

(No Model.)

2 Sheets—Sheet 1.

C. H. BEELER, Jr.
ROTARY ENGINE.

No. 536,009.

Patented Mar. 19, 1895.

Fig. 2.

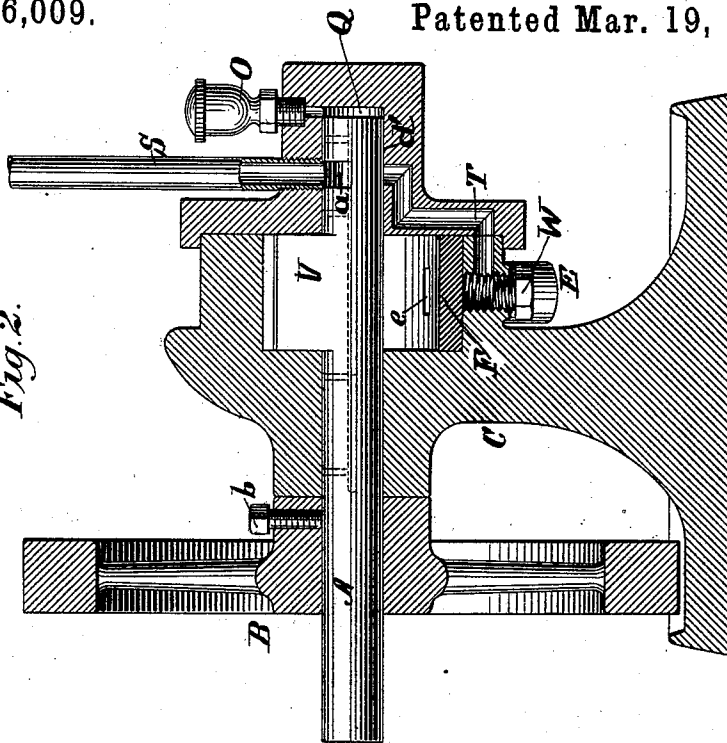
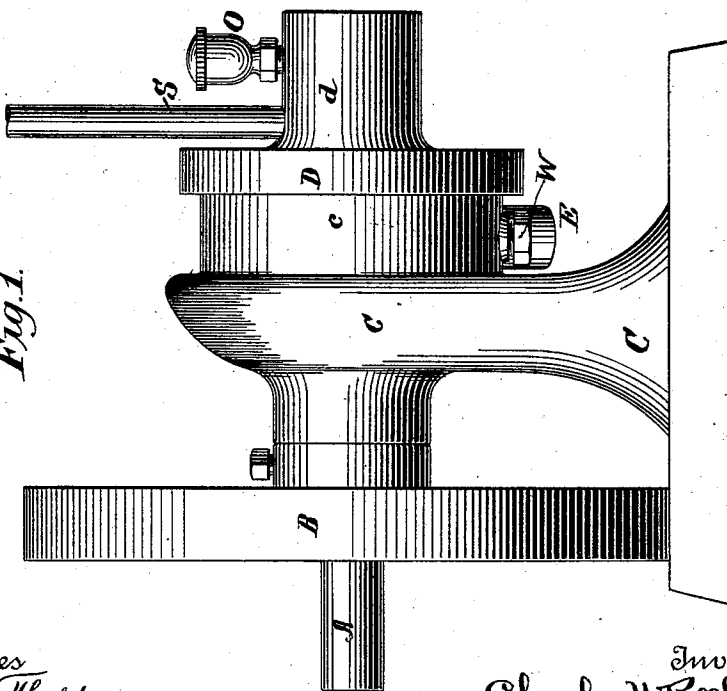


Fig. 1.



Witnesses
Edward Thorpe
Geo. H. Sonneborn,

Inventor
Charles H. Beeler, Jr.
By his Attorney
H. B. Biny

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2 Sheets—Sheet 2.

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Fig. 3.

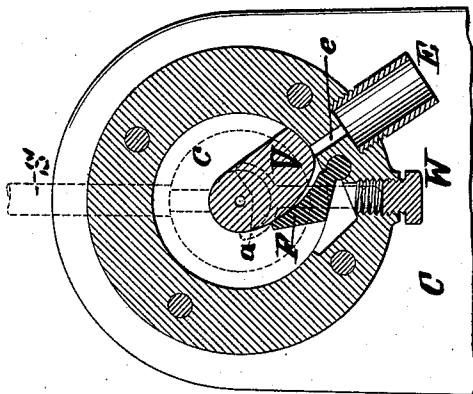


Fig. 4.

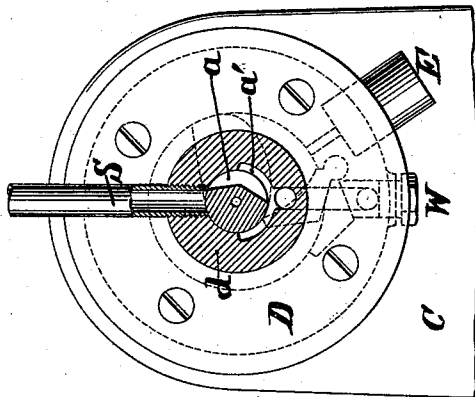


Fig. 5.

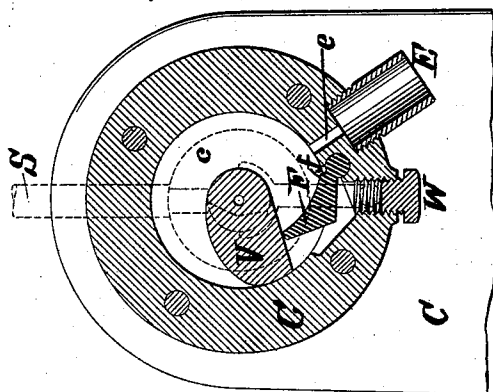


Fig. 7.

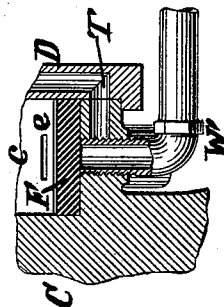
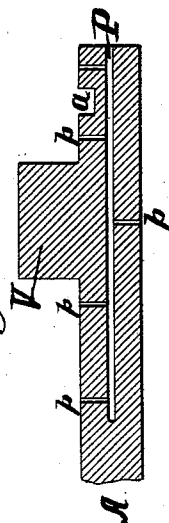


Fig. 6.



Witnesses
Edward Thorpe.
Geo. H. Gommelborn,

Inventor
Charles H. Beeler, Jr.
By his Attorney
Harold S. Shumway

UNITED STATES PATENT OFFICE.

CHARLES H. BEELER, JR., OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF SEVEN-SIXTEENTHS TO HENRY GROSWITH, OF SAME PLACE.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 536,009, dated March 19, 1895.

Application filed March 21, 1894. Serial No. 504,512. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. BEELER, Jr., of Philadelphia, Pennsylvania, have invented a new and useful Improvement in Rotary Engines, of which the following is a description, referring to the accompanying drawings, which form a part of this specification.

My invention relates particularly to the class of rotary engines in which a rotary shaft, extending into or through a circular chamber, is provided with one or more vanes or radial heads against which the fluid pressure is applied to give rotation to the shaft. Each vane fits snugly the walls of the circular chamber and revolves within it. Separate admission and exhaust ports are usually provided, and are operated by the motion of the vane or vanes. A vane coming into contact with the admission valve closes it, thereby shutting off the admission until the vane has passed over the valve, when the valve may again rise behind the vane and form a stationary steam head until again the vane comes into contact with it. Many forms of rotary engines operating on these general principles have been constructed, but so far as I am aware the excessive friction resulting from the design and operation of the valves and the formation of the rotating parts has prevented them from being commercially successful. In many of these old forms, the valve slides or is pivoted within a valve chamber in the wall of the main chamber, and the full force of the fluid at all times presses the valve against the rotating parts, causing an enormous amount of unnecessary friction, and even in some cases the cutting away of the metal. Moreover, the form of the rotating parts being usually a disk mounted upon a shaft, is such that the fluid instead of acting tangentially acts at a great inclination to the line of motion.

Under my improvement, all the defects enumerated, as well as many others not mentioned, are entirely overcome. The rotating head, or vane, itself closes the exhaust port by merely passing across it. After the exhaust has closed the vane in its motion confines the fluid behind the flap or admission valve, producing compression and closing the valve with the least possible shock and friction.

To still further reduce the friction of passing over the closed admission valve, I greatly reduce the steam or other fluid pressure beneath the valve during this action, so that the valve is not then forced up against the rotating vane as in other engines with which I am familiar. Having passed over the closed admission valve, pressure is supplied beneath the valve and the valve rises, allowing the steam to enter behind the vane and to drive it forward. At a suitable point in the rotation, the valve pressure is cut off and expansion permitted; and it is by this means that the pressure beneath the valve is diminished, no live steam being again admitted until just before the edge of the vane passes clear of the valve. It is these features of cut-off, expansion, and compression, together with the other points named, which form perhaps some of the more important improvements in my construction and operation of rotary engines. When, however, the engine is to be used with water or other incompressible fluid, the cut-off is entirely removed from operation and the pressure of the water at all times directly applied beneath the valve. In this way my rotary engine is readily and quickly convertible into a water motor or back again into a steam or other gas motor.

In addition to the features and actions already mentioned, my invention purposes the production of a simple means for oiling the bearings; and also, throughout the engine, great simplicity, reliability and economy of construction and operation. Indeed, in the smaller sizes of my engine, five parts are all that are necessary, excepting of course, screws and other fastening devices and pipe connections.

To all these and certain other useful purposes hereinafter more fully explained, my invention is embodied in the apparatus and its several parts constructed, arranged, combined and used substantially in the manner hereinafter described, illustrated and claimed.

Having thus briefly set forth my invention in its more general aspects, I will now, in referring to the accompanying drawings, explain it more at length and in detail as illustrated in its most preferred embodiment; but of course it must not be understood that my

invention is in any way limited to the precise details shown.

Figure 1 is a side elevation of a small engine, scale one to one. Fig. 2 is a vertical axial cross section of the same. Fig. 3 is a vertical transverse cross section taken through the central plane of the cylinder, indicating the cut-off in dotted lines and showing all the parts in position for admission. Fig. 4 is a vertical transverse cross section through the cut-off valve and connections, the vane and admission valve being in dotted lines, and the parts being shown as at cut-off. Fig. 5 is a cross section on the same plane as Fig. 3, the parts being shown at compression. Fig. 6 is a detail cross section of my shaft, showing the oil passages, and Fig. 7 is a fragmentary sectional view showing the manner of substituting a water connection for the steam connection and cut-off, and thereby converting the device into a water motor.

Throughout the drawings like letters of reference indicate like parts.

I will first describe my rotary engine as employed with steam or with other highly expansible fluid.

The shaft A and the fly wheel B are suitably mounted in a housing C, which contains the cylindrical chamber *c* within which turns the vane V carried by the shaft. The chamber *c* is closed by a head D having bearings *d'* which support and entirely inclose the end of the shaft. A slight interval between the end of the shaft and the wall of the projecting portion of the head D forms an oil chamber Q which is supplied with oil from an oil cup O. The shaft A has an axial passage P leading from the chamber Q and connecting with radial branches *p* carrying the oil directly to the bearings of the shaft and to the surface of the vane V. An axial section of the shaft is shown in Fig. 6.

The vane V fits, steam-tight, within the chamber *c* and revolves with the shaft A. The admission, or flap valve F, which acts also as the stationary head to separate the pressure from the exhaust during each revolution of the vane, is formed in the manner shown and pivoted in a recess in the wall of the chamber *c*. The upper face of this valve forms, when closed, a continuation of the inner wall of the chamber *c* across which the edge of the vane travels at the end of each impulse. The steam, or other gas, is admitted beneath the valve F, causing it to rise behind the vane as the vane passes clear of it, as in Fig. 3. The rear face of the vane is formed to permit the more or less gradual rise of the valve as the vane moves away from it. The pressure upon the valve causes it to rise against the inclined rear face of the vane and press it forward in its rotation. In its raised position (which is best seen in Fig. 5, or in dotted lines in Fig. 4) the valve F forms a radial head separating the pressure upon one face of the vane from the exhaust fluid at the other side, and causes the vane to be driven around by

the pressure to the position shown in Fig. 5. The fluid in front of the vane is, during this action, forced out or exhausted through the exhaust port *e* and exhaust pipe E, until the vane reaches the position of Fig. 5 and covers and thereby closes the exhaust port. The instant the exhaust is closed the fluid in advance of the vane is compressed between the vane and the valve F, causing the valve to close instantly and noiselessly without shock and with a minimum friction, that the vane may pass over the closed valve and return to its initial position as in Fig. 3. To facilitate this cushioning and compression action, the front face of the vane is formed in a curve corresponding to the upper or rear face of the valve F. With such conformation the greatest compression and hence the best cushioning effect with the least amount of confined fluid is obtained.

So far in the description of my invention I have made no mention of the connection for cut-off and expansion, although this forms a very important feature. I have described the effective pressure as being admitted through the admission port beneath the valve F. This pressure is however entirely cut off at the proper time in each revolution, by means of a specially designed cut-off valve formed in the end of the shaft A within the projecting portion *d* of the cylinder head D.

Fig. 4 shows a cross section of the cut-off valve. The shaft is recessed or cut away, as at *a* Fig. 4, at a point revolving in front of the mouth of the steam pipe S and the bearing of the shaft *d'* is recessed or cut away as at *a'* opposite the steam pipe S. When, therefore, the cut away portion *a* of the shaft is opposite the mouth of the steam pipe S steam will be admitted through the space *a* into the recess *a'*, whence it passes freely through the connection T to a point directly beneath the admission valve F. The cut away portion *a* is formed at such an angle upon the shaft that just before the vane V passes clear of the valve F it admits steam from the pipe S to the valve F causing the valve to rise as in Fig. 3 as soon as the edge of the vane has passed clear of it. The position of the cut-off valve is shown in dotted lines in the figure. When the vane F has made about a half revolution the recessed portion *a* which forms my cut-off valve, again closes the steam pipe S and shuts steam off from the cylinder. The position at cut-off is shown in Fig. 4, the valve F and vane V being shown in dotted lines. From this point the vane is driven by the expansion of the steam. The exhaust or waste steam in front of the vane in the meantime escapes through the exhaust port *e* into the exhaust pipe E either at atmospheric pressure or into a vacuum condenser. When, however, the vane is turned to the position shown in Fig. 5 it passes across and thereby closes the exhaust port, and the steam in front of the vane is compressed between the vane and the valve F. The similarity of curvature of

the meeting faces of the vane and of the valve are clearly shown in the figure. From such conformation the greatest amount of cushioning effect will be produced with the least amount of compressed fluid. The valve F, forced shut by this cushioning and compression effect, allows the vane to be carried over it by the impetus of the machine, opening the exhaust and then again immediately opening the admission valve F as in Fig. 3; and as already stated, the cut-off valve *a* will admit steam beneath the valve F just before the vane passes clear of it. During the action, therefore, of passing across the face of the valve the friction of the vane is greatly reduced by the decrease of steam pressure beneath the valve, and this is one very important and novel feature of my device.

In Fig. 7 I show the manner in which my expansion engine, is converted into a water motor having no expansion. The plug screw W is withdrawn and a long screw water pipe connection W' introduced in its place carrying and closing the mouth of the steam passage T and supplying water directly beneath the valve F. In this manner the cut-off valve and the steam pipe S are entirely removed from operation and the engine converted into an extremely simple and economical water motor.

In addition to the distinctions between my engine and the prior art as already explained, the flap valve or admission valve F differs materially in being so formed that when raised it entirely clears the recess within which it is pivoted and extends approximately radially across the chamber *c* resting against the shaft. It is therefore held in place by the difference in pressure between the active steam and the exhaust steam instead of being at all times forced directly against the revolving parts by the full pressure of the steam beneath it, as has heretofore been customary. Moreover, the valve is provided with a shoulder *f* which comes against a corresponding shoulder in the wall of the chamber as the valve becomes worn away by contact with the revolving shaft and vane. When so worn away, the shoulder *f* will support a large part of the pressure upon the valve and proportionately reduce the friction between the valve and the revolving shaft and vane.

I have now described my invention in one of its most simple and preferred forms. I have purposely omitted the enumeration of many details and modifications which may be made and supplied by mere skill in the art; because to set these forth at length would obscure rather than make clear the more essential features. It will be seen, however, that the valve V may be symmetrically formed and the engine made reversible by providing the necessary admission valve for driving it in the opposite direction. So also many other changes

of a similar nature may be made. I have, however, clearly set forth my invention in a manner which will enable those skilled in the art to put it into practice, and, therefore,

I claim as my own, and desire to secure by these Letters Patent of the United States, together with all such modifications, additions, and improvements as may be made by mere mechanical skill, and with only the limitations and restrictions expressed or necessarily implied, the following:

1. In combination in a rotary engine, a shaft A, vane V, chamber C, admission valve F, and admission pipes and connections ST, and a cut-off valve formed in the projecting end of the said shaft and controlling the passage of steam or other fluid through the said connections, substantially as and for the purposes set forth.

2. In combination in a rotary engine, a shaft carrying a vane V, a chamber *c*, an admission valve F, co-operating with said vane V to admit steam or other fluid at the proper time, admission pipes and connections S T, a valve seat or chamber surrounding the end of said shaft and a cut-off valve formed in said shaft and controlling the passage of the steam or other fluid through said connections, substantially as and for the purposes set forth.

3. In combination in a rotary engine, a shaft provided with a recessed or cut-away portion *a* forming a cut-off valve, admission pipe S and connection or passage T co-operating with the said cut off valve, substantially as and for the purposes set forth.

4. In combination in a rotary engine, admission port, means for supplying water or other pressure thereto, connections, as ST, provided with a cut-off valve controlled by the rotation for supplying the said engine and means for admitting the steam, water or other fluid either directly through the said admission port or by way of the said cut off valve, at will, whereby the motor may be run at will with or without cut-off and expansion, substantially as and for the purposes set forth.

5. In combination in a rotary engine, a chamber *c*, a shaft A and vane V therefor, a head D inclosing the said vane and shaft within the said chamber and leaving an interval or chamber between the end of the said shaft and the wall of the said head, a passage P within the said shaft opening into the said interval or chamber, branch connections from the said passage to the bearings of the said engine, and an oil cup or other device for supplying oil to the said interval or chamber, substantially as and for the purposes set forth.

In testimony whereof I have hereunto set my hand, at the city of Philadelphia, Pennsylvania, this 15th day of March, 1894.

CHARLES H. BEELER, JR.

Witnesses:

WM. J. DIVINE,
MARY H. RYAN.