No. 648,329. Patented Apr. 24, 1900.

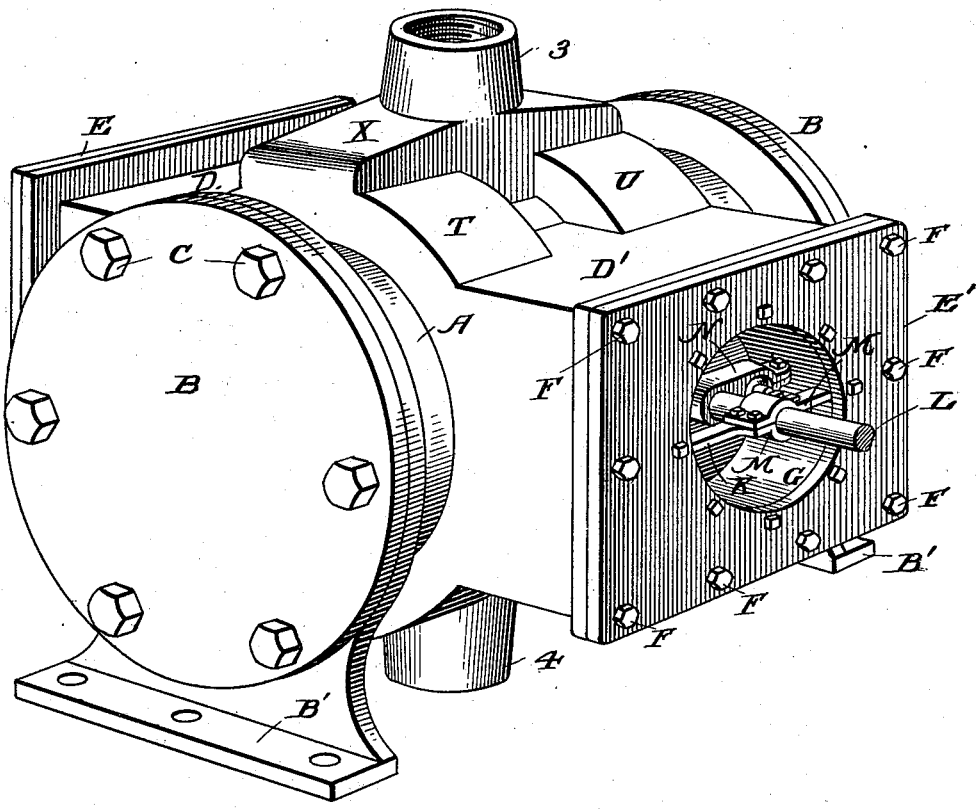
J. C. ANDERSON.

ENGINE.

(Application filed Oct. 10, 1899.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



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No. 648,329. Patented Apr. 24. 1900.

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(Application filed Oct. 10, 1899.)

(No Model.) 5 Sheets—Sheet 2.

Fig. 2.

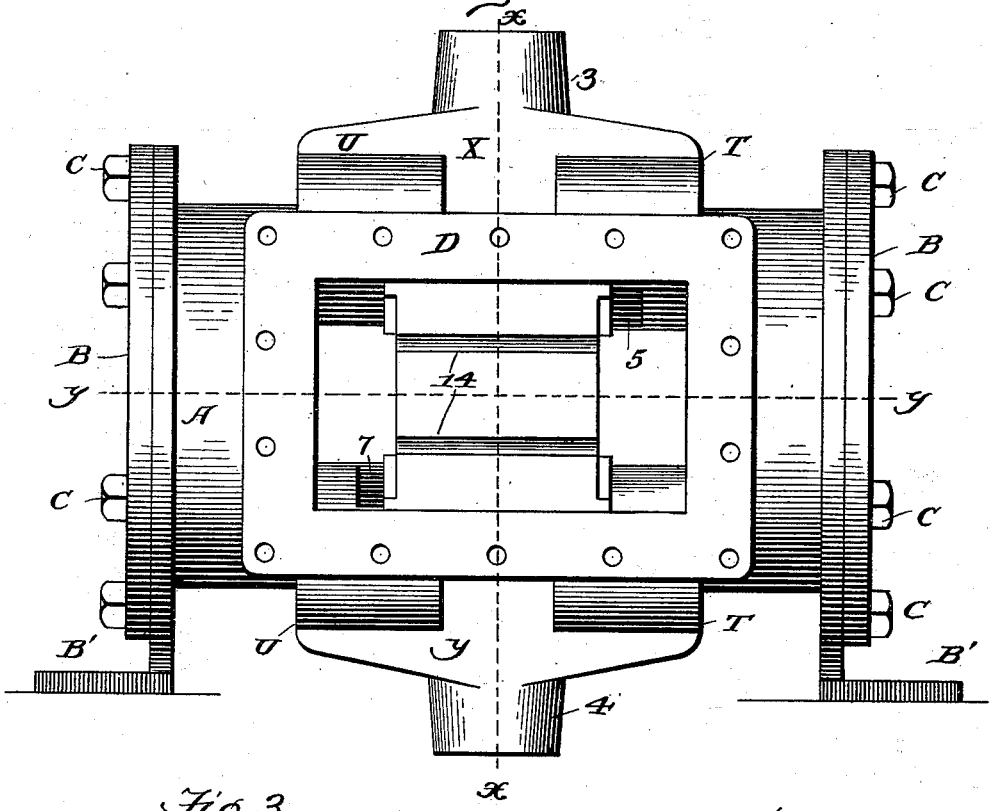


Fig. 3.

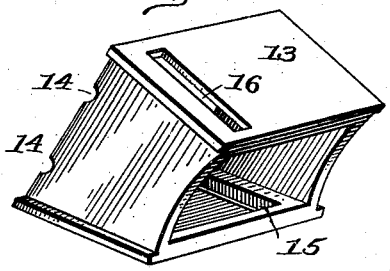
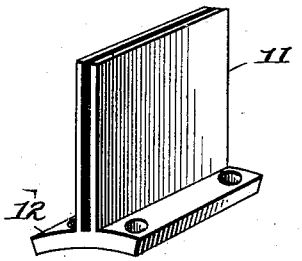


Fig. 4.



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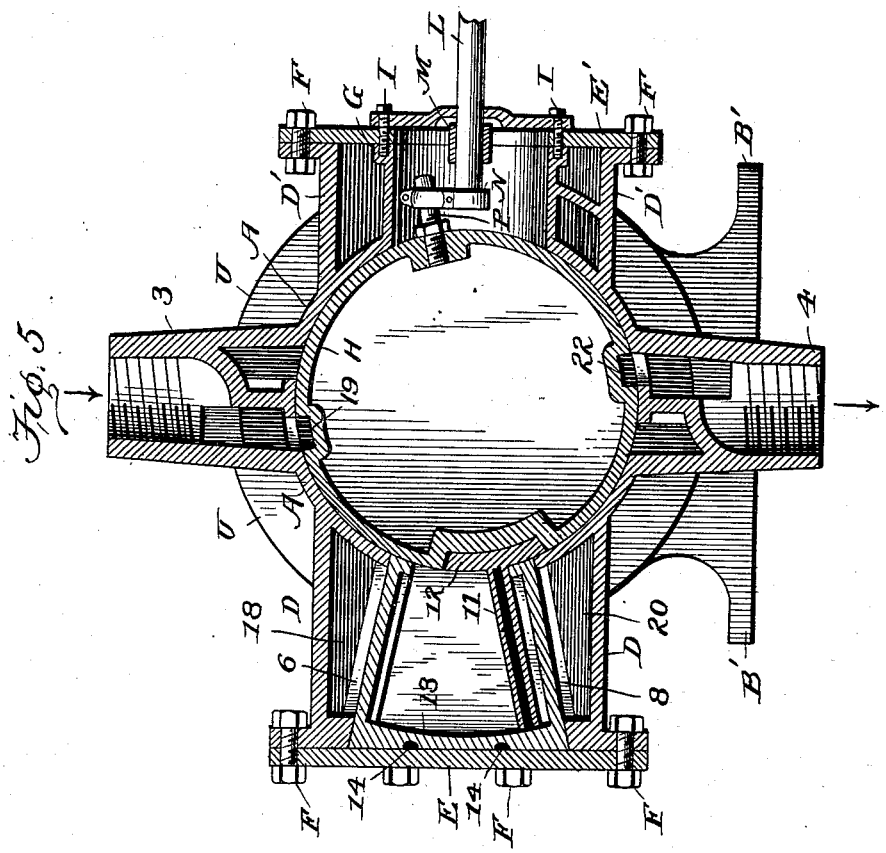
(No Model.) 5 Sheets—Sheet 3.

Fig. 5



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(Application filed Oct. 10, 1899.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 7.

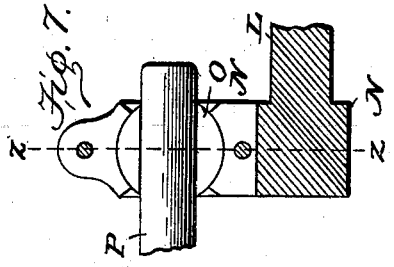


Fig. 8.

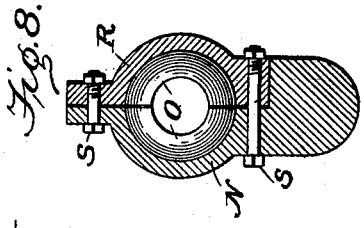
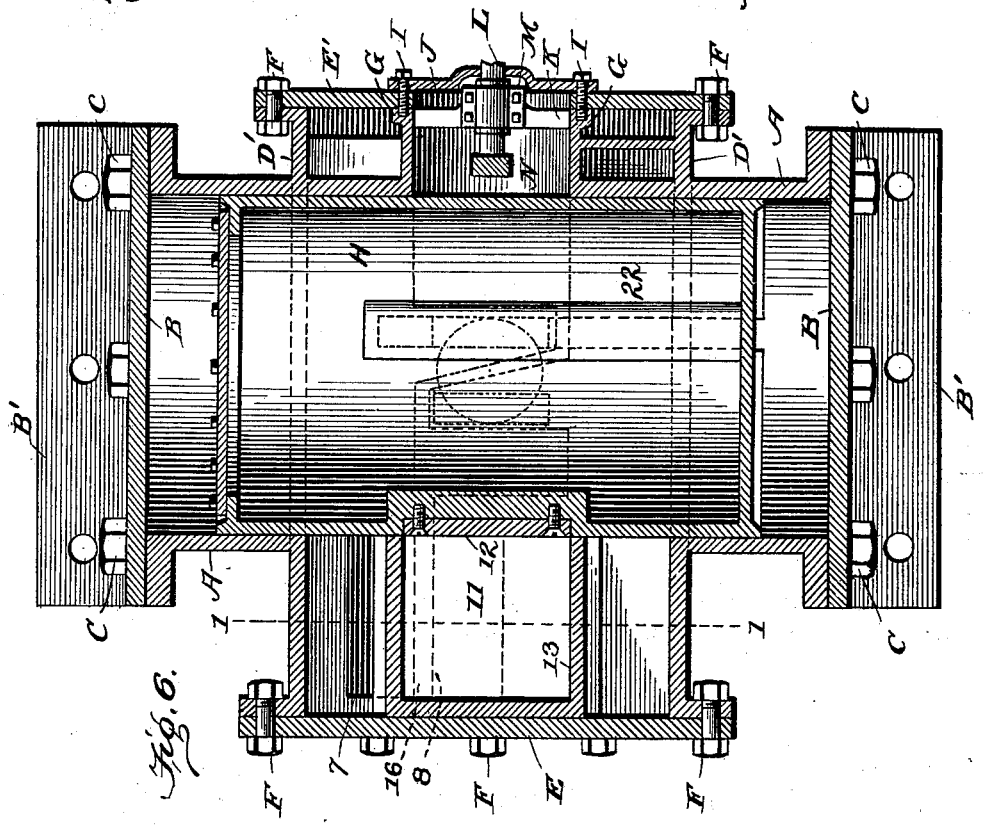


Fig. 6.



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(No Model.) 5 Sheets—Sheet 5.

Fig. 10.

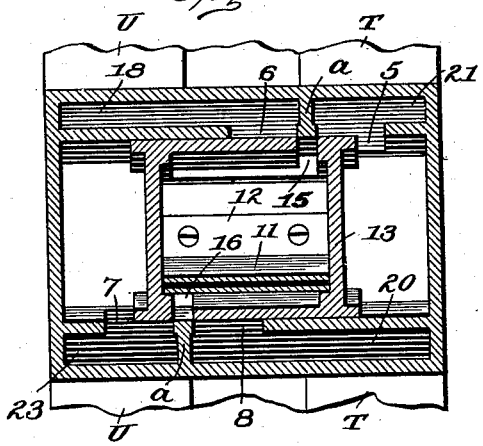


Fig. 11

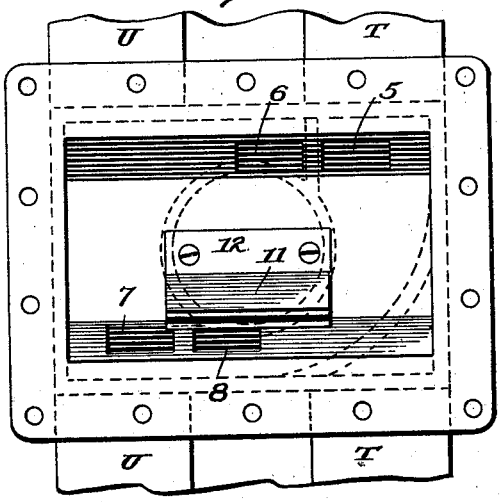
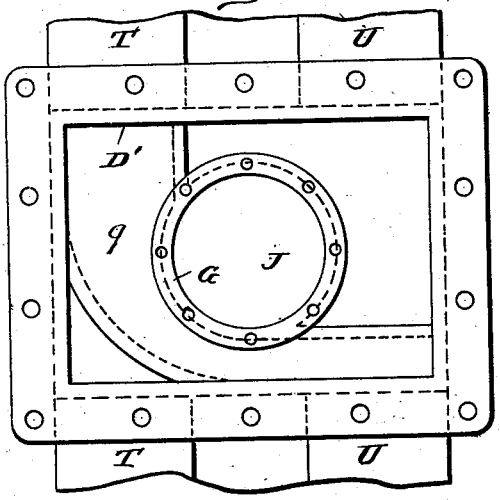


Fig. 9.



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UNITED STATES PATENT OFFICE.

JAMES C. ANDERSON, OF HIGHLAND PARK, ILLINOIS.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 648,329, dated April 24, 1900.

Application filed October 10, 1899. Serial No. 733,189. (No model.)

To all whom it may concern:

Be it known that I, JAMES C. ANDERSON, a citizen of the United States, residing at Highland Park, in the county of Lake and State of Illinois, have invented certain new and useful Improvements in Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to certain new and useful improvements in that class of engines in which the power derived from the initial force or agent is delivered in a constant rotary direction, in contradistinction to the reciprocating movement of the ordinary piston-engine, which is converted through the medium of a crank and pitman into rotary motion.

In the present advances being made in automachines or machines provided with self-contained power for propelling the same the need of an engine adapted to utilize the full capacity of the motive force or agent, such as steam or compressed air, has been fully realized; but up to the present time, so far as I am aware, no practical engine delivering its motion in a constant rotary direction has been devised in which the entire power of the motive force can be utilized to the same extent and in the same way that it may be utilized in a reciprocating engine—that is, by employing all of the power of the motive agent—as, for instance, with steam, where all of the force at boiler-pressure is exerted against the head of the piston. Many attempts have been made to utilize all of these properties of the motive force or agent in a rotary engine in order to avoid the disadvantage of dead-centers and loss of power in converting reciprocating motion into rotary motion; but so far as I am aware no successful or practical rotary engine has been devised embodying the necessary construction to utilize in a constant rotary direction all of the forces of the power employed to run it. In all cases, so far as I am familiar with the progress of the art, where attempts have been made to produce such an engine the principal inherent defect lies in the fact that it has been impossible to utilize the full force of the power employed.

In order to illustrate my meaning and make perfectly clear the advance made by my improvement in the construction and operation of engines, I desire to call attention to the fact that prior to my invention in the use of steam as applied to engines only the projectile or escaping force of steam under pressure has been utilized in much the same manner as a blast or current of wind is utilized to turn the wheel of a windmill. I am aware that it has been suggested in some cases with the use of steam to utilize this projectile force initially and to subsequently utilize the inherent expansive property of the steam as a motive force; but in all such suggested cases such expansive force is entirely devoid of the boiler-pressure, because at the time when it is proposed to utilize the expansion of the steam the pressure from the boiler has been cut off, and hence if such expansive force as may be inherent in the cut-off steam could be utilized it would be practically ineffective by reason of the absence of boiler-pressure. In addition, however, to this deficiency of power it is well understood that the expansive force of steam being equal in all directions will establish a perfect equilibrium unless such result is provided against, and I am not aware of any construction in rotary engines involving any such provision.

My invention has for its object to provide an engine in which all of the properties or forces employed to run the same may be utilized to the fullest extent or a minimum amount of power may be exerted to the best advantage, which latter condition is especially desirable in the propulsion of automobile vehicles, where the carrying capacity and other conditions render it necessary that the least amount of motive force be expended within a given time or distance of travel.

With these ends in view my invention consists, generically, in an engine embodying in its construction its adaptability to economically utilize the full complement of the motive force of the agent employed to run the same, all as will be hereinafter more fully set forth.

My invention consists, further, in the details of construction, arrangement, and operation hereinafter fully explained.

In order that those skilled in the art may fully understand my invention, I will proceed to describe the construction and opera-

tion of my improved engine, referring by letters and figures to the accompanying drawings, in which—

Figure 1 is a perspective view of an engine embodying my invention with the dust-cap removed. Fig. 2 is a side elevation of the same with the cap removed. Fig. 3 is a perspective view of the box or housing which incloses the radial wing. Fig. 4 is a perspective view of the radial wing adapted to be secured to the piston. Fig. 5 is a central cross-section on the line *x x* of Fig. 2. Fig. 6 is a longitudinal horizontal section on the line *y y* of Fig. 2, but with the cap in place. Fig. 7 is a detail plan view, partly in section, showing the connection between the shaft extending radially from the piston and a driving-shaft. Fig. 8 is a section on the line *z z* of Fig. 7. Fig. 9 is a detail face view or elevation of one of the lateral boxes of the casing. Fig. 10 is a detail section taken at the line 1 1 of Fig. 6. Fig. 11 is a similar view to Fig. 9, but showing the opposite lateral box.

Similar letters and numerals indicate like parts in the several figures of the drawings.

A represents the shell or cylinder, which is inclosed at either end by heads B B, secured in place by screw-bolts C and provided with feet or lugs B′. The ends of the cylinder A are provided with flanges to receive the screw-bolts C, and a suitable packing of any desired material is interposed between the flanges of the cylinder and the heads.

The cylinder A extends laterally on each side to constitute boxes D and D′, which are closed by caps E E′, respectively, which are secured in place by screw-bolts and nuts F.

The bottom of the box D′ is cast with a circular wall G, surrounding a circular opening in the bottom of said box leading to and exposing the cylindrical piston H, as clearly shown at Figs. 5 and 6 and for the purpose presently explained. The upper edge of the wall G is slightly reinforced or thickened and adapted to receive metal screws I, which constitute means auxiliary to the screw-bolts and nuts F for securing the cap E′ in place and also for securing an auxiliary or dust cap I in position to close the well within the circular wall G. The caps E, E′, and J are all secured in place with suitable packing to make tight joints in an obvious manner. Extending between the opposite sides of the wall G and formed integral therewith and in a diametric line is a bridge K, with a transverse journal-recess to receive the driving-shaft L, which is secured in place by a journal-box M, similarly recessed, as clearly shown in Figs. 1, 6, and 9.

The well or space within the circular wall G provides the necessary space for the rotation of the crank-arm N on the end of the shaft L and to contain the necessary lubricant for the parts located therein. This crank-arm is formed integral with the shaft L, as shown at Figs. 7 and 8, and with one-half of a spherical recess to receive a centrally-divided ball or sphere O, formed with an axial channel for the passage of a short radial arm P, threaded into the wall of the cylindrical piston H, which is interiorly reinforced, as shown at Fig. 6, and a jam-nut Q secures the arm P in its fixed relation with the cylindrical piston. The ball or sphere O is secured in place within the recess in the free end of the crank-arm N by a similarly-recessed block or forging R, secured to the crank-arm by screw-bolts and nuts S, as shown at Fig. 8.

The cylindrical piston H is caused to reciprocate and to also oscillate upon an imaginary longitudinal axis, as will be more fully explained, and in following these motions the short arm will traverse in a circle, or, in other words, a card taken from the movement of said arm will be a circle, the diameter of which will be equal to the distance traveled by the piston in its reciprocating or in its oscillatory movement. The piston H is hollow and reciprocates within the cylinder or casing A, between the heads B B, and as it approaches the end of each reciprocating movement it is caused to oscillate or partially rotate in opposite directions alternately upon an imaginary longitudinal axis, so that the fixed short arm P will traverse in a circle, and as it is connected through the medium of the spherical joint at the outer end of the crank formed on the end of the shaft L the latter is necessarily rotated or driven in an obvious manner.

I will now proceed to describe the construction through the medium of which the cylindrical piston is caused to move longitudinally and rotatively.

The casing A is formed with circumferential enlargements T U, extending each side from the lateral boxes D and D′ to central longitudinal enlargements X Y, which terminate in interiorly-threaded extensions 3 and 4, adapted to connect, respectively, with the supply and exhaust pipes. The sides of the lateral box D are made hollow, with the inside walls tapering or converging, as clearly shown at Fig. 5, and said inside walls are formed with ports 5, 6, 7, and 8, leading into the space between the straight outside and the converging or tapering inside walls. The two spaces between the side walls are each provided with a partition *a*, one between the ports 5 and 6 and the other between the ports 7 and 6, thus dividing the space on each side of the box D into two compartments, (or four on both sides,) each of said compartments communicating with the passages in the circumferential enlargements T and U—ports 5 and 8 with the passages in U and the ports 6 and 7 with the passages in T, in the manner to be hereinafter explained. The bottom and top of the spaces between the sides of the lateral box D are of course closed. The ports 5 and 6 are arranged to register successively with the port 15 in the hollow valve-box 13 and the ports 7 and 8 with the port 16 in the

valve-box 13. The circumferential enlargements T U are formed with interior passages leading as follows: Starting from the inlet 3 the passage leads to the right through enlargement X into the interior of the circumferential enlargement U, which being hollow communicates upwardly with the hollow space between the side walls of the lateral box D and in the opposite direction with the space within the box D, between its walls and the circular wall G of the central well. The continuation of this hollow enlargement U from the opposite side of the box D forms a passage or conduit from the space on that side between the side walls of the lateral box D and across the longitudinal enlargement Y to one end of a passage in an **S**-shaped pipe or trunk 9 in the box D', which communicates at its opposite end with the hollow space or passage within the circumferential enlargement T of the casing. The channel or passage in this enlargement T passes unobstructedly upwardly and through the opposite end of the longitudinal enlargement X and continues into the space between the walls of the lateral box D. The continuation of the enlargement T on the opposite side of box D leads from the hollow space between the walls of the said box D across the longitudinal enlargement Y, downwardly into the space between the outer walls of the box D' and the circular wall G therein, and diagonally opposite to the entrance into said space of the passage within the enlargement U.

The **S**-shaped pipe or trunk 9 is of less height than the walls of the box D', so that when the cap E' is in place there will be a space between the inner surface of said cap and the outer surface of the **S**-shaped trunk 9 to establish a free communication between the space in the box D' and the circumferential passages in the enlargements T and U.

The cylindrical piston H is formed hollow and with closed heads H', as clearly shown at Fig. 6, and the difference between the length of this piston and the cylindrical casing A is substantially equal to the distance the piston is designed to reciprocate. This piston is formed with diametric longitudinal grooves or channels closed at their inner ends and leading in opposite directions and open at their outer ends to communicate alternately with the spaces between the heads of the piston and the heads B of the piston-casing. The piston is provided with a radial wing 11, (see Fig. 4,) which may be secured in place by securing its base 12 within a recess in the periphery of the piston by metal screws. This wing is designed to fit between the ends of a hollow box-valve 13, (see Fig. 3,) the side walls of which are tapered to correspond with the inner tapered walls of the lateral box D. The lower edges of the ends of this box-valve are curved to lie upon the cylindrical surface of the piston H, and the upper closed surface or top is provided with longitudinal grooves 14, which permit the steam or other motive agent to enter therein for the purpose of equalizing the pressure upon said box to hold it in its true working position and to permit any steam which may accumulate at either end to pass through said grooves to the exhaust-ports in the oblique sides of the box D. The tapered sides of this box-valve 13 are provided, near their opposite ends, with ports 15 and 16, designed to register successively with the ports 5 6 and 7 8, leading into the hollow spaces between the opposite side walls of the lateral box D. When the cap E is in place, the hollow box-valve 13 will be held in operative position in an obvious manner. The engine being secured in position by the feet or lugs on the base and assuming that steam is used as the motive force, connection is made between the boiler and the inlet 3, and a suitable exhaust-pipe is connected with the outlet 4. The inlet connection is provided with any suitable valve for controlling the supply of steam. It will be understood that I may in many ways so connect the live-steam conduit that the engine may be readily reversed; but as my present invention does not include any special reversing mechanism I have avoided any confusion in the drawings by omitting reversing mechanism.

Thus far I have confined the description to the actual construction of the working parts of the engine, and I will presently explain how the steam traverses the several passages and ports to effect the necessary movements; but before doing so and in order that the purposes and results of said movements may be fully appreciated I will state that the piston is caused to move in paths which result from the resolution of forces and that while the direct action of the forces applied independently and at right angles to each other would cause the piston in its movements to describe a parallelogram the relation of the parts and the time of their movements are such that instead of the arm P on the piston H describing a parallelogram it traverses a perfect circle, and hence the driving-shaft is rotated without having to overcome any dead-centers and without the employment of a fly-wheel, and from this statement it will be understood that the piston may be started at any point in its path of movement. This ability of starting the piston at any point in its path of movement is due to the fact that it is caused to reciprocate under the action of steam against one of its heads with the exhaust open from the opposite end and to oscillate by the direct action of steam from independent ports against opposite sides of the wing 11, said steam being alternately exhausted and the relation between the ports leading to the heads of the pistons and to the opposite sides of the wing 11 and such that the longitudinal and oscillating movements of said piston are always at half-stroke relatively to each other—that is to say, when the piston has completed its reciprocating move-

ment in one direction the wing 11 has moved through just one-half of its path, and as the piston begins its longitudinal movement in the opposite direction the wing 11 is completing its path of movement and completes it when the piston has reached just one-half of its movement, and when the piston has completed its movement the wing 11 has half completed its reverse movement, and hence, as before stated, there can be no dead-center and the engine can be started at any point.

I will now describe the action of the steam to produce the movements just referred to, and in doing so it will be understood that the drawings are intended to represent the piston at half of its longitudinal stroke to the right and the wing 11 at the end of its complete movement in one direction. This condition of the engine will be best understood by reference to Figs. 6. 10, and 11. The valve being opened to admit steam to the inlet 3 it enters the passage leading from said inlet through the longitudinal enlargement X to the circumferential channel in U and thence upwardly to the space 17, between the sides of the lateral box D, and downwardly into the space in the box D′ surrounding the well-wall G, and upwardly through the channel in the circumferential enlargement T to the space 18, between the sides of the box D. At the same time the steam passes straight through to the longitudinal recess or channel 19 in the piston (see Fig. 5) and through said channel into the space between the left-hand head of the piston-cylinder and the head B of the casing. The first effect of the steam is to start the piston H to the right to make the last half of the stroke it was making when brought to a state of rest, as illustrated in the drawings, in which condition ports 15 and 16 in the sides of the box-valve 13 are closed against the inside walls of the lateral box D and the sides of the valve-box have closed the live-steam ports 6 and 8 in the sides of the box D, and consequently the wing 11 is necessarily at a state of rest, as shown. The moment the piston starts, carrying with it the wing 11 and inclosing valve-box 13, the port 16 of the latter begins to register with the live port 8, leading from the space 20 in the side of box D, and the steam entering from the port 8 and through the port 16 forces the wing 11 over toward the opposite side, and consequently partially rotates the piston, and at the same time the steam which had forced the wing 11 and piston into the position shown in the drawings is exhausted through the port 15 of the valve-box and the port 5 of the space 21 in the box D into the passage of circumferential enlargement U on that side of the case and through the passage in the longitudinal enlargement Y to the exhaust or outlet 4. During the movement just described of the piston the dead steam between its advancing head and the opposite head B of the casing is exhausted through the longitudinal channel 22, diametrically opposite to the channel 19 on the piston. The lengths of the channels 19 and 22 bear such relation to the steam ports or passages leading directly from the inlet and outlet 3 and 4 that live steam is taken and the dead steam is exhausted during the entire stroke of the piston. When the piston has reached the limit of movement which I have described, its motion has necessarily been such that the arm P on its periphery has traveled in the arc of a true circle. Now having described the completion of the movement of the piston in a direction to the right, I will explain its return or reverse movement, it being understood that the wing 11 has traveled through just one-half of its movement. The live steam now passes into the channel 22 and between the heads of the piston and case on the right and the piston begins its reverse reciprocation, and the ports 8 and 16 being still in register live steam from the space 20 continues to act upon the wing 11 until it has completed its movement and caused the piston to continue its rotative movement. When the wing has completed its movement in the direction indicated, the piston will again have made only half of its longitudinal movement, and the port 6 from the live space 18 and the port 15 in the side of the valve-box will open to each other and continue in such relation during the last half of the stroke of the piston and the first half of the return or reverse stroke, as heretofore described, and in the meantime the port 16 in the side of the valve-box 13 registers with the port 7, leading to the exhaust-space 23 in the side of the box D, and the dead steam in front of the wing 11 is exhausted through said ports and space and through the channel in the circumferential enlargement T into one end of the **S**-shaped trunk 9 through the same to the exhaust portion heretofore described of the enlargement U and to the outlet 4.

As clearly shown in the drawings, the wing 11 is made of two leaves slightly separated and designed to receive any suitable packing material, which, extending slightly beyond the upper edges and the ends of such leaves, will constitute an efficient packing between the wing and the box 13, and this packing will be rendered all the more effective by reason of the pinching action of the leaves under the pressure of the steam.

It will be understood that my invention necessarily contemplates the use of suitable packing and lubrication at all points where such may be necessary or desirable, and as I do not wish to be confined in these particulars I have not shown the same.

Many changes may be made in the mere details of construction without departing from the spirit of my invention, which involves the generic principle of utilizing in an engine the full motive force of the agent employed to run it, absolutely avoiding all dead-centers, avoiding the necessity for a fly-wheel, and accomplishing all of these desirable ends

through the medium of a prime mover set in motion by applying motive force under full pressure from more than one direction at the same time, as hereinbefore explained.

I desire to call particular attention to the fact that as the piston H is cylindrical and is caused to both reciprocate and oscillate that of necessity the radial arm P, which occupies a fixed relation to the periphery of the piston, must, as a result of the two movements of the piston, describe a circular path, and as the cylindrical piston oscillates upon its longitudinal axis during its reciprocating movement the arm P in addition to describing a circular path parallel with the longitudinal axis of the piston moves toward and from such circular plane, resulting in a compound motion, and hence, as shown, I have provided the ball-and-socket joint and have provided for the slip movement between the ball and the arm P by locating the latter within an axial channel or box of the sphere; but I do not wish to be confined to this particular construction of the connection between the arm P and the driving-shaft, as I may employ any other means which will convert and transmit the compound curvilinear motion of the arm P into the rotary motion of the shaft L on an axis having a fixed relation.

From the foregoing description of the construction and operation of my improved engine it will be understood that while the piston has a four-way movement it exerts its power in a constant rotary direction in contradistinction to pistons which momentarily cease in the application of power—as, for instance, in simple reciprocating pistons which of necessity cease in applying power at each end of the half-stroke—and under all such conditions a fly-wheel becomes a necessity to compensate for the temporary cessation of the applied power.

With my improved construction the full motive force of the steam or other motive agent is at all times and constantly applied directly to the rotation of the driving-shaft, thus rendering a fly-wheel unnecessary and eliminating entirely dead-centers. I am aware that it has been proposed to drive a crank directly from the periphery of a reciprocating piston through the medium of a radial or peripheral wrist-pin and to have said wrist-pin constitute a medium for returning a part of the power stored up in the fly-wheel for the sole purpose of rotating the piston to open and close the steam-ports in the piston and cylinder to secure the reciprocation of the latter and has no part whatever in driving the crank-shaft at such time, and I do not wish to have my invention confounded with any such construction and operation, for it will be understood that with my improved construction there are not only no dead-centers to overcome, but that the ports are always in proper register to admit and exhaust the steam or other motive agent to the piston and that the latter will immediately respond upon the admission of steam from the boiler.

Having described the construction and operation, as well as the advantages, of my improved rotary engine, what I claim as new, and desire to secure by Letters Patent, is—

1. In an engine, a rotative, reciprocating piston having a peripheral wrist-pin adapted to connect with a driving-shaft, in combination with means, substantially as described for controlling and directing the admission of the motive agent to the piston in planes transverse to one another, whereby the piston is reciprocated and oscillated and its power transmitted in a constant rotary direction, substantially as hereinbefore described.

2. In an engine, a piston adapted to reciprocating and rotative movements and provided with a peripheral wrist-pin and a peripheral wing in combination with a cylinder and means substantially as described for controlling and directing the motive agent alternately against each head of the piston and on each side of the radial wing, whereby the full pressure of the motive agent is exerted during all the movements of the piston and the power of the latter is transmitted in a constant rotary direction in a plane parallel with the longitudinal axis of said piston, substantially as hereinbefore set forth.

3. In an engine, a reciprocating rotative piston confined within a casing and provided at its periphery on one side of its axis with a radial arm, and diametrically opposite thereto, with a centrally-arranged radial wing 11, and with longitudinal steam-passages 19 and 22, a casing confining the piston and formed with lateral boxes D and D′, the former with steam-spaces 18, 20, 21, 23 and ports 5, 6, 7, 8, a box-valve 13 inclosing the wing 11, and formed with ports 15 and 16, and confined within the box D, and means for supplying and exhausting steam or other motive agent, substantially as and for the purposes hereinbefore set forth.

4. In combination with the casing A, formed with inlet and outlet passages, 3, 4, and with boxes D and D′ constructed as described and circumferential and longitudinal enlargements provided with steam-passages, the piston H provided with longitudinal passages 19, 22 and with radial arm P, and wing 11, and the box-valve 13, inclosing the wing 11, and provided with ports 15 and 16, substantially as and for the purposes hereinbefore set forth.

5. The wing 11, secured to the periphery of the piston H and composed of two separated wings adapted to receive a packing, in combination with the valve-box 13, inclosing the wing 11, substantially as and for the purpose set forth.

6. The casing A formed with the steam-passages in the enlargements T, U X, Y, and inlet and outlet 3, 4, the lateral box D′ formed with a well leading to the piston H and with the exhaust **S**-shaped trunk 9, crossing the

live-steam space within said box, substantially as and for the purpose set forth.

7. In combination with the casing A, inclosing the piston H and formed with the lateral box D having an open bottom, interior inclined walls, with steam-spaces 18, 20, 21 and 23, and ports 5, 6, 7, and 8, the piston H, formed with a radial wing 11, and the valve-box 13, having inclined side walls and ports 15 and 16, substantially as and for the purposes set forth.

8. In an engine such as described, the driving-shaft L mounted rotatively within boxes secured centrally of the wall G, of the box D′, said boxes concealed or protected by the cap J, whereby a dust-proof lubricating-well is provided, substantially as hereinbefore set forth.

9. In an engine such as described, in combination with the box D′, provided with the circular well-wall G, the bridge K, box M, shaft L, and caps E′, and J secured in place by bolts F, I, substantially as shown and described.

10. In an engine, the casing A, provided with lateral boxes D, D′, the former D with steam-spaces 18, 20, 21 and 23, and ports 5, 6, 7, and 8, and the latter D′, with a well leading to the interior of the casing and surrounded by a wall G, and formed with an exhaust-trunk 9, inlet 3, outlet 4, enlargements X and Y, provided with interior channels communicating with the interior passages in circumferential enlargements T, U, the passage in U terminating at each upper end in the spaces 20 and 21, respectively, of the box D′ and at their lower ends one in the space surrounding the wall G in the box D′ and the other in the exhaust-trunk 9, in combination with the reciprocating rotative or oscillating piston H, provided with radial arm 11, longitudinal passages 19 and 22, and radial wing 11, and the valve-box 13, provided with ports 15 and 16, substantially as and for the purposes set forth.

11. The piston H, provided with a radial wing adapted to receive steam-pressure on either side, in combination with a reciprocating hollow box-valve, and means for admitting and exhausting steam or equivalent from within the casing on each side of the wing, substantially as and for the purpose set forth.

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

JAMES C. ANDERSON.

Witnesses:
J. G. BOOTH,
JOSEPH E. DOWNING.