No. 777,417. PATENTED DEC. 13, 1904.

E. S. HIGGINS.

ROTARY ENGINE.

APPLICATION FILED MAY 20, 1904.

NO MODEL.

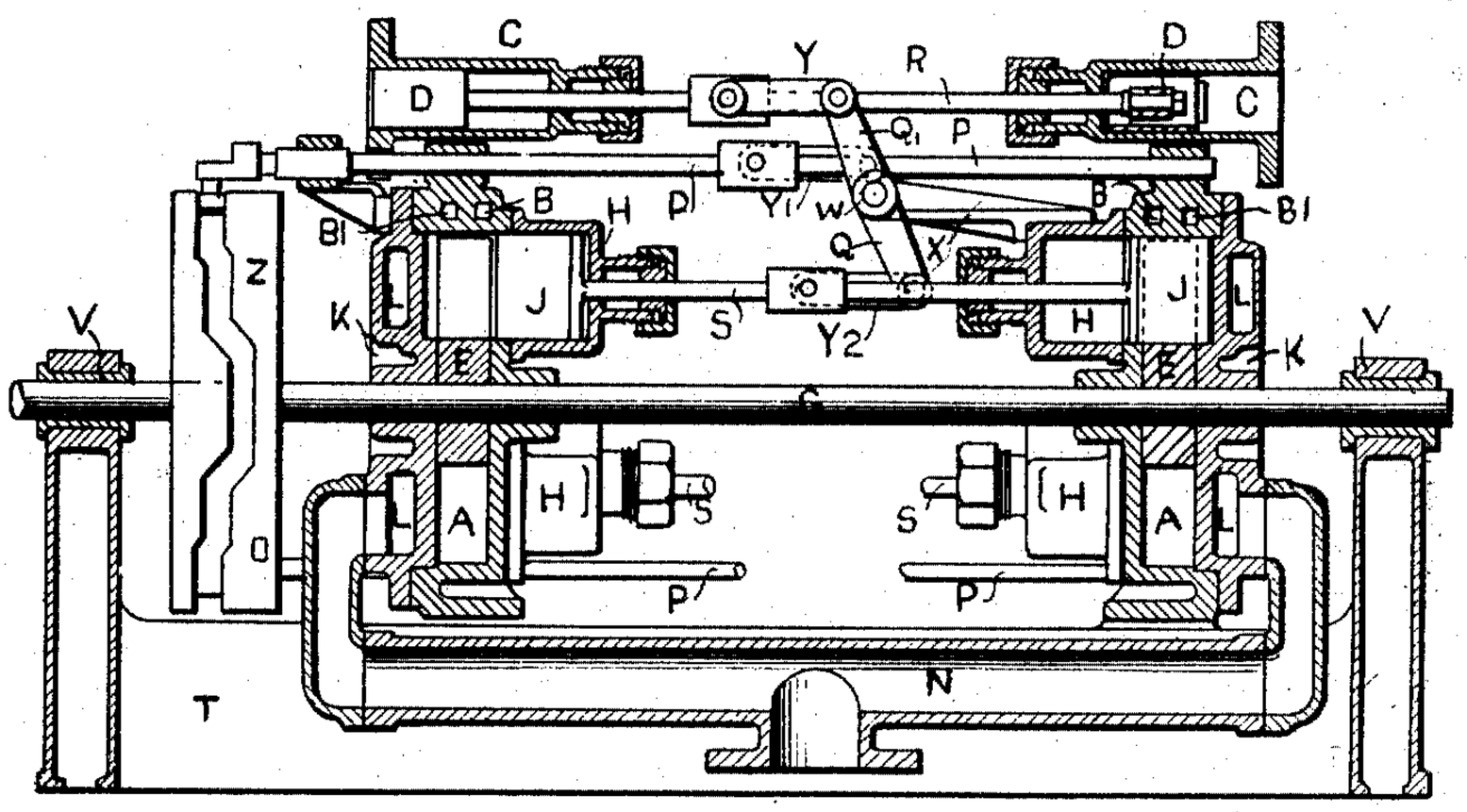

FIG. 1.

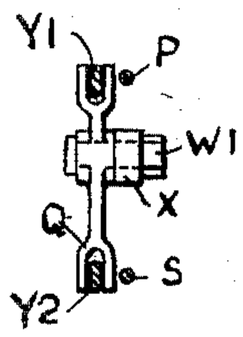

FIG. 4.

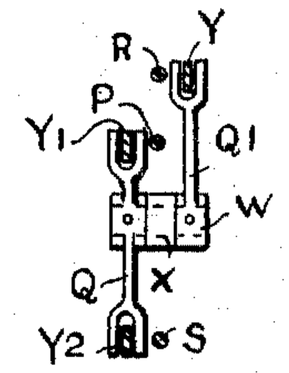

FIG. 5.

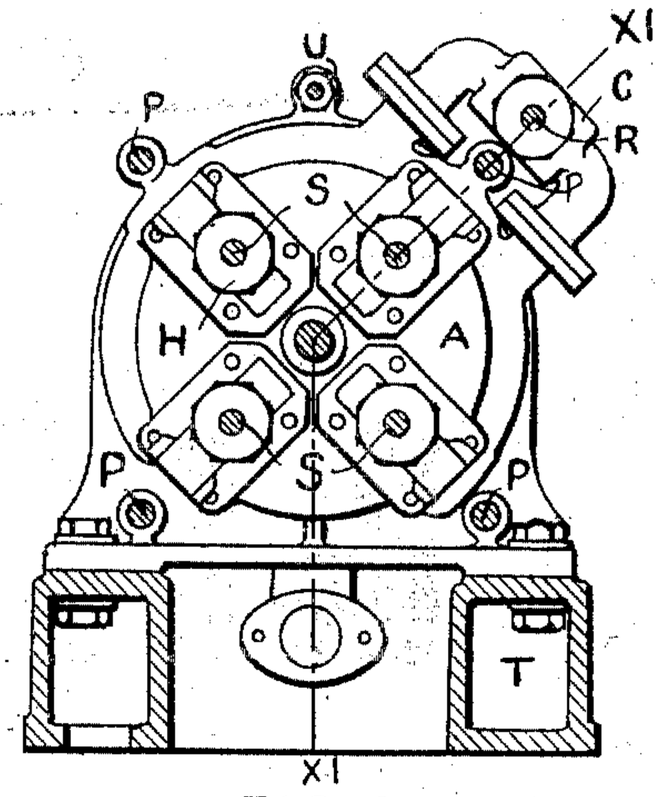

FIG. 2.

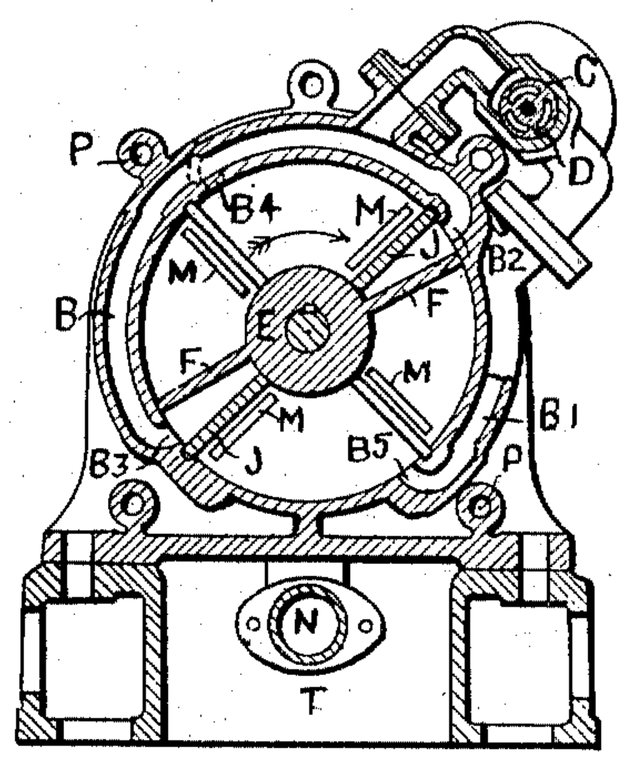

FIG. 3.

Witnesses.
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No. 777,417. Patented December 13, 1904.

UNITED STATES PATENT OFFICE.

EDWARD SMITH HIGGINS, OF COUNTY OF SURREY, ENGLAND.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 777,417, dated December 13, 1904.

Application filed May 20, 1904. Serial No. 208,963. (No model.)

To all whom it may concern:

Be it known that I, EDWARD SMITH HIGGINS, engineer, a citizen of England, residing at 11 Leigham Court Road West, in the county of Surrey, England, have invented certain new and useful Improvements in Rotary 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 rotary engines driven either by steam-vapor or an explosive mixture.

In my engine I use one or more cylinders closed at the ends and which are preferably short compared with their diameter. A revolving shaft passes through the center of the cylinder, and on this shaft is keyed a boss, to which are secured on opposite sides two vanes which fit steam-tight against the sides and periphery of the cylinder. Four slides are provided set at ninety degrees to one another and arranged with a reciprocating motion to move in and out of boxes on one side of the cylinder in a direction parallel with the axis. The slides work in pairs and are so arranged that when one pair is in position in the cylinder the other pair is withdrawn. I prefer to use two cylinders side by side on the same axis, so that one pair of slides is in the first cylinder while the other pair is in the second, and the slides change position from one cylinder to the other every quarter of a revolution, or the said slides may be arranged one at each end of a rod and instead of passing from one cylinder to the other may be withdrawn into suitable pockets or boxes. The slides may be operated from a cam-wheel keyed on the shaft or by any other suitable mechanism. The valves for controlling the admission of steam and the exhaust may be arranged in one with the slides or may be separate, operated by the cam-lever working the slides or in any other convenient manner.

By suitable arrangements of valves the engine may be arranged as an explosion or internal-combustion engine.

In order that my invention may be more readily understood, I have caused to be attached hereto one sheet of drawings, showing a two-cylinder engine, and in which similar letters refer to similar parts.

Figure 1 represents a section taken through the valve-boxes and cylinders on the line X′ X′, the cam-wheel being shown in elevation. Fig. 2 represents an end elevation of a cylinder. Fig. 3 represents a transverse section through a cylinder. Fig. 4 represents an end elevation of a lever for operating a slide-rod. Fig. 5 represents an end elevation of the levers for operating the valve-rod and slide-rod.

Each cylinder A has two steam-ports B and B′, each port opening into the cylinder at two points diametrically opposite, as shown at B^2 B^3 and B^4 B^5. The valve-boxes C are provided with flanges for bolting to flanges on the steam-ports of the cylinders, and each is arranged with two ports, so that by means of valves D steam can be admitted to either cylinder-port. A flange is also provided at one end of each valve-box for connection to the steam-pipe. The bosses E, to which are secured the vanes F, are keyed to the shaft G and set so that the vanes in one cylinder are at right angles to the vanes in the other cylinder. The slide-boxes H are bolted to the cylinders and contain the slides J when they are withdrawn from the cylinders. The covers K are bolted to the cylinders, and each is provided with an exhaust-port L and four openings M, through which the exhaust-steam passes from the cylinder to the port L and away through the pipe N. The two cylinders are bolted to the bed-plate T and tied at the top by means of a bolt U. The shaft G is carried in the bearings V. The cam-wheel O, which may also be used as a fly-wheel, is keyed to shaft G and is provided with a groove Z in its periphery, arranged in steps to give the necessary movements to the valve and slides by operating the cam-rods P. The motion of the cam-rods is conveyed to the slides by means of the connecting-links Y′ and Y^2 and the levers Q, which rock on the pins W′, carried by the brackets X, as shown in Fig. 4. This arrangement applies to the working of three of the slides. In the case of the fourth slide the motion also has to be conveyed to the valve. (Reference to Fig. 1 and Fig. 5 will

show the arrangement adopted.) The motion of the cam-wheel is, as before, conveyed to the slides by means of the connecting-links Y′ and Y^2 and the lever Q. The lever Q is secured to a pin W, which passes through a boss on the bracket X. On the other side of the boss the lever Q′ is secured to the pin W, and this lever, by means of the link Y and rod R, operates the valves D.

In Fig. 1 the complete arrangement for working the slides and the valves is shown in elevation. The lever and links for working the slides are omitted from the lower portion of the drawing, the cam-rod P and the slide-rod S being shown broken.

The working cycle is as follows: Consider the action in one cylinder. In Fig. 3 the slides J are shown in position in the cylinder with the vanes F slightly in advance, the valve D being arranged to admit steam to the port B. Steam enters the cylinder through the openings B^2 and B^3, occupying the spaces between the slides J and vanes F. The pressure of the steam acting on the vanes F causes them to rotate. At a predetermined fraction of the stroke the supply of steam to the port B is cut off by the valve D, which is operated, as already described, by the cam-wheel O, the steam being used expansively for the remainder of the stroke. On the vanes F passing the openings M the steam is free to escape through these openings to the port L and away to the exhaust-pipe N. Continuing to rotate, the vanes F pass the slide-openings at right angles to the pair of slides which have just been in operation. The first pair of slides are now withdrawn into the slide-boxes H, while the second pair of slides move into the cylinder, the valve D being moved at the same time by means of the combination of levers operated by the cam-wheel, as previously described. Steam is admitted to the port B′ and passes into the cylinder through the openings B^4 and B^5, the same cycle of operations as above described being repeated. An exactly similar cycle is performed in the second cylinder, the slides which work in the first cylinder being connected to the slides in the second cylinder by means of the rods S, so that when the slides J move into the first cylinder the slides at the other ends of the rods S are withdrawn from the second cylinder into the slide-boxes H. The pair of slides which work in a plane at right angles to the plane of the pair just considered will occupy positions opposite to those of the first pair. In other words, the slides which work in the first cylinder will lie in the slide-boxes, while the slides at the other ends of the rods S will be in position in the second cylinder. From the above description it will be readily understood that if the slides in the first cylinder are in the position shown in Fig. 3 and steam is being admitted through the openings B^2 and B^3 in the second cylinder steam will be admitted through the openings B^4 and B^5 into the space between the vanes and the slides. It will thus be seen that each vane comes under the action of steam four times in each revolution and that the cycle of operations is the same in each cylinder.

When it is desired to make a compound engine, instead of both cylinders exhausting into a common pipe the exhaust from one cylinder is led into the valve-box of the second cylinder, this cylinder being made of larger capacity than the first, the steam passing from the second cylinder into the condenser in the usual manner.

If it is preferred, two or more small cylinders may be used together as low-pressure cylinders instead of one large cylinder of equal capacity.

In the event of very high-pressure steam being used it will be readily understood that a triple, quadruple, or any desired expansion engine can be obtained by arranging the capacity of the various cylinders and exhausting from one into the other, or the cylinders may be arranged in sets of varying capacity, the high-pressure exhausting into the intermediate, the intermediate into the low, and thence into the condenser in the usual manner.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a rotary steam-engine, the combination with the cylinder A, having the steam-inlets B^2, B^3, B^4, B^5, and exhaust-ports M, M, M, M, of the shaft G having keyed thereto the hub E, with vanes F, diametrically opposed, the slides J, J, J, J, means for moving said slides alternately in pairs into and out of the cylinder, and means for controlling, cutting off and exhausting the steam substantially as described.

2. In a rotary engine, the combination with the steam-cylinder, of the power-shaft having two diametrically-opposed vanes and four steam inlet and exhaust ports, and means for admitting and exhausting steam at each quarter-revolution of the shaft.

3. In a rotary engine, the combination with a main shaft having two sets of vanes arranged respectively at right angles to each other, of two cylinders, each having four inlet and exhaust ports and having slides arranged and adapted to enter and recede in pairs; a cam-wheel, slide-valves and connections whereby, while one cylinder is taking steam on one side of its vanes, the other cylinder will be exhausting on the corresponding side of its vanes, substantially as set forth.

4. In a rotary engine, the combination of the main shaft, G, the two cylinders, A, A, the vanes F mounted on said shaft, and the slides J and slide-valves D, those of one cylinder being connected to those of the other; the cam-wheel O and the connecting rods and links, whereby the slides of one cylinder are

being withdrawn while the corresponding slides of the other are being inserted, and whereby the space on one side of the vanes of one cylinder is being supplied with steam while the corresponding space in the other cylinder is exhausting, substantially as described.

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

EDWARD SMITH HIGGINS.

Witnesses:
S. W. B. McGregor,
Geo. J. B. Franklin.