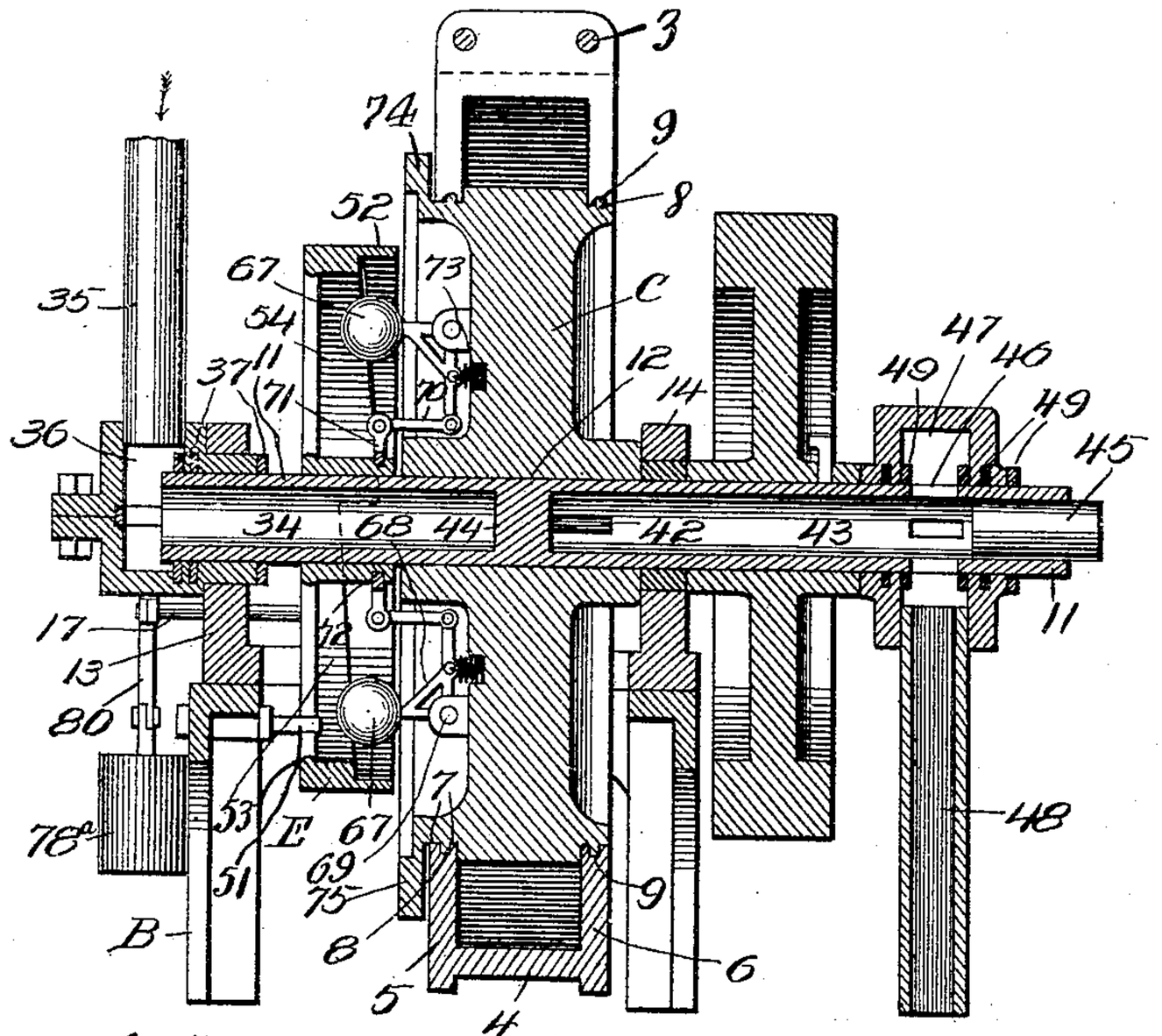


Fig. 4.

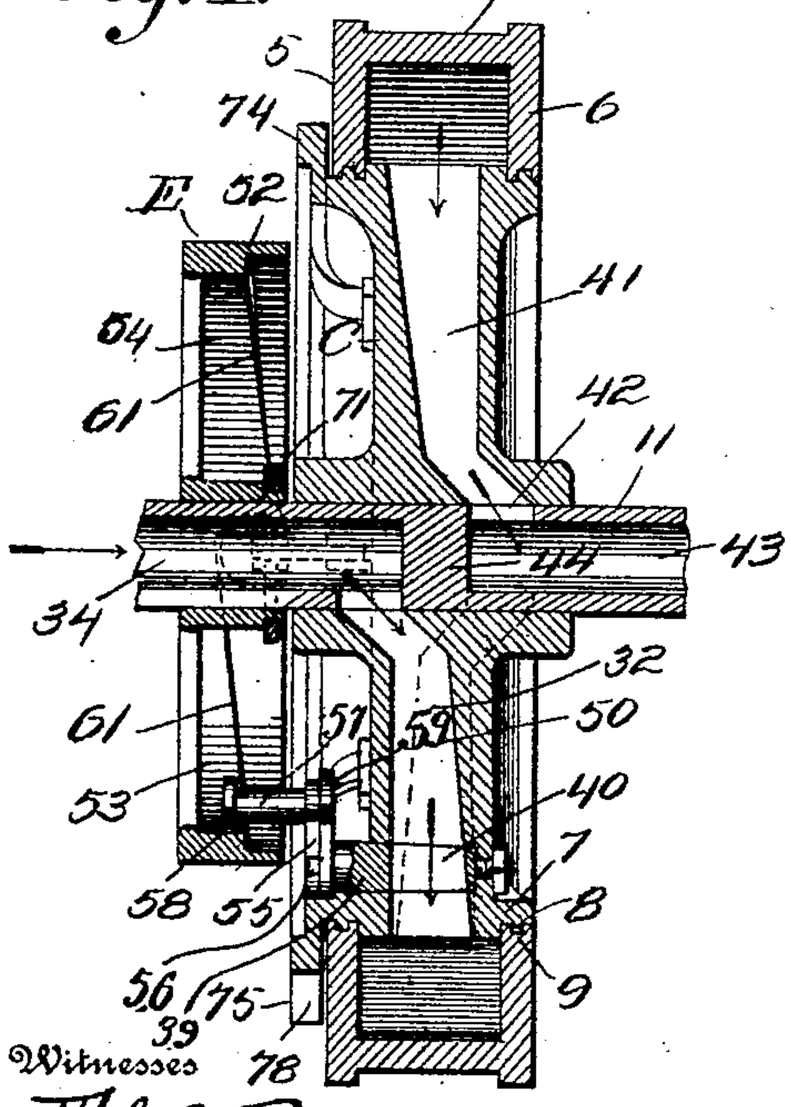
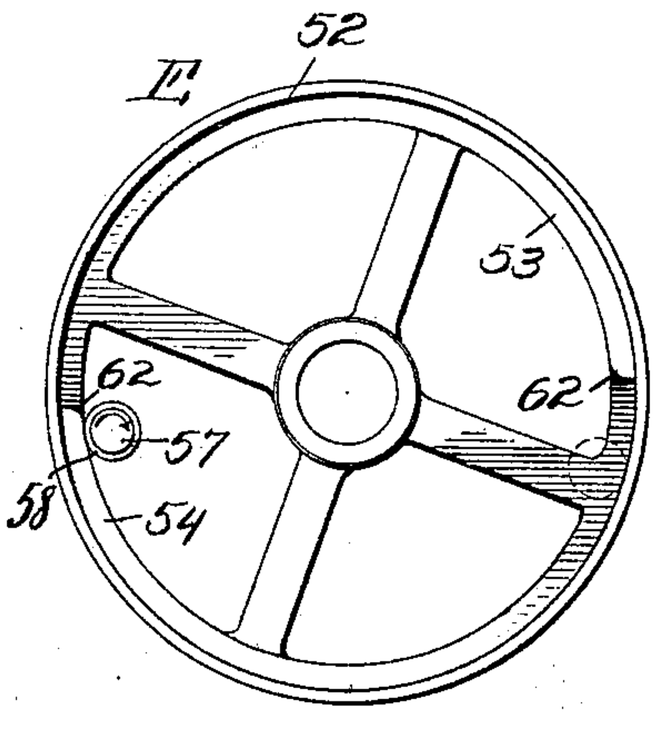


Fig. 5.



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3 SHEETS—SHEET 3.

Fig. 6.

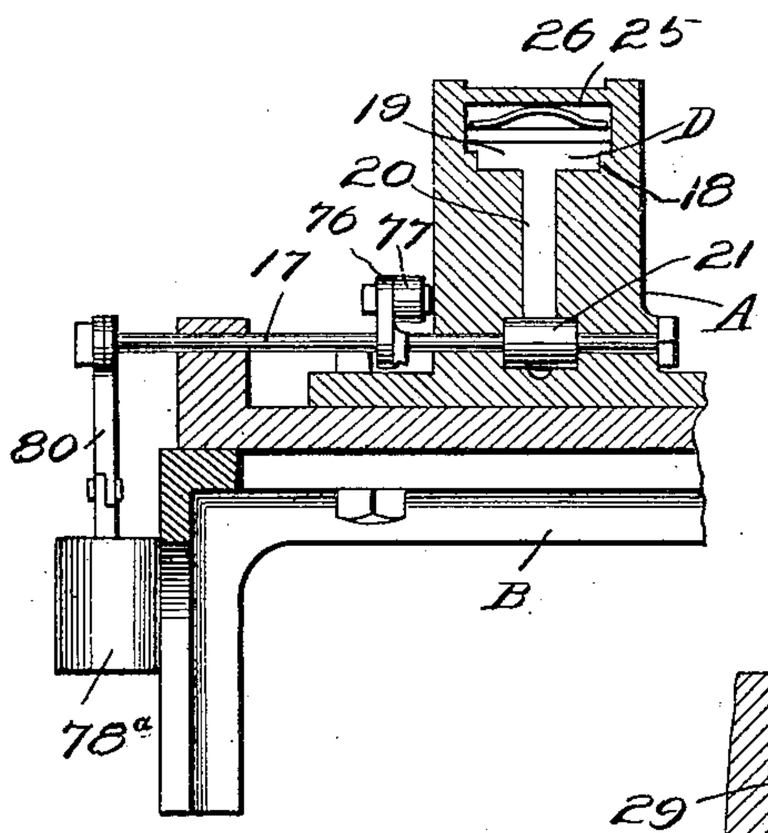


Fig. 7.

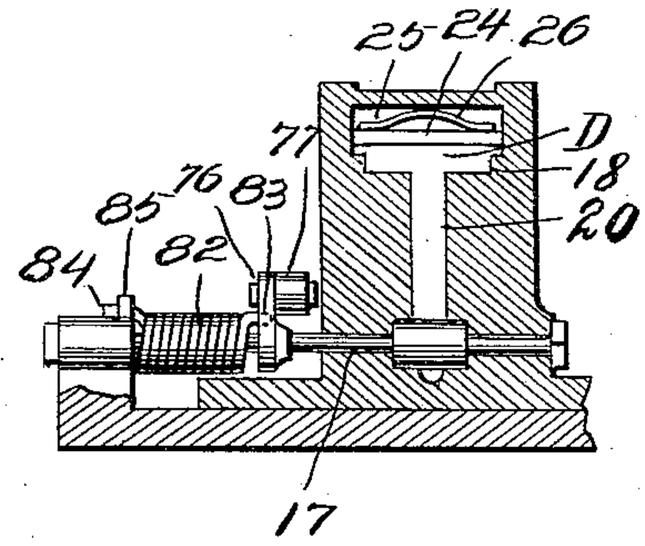


Fig. 10.

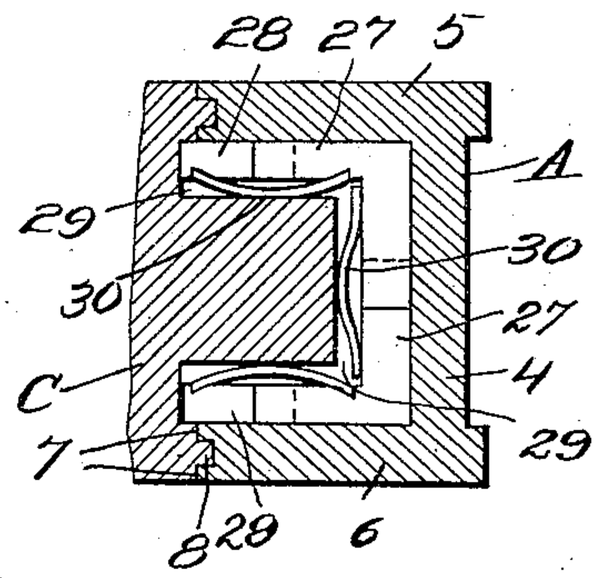


Fig. 8.

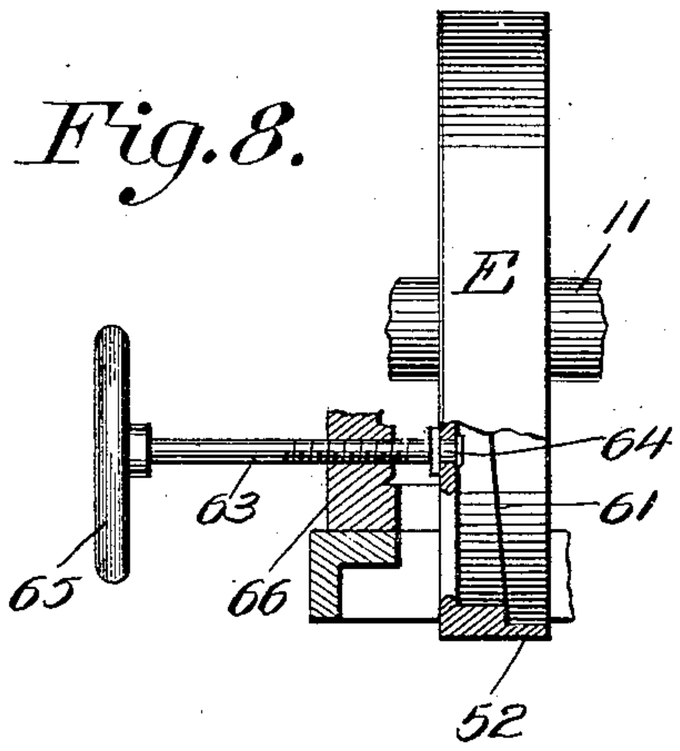
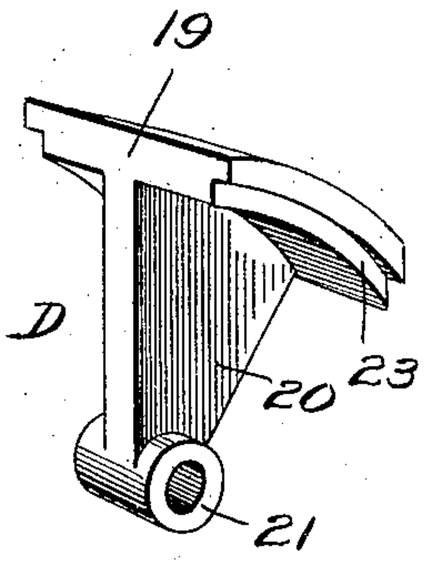


Fig. 9.



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UNITED STATES PATENT OFFICE.

JOHN HOUSTON HARRISON, OF BROADWAY, VIRGINIA.

ROTARY ENGINE.

945,525. Specification of Letters Patent. Patented Jan. 4, 1910.

Application filed January 14, 1909. Serial No. 472,270.

To all whom it may concern:

Be it known that I, JOHN HOUSTON HARRISON, a citizen of the United States, residing at Broadway, in the county of Rockingham and State of Virginia, have invented new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to a rotary engine of the elastic fluid type in which the rotatable element thereof is impelled by the expansive effect of steam or other elastic fluid acting between relatively-movable abutments arranged, respectively, on the piston or movable element and casing of the engine.

The invention has for one of its objects to improve and simplify the construction and operation of apparatus of this character so as to be comparatively simple and inexpensive to manufacture, thoroughly reliable and efficient in use, and composed of comparatively few parts.

Another object of the invention is the provision of an improved cut-off mechanism for the steam admission valve whereby the supply of steam will be automatically cut off at the desired point to permit the expansive force of the steam to impel the rotary element or piston so that the energy of the steam can be most effectively extracted and converted into mechanical power.

A further object is the provision, in connection with the cut-off mechanism, of a speed-responsive device whereby substantially uniform speed of rotation can be maintained under varying load conditions.

A still further object is the employment of one or more oscillatory abutments or wings arranged in the wall of the casing in coöperative relation with a wing or abutment on the cylindrical piston so that steam can be admitted between the abutments to re-act thereon for rotating the piston, there being improved means for operating the oscillatory abutments to permit the piston abutment to pass and thereafter restore the oscillatory abutment to operative position behind the piston abutment to form a chamber into which steam is admitted for impelling the piston.

With these objects in view and others, as will appear as the description proceeds, the invention comprises the various novel features of construction and arrangement of parts which will be more fully described hereinafter and set forth with particularity in the claims appended hereto.

In the accompanying drawings, which illustrate certain embodiments of the invention, Figure 1 is a front view of the engine. Fig. 2 is a vertical section thereof taken transversely to the axis of rotation. Fig. 3 is a vertical longitudinal sectional view. Fig. 4 is a fragmentary longitudinal sectional view showing the admission and exhaust passages. Fig. 5 is a front view of the cam wheel for actuating the admission valve. Fig. 6 is a detail sectional view on line 6—6, Fig. 1, showing a modified form of restoring device for the oscillatory abutment. Fig. 7 is a similar view of a modified form of restoring device. Fig. 8 is a detail view of the means for manually adjusting the cam wheel for varying the cut-off. Fig. 9 is a perspective view of one of the oscillatory abutments. Fig. 10 is a sectional view on line 10—10, Fig. 2.

Similar reference characters are employed to designate corresponding parts throughout the views.

In the present instance, I have elected to illustrate the invention as an engine of the single piston type but it is to be understood that any desired number of pistons may be employed according to the horse power desired, and, obviously, the pistons can be operated in multiple or in series.

Referring to the drawings, A designates the casing of the engine which is mounted upon a suitable bed B and the casing is of annular form and constructed in two or more sections 1 and 2 and secured together by bolts 3. The casing is constructed with a cylindrical wall 4 and inwardly-extending parallel circular walls 5 and 6 at the front and rear thereof. In other words, the casing is in the form of a ring of channel cross section, and rotatably mounted in the opening of the ring is the disk-shaped rotary element or wheel C constituting the piston of the engine. The peripheral surface of the piston C is formed with a pair of annular grooves 7 adjacent each edge, which grooves are separated by an annular tongue 8. The internal circular surfaces of the walls 5 and 6 are formed with annular grooves 9 into which the tongues 7 project so that the zigzag passages will be formed between the stationary and movable parts of the engine which effectively prevent the escape of steam from

the annular or circular chamber 10 surrounding the periphery of the piston. The piston C is secured to a rotatable shaft 11 passing through the hub-opening 12 of the piston and this shaft is mounted in bearings 13 and 14 mounted on the bed B.

The piston C is provided with a radial abutment or wing 15 which is of substantially the same cross section as the annular chamber 10 and this abutment has a radial face 16 against which the steam acts in rotating the piston. One or more abutments D are arranged in the casing in such coöperative relation with the wing or abutment 15 that steam can act between the piston abutment and casing abutment for rotating the piston. The abutments D, which, in the present instance, are located at diametrically opposite points, are mounted for oscillatory movement on rock shafts 17 and they are adapted to move into pockets 18 in the wall of the casing when the piston abutment 15 moves past the oscillatory abutments successively. As shown in Fig. 9, each oscillatory abutment comprises an arcuate plate 19 formed with a central web or arm 20 which has a hub 21 through which the rock shaft 17 therefor extends. The side walls of the pockets 18 are provided with arcuate grooves 22 for receiving the flanges 23 formed at the edges of the arcuate plate 19, the said grooves being concentric with the axis on which the oscillatory abutment swings. Bearing against the curved outer surface of the plate 19 is a packing strip 24 arranged in a recess 25 in the curved wall of the pocket 18, as shown in Figs. 2 and 6, the packing strip being urged outwardly by a bowed spring 26 arranged in the groove or recess 25 for holding the packing strip against the abutment so that leakage of steam past the abutment will be prevented. The piston abutment or wing 15 is provided with a packing which, as shown in Figs. 2 and 10, comprises L-shaped package members 27 and straight packing members 28, which, with the others, are set into grooves or chambers 29 formed in the side and end walls of the abutment 15, and behind these packing strips are arranged springs 30 which urge the packing members outwardly into intimate contact with the internal surfaces of the cylindrical wall 4 and side walls 5 and 6 of the casing, so that steam will be prevented from escaping from the high to the low pressure side of the abutment 15. In order to balance the pressure of the steam or motive fluid acting on the oscillatory abutments, each pocket 18 is connected with the piston chamber 10 by a short passage 31, as shown in Fig. 2, whereby steam can be admitted behind the abutment to afford free action thereof.

The rotatable element or piston C is provided with an admission passage or conduit 32 that extends radially thereof, as shown in Fig. 2, and the inner end communicates through an opening 33 in the shaft 11 with the bore 34 thereof. As shown in Fig. 3, this bore is connected with a suitable source of fluid that is delivered through a pipe 35 which is connected with a chamber or steam chest 36 arranged at and supported on the front bearing 13, the bore 34 of the shaft opening into said chamber 36, and the pipe 35 being equipped with a throttle valve 35[a], Fig. 1, and where the shaft 11 enters the chamber 36, packing rings 37 are provided so that leakage of high pressure steam will be avoided. The outer end of the supply passage 32 of the piston terminates directly at the fluid-impinging face 16 of the piston abutment 15, so that immediately after either oscillatory abutment D passes behind the piston abutment 15, steam can be admitted between the abutments for imparting an impulse to the piston. As shown in Fig. 2, each oscillatory abutment is cut away at 38 so as not to cover the outer end of the supply passage 32 when the oscillatory abutments are in initial operative position. In the passage 32 is a rock valve 39 provided with a port 40 through which steam passes when the valve is moved to cause the port to register with the passage 32. The exhaust steam passes out through an exhaust passage 41 arranged diametrically opposite the passage 32 and having its outer end communicating with the annular chamber 10 and its inner end communicating through an opening or port 42 with the bore 43 of the shaft 11, which bore is separated from the bore 34 by a partition 44. The bore 42 is closed at its outer end by a plug 45 or other suitable device, and the steam passes out of the bore through a plurality of ports 46 that discharge into a stationary exhaust chamber 47 which communicates with a condenser, heating system, or with the atmosphere through a pipe 48. Where the shaft 11 passes through the exhaust chamber 47, packing rings 49 are provided for preventing the waste of steam, as shown in Fig. 3. An auxiliary exhaust passage 50 is provided in the piston C, as shown in Fig. 2, and this passage is arranged with its outer end at the side of the abutment 15 opposite from the fluid-impinging face 13 thereof while the inner end of the passage communicates with the exhaust bore 43 of the shaft. By means of the passages 41 and 42, the exhaust steam from every portion of the chamber 10 other than that where the working steam is confined, will be effectively cleared so that back pressure will be reduced to a minimum.

The operating device for the steam admission valve 39 is so designed that the steam can be admitted during any desired period and then cut off so that during a portion of the movement of the piston, steam at full

boiler pressure will operate on the piston, and during another portion, the steam will act expansively so that maximum efficiency can be obtained. Arranged on the axle 11 at a point in front of the piston C is a relatively stationary cam wheel E that is prevented from rotating by a projecting member or finger 51 on the bed of the engine as shown in Fig. 3. This wheel is formed with a rim 52 which, on its internal surface, is provided with cams 53 and 54 arranged at diametrically-opposite points and these cams serve to actuate the steam-admission valve by means of an arm 55 arranged on the stem 56 of the valve, as shown in Figs. 1 and 4, and on the arm 55 is a forwardly-projecting member 57 that carries a roller 58 that rides on the cams. The valve stem 56 is provided with a second arm 59 which is connected with a helical extension spring 60 that has one end anchored at 61ª to the piston C. The valve and attached parts rotate with the pistons C so that as the roller engages the cams 53 and 54 of the stationary cam wheel E, the admission valve will be successively opened and closed. As shown in Fig. 4, the cams 53 and 54 have their inner edges 61 arranged obliquely to the plane of rotation so that by changing the position of the wheel E backwardly or forwardly, the period during which the roller 58 rides on each cam can be changed to thereby vary the point of cut-off or closing of the steam supply. As shown in Fig. 5, the beginning of each cam is rounded at 62 so that the roller 58 can freely pass on the cams. For some class of service, it may be desirable to adjust the cam wheel by hand, as for instance, by a screw 63, Fig. 8, that has its inner end 64 swiveled or loosely connected with the cam wheel E, while its outer end is provided with a hand wheel 65 for facilitating the adjustment of the screw which is threaded in a fixed part 66 of the engine.

When automatic regulation of the speed is desired under variations in load, a speed-responsive device may be employed as shown in Figs. 3 and 4. This speed-responsive device consists of centrifugally-acting weights or balls 67 mounted on bell crank levers 68 that are fulcrumed at 69 on the piston C at diametrically-opposite sides of the shaft 11, the balls being located inside the cam wheel E so that the latter forms a shield or guard for the governor. The inner ends of the bell crank levers are connected by links 70 with a ring 71 which is disposed in an annular groove 72 in the hub of the wheel E so that the ring will rotate with the ball bearing levers and cause the wheel E to move back and forth on the shaft 11 as the balls 67 move inwardly and outwardly under variations in speed. The weights 67 act against springs 73 of any suitable character or arrangement. By thus moving the cam wheel E forwardly or backwardly, the point of cut-off can be varied so that the supply of steam to act on the piston may be automatically changed to suit the varying conditions as to load and thereby maintain a substantially uniform speed.

The oscillatory abutments are each retracted out of the path of the piston abutment 15 so as to be out of the way of the latter in approaching the abutment. For this purpose, the piston C is provided at its front side with a peripheral flange 74 which has a portion formed into a cam 75 for oscillating the abutment in one direction. The rock shaft of each abutment is provided with an arm 76 that is equipped with a roller 77 which rides on the periphery of the flange 74 and cam 75. The end 78 of the cam terminates abruptly so that as the roller 77 passes off the cam, the arm 76 can quickly swing inwardly to restore the oscillatory abutment to operative position behind the piston abutment 15 so as to occupy the position shown in Fig. 2, at the right. In the construction shown in Fig. 1, vacuum cups 78ª are employed for restoring the abutment to operative position and the movable elements 79 of these cups are connected by links 80 with the arms 81 of the respective abutments. As the arms or levers 76 are tilted by the cams 75, the movable elements of the vacuum cups are drawn upwardly so as to create a suction or vacuum under the said elements, which has the effect of quickly restoring the abutments as soon as the rollers 77 pass off the cams 75. Instead of vacuum cups for restoring the oscillatory abutments, a torsional spring 82 may be employed as shown in Fig. 7, one end of the spring being connected at 83 with the arm 76 and the other end 84 connected at 85 with a fixed part of the engine.

From the foregoing description, taken in connection with the accompanying drawings, the advantages of the construction and of the method of operation will be readily apparent to those skilled in the art to which the invention appertains, and while I have described the principle of operation of the invention, together with the apparatus which I now consider to be the best embodiment thereof, I desire to have it understood that the apparatus shown is merely illustrative, and that such changes may be made when desired as are within the scope of the claims appended hereto.

Having thus described the invention, what I claim is:—

1. In an engine, the combination of a casing provided with a fluid chamber, a piston having an abutment disposed in the chamber, a plurality of spaced abutments in the casing movable back and forth into and out of coöperative relation to the piston abutment, a shaft for the piston provided

with separate bores for admitting and exhausting fluid, a conduit in the piston communicating with the admission bore and discharging into the chamber at a point immediately behind the piston abutment, a plurality of exhaust conduits in the piston having their inner ends communicating with the exhaust bore of the shaft and their outer ends communicating with the chamber, a valve mounted in the piston and rotatable therewith for controlling the first-mentioned conduit, a valve actuating mechanism, and means for adjusting the valve actuating mechanism to vary its period of operation.

2. In a rotary engine the combination of a casing, a piston rotatable within the casing, a valve mechanism for controlling admission of motive medium to the casing for operating the piston therein, a cam for operating said valve mechanism, and means for varying the position of the cam to cause the latter to remain in contact with the valve mechanism for holding the valve open a greater or less period during the rotation of the piston, substantially as and for the purpose specified.

3. In a rotary engine the combination of a casing, a piston rotatably mounted within the casing, a valve mechanism mounted upon the piston for controlling the admission of motive medium into the casing, a non-rotating element provided with a cam adapted to actuate said valve mechanism, said cam tapering in width throughout its length, and means for moving said non-rotating element toward and from the plane of rotation of the piston to vary the interval of time of contact between said cam and valve mechanism during each revolution of the piston, substantially as and for the purpose described.

4. In combination in an engine of the type described, a casing, a piston rotatably mounted within the casing and having an abutment, a plurality of abutments within the casing adapted to coöperate with the piston and the abutment thereof, a valve mechanism mounted upon the piston for admitting motive medium into the casing, a non-rotating element provided with a plurality of cams corresponding in number to the number of abutments of the casing, each of said cams tapering in width throughout its length in the same direction and adapted to operate said valve mechanism, and means for adjusting the non-rotating element to vary the contact of each cam thereof with the valve mechanism, substantially in the manner and for the purpose set forth.

5. In an engine of the variety specified, the combination of a casing, a piston rotatably mounted within the casing, a valve mechanism mounted upon the piston for controlling admission of the motive medium to the casing, a non-rotating element provided with a cam for operating the valve mechanism, and a governor mechanism mounted upon the rotatable piston and adapted to automatically move said non-rotating element to adjust the cam thereof to vary its length of contact with said valve mechanism during a revolution of the piston.

6. In an engine of the class described, the combination of a casing, a piston rotatably mounted within the casing, a valve mechanism mounted upon the piston for controlling admission of the motive medium into the casing, a cam wheel arranged coaxially with said piston and adapted to coöperate with the vave mechanism, and a governor mechanism mounted upon the rotatable piston for moving the cam wheel toward and from the plane of rotation of said piston, said governor mechanism being protected and housed by the same cam wheel.

7. In an engine of the variety specified, the combination of a casing having a pocket, a piston rotatable within the casing and having an abutment, a movable abutment mounted in the pocket of the casing, a rock shaft mounted in the casing and having said movable abutment fastened thereto, an arm secured to said rock shaft, a cam rotatable with said piston and adapted to engage the arm of said rock shaft, and means coöperating with the rock shaft and normally exerting a force therethrough to hold the movable abutment in contact with the rotatable piston.

8. In an engine, the combination of a casing provided with an annular chamber, a piston mounted in the casing and provided with an abutment disposed in the chamber, a pocket formed in the casing and having arcuate grooves in its opposed walls, an oscillatory abutment mounted in the casing to move back and forth in the pocket in coöperative relation with the piston abutment, said oscillatory abutment having arcuate end flanges disposed in the said grooves, said pocket having a recess, a packing strip in the recess and extending across the oscillatory abutment, and a spring for urging the packing strip into engagement with the oscillatory abutment.

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

J. HOUSTON HARRISON.

Witnesses:
JAS. V. BROOKE,
HENRY B. SMITH.