

(No Model.)

2 Sheets—Sheet 1.

A. D. BELLINGER.
ROTARY ENGINE.

No. 491,402.

Patented Feb. 7, 1893.

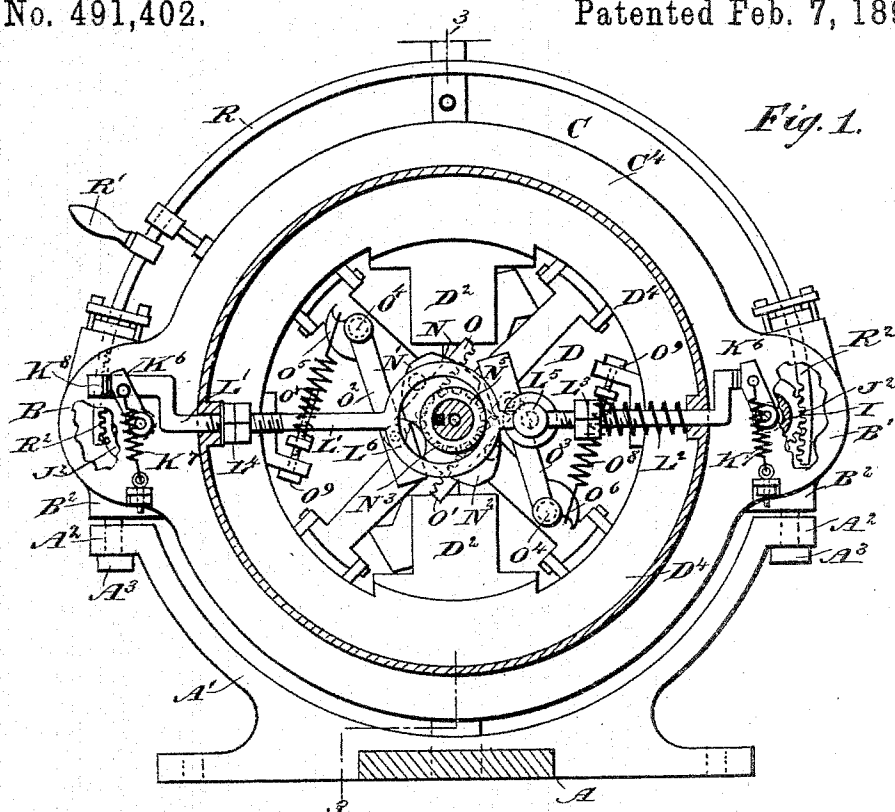
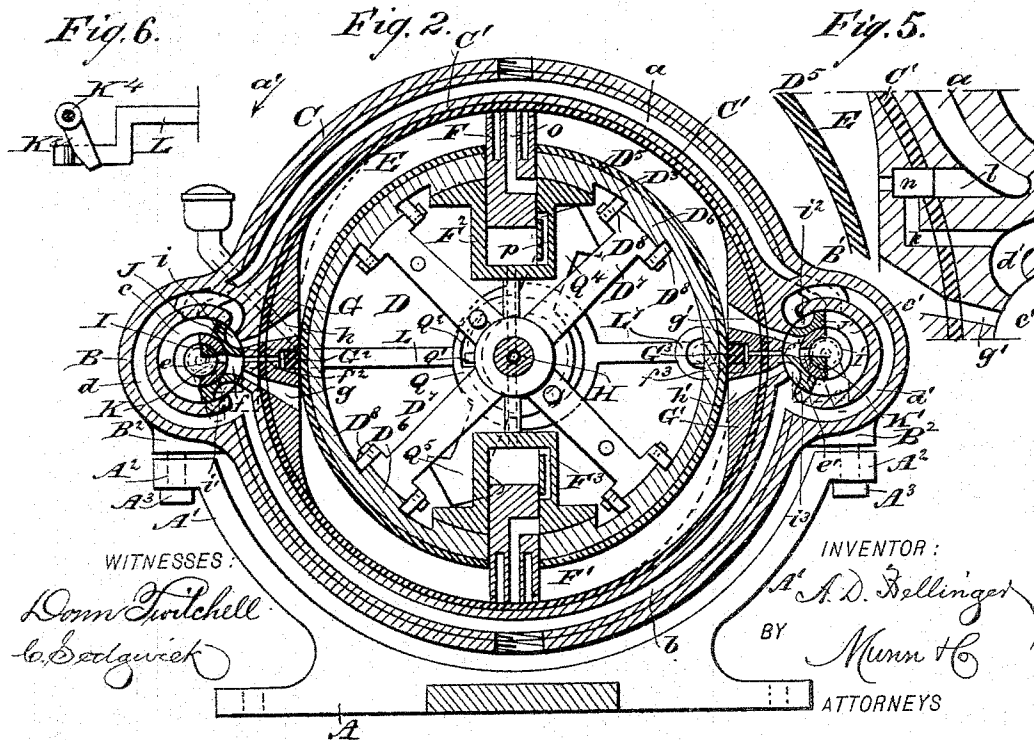


Fig. 1.



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BY Munn & Co
ATTORNEYS

(No Model.)

2 Sheets—Sheet 2.

A. D. BELLINGER.
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Fig. 3.

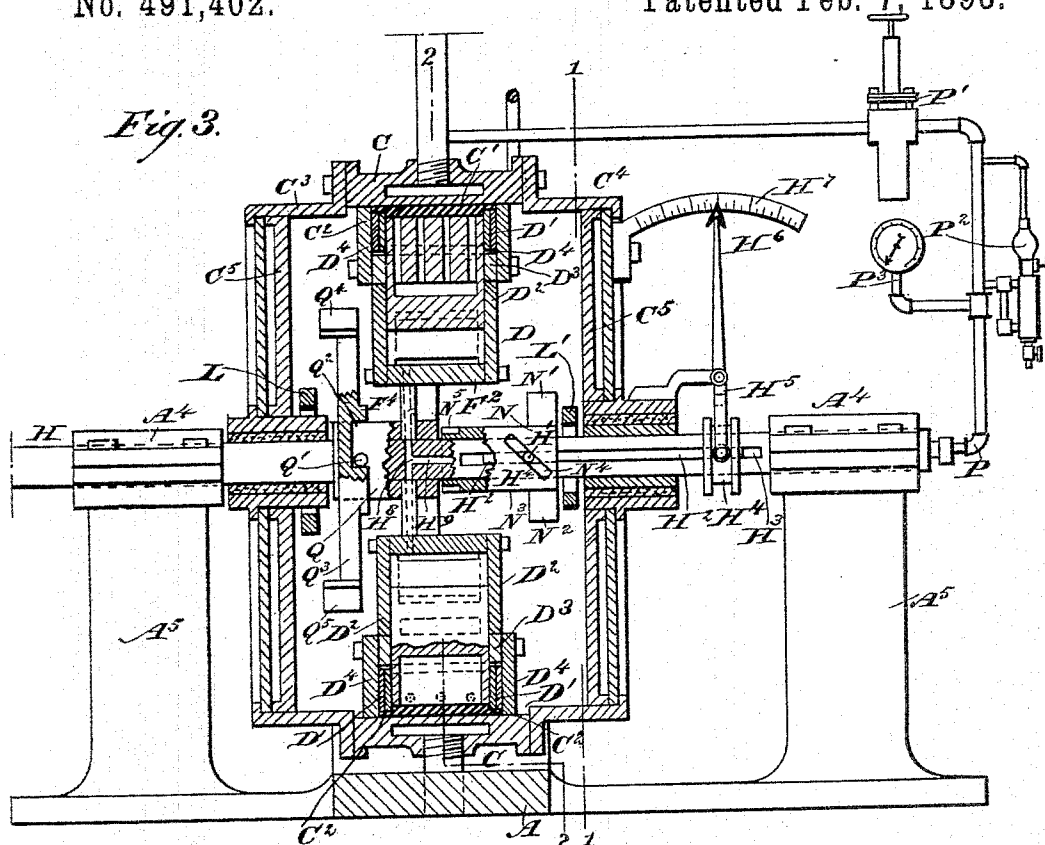
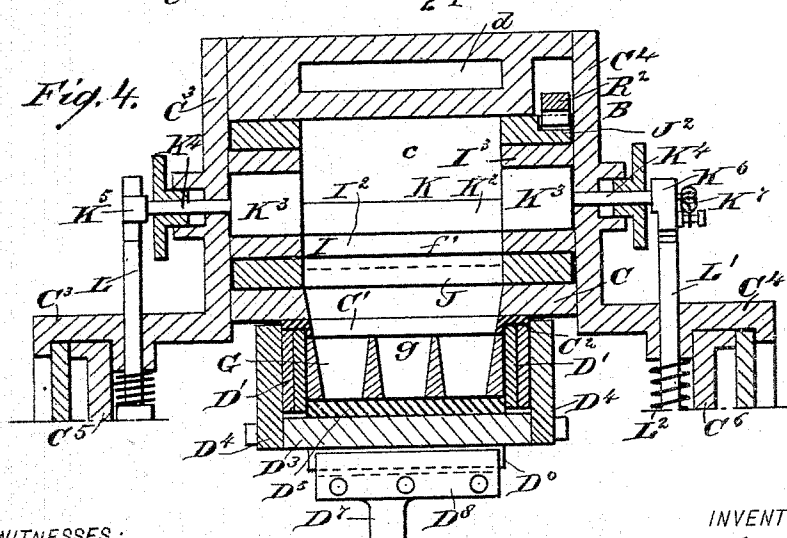


Fig. 4.



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UNITED STATES PATENT OFFICE.

ALBERT D. BELLINGER, OF BLACK RIVER FALLS, WISCONSIN, ASSIGNOR TO
HIMSELF AND HENRI B. COLE, OF SAME PLACE.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 491,402, dated February 7, 1893.

Application filed December 8, 1891. Serial No. 414,360. (No model.)

To all whom it may concern:

Be it known that I, ALBERT D. BELLINGER, of Black River Falls, in the county of Jackson and State of Wisconsin, have invented a new and useful Improvement in Rotary Engines, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved rotary engine which is simple and durable in construction, very effective in operation, and arranged to utilize the motive agent to the fullest advantage, at the same time reducing friction to a minimum and compensating for any endwise thrust or movement of the shaft, so as not to disturb the relative position of the piston and cylinder.

The invention consists of certain parts and details, and combinations of the same as will be hereinafter fully described and then pointed out in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional end elevation of the improvement on the line 1—1 of Fig. 3; Fig. 2 is a like view of the same on the line 2—2 of Fig. 3; Fig. 3 is a sectional side elevation of the same on the line 3—3 of Fig. 1; Fig. 4 is an enlarged sectional plan view of the steam chests and adjacent parts; Fig. 5 is an enlarged sectional side elevation of part of the same; and Fig. 6 is a side elevation of the device for returning the cut off valves.

The improved rotary engine is mounted on a base A, formed at or near its center with a transversely extending segmental arm A', provided at its upper end with outwardly extending flanges A², supporting screws or bolts A³, engaging lugs B², formed in the under side of the steam chests B and B', arranged diametrically opposite each other on the cylinder C, and forming part of the same. The cylinder C is lined on its inside with a ring C', formed with annular shoulders C², on its ends, the said shoulders being engaged by sets of packing rings D', forming part of a wheel D, mounted to rotate within the stationary cylinder C.

The rings D' are supported partly on plates D² and on the rim D³, on which the former

are bolted or otherwise secured at their inner ends. The faces of the two outermost rings of the sets of rings D' abut against the inner surface of the rings D⁴, bolted to the outer edges of the rim D³ and the plates D², as plainly shown in Figs. 3 and 4.

The peripheries of the rings D⁴ extend closely to the inner surface of the cylinder C, and the inner sides of the said rings also abut against the edges of the lining C, thus holding the rings D', which are packing rings, in place on the shoulders C² of the lining C'. The periphery of the rim D³ is lined by a sectional ring D⁵, which latter forms with the lining C' and the packing rings D', a steam space E, into which passes and acts, the motive agent for driving the machine. The motive agent introduced into the steam space E acts on the pistons F and F', fitted to slide in casings F² and F³, respectively extending to the rim D³ of the wheel D. The outer ends of the said pistons pass through the rim D³ and lining D⁵ and are adapted to travel on the inner surface of the lining C' of the cylinder C and also come in contact with the abutments G and G', located diametrically opposite each other next to the steam chests B and B' respectively, as plainly illustrated in Fig. 2.

The rim D³ of the wheel D is provided with inwardly projecting and longitudinally extending lugs D⁶, engaged at opposite sides by plates D⁸, bolted or otherwise secured to the arms of a spider D⁷, secured by suitable means on the main driving shaft H, passing centrally through the cylinder C and journaled in suitable bearings A⁴, formed or attached to standards A⁵, supported on the base A of the main frame. Thus the shaft H is journaled in bearings independent of the support for the cylinder C. The outer surfaces of the arms of the spider D⁷ abut on the inner surfaces of the lugs D⁶, but the ends of the said arms are unrestricted so that a lengthwise shifting of the shaft H and the spider D⁷ does not disturb the position of the rim D³, as the said spider arms D⁷ are free to slide longitudinally on the lugs D⁶. When the shaft H, however, is turned, the spider arms by their plates D⁸ engaging the lugs D⁶ at opposite sides carry the rim D³ along, thus revolving

the entire wheel D within the casing C. The lining D⁵ abuts at its outer edges on the innermost rings of the sets of rings D' so as to hold the same in proper position on the rim D³, the said rings thus forming with the lining C', and the lining D⁵, a tight joint to prevent all leakage of the motive agent from the steam space E.

In the rim of the cylinder C are formed the channels *a* and *b*, of which the channel *a* is connected with a suitable source of motive agent supply, while the channel *b* is connected with an exhaust pipe. The channels *a* and *b* extend each through nearly one-half of the rim of the cylinder C, as plainly shown in Fig. 2, so as to steam-jacket the cylinder C. The ends of the channels *a* open into the cylindrical spaces *c* and *c'*, formed in the steam chests B and B' respectively, and the ends of the channel *b* terminate in circular channels *d* and *d'*, also formed in the steam chests B and B', respectively, and surrounding the central spaces *c* and *c'*. In the latter are secured the valve seats I and I', containing the cut-off valves K and K', respectively, each of the said valve seats being formed with a cross bar I², attached to the cylindrical parts I³, fastened to the head plates C³ and C⁴, of the cylinder C, as plainly illustrated in Fig. 4.

The cross bars I² of the valve seats I and I' engage the back of the reversing valves J and J' respectively, mounted to turn in the spaces *c* and *c'*, the shifting of the reversing valves being accomplished by hand whenever it is desired to reverse the engine, as hereinafter more fully described.

In the cross bars I² of the fixed valve seats I and I' are formed the inlet ports *e* and *e'*, respectively, opening at all times into larger ports *f* and *f'*, formed in the reversing valves J and J' respectively. The ports *f* and *f'* in the reversing valves J and J', connect with the ports *g* and *g'*, extending through the cylinder C, and lining C' and the abutments G and G', to open into the steam space E below and above a horizontal plane extending diametrically through the shaft H and the centers of the steam chests B and B'. When the reversing valves J and J' are turned in order to reverse the engine, the ports *f* and *f'* connect with the ports *h* and *h'*, respectively, also extending through the cylinder C, its lining C' and the abutments G, G' respectively, to open into the steam space E at opposite sides, that is above and below the ports *g* and *g'*, as plainly illustrated in said Fig. 2.

In the abutment G between the inner ends of the ports *g* and *h* is arranged a packing bar G², pressing on the outer surface of the ring lining D⁵, the pressure on the bar G² being exerted by the motive agent passing through the port *f* and a small port *f*², to the back of the said bar, as plainly shown in Fig. 2. A similar packing bar G³, is arranged in the abutment G' and is located between the inner ends of the two ports *g'* and *h'*. The mo-

tive agent from the port *f'* passes through a port *f*², to the back of the packing bar G² so as to press the latter in contact with the outer surface of the ring lining D⁵. In the periphery of the reversing valve J and above and below the port *f* are formed cavities *i* and *i'*, and similar cavities *i*² and *i*³, are formed on the reversing valve J' above and below the port *f'*. The cavity *i* is adapted to connect the port *h* with the channel *d* so that the exhaust motive agent from the space E can pass through the port *h*, cavity *i*, into the channel *d* and from the latter to the exhaust channel *b* to finally pass to the outer air. The other cavity *i'* is adapted to connect the port *g* with the channel *d* when the reversing valve J has been changed to reverse the engine, as above described. In a like manner the cavity *i*² is adapted to connect the port *g'* with the channel *d'* at the time the position of the reversing valve J' has been changed to reverse the engine. The other cavity *i*³ is adapted to connect the port *h'* with the channel *d'* when the engine is run in the direction of the arrow *a'*, the exhaust steam passing through the port *h'*, cavity *i*³, into the channel *d'* and from the latter to the channel *b* to finally pass to the outer air.

When the several parts are in the position illustrated in Fig. 2, and steam is admitted to the channel *a* then it passes into the spaces *c*, *c'* and from the latter through the ports *e*, *e'* and ports *f*, *f'* respectively, into the ports *g*, *g'*, respectively, and then into the space E below and above the abutments G, G', respectively, so that the motive agent acts on the two pistons F and F' to turn the wheel D in the direction of the arrow *a'*. The exhaust steam in front of the pistons F, F' passes through the ports *h*, *h'*, cavities *i*, *i*³ into the channels *d*, *d'* and from the latter through the channel *b* to the outer air. When the positions of the reversing valves J and J' are changed, then the ports *h*, *h'* become the inlet ports for the motive agent, and the ports *g*, *g'* the exhaust ports, to conduct the exhaust into the channel *b* by means of the cavities *i'*, *i*² and the channels *d*, *d'*. Each of the channels *d* and *d'* is connected by a channel *k*, with a port *l*, connecting the inlet channel *a* with the interior of the cylinder, that is the space E, as plainly illustrated in Fig. 5. In this port *l* is arranged to slide a block or valve *n*, held normally closed, as shown in the said figure, by the pressure of the motive agent in the channel *a*. In case of the increase of pressure (back pressure) in the space E, the valve *n* is forced outwardly so that the channel *k* is opened and connection is established between the space E and the channel *d* or *d'* to permit the excess of pressure to pass into the exhaust channel *b*. The amount of motive agent passing from the respective space *c*, *c'* through the ports *e*, *e'* respectively in the valve seat I or I' respectively, is controlled by the respective cut-off valve K or K' each of which is provided with a cross bar

K², connecting the cylindrical ends K³, with each other. The cylindrical ends K³ are mounted to turn in the valve seats I, I' respectively, as plainly shown in Fig. 4. Each valve stem K⁴, of the two cut-off valves K and K' carries on its outer ends arms K⁵ and K⁶, of which the latter are each connected with a spring K⁷, attached on the casing C and serving to hold the arm K⁶ and its valve in either of the two positions into which it is moved, as hereinafter more fully described. The arms K⁵ stand diametrically opposite the arms K⁶ as plainly shown in Figs. 1, 4 and 6.

The arms K⁵ and K⁶ of the valve K are adapted to be engaged by the left ends of the bars L and L', respectively mounted to slide in suitable bearings in the cylinder heads C³ and C⁴ respectively. The other or right hand ends of the bars L and L' abut against and are adapted to impart a swinging motion to the arms K⁵ and K⁶ of the valve K'.

The bar L' serves to move the valves K and K', to cut off on the ports *e* and *e'* respectively, the valves being held in this cut off position by the action of the spring K⁷ until the other bar L moves the valves in an opposite direction to reopen the ports *e* and *e'* to admit the motive agent.

Both bars L and L' are actuated from the main driving shaft H, the bar L by means of a cam and the other bar L' by a cam controlled by a centrifugal governor to regulate the amount of cut off according to the speed of the engine. Each of the bars L or L' is pressed on by a spring L², resting with one end against the head C⁴ and with its other end presses against a nut L³, held adjustably on the respective bar L or L'. A jam nut abutting against the nut L³ locks the latter in place. The sliding motion of the bar L' is limited in one direction by adjustable nuts L⁴, held on the bar L' and abutting against the head C⁴, as shown in Fig. 1. In the middle of each of the bars L or L' is formed a ring L⁶, through which passes loosely the main driving shaft H. On one side of the ring on the bar L' is arranged a friction roller L⁵, adapted to be alternately engaged by the ends N' and N² of a cam N, provided with a sleeve N³, fitted on the main driving shaft H. In the sleeve N³ is formed a diagonal slot N⁴, engaged by a pin H', projecting from a key H², mounted to slide in a longitudinal groove or key-way H³, formed in the main driving shaft H. On the outer end of the key H² is secured a grooved collar H⁴, engaged by the forked end of a lever H⁵, pivoted on a bracket supported from the casing C. The free end of the lever H⁵ is provided with a pointer H⁶, indicating on a graduated segment H⁷, as illustrated in Fig. 3.

On the inner end of the sleeve N³ of the cam N is formed or secured a gear wheel N⁵, engaged at opposite sides by racks O and O', pivotally-connected with weighted governor arms O² and O³, respectively pivoted at O⁴ on arms of the spider D², the two pivot points

being located diametrically opposite each other, as indicated in Fig. 1. Each of the arms O² and O³ is formed near its pivot end with a lug O⁵ and O⁶, connected with springs O⁷ and O⁸, respectively, attached on adjustable bolts O⁹, held on the wheel D. The pressure of the springs O⁷ and O⁸ holds the weighted ends of the governor arms O² and O³ in an innermost position, but when the speed of the engine increases above a normal rate then the said arms O² and O³ swing outwardly against the tension of the springs O⁷ and O⁸ respectively. The swinging movement of the arms O² and O³ causes the racks O and O' to turn the gear wheel N⁵ so that the sleeve N³ of the cam N is turned, and the position of the cam ends N' and N² of the cam N is changed. At the same time the slot N⁴ of the sleeve N³, engaging the pin H' imparts a sliding motion to the latter and consequently to the key H² so that the collar H⁴ imparts a swinging motion to the lever H⁵, the point H⁶ of which then indicates the amount or cut-off on the segment H⁷. The cam ends N' and N² in revolving with the shaft H alternately engage the friction roller L⁵ so that the bar L' is shifted to the right against the tension of the spring L². The latter returns the bar to the normal position shown in Fig. 1, as soon as the cam ends have left the friction roller L⁵. The shifting of the bar L to the right causes a swinging of the arms K⁶ so that the cut-off valves K and K' are turned and the cross bars K² of the said valves cut off sooner or later on the ports *e* and *e'*, thus admitting more or less steam to the space E. It is understood that the bar L is returned to its former position after passing the arrow-shaped ends Q⁴, Q⁵ of the lever Q³ by its spring L². At this point the admission valve is open, effected by the movement of the bar L' by pushing arms K⁶ over the center, the spring K⁷ finishing the movement. The length of this movement is checked by the arms K⁵ striking ends of bar L. It is further understood that the two arms K⁵ and K⁶ play outside the ends of bars L and L' and the two arms on the opposite or left side play between the turned-up or right angle ends of bars L and L'. This arrangement allows the four arms to have a free movement and to play to and from their respective abutting points.

It will be seen that when the speed of the engine increases above a normal rate the position of the cam N is changed so that the cam ends N' and N² act sooner on the friction roller L⁵, thus changing the position of the valves K and K' to cut off the motive agent sooner at the ports *e* and *e'*.

On the shaft H is secured a sleeve Q, provided with a pin Q', extending into a notch Q², formed in a lever Q³, mounted to turn loosely on the said sleeve Q and having its outer ends Q⁴ and Q⁵, arrow-shaped as plainly illustrated in Figs. 2 and 3. The outer ends Q⁴ and Q⁵ are adapted to alternately engage a friction roller L⁷ held on the bar L, to shift

the latter so as to turn the valves K and K' to reopen the ports *e* and *e'* as before described. It will be seen that on reversing the motion of the engine the shaft II turns in an opposite direction for a distance before the pin Q' of sleeve Q strikes the other end of notch Q² and carries lever Q³ along, so that the latter does not act on friction roller L⁷ until piston F or F' has passed the respective live steam port in the abutment G or G'. It is understood that when the arms K⁵ and K⁶ are pushed or pulled past a central position by the action of the bars L and L', as above described, the springs K⁷ finish the opening or closing motion of the valves K and K'. A pad or other device is arranged in casing C¹ for the rod L', to deaden the noise on the return of rod L' and its nuts L⁴. The cut-off cam N can follow the cam lever Q³ so closely that the motive agent can be cut off at less than one-tenth of full stroke and owing to the free exhaust ports uncontrolled by valves and open at all times into the channel *b*, the cut-off can be prolonged ninety-nine one-hundredths of the full stroke and the governor will likewise work automatically within the range of one-tenth to ninety-nine one-hundredths.

The pistons F and F' are mounted to slide in casings F² and F³ respectively attached to the inside of the rim D³ of the wheel D, the plates D² covering the sides of the said casings. The inner ends of the casings F² and F³ are connected by pipes F⁴ with a diametrical opening H⁸, formed in the main driving shaft II connected with a central opening H⁹, arranged longitudinally in the said shaft and extending to one end thereof. The outer end of the shaft is connected at the central opening H⁹ with a pipe P, connected with the inlet pipe of the motive agent, as plainly shown in Fig. 3. On the pipe P is arranged a reducing valve P', a lubricant-feeding device P², and a pressure gage P³, all of approved constructions. The reducing valve P' serves to maintain a constant pressure in cylinder in case of varying boiler pressure. Now a part of the motive agent can pass through the pipe P into the openings H⁹ and H⁸ to pass through the pipes F⁴ into the inner ends of the casings F² and F³, so that the motive agent presses against the inner ends of the pistons F and F' to hold the same with their outer ends in contact with the lining C' and the inner surfaces or sides of the abutments G and G'. The inner sides of the abutments extend vertically and tangentially to the ring lining D⁵ as shown in Fig. 2.

The pistons F and F' are moved inward when passing onto the respective abutment G or G' and are finally pressed into an innermost position when passing the respective packing bar G² or G³. The pistons are then again forced outward while passing over the other half of the respective abutment by the action of the motive agent in the casings F² and F³ pressing on the inner ends of the said

pistons. When the pistons pass onto the abutments G and G', then the said pistons in passing over the exhaust ports exhaust the motive agent in the casings F² and F³, to permit the pistons to readily slide inward while traveling over the remainder of the abutments. For this purpose each of the abutments is provided with a channel *o*, adapted to connect with a port *p* formed in one side of the exhaust casing F², so that the motive agent from the casing can pass through the port *p* into the channel *o* and from the latter into the respective exhaust port at the time the piston passes over the latter. The shifting of the reversing valves J and J' is accomplished by hand and for this purpose the following device is employed.

A segmental rod R is mounted to slide in suitable bearings attached to the casing C and is provided with a handle R' for conveniently shifting the said rod R, the ends of the latter passing through suitable stuffing boxes into the steam chests B and B', and each inner end is formed with segmental gear teeth R² in mesh with gear teeth J² formed on the respective reversing valves J or J', as plainly illustrated in Figs 1 and 2. By moving the handle R' in one direction, the two valves J and J' are turned so that their positions are changed to reverse the engine, as above described. It is understood that the reversing valves J and J' turn in the steam chests in the space *c* on the cylindrical ends I³ of the fixed valve seats I and I' respectively, as above described.

It will be seen that by this machine full provision is made for all endwise thrust of the shaft II, as the longitudinal shifting of the latter does not affect the relative positions of the wheel D and the cylinder C. It will further be seen that the cylinder is steam-jacketed by forming the inlet channel *a* and the exhaust channel *b* semi-circular, as above described and shown in the drawings.

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

1. In a rotary engine, a wheel provided with a rim having projections, a spider abutting with its arms on the said projections, and plates attached to the spider arms and abutting on the sides of the said projections, substantially as shown and described.

2. A rotary engine, provided with a wheel comprising a spider, a rim formed with inwardly-extending projections abutting on the arms on the spider, plates secured on the spider arms and engaging opposite sides of the said projections, a lining held on the outer surface of the said rim, and packing rings supported on the said rim and abutting against the said lining, substantially as shown and described.

3. A rotary engine, provided with a wheel comprising a spider, a rim formed with inwardly-extending projections abutting on the arms of the spider, plates secured on the

spider arms and engaging opposite sides of the said projections, a lining held on the outer surface of the said rim, packing rings supported on the said rim and abutting against the said lining, and outer rings abutting against the said packing rings and secured on the said rim, substantially as shown and described.

4. In a rotary engine, the combination with a cylinder provided with a lining in the form of a ring having annular shoulders, of a wheel mounted to turn within the said cylinder and comprising a ring, a spider carrying the said rim, a lining held on the said rim, and packing plates extending from the said rim and its lining to the shoulders on the lining of the said cylinder, and rings secured to the outer edges of the said rim to hold the packing rings in place, substantially as shown and described.

5. In a rotary engine, the combination with a cylinder provided with a lining in the form of a ring having annular shoulders, of a wheel mounted to turn within the said cylinder and comprising a rim, a spider carrying the said

rim, a lining held on the said rim, and packing plates extending from the said rim and its lining to the shoulders on the lining of said cylinder, rings secured to the outer edges of the said rim to hold the packing rings in place, projections extending inwardly from the said ring, and plates attached to the spider arms and engaging the sides of the said projections, substantially as shown and described.

6. In a rotary engine, the combination with a wheel provided with sliding pistons, of a cylinder forming a steam space with the said wheel and provided with an inlet channel and an exhaust channel, a channel leading from the said inlet channel to the said steam space, and an auxiliary channel leading from the last mentioned channel to the exhaust channel, and a valve fitted to slide in the channel connecting the steam space with the inlet channel, substantially as shown and described.

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