No. 867,581. PATENTED OCT. 8, 1907.

E. HORN.

ROTARY EXPANSION ENGINE.

APPLICATION FILED JAN. 25, 1907.

2 SHEETS—SHEET 1.

Fig. 2.

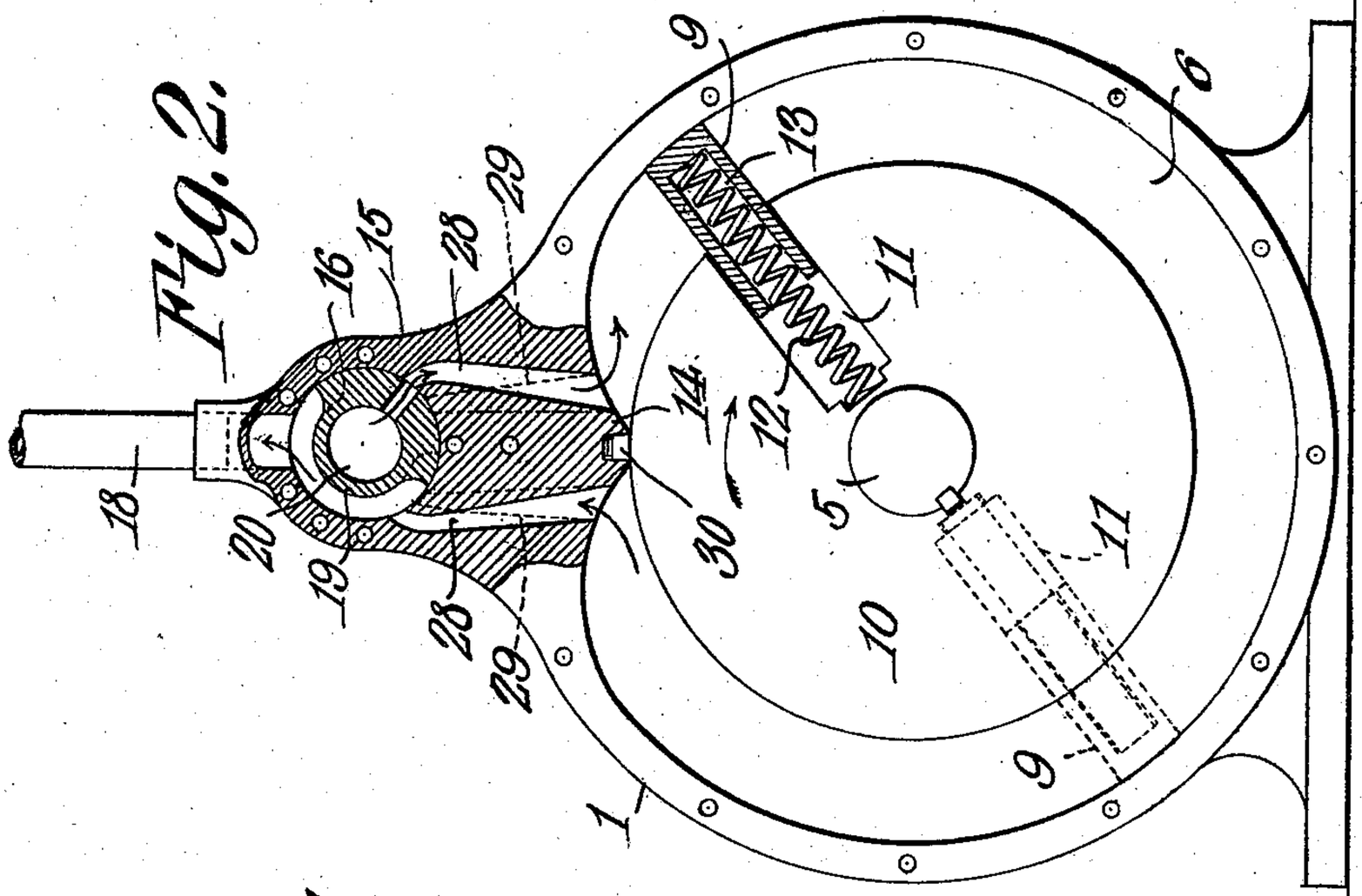

Fig. 1.

WITNESSES:

E. J. Stewart

C. Bradway

Emil Horn, INVENTOR.

By C. A. Snow & Co.

ATTORNEYS

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2 SHEETS—SHEET 2.

Fig. 4.

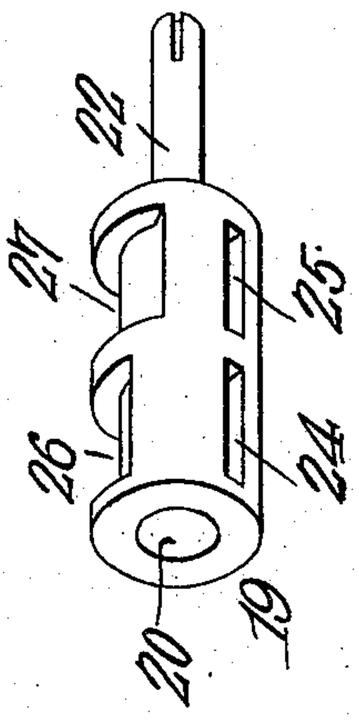


Fig. 5.

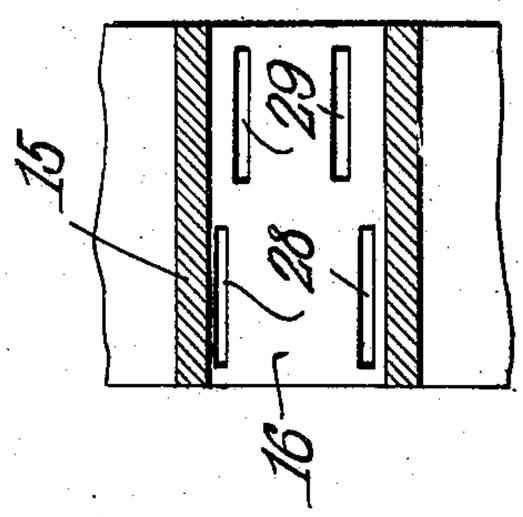
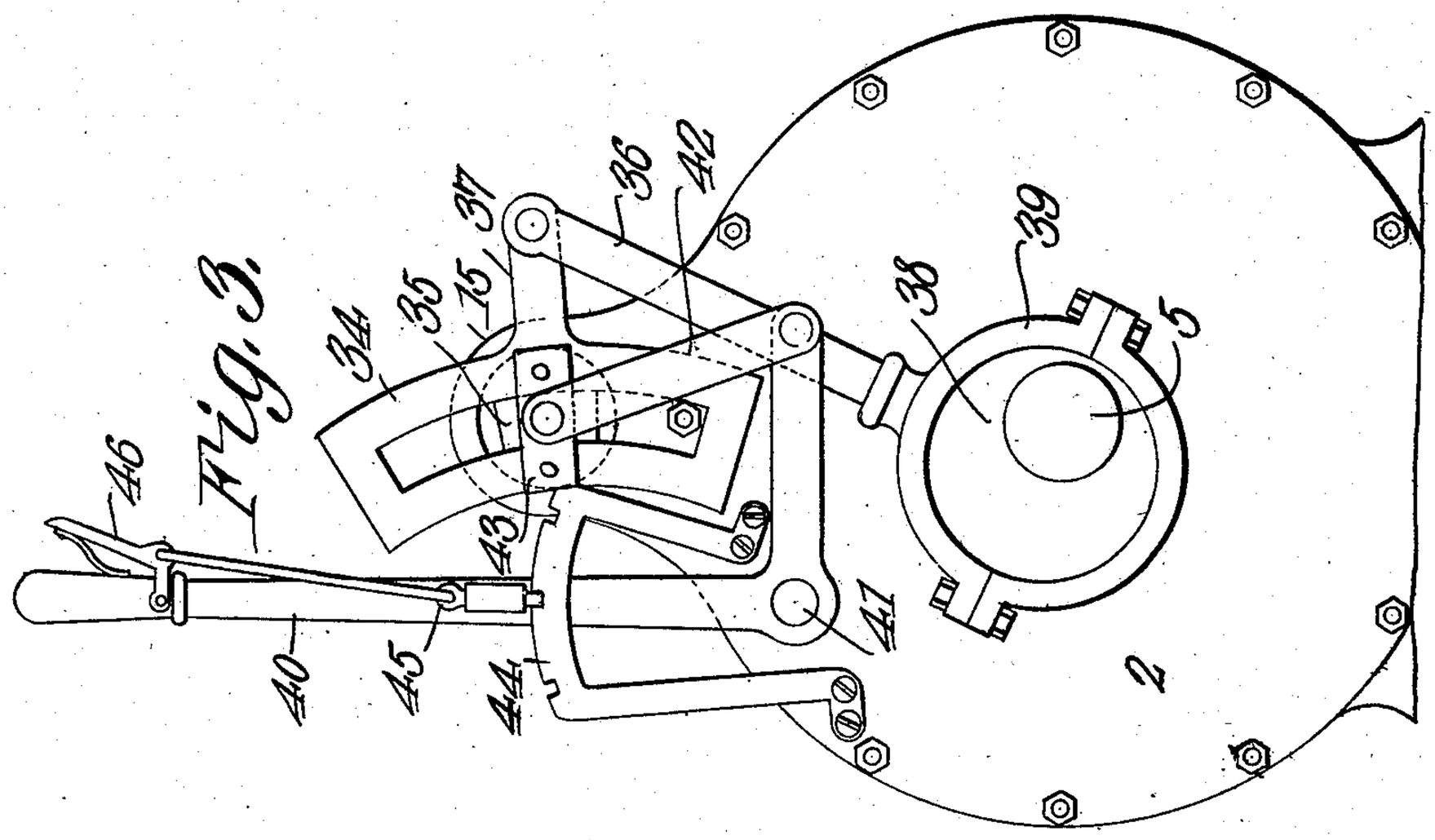


Fig. 3.



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By C. A. Snow & Co.

ATTORNEYS

UNITED STATES PATENT OFFICE.

EMIL HORN, OF HILLYARD, WASHINGTON, ASSIGNOR OF ONE-THIRD TO JOSEPH A. STEELE AND ONE-THIRD TO WILLIAM E. JAMES, BOTH OF HILLYARD, WASHINGTON.

ROTARY EXPANSION-ENGINE.

No. 867,581. Specification of Letters Patent. Patented Oct. 8, 1907.

Application filed January 25, 1907. Serial No. 354,025.

To all whom it may concern:

Be it known that I, EMIL HORN, a citizen of the United States, residing at Hillyard, in the county of Spokane and State of Washington, have invented a new and useful Rotary Expansion-Engine, of which the following is a specification.

This invention relates to a rotary engine of that type having a plurality of pistons against which steam or other motive fluid is successively directed at full inlet pressure during a suitable portion of the revolution of each, after which the motive fluid acts expansively so that the total energy is extracted and high economy obtained.

The invention has for one of its objects to improve and simplify the construction and operation of prime movers of this character, so as to be comparatively simple and inexpensive to construct, composed of few parts which are easily maintained in order, thoroughly reliable and efficient in use, and of relatively high power for the quantity of motive fluid consumed.

A further object of the invention is the provision of a smooth and easy running engine in which the piston wings have an approximately uniform area exposed to the working fluid throughout the stroke so that the steam can act to the best advantage, each piston having only a single wing on the front of which the steam acts to impel the piston while the steam at exhaust pressure on the rear side of the wing is discharged as the piston rotates, so that comparatively little back pressure is required to be overcome.

A further object of the invention is to provide a single rotary valve for controlling the admission of motive fluid to the various piston cylinders and the exhaust of the fluid therefrom in any desired order for producing a comparatively uniform torque.

A further object of the invention is the employment of a suitable mechanism in connection with the rotary valve for starting and stopping the engine and controlling the admission of fluid to either side of the piston wings for propelling the engine in either a forward or reverse direction.

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

In the accompanying drawings, which illustrate one of the embodiments of the invention, Figure 1 is a vertical longitudinal section of an engine of the double piston type. Fig. 2 is an end elevation with one of the heads of the cylinder removed and the steam chest in section. Fig. 3 is an end view of the engine showing the controlling mechanism therefor. Fig. 4 is a perspective view of the controlling valve. Fig. 5 is a fragmentary sectional view of the steam chest showing the inlet and exhaust ports.

Corresponding parts in the several figures are indicated throughout by similar characters of reference.

In the present instance, I have elected to illustrate the invention as applied to a double piston engine, but I desire to have it understood that the invention is not necessarily limited to this form since any desired number of pistons may be employed. In a multiple piston engine, steam may be admitted to act on the pistons singly or in sets in a successive manner, so that an even and uniform torque will be produced.

Referring to the drawings, 1 designates the cylinder of the engine, which may be made in segments suitably secured together or cast in one piece, as shown, and fitted to the ends of the casing cylinder are the heads 2 bolted, or otherwise secured in place, the parts being carefully machined so as to produce tight joints between them. The heads 2 are formed with hubs or bosses 3 at the shaft openings 4 to serve as bearings for the shaft 5 of the engine. The casing is divided into separate piston chambers or compartments 6 by one or more partitions 7, one being shown in the present instance. This partition is preferably formed integral with the cylinder 1 and has a central opening 8 through which the shaft 5 extends. The inner surfaces of the heads and opposite sides of the partitions 7 are preferably flat and carefully finished. The cylindrical internal surfaces of the cylinder 1 are also carefully finished for the purpose of making a tight working fit with the piston wings 9. In each compartment 6 is a piston 10 of the drum type whose flat end surfaces are adapted to make a working fit with the flat walls of their respective compartments. Each piston is provided with a radial slot 11 which is open at the periphery thereof and at the end surfaces, and in each slot is mounted one of the wings 9. These wings are mounted to move in and out of their slots and bear at their outer ends against the internal surfaces of the compartments 6, and the sides of the wings are adapted to make a working fit with the transverse flat walls of the compartments, so that leakage of the motive fluid from points of high to points of low pressure will be prevented. In a double piston engine, the pistons are keyed to the shaft 5 in such a position that the wings 9 are preferably located at diametrically opposite points with respect to the shaft. Obviously, in an engine employing a larger number of pistons, the angular displacement of the wings may be varied, as desired, the main object being to enable the steam or other motive fluid to produce a succession of regular impulses during each revolution so as to produce smooth running. The piston wings 9 are urged outwardly by helical compression springs 12 which are seated at their inner ends on the bottom of the slots 11 and engage at their outer

ends in pockets 13 of the wings. Besides maintaining the wings in contact with the cylindrical walls of the compartments 6, the springs permit the wings to move inwardly as they pass under the dividing partitions 14 which separate the inlet from the exhaust ends of the compartments 6.

At the top of the cylinder 1 is arranged a steam chest 15 which has a cylindrical chamber 16 closed at its ends by the heads 17. Communicating with the chamber is an exhaust pipe 18 that forms a common exhaust for the motive fluid from the compartments 6. In the chamber 16 is a rotary valve 19 which serves to control the admission and exhaust of motive fluid to the piston containing compartment. This valve is a tubular structure having its bore 20 open at one end to communicate with the steam supply pipe 21 that is connected with one of the heads 17 of the steam chest. The opposite end of the valve is closed and provided with a stem 22 extending axially therefrom through the other head 17 for connection at its outer end with a suitable actuating mechanism. Around the stem 22 is arranged a stuffing box 23 for preventing leakage. In the body of the valve are a pair of spaced inlet ports 24 and 25 for supplying steam to the separate piston containing compartments, and extending around the body of the valve are the spaced arc-shaped ports 26 and 27, as best shown in Fig. 4. Extending from the chamber of the valve chest are two pairs of passages 28 and 29 communicating respectively with the two piston containing compartments 6. The passages of each pair are slightly spaced apart and arranged with their lower ends disposed on opposite sides of the central plane passing through the dividing partition 14, so that the said passages communicate with opposite ends of their respective compartments 6. As shown by dotted lines in Fig. 2, the passages 29 are out of line with respect to the passages 28, so that as the inlet port 24 is communicating with one of the passages 28, the inlet port 25 will be out of register with the corresponding passage 29, so that steam will be admitted to the compartments successively. As shown in Fig. 4, the admission ports 24 and 25 are arranged in the same line, so that it is necessary to stagger the passages 28 and 29. If desired, however, the passages can be arranged in line with each other and the inlet ports staggered accordingly, so as to accomplish the same results. Since the upper ends of the passages 29 are arranged inwardly with respect to the upper ends of the passages 28, as shown in Fig. 2, the exhaust port 27 is somewhat longer than the exhaust port 26 so as to obtain the proper relation of the parts.

When the parts are in the position shown in Fig. 2, live steam is admitted through the port 24 and right hand passage 28 to the front compartment, so as to act on the wing of the piston therein. As the piston rotates, the dead steam on the rear side of the wing is exhausted through the other passage 28 and exhaust port 26 registering therewith. Simultaneously with the admission of live steam to this compartment, the steam in the rear compartment is acting expansively on the piston wing therein, since the inlet port 25 is out of register with the adjacent supply passage 29. The cut-off of the steam may take place at any desired point, preferably after the wings have each moved through the first half of their strokes. Thus when the front piston has moved through half a revolution, the valve is actuated so that the port 24 will cut off the supply of steam and the port 25 open the supply to the rear compartment. The exhaust ports are so proportioned that the steam on the rear side of the piston wings is free to exhaust continuously. As the wings come into contact with the dividing partition 14, they are each moved inwardly and pass under and beyond the dividing partition so as to be in position to begin another stroke. Simultaneously with the wings passing by their respective supply passages 28 and 29, the controlling valve is actuated so that a fresh supply of steam will be admitted. It will thus be seen that live steam is acting on the piston wings approximately throughout the complete revolution of the engine shaft, that is to say, live steam acts alternately on the pistons for about half a revolution and then expansively for the remaining portion of the revolution. In order to prevent steam under high pressure from passing directly to the exhaust passage, a spring pressed packing rod 30 is provided in the dividing partition 14 which bears against the drum 10 in each compartment. When it is desired to reverse the direction of rotation, the valve 19 is turned to such a point that the admission ports 24 and 25 will register with the passages 28 and 29 at the left hand side of the steam chest, as will be readily understood by reference to Fig. 2. It will thus be seen that the passages 28 and 29 will be used interchangeably as supply and exhaust conduits communicating with their respective piston containing compartments. Furthermore, the construction of the valve is such that it readily lends itself for use in connection with engines of any desired number of pistons.

The valve actuating mechanism shown in Fig. 1 comprises an arm 31 secured to the valve stem 22 and an eccentric rod 32 connected therewith and actuated by an eccentric 33 on the shaft 5. By this means, the valve 19 is rocked back and forth so as to control the alternate supplies of steam to the two pistons. This form of actuating mechanism is suitable in that class of work where continuous rotation in one direction is desirable, as, for instance, in mills where machinery does not require to be reversed.

To render the engine reversible, the mechanism shown in Fig. 3 is employed. This comprises a link 34 which is shiftable along the segmental block 35 which engages in the slot of the link and is suitably attached to the valve stem. The link 4 is oscillated by the eccentric rod 36 connected with the arm 37 of the link, and connected with the eccentric 38 by the strap 39. The link 34 is shifted by the operating lever 40 which is of the bell crank form and fulcrumed at 41 at a suitable point on the engine casing. The short arm of the lever is connected with the link by the member 42 which is pivoted to the link saddle 43. Associated with the operating lever is a toothed sector 44 which is engaged by the latch 45 on the operating lever. This latch is actuated by the spring pressed grip 46. When the parts are in the position shown, the engine is idle, since the valve has been shifted to such a point that the inlet ports thereof do not register with any of the passages communicating with the piston compartments. When the operating lever is moved to one side or the other to the neutral position, the engine will be driven in a forward direction, or

reverse, and by returning the lever to its central position, the engine will be stopped.

For automatically controlling the speed of the engine, the throttle valve 47 of any approved construction is arranged in the steam supply pipe 21, and associated therewith is a speed responsive device 48 that is driven from the main shaft 5 by the belt and pulley transmission 49, as shown in Fig. 1. By this means, the supply of steam to the several inlet ports of the controlling valve 19 is regulated in accordance with changes in load on the engine, so that a constant speed can be maintained.

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

What is claimed is:—

1. In a rotary engine, the combination of a casing divided into compartments, a drum piston in each compartment, wings on the pistons angularly displaced one with respect to another, and a shaft for the pistons, with a single valve for admitting and cutting off the motive fluid to the front side of the wings and exhausting the fluid from the rear side of the wings, an automatically actuated throttle for regulating the supply of motive fluid to the valve, and a reversing mechanism connected with the valve.

2. The combination of a rotary engine comprising a casing divided into compartments, and pistons therein, with a cut-off valve mechanism therefor, said mechanism comprising a steam chest, a set of spaced passages between each compartment of the engine casing and the chest, a rotary valve in the chest comprising a hollow body, radially extending ports in the valve each adapted to communicate with one of the passages of each set, an arc-shaped port in the valve for the other passage of each set, a pipe communicating with the hollow of the valve and all of the radial ports thereof, and a second pipe communicating with the steam chest and the arc-shaped ports of the valve.

3. The combination of a rotary engine comprising a casing divided into compartments, pistons therein, and a shaft for the pistons, with a cut-off valve mechanism therefor actuated by the shaft, said mechanism comprising a valve chest mounted on the casing, a plurality of sets of passages extending from the chest to each compartment of the casing, a single rotary valve in the chest which is hollow at its center, sets of inlet and exhaust ports each arranged to communicate with one of the sets of passages, heads on the chest, a supply pipe connected with one of the heads and communicating with the hollow of the valve, an exhaust pipe communicating with the chest, a stem on the valve extending through the other head of the chest, means between the engine shaft and stem for locking the valve, and a device for adjusting the valve to reverse the engine or stop the same.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

EMIL HORN.

Witnesses:
W. E. JAMES,
J. A. STEELE.