No. 645,983. Patented Mar. 27, 1900.

J. H. STREET.

STEAM OR OTHER ELASTIC FLUID ENGINE.

(No Model.) (Application filed June 17, 1899.)

6 Sheets—Sheet 1

Fig. 2.

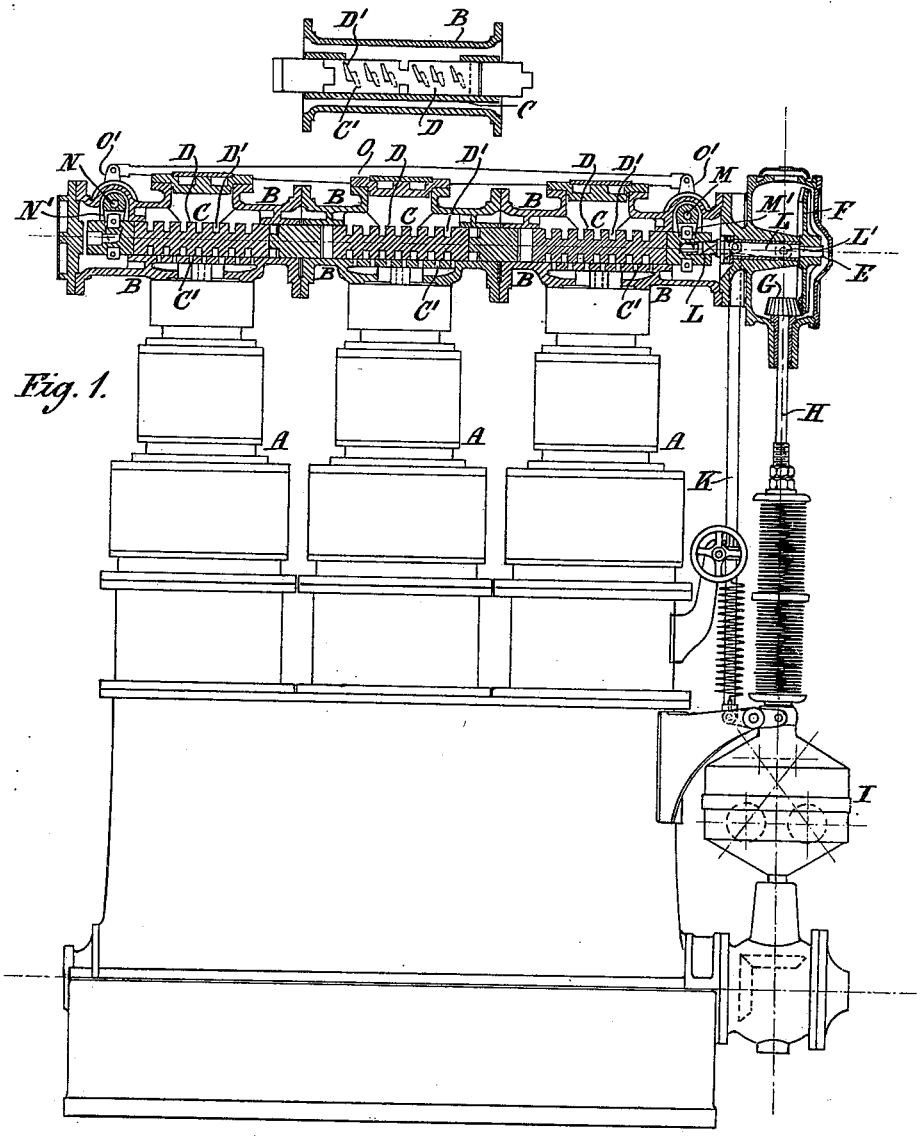


Fig. 1.

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STEAM OR OTHER ELASTIC FLUID ENGINE.

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(No Model.) 6 Sheets—Sheet 2.

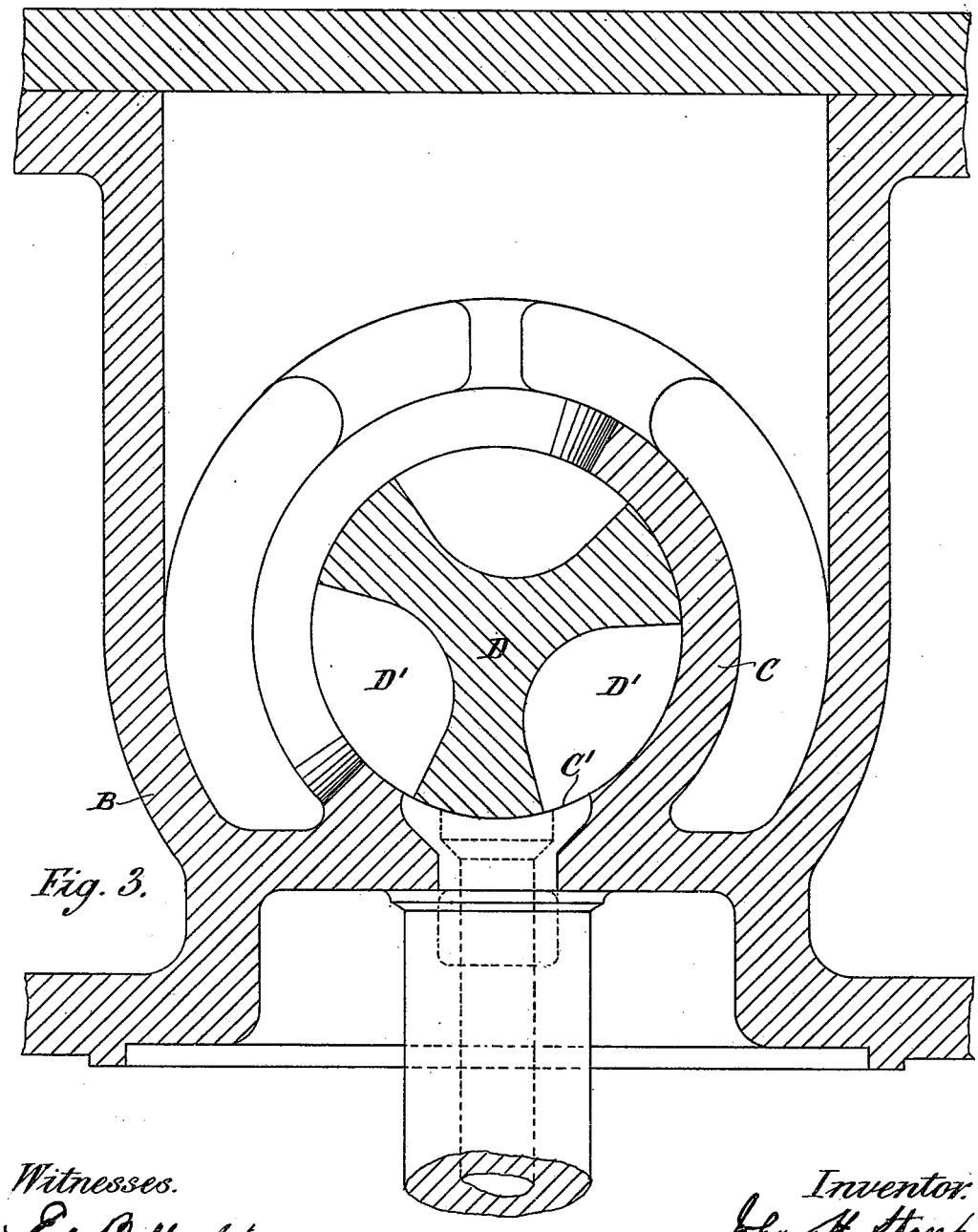


Fig. 3.

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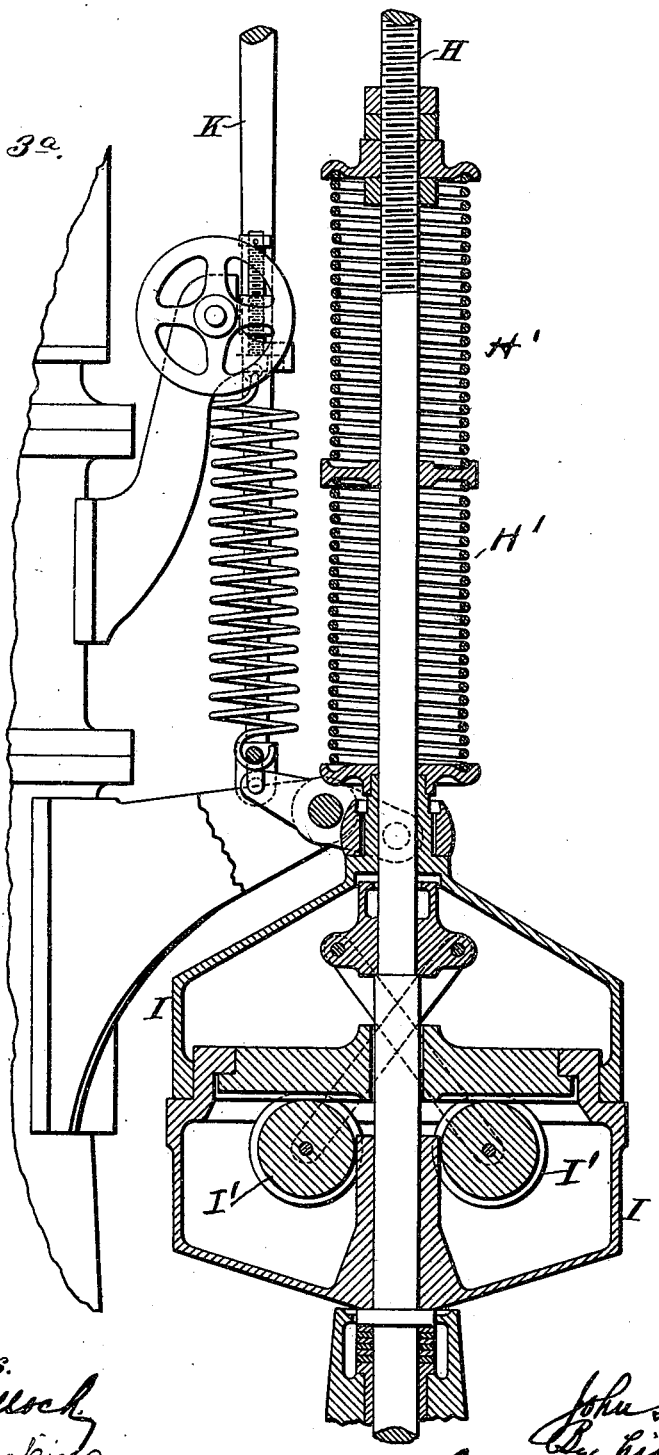
STEAM OR OTHER ELASTIC FLUID ENGINE.

(No Model.) (Application filed June 17, 1899.) 6 Sheets—Sheet 3.

Fig. 3a.

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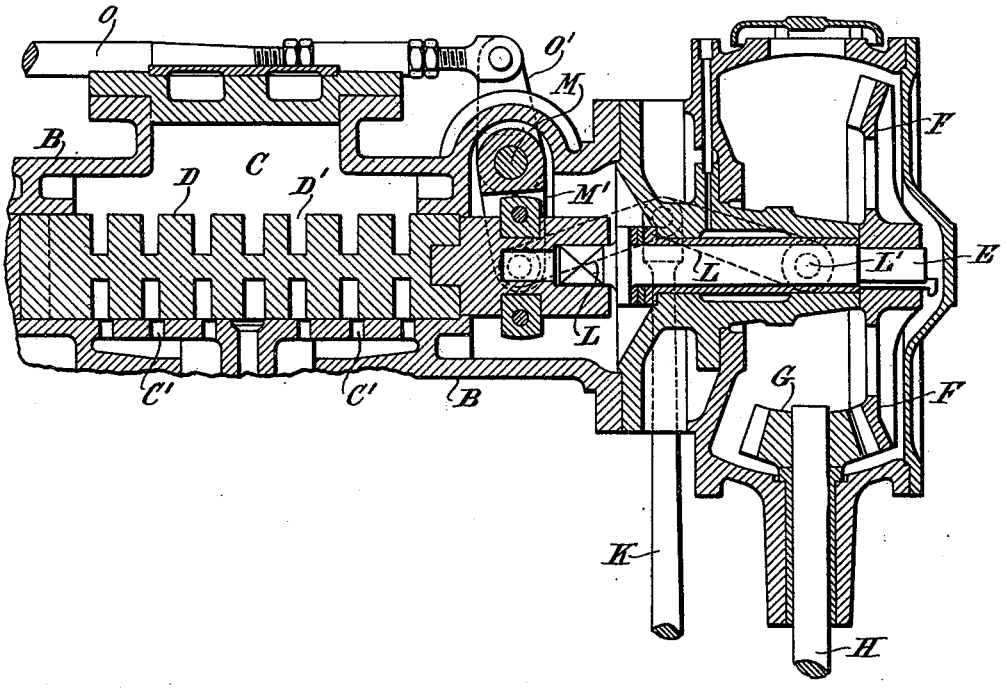
J. H. STREET.

STEAM OR OTHER ELASTIC FLUID ENGINE.

(Application filed June 17, 1899.)

(No Model.) 6 Sheets—Sheet 4.

Fig. 3b.

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J. H. STREET.

STEAM OR OTHER ELASTIC FLUID ENGINE.

(No Model.) (Application filed June 17, 1899.)

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Fig. 4.

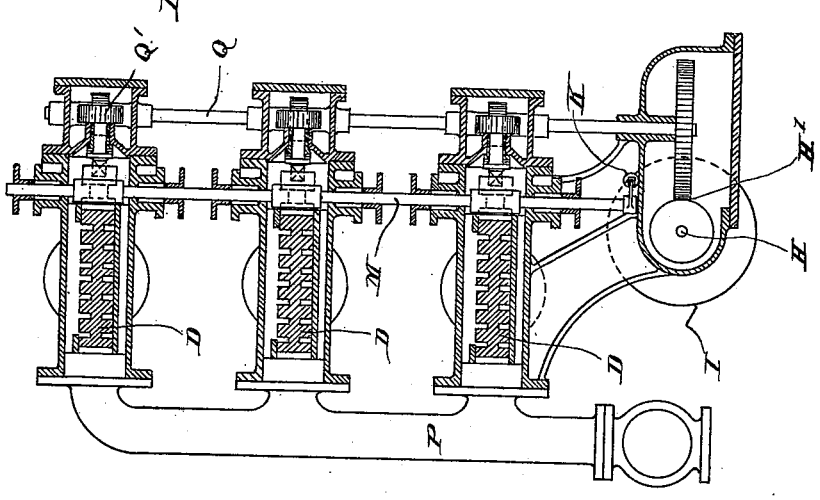
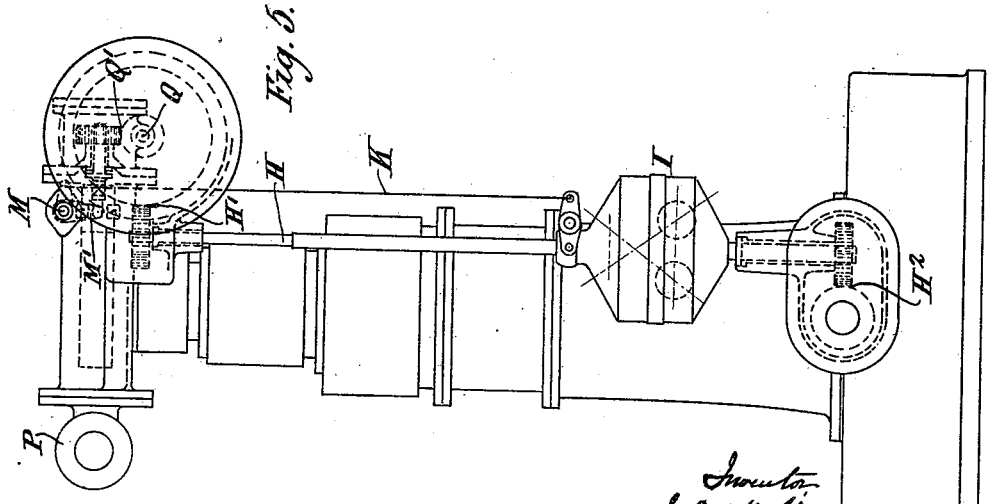



Fig. 5.




Witnesses.
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No. 645,983. Patented Mar. 27, 1900.

J. H. STREET.

STEAM OR OTHER ELASTIC FLUID ENGINE.

(No Model.) (Application filed June 17, 1899.) 6 Sheets—Sheet 6.

Fig. 6.

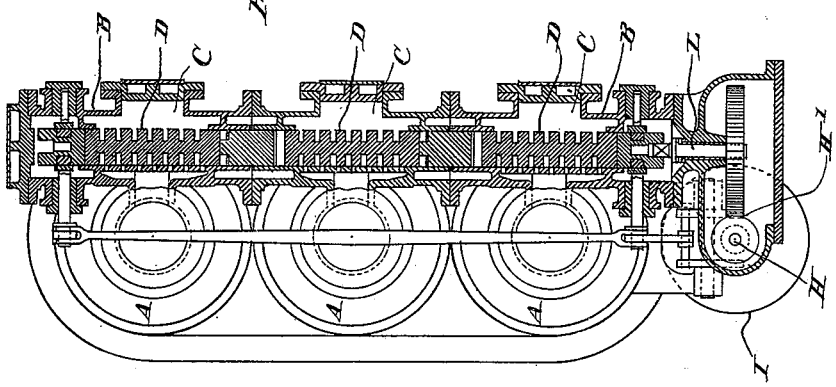
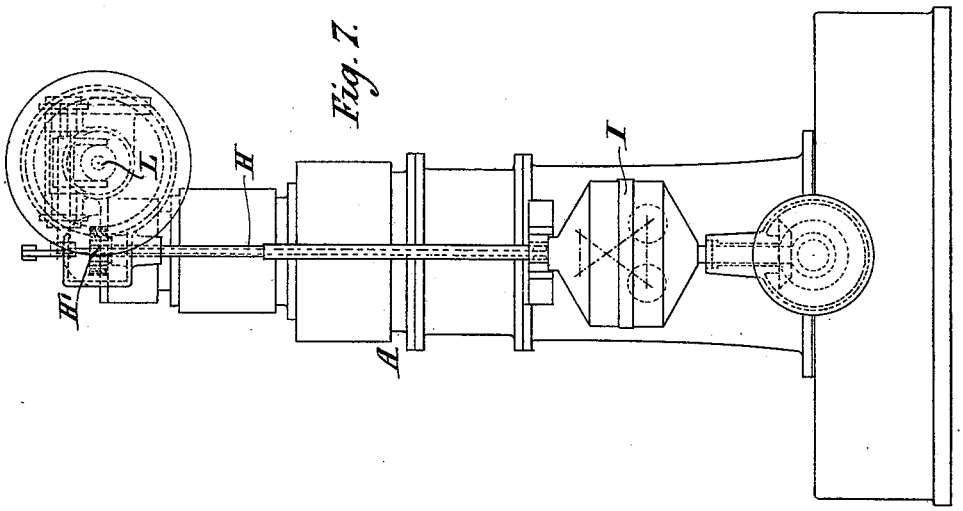



Fig. 7.




Witnesses.
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# UNITED STATES PATENT OFFICE.

JOHN HADFIELD STREET, OF RUGBY, ENGLAND, ASSIGNOR TO THE WILLANS & ROBINSON, LIMITED, OF SAME PLACE.

## STEAM OR OTHER ELASTIC-FLUID ENGINE.

SPECIFICATION forming part of Letters Patent No. 645,983, dated March 27, 1900.

Application filed June 17, 1899. Serial No. 720,936. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN HADFIELD STREET, engineer, a subject of the Queen of Great Britain, residing at Victoria Works, Rugby, in the county of Warwick, England, have invented certain new and useful Improvements in Steam or other Elastic-Fluid Engines, of which the following is a specification.

This invention relates to valve mechanism for admitting and cutting off steam or other elastic fluids in steam or other elastic-fluid engines.

According to this invention I use a constantly-rotating cylindrical valve, which lies in a corresponding cylindrical segmental recess in the steam-chest. A port or ports are formed in the segmental recess, and a passage extends therefrom to the cylinder of the engine. The cylindrical valve has corresponding recesses formed in its circumference. As the valve rotates the recesses in it come over the ports in the valve-seat and at the same time are opened to the steam in the steam-chest, and steam is then free to pass to the cylinder. When the recesses pass beyond the ports, the ports are closed by the cylindrical valve and no steam passes. The ports in the valve-face are inclined to the axis of the cylindrical valve. The recesses in the valve are also inclined to the axis. It follows that as the recesses or valve-ports pass across the ports in the valve-face the point of cut-off can be made later or earlier, moving the valve endwise, the point of admision, however, remaining constant, since admission corresponds with the commencement of the crossing of the ports, which does not vary with the endwise position of the valve. Endwise motion is given to the valve directly or indirectly by the governor to vary the cut-off.

Figure 1 of the drawings annexed is a side elevation, partly in section, of a steam-engine having three sets of tandem cylinders and valve mechanism constructed, as above described, for controlling the admission and the cut off of steam to the uppermost cylinder of each set of cylinders. Fig. 2 is a horizontal section, and Fig. 3 a cross-section on a larger scale, of one of the valves and its valve-seat. Fig. $3^a$ is a view on an enlarged scale, partly in section, showing the governor mechanism. Fig. $3^b$ is a sectional view, on an enlarged scale, corresponding to the upper right-hand side of Fig. 1. Fig. 4 is a plan in section of a modification in which the valves are placed at right angles to the crank-shaft in place of all being in a line and parallel with the crank-shaft, as in Fig. 1. Fig. 5 is an end elevation of this modification. Fig. 6 is a plan in section, and Fig. 7 an end elevation, of a modification in which the steam-chest is at one side of the cylinders instead of above them.

In Fig. 1, A A A are three sets of tandem cylinders, the piston-rod of each of which is coupled to a separate crank on the crank-shaft, which is below them.

B is the steam-chest.

C are three segmental recesses in the valve-chest, one for each set of tandem cylinders. The form of each of these segmental recesses is better seen in the cross-section Fig. 2.

D are three cylindrical valves lying in the recesses C. They are all in a line and abut one against the other and are connected, as shown in Figs. 1 and 2, in such a way that when one is revolved the others revolve with it.

C′ are ports formed in each segmental recess. These are inclined to the axis of the valves D. D′ are corresponding recesses formed in the circumference of each valve D. In the arrangement shown there are three rows of such recesses at equal distances apart. In this case the valve has to be driven at such a speed as to make one revolution for every three revolutions of the crank-shaft of the engine.

The valves are rotated continuously by a spindle E, having upon it a bevel-wheel F, which is itself driven by a bevel-pinion G on a vertical shaft H, which is driven by bevel-wheels from the crank-shaft of the engine.

I is a governor carried by the vertical shaft H. It serves to raise and lower a connecting-rod K, which at its upper end is coupled to the central joint of toggle-links L. The special construction employed is not material to the operation of the invention herein claimed. In the governor illustrated the balls I′ are within a casing which is lifted as the balls separate and which, with the springs H′, afford the resistance which balances the cen-

trifugal action of the ball. The governor illustrated resembles that shown in the United States Patent of Robinson, No. 521,573, except that in the former the weight of the casing inclosing the governor-balls coöperates with the springs to balance the centrifugal action of the balls. The construction is plain from the drawings, and further detailed description is unnecessary, particularly as the special style of governor is not material to the invention herein claimed. The outer end of one of the toggle-links L turns on a fixed center at L′ and the outer end of the other is coupled to the lower end of an arm which projects downward from a rocking shaft M. This rocking shaft extends into and across the steam-chest and within the steam-chest has an arm M′ upon it, which serves to shift the valves D endwise in one direction. A corresponding arm N′ on a rock-shaft N at the opposite end of the steam-chest serves to shift the valves D endwise in the opposite direction. The rock-shafts are coupled one with the other by the connecting-rod O and arms O′, extending from their outer ends.

In the modification shown in Figs. 4 and 5 the valves D are each in a separate steam-chest supplied with steam through the steam-pipe P. The valves are driven continuously by skew-gear wheels Q′ from a shaft Q, which is itself driven by skew-gear wheels H′ from a vertical shaft H, driven at its lower end by skew-gear wheels $H^2$ from the crank-shaft of the engine. The shaft H, as in Fig. 1, carries the governor I, which acts to raise or lower a rod K. The upper end of this rod is coupled to an arm on the rock-shaft M, and other arms M′ upon this shaft shift the valves D endwise.

In the modification shown in Figs. 6 and 7 the construction is the same as that shown in Fig. 1, except that the steam-chest B is at one side of the cylinders instead of above them and that the axis L, by which the valves are rotated, is driven by skew-gear wheels H′ from the shaft H instead of by bevel-wheels. The circumferential positions of the recesses in the valves for supplying steam to the three sets of cylinders bear an angular relation to each other corresponding to the angular relations of the several cranks which the pistons of these sets of cylinders serve to drive, so that admission may take place at the proper times in the several cylinders. It is obvious that the series of cylinders served by one series of valves, as here described, may be high-pressure and low-pressure or high-pressure, intermediate, and low pressure, instead of all taking steam of like pressure and from the same source. In this case the several cylinders will require separate steam-chests and the valves will be connected by spindles which leave and enter the several steam-chests through glands.

In a tandem engine the admission-valves of the lower cylinder or cylinders may be of the same description, or they may be simply rotating valves without any mechanism for giving end motion, or they may be valves of any other description whatever.

The engine indicated in the drawings is of the type known as the "Willans" engine; but so far as the subject-matter herein claimed is concerned any other suitable type of engine may be used in connection therewith. The special construction of parts of the engine shown in the drawings below the ports C′ in the segmental recess, as well as the pipe X, Fig. 3, are quite immaterial and require no consideration. I may say, however, that they partly indicate a construction of engine described and claimed in my application filed June 17, 1899, Serial No. 720,937.

I claim—

1. In a steam or like engine the combination of a segmental recess or valve-seat in the steam-chest, a continuously-rotating cylindrical admission-valve seated therein, one or more inclined ports formed in the segmental valve-seat, one or more inclined recesses formed in the circumference of a rotating valve, which as the valve rotates are brought over the ports and are at the same time open to the steam in the steam-chest and allow steam to pass to the ports, and means for shifting the rotating valve endwise by the action of the engine-governor to vary the cut-off according to the speed of the engine.

2. The combination of a steam-chest, a segmental recess or valve-seat therein, a continuously-rotating cylindrical valve seated in the segmental recess, ports formed in the segmental recess and recesses formed in the circumferential face of the cylindrical valve, which as the valve rotates are brought over or opposite the ports and are at the same time open to the steam in the steam-chest and allow steam to pass to the ports, and means for shifting the rotating valve endwise by the action of the engine-governor according to the speed of the engine.

3. The combination of two steam or valve chests arranged end to end and connected by a circular passage constituting a bearing for cylindrical valves and having respectively at their outer ends similar bearings, segmental valve-seats located within the chests and between said bearings, two continuously-rotating cylindrical valves seated in the respective segmental valve-seats and turning in said bearings, an interlocking connection between the abutting ends of the two valves, means for continuously rotating both valves applied at the end of one of them, one or more ports formed in each segmental valve-seat, one or more recesses formed in the circumferential surface of each cylindrical valve, and means for shifting the two valves simultaneously by the action of the governor to vary the cut-off according to the speed of the engine.

4. The combination of two steam or valve chests arranged end to end and connected by a circular passage constituting a bearing for cylindrical valves and having respectively at

their outer ends similar bearings, segmental valve-seats located within the chests and between said bearings, two continuously-rotating cylindrical valves seated in the respective segmental valve-seats and turning in said bearings, an interlocking connection between the abutting ends of the two valves, means for continuously rotating both valves applied at the end of one of them, one or more ports formed in each segmental valve-seat, one or more recesses formed in the circumferential surface of each cylindrical valve, two pivoted levers mounted to exert endwise pressure at the outer ends of the respective valves to shift them axially in either direction, a cross-bar connecting the outer ends of said levers, a governor and operative connections between the governor and levers to rock them in either direction and shift the valves endwise in either direction.

5. The combination of two steam or valve chests arranged end to end and connected by a circular passage constituting a bearing for cylindrical valves and having respectively at their outer ends similar bearings, segmental valve-seats located within the chests and between said bearings, two continuously-rotating cylindrical valves seated in the respective segmental valve-seats and turning in said bearings, an interlocking connection between the abutting ends of the two valves, means for continuously rotating both valves applied at the end of one of them, one or more ports formed in each segmental valve-seat, one or more recesses formed in the circumferential surface of each cylindrical valve, a governor and operative connections interposed between the governor and the respective outer ends of the two continuously-rotating valves whereby they may be shifted axially in either direction.

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Witnesses:
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WALTER J. SKERTEN.