C. F. PAUL, Jr.

ROTARY ENGINE.

APPLICATION FILED NOV. 22, 1910. RENEWED OCT. 28, 1912.

1,047,559. Patented Dec. 17, 1912.

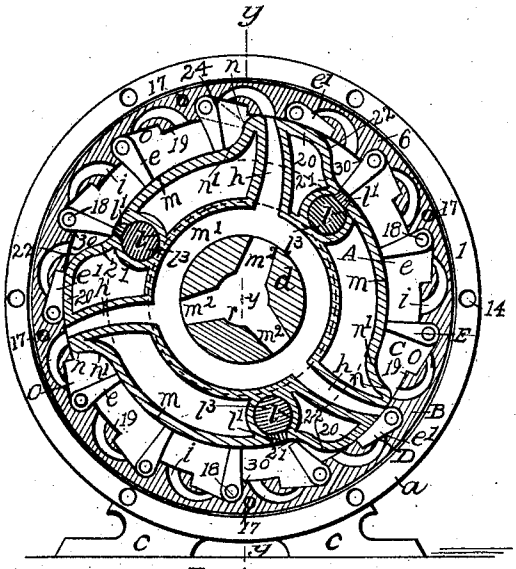

Fig. 1

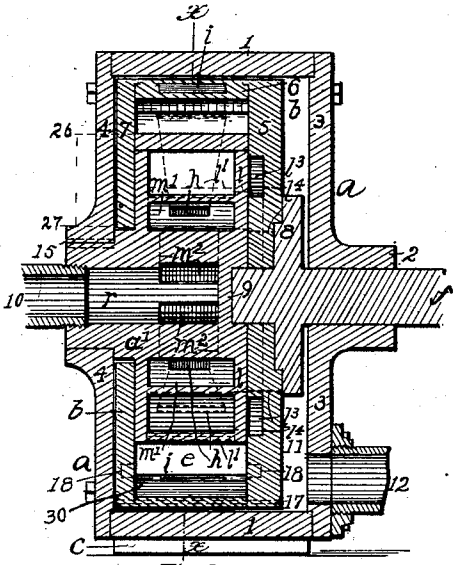

Fig. 2

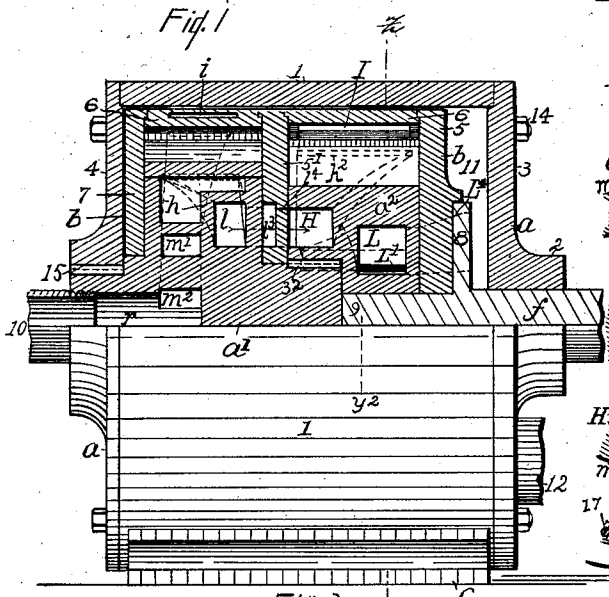

Fig. 3

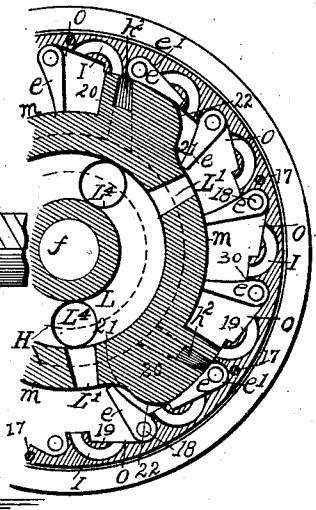

Fig. 4

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ROTARY ENGINE.

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Application filed November 22, 1910, Serial No. 593,735. Renewed October 28, 1912. Serial No. 728,265.

To all whom it may concern:

Be it known that I, CHRISTIAN F. PAUL, Jr., a citizen of the United States, and resident of Peekskill, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to rotary engines, and has for its objects first, an embodiment in simplified form of certain elements that are embraced in an application filed by myself under date of December 28, 1908, Serial Number 468,667, and second, the employment of those elements to constitute a rotary engine using the steam expansively. These objects are attained by the means set forth in this specification and the accompanying drawings, in which like letters and numbers refer to similar parts throughout the several views, and which together constitute a full, clear, and exact description of my invention.

Figure 1 is a transverse elevation of the engine through the line x, Fig. 2. Fig. 2 is a longitudinal section of the engine through the line y, Fig. 1. Fig. 3 is an elevation partly in longitudinal section of the engine compounded. Fig. 4 is a transverse section through the line z, Fig. 3.

Reference will first be made to Fig. 2 which shows the engine to be composed of two principal parts, one, a, a', a stationary, and the other b a rotating element. The element a, a', rests upon a base c and embraces the internal steam head a' composed of one piece, and the external casing a composed of the ring 1, integral base c, and the heads 3, 4. The internal rotating element b is composed of the disk 5, the ring 6 which carries the steam blades e, and the disk 7, the two disks being secured to the ring by bolts as at 17, and movably embracing the steam head between them. The shaft f is secured to the disk 5 preferably by means of a flange as 8. One end of the shaft has a bearing in the steam head as at 9, while the outer end of the shaft is supported in the hub 2 of the head 3. As this bearing opens into the exhaust steam space it may be provided with a packing box to prevent the escape of steam around the shaft, but preferably the bearing should be made long and so closely and accurately fitted as to make a steam tight joint without packing.

Steam is admitted to the engine through the center of the steam head by means of a pipe 10 therein. The exhaust is taken from the exhaust chamber 11 through the outlet pipe 12. Fig. 1 illustrates the steam blades e upon which the steam acts to produce motion, the steam admission passages h, the ports i, and the steam exits l. The ring 6 is provided upon its internal surface with transverse pockets o within which the steam blades e are foldable, as at e^1, the blades being pivoted in the disks 5 and 7 by means of trunnions 18 on the blades. When the blades are folded they lie flush with those parts of the ring 6 that occupy the spaces between the blade pockets, as shown where the blades approach a steam port. Steam passages i begin in the spaces 19 and curve over to the pockets, and the folded blades, as at e^1, close the steam passages or ports. In dropping into action the blades lodge against the abutments 30 which constitute one end of the pockets o.

The steam head is shown to be divided peripherally into three divisions by elevations, 20, called herein steam breasts, they affording fixed abutments from which the steam acts against the blades. The circumference of the steam head is not symmetrically separated into divisions, but in such a manner that, when the steam blades are of an uneven number, no two of the divisions shall be out of action at the same moment. Thus, referring to Fig. 2, the upper left hand division contains two active blades between the induction and the eduction ports, the upper right hand division contains three blades, and in the lower division there is nearly room for four blades. The rear sides of the steam breasts are rounded into such a shape, by curves 21, 22, that they act upon the moving steam blades in a manner to easily and noiselessly fold them into their pockets. Fig. 1 shows the steam breast provided with like curves n, n^1, to ease the dropping of the blades into position, while in Fig. 4 the steam breast is of such form as to admit of an abrupt drop of the blades.

The paths m m m on the steam heads that are traversed by the free ends of the steam blades are concentric with the ring that carries the said steam blades. As soon as the ends of the steam blades begin to drop from the steam breasts they open the steam ports, as at 24, Fig. 1, where the blade is shown in broken lines just after it begins its descent.

The steam passages through the steam breasts are shown at h, h, h, connecting into

the annular steam chamber m^1, which receives steam through ports m^2 from the center r of the steam head, the pipe 10 supplying the steam to the center of the head. Just before the steam blade is acted upon to be lifted to its pocket the blade passes over the exhaust port l^1. The steam, as will be seen, is not exhausted from a compartment between blades as soon as the steam begins to act upon the succeeding blade. While it is true that the steam produces power only when acting upon a blade and the opposing steam breast, the steam that is carried in the compartment that ceases to be active, serves in a measure as a steam packing to prevent loss of steam from the active compartment; provided there should be any points of leakage around the blades. Even in the shortest compartment there will always be two blades between the induction and the eduction ports.

The exhaust ports l are adjacent to the annular steam chamber l^3 in the disk 5, Fig. 2, and there are passages indicated by the broken lines l^4 through the disk 5 connecting the annular chamber with the exhaust space 11, which constitutes the exhaust chamber. The outlet from the chamber 11 is through the pipe 12. It will be observed that there is a space all around the rotating element b, between the disks 7, 4, 3, 5, and the rings 1, 6. This space constitutes an exhaust steam jacketing of the rotating element.

The disks 5, 7, are made to embrace the steam head to make an effective steam tight joint; but owing to the breadth of surface from 26 to 27, Fig. 2, the joint can be free enough for easy rotation by reason of water packing afforded by the condensation that will gather therein. For this reason the wear of these surfaces will be very slight, and means for taking up the wear is a matter of constructive detail.

The centrifugal force due to the velocity of this engine is depended upon to keep the steam blades within their respective pockets, except that when they meet the steam ports, as at e^1, the support of the steam breasts causes the blades to serve the purpose of valves to close said ports.

By reference to the point B, Fig. 1, it will be seen that the port h is closed to the compartment C, and that there will be an interval of time before the blade D comes into action, so that the steam is acting expansively upon the blade E. So, all the blades are arranged to have the steam cut off at a point adapted to give an efficient expansive use of the steam.

Figs. 3 and 4 show these elements combined to produce a compound engine. The outer casing of the engine is similar to that shown in Fig. 1, except that the ring 1 is nearly doubled in length. The internal steam head is also doubled, the head a^1 having a like head a^2 secured to it, a fastening key being shown at 32. The second head is similar to the first except that it affords space for larger steam blades, and all the steam ports and passages are increased in size. The two heads are separated outside of their hubs by a disk 5^1, that corresponds to the disk 5 in Fig. 2. The arrangement of the steam chambers, passages, and ports in the head a^1 is practically the same as in Fig. 1, except that the exhaust chamber l is nearer to the center of the head than in the first figure. In the second steam head there is no central steam chamber, the exhaust from the first head passing from the first head through the opening l^4 into the annular chamber H in the second head. From said chamber the steam is admitted through the passages h^2 and ports I to the steam blades, and is exhausted through the ports L^1 to the annular chamber L, thence through exits L^4 to the exhaust chamber 11, and out through the pipe 12. All the parts except that they are on a scale of larger areas, are practically the same and operate the same in the second engine as in the first, the blades opening and closing the ports as in the first combination in a manner to further use the steam expansively.

It will be observable that there are no separate valves in this engine, that the admission and the exhaustion of the steam are controlled by the extended peripheral surfaces of the steam breasts and the steam blades, also, that there are no appliances or devices for actuating the steam blades.

Claims:

1. The combination in a rotary engine having two principal members, one comprising a stationary outer casing and an internal steam head operating as integral parts, and an internal revolving member that embraces all of one end and part of the opposite end of the steam head and circling around the steam head fitting over the steam breasts on the steam head, and a shaft attached to said member and supported in the stationary member, the steam head provided with three or more steam breasts, steam ports in the peripheral surfaces of the steam breasts connecting with an annular steam chamber within the steam head, the internal revolving member provided on its inner surface with a multiplicity of steam blades, pockets for the steam blades, the steam blades trunnioned in said pockets, the surfaces between the pockets having ports from their centers to the centers of the pockets, the steam blades adapted to move over the steam breasts when folded within the pockets and to close the ports in the pockets, the steam blades acting as induction and eduction valves, the steam blades opening the pocket ports as the blades drop in front of the steam breasts, the pocket

ports adapted to act as cut-off valves closing the induction ports at a point to admit of the use of the steam expansively, the said steam blades also acting as eduction valves, and so spaced with respect to the eduction and induction ports that at least two steam blades will always be interposed between the induction and the eduction ports, the different spaces between the steam breasts non-symmetrically spaced so that no two induction ports will be entirely closed at the same instant, the eduction ports connected with an annular chamber between the internal and the outer members, an opening in the outer member containing the exhaust pipe, the annular steam chamber within the steam head connected by steam passages with the hollow center of the stationary member.

2. The combination in a rotary engine having a stationary steam head with steam breasts as described, provided with induction ports on their peripheral surfaces, a revolving member with inner surfaces fitting over the said steam breasts, pockets in said revolving member for steam blades, steam blades trunnioned in said pockets, said steam blades adapted to have steam act upon them when in front of the steam breasts, the spaces between said pockets provided with steam passages to conduct the steam from the ports in the steam breasts to the pockets in the rear of the steam blades, the blades acting as cut off valves to open and close the induction ports.

3. The combination in a rotary engine having a stationary steam head with steam breasts provided with induction ports on their peripheral surfaces, and a revolving member fitting over the said steam breasts, pockets in said revolving member for steam blades, steam blades trunnioned in said pockets, the spaces between the steam blade pockets provided with steam passages to connect the induction ports with the steam blade pockets, the steam breasts to consist of three or more with non-symmetrical distances between them, whereby no two of the induction ports will be entirely closed at the same time.

4. The combination for a compound rotary engine comprising two principal members, one a stationary outer casing and internal steam heads provided with steam breasts combined as integral parts, the other an internal revolving member provided with trunnioned steam blades with pockets for said blades and embracing the steam heads, these elements extended in length to contain two or more steam heads, the steam heads having a recess betwen them to receive a flange of the revolving element, said flange provided with an annular exhaust chamber from the first head and steam passages from said exhaust chamber to the induction steam chamber in the following steam head, an annular steam chamber in the said following steam head provided with steam induction ports corresponding to those in the first steam head, an annular exhaust chamber in the following steam head corresponding to the like exhaust chamber in the first steam head; the revolving elements having like arrangements of steam blades, steam blade pockets, and steam ports, except that each succeeding duplicated part has steam blades, steam pockets and steam passages of increased areas.

Signed at Peekskill in the county of Westchester and State of New York this 16th day of November A. D. 1910.

CHRISTIAN F. PAUL, Jr.

Witnesses:
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BERTHA PAUL.