Sheet 1-2 Sheets.

G. I. Washburn,

Recipnrocating Steam Engine,

No. 62,710, Patented Mar. 5, 1867.

Fig. 1

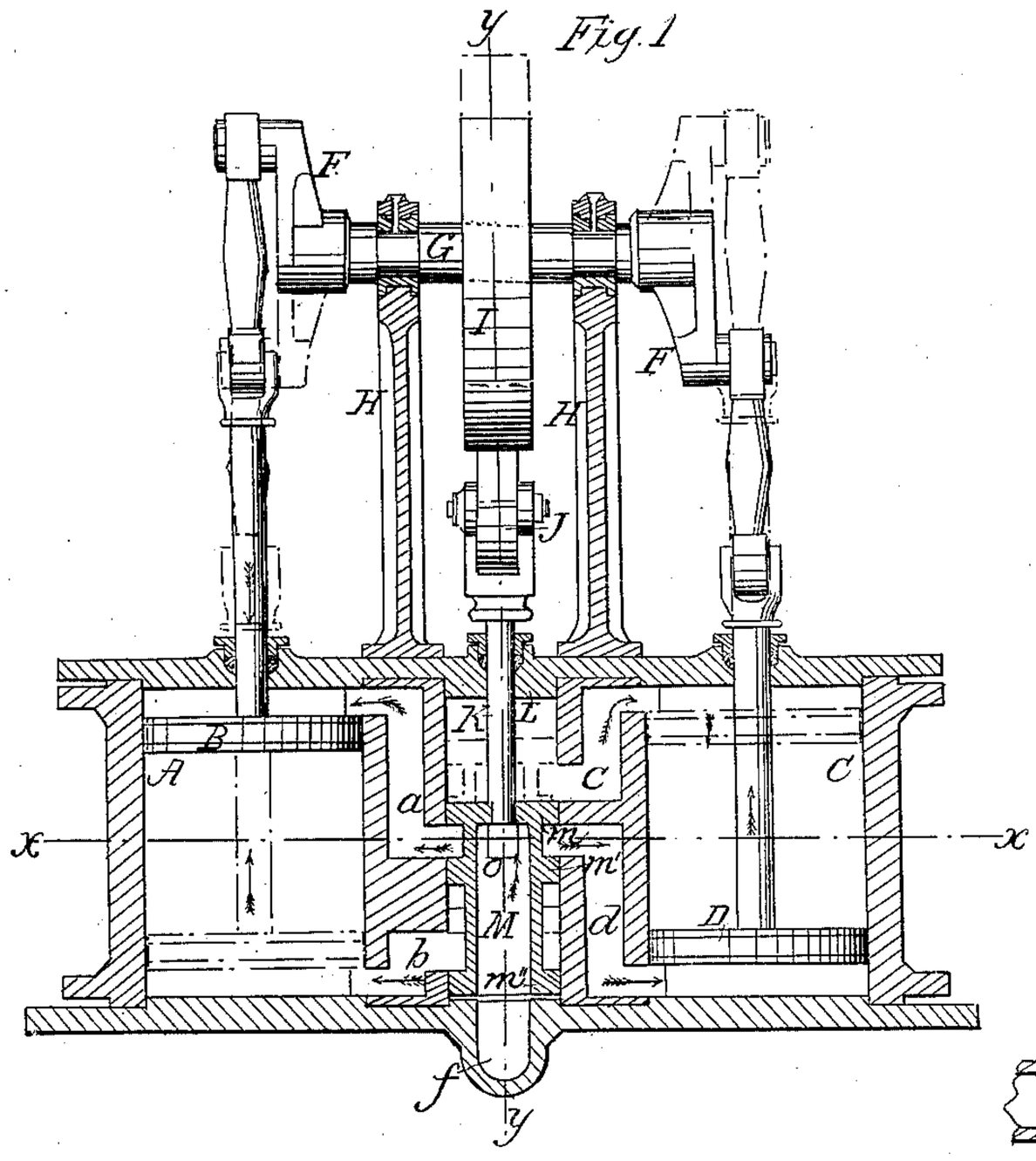
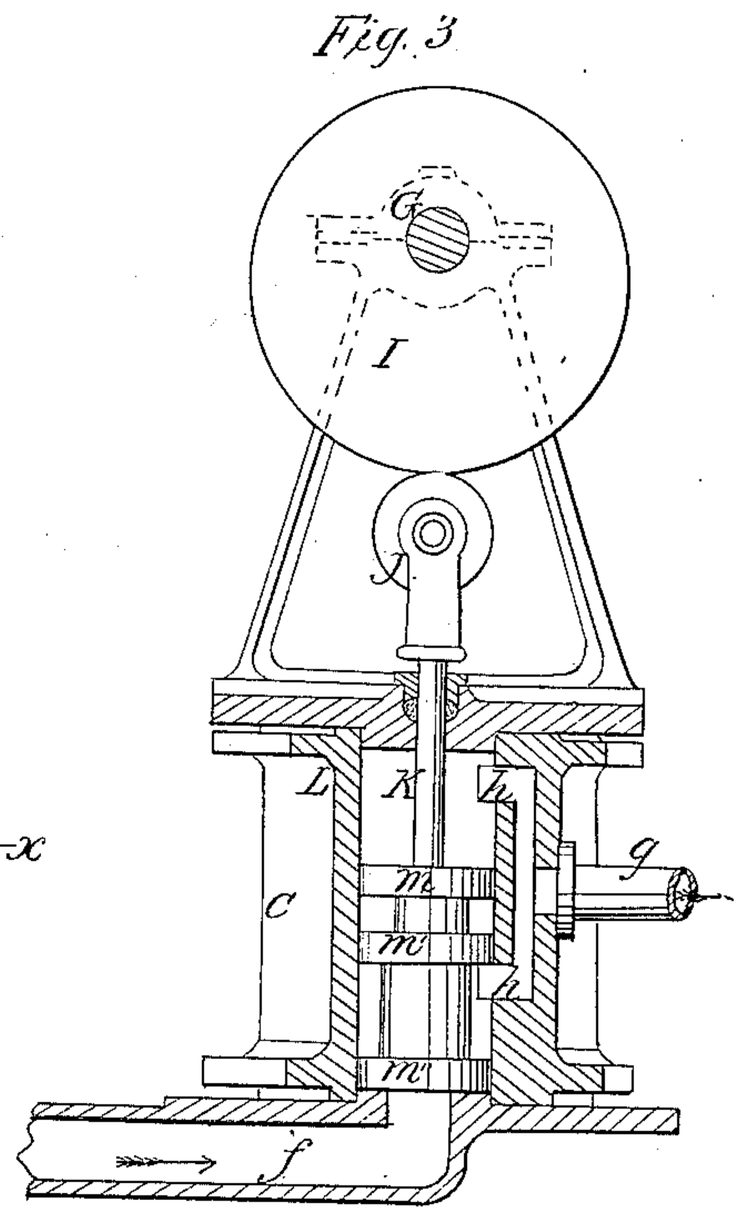


Fig. 3



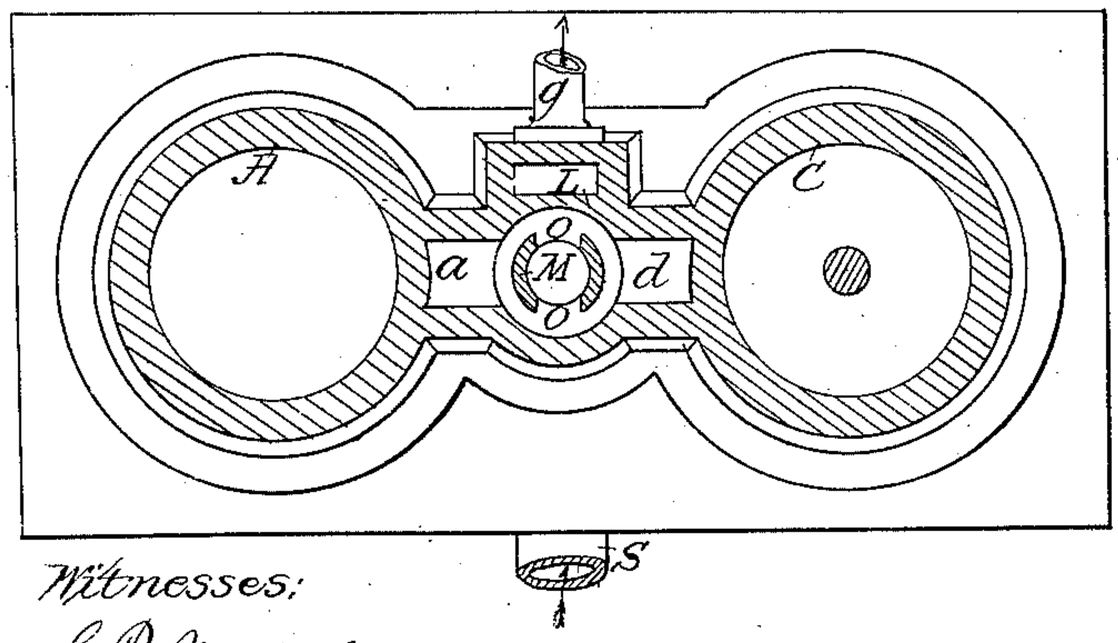


Fig. 2.

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Sheet 2-2 Sheets

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Fig. 4

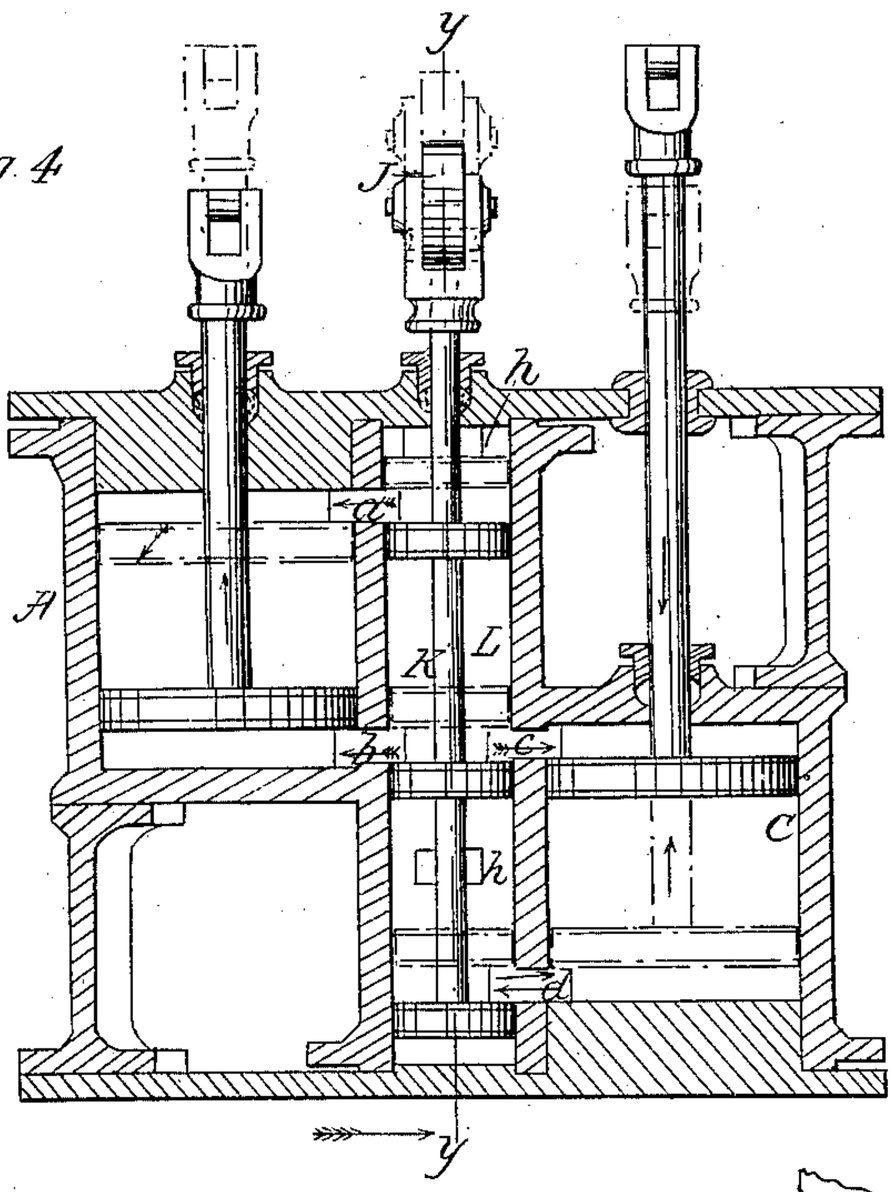


Fig. 5.

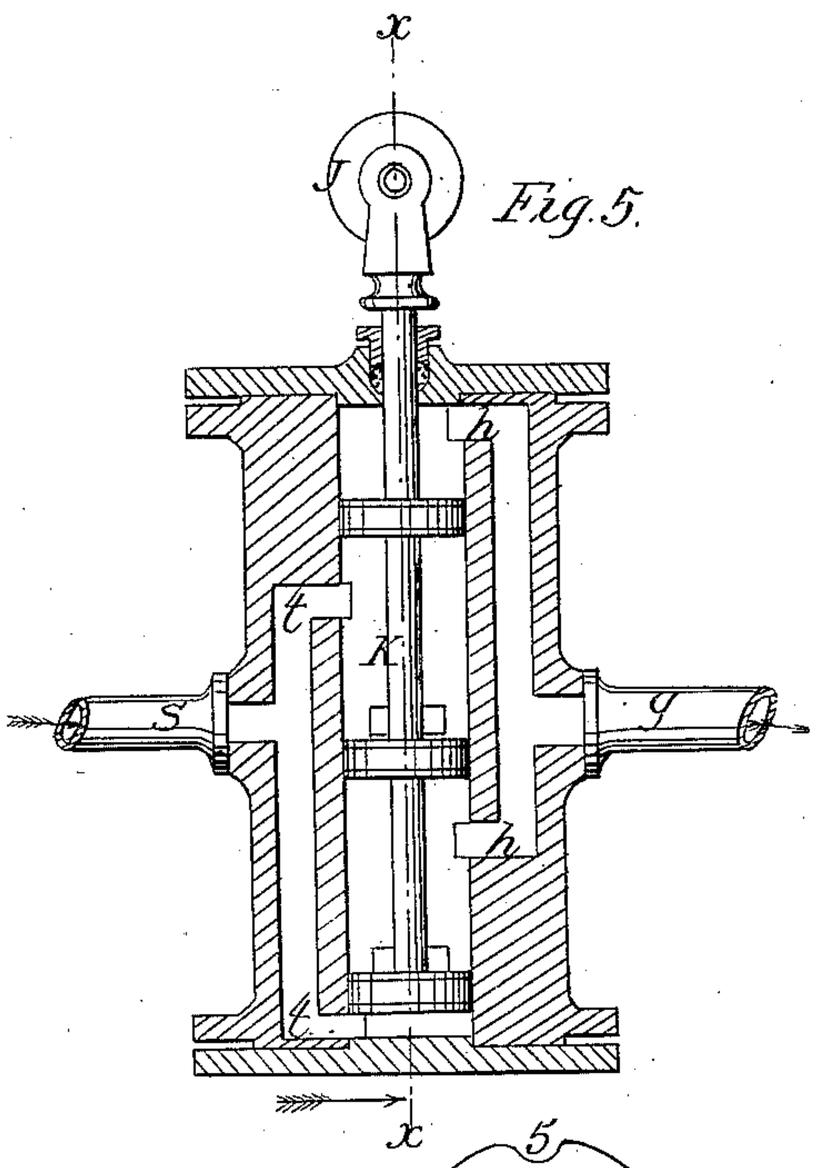


Fig 6.

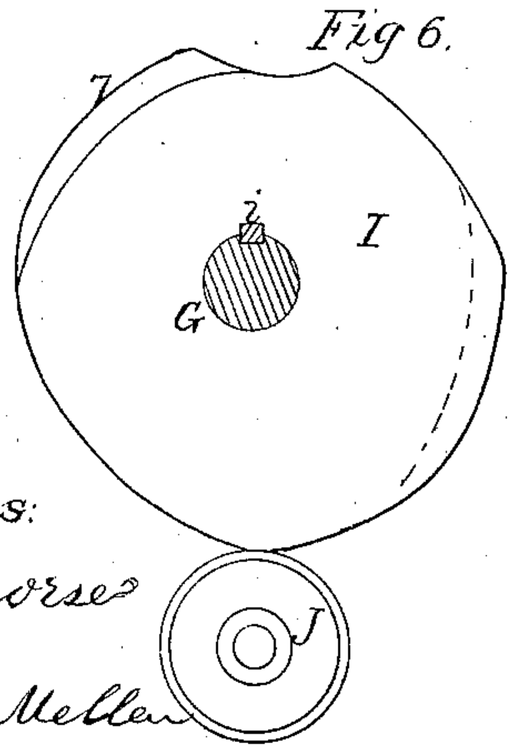
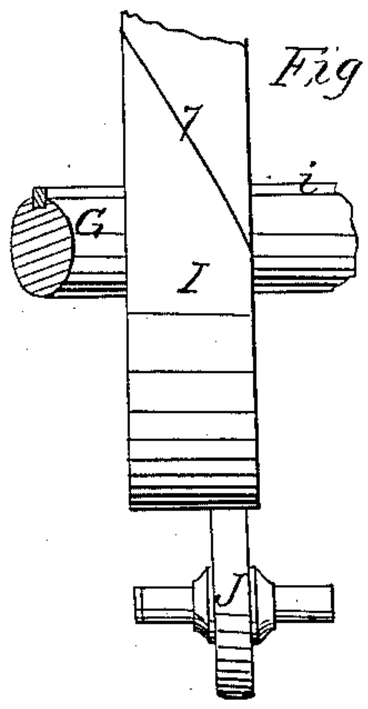
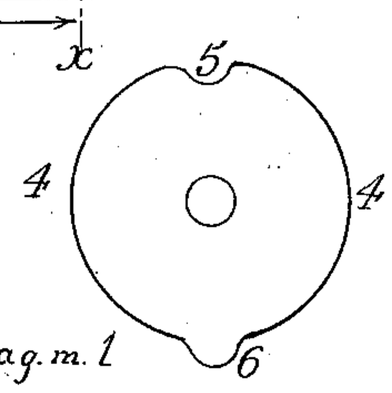


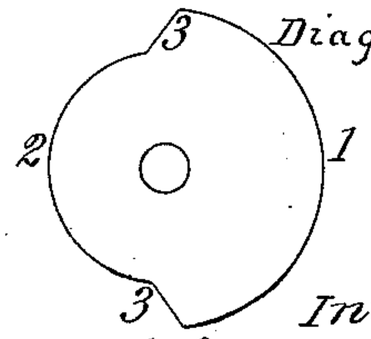
Fig 7.





Diag. m. 1

Diag. m. 2.



Witnesses:

S. P. Morse

Edward Mellen

Inventor:

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United States Patent Office.

GEORGE I. WASHBURN, OF WORCESTER, MASSACHUSETTS.

Letters Patent No. 62,710, *dated March* 5, 1867.

IMPROVEMENT IN STEAM ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, GEORGE I. WASHBURN, of Worcester, in the county of Worcester, and State of Massachusetts, have invented a new and useful Improvement in Steam Engines; and I do hereby declare the following to be a full, clear, and exact description of the same, sufficient to enable one skilled in the art to which the invention appertains to make use of it, reference being had the accompanying drawings, which form a part of this specification, and in which—

Figure 1 is a vertical central section through the engine.

Figure 2 is a horizontal section on the line *x x*, fig. 1.

Figure 3 is a vertical central section on the line *y y*, fig. 1.

Figure 4 is a vertical section of an engine on the line *x x*, fig. 5, and differing from fig. 1 in the positions of the cylinders relatively to each other and to the valve-chamber, and showing also a difference in the construction of the valve.

Figure 5 is a vertical section on the line *y y*, fig. 4.

Figure 6 is a side elevation of the variable cam which controls the motions of the valve.

Figure 7 is an edge elevation of the same.

This engine has two cylinders, with double acting pistons, to which the steam is admitted through passages guarded by a single valve of peculiar construction; the valve is tubular, in addition to the circular disk, which closes its upper end, and whose projecting periphery fits the wall of the valve-chamber; has two annular disks, one around its lower open end and the other at a point intervening between the two former; steam is constantly admitted to the interior of the valve and passes out through ports in the latter, which are between the upper disk and the one next below, the annular space between the two being a steam space, which is brought into correspondence with the passage leading to the cylinders; the annular space between the second disk and the lower one is an exhaust space, which communicates in turn with the cylinders, in addition to the above, there is one steam communication below the valve and one exhaust communication above it, as will be more fully explained. The valve by the pressure of steam below is kept constantly pressed upward, so that the roller on the upper end of the valve-rod is maintained in contact with the cam on the main shaft, and the cam is so shaped and set upon the shaft as to govern the motions of the valve in the manner desired; the face of the cam on the main shaft has a certain longitudinal variability, so that being shifted along on its axis it may effect a variable expansion under the influence of the governor-balls.

In the drawings, A C are two cylinders, in which the respective pistons B D reciprocate; the pistons are connected by rods and pitmen to the cranks E F, which are attached to the main shaft G, which revolves in bearings supported by the frame H H. Midway of the length of the main shaft is a cam, I, of peculiar conformation, shown in more particular detail in figs. 6 and 7; this cam is capable of adjustment longitudinally of the main shaft, a feather, *i*, causing it to rotate therewith. The face of the cam comes in constant contact with the friction-roller J, on the upper end of the valve-rod K, which passes through a stuffing-box into the valve-chamber L, in which the valve M reciprocates. The valve M is a tube closed at one end by a disk, *m*, whose projecting flange is in contact with the walls of the valve-chamber L; around the lower end of the tube of the valve is an annular disk, *m'*, and at an intervening point is another disk, *m''*, which, like the disk *m*, fits the walls of the chamber. Between the upper disk and the ring below it are two ports, *o o*, through which steam passes to the annular space enclosed by said disks; the space between the second disk and the lower one is an exhaust space, as will presently be explained. Steam passages, *a*, *b*, *c*, *d*, lead from the valve-chamber to the respective ends of the cylinders, and these passages are alternately induction and eduction passages, as they by the motions of the valve are brought into communication with the boiler by pipe *f*, or with the exhaust pipe *g*. The live steam from the boiler is constantly present in pipe *f*, and presses the valve M upward, so that the roller J is always in contact with the cam I, and the steam is ready to pass to the cylinders as the valve is moved for that purpose.

The operation is as follows: Steam is admitted from the boiler through pipe *f*, and passes through the valve M and the ports *o o* to the annular space between the disks *m m'*, to the passages *a d*, which lead respectively to the upper side of piston B and the under side of piston D, the exhaust steam from below piston B passing through port *b* to the annular space between disks *m' m''*, and from them by port *h*, fig. 3, to the exhaust pipe *g*; the exhaust steam from above piston D escapes through port *c* to the valve-chamber above

the valve, and thence by port *k* to the exhaust pipe *g*. When the steam is reversed and the valve rises to the position shown in red lines, the passages which were eduction become induction; and conversely, steam being admitted below piston B through port *b*, without passing through the valve, while the steam for the upper side of piston D passes through the valve and ports *o* to the port *c;* the exhaust steam escapes from above the piston B through port *a*, between disks *m' m''*, to port *h* and pipe *g*, while the exhaust steam from below piston D escapes by port *d* to the same eduction passage. It will thus be seen that while the disks on the valve open and close the ports, that when the valve M is down the eduction of steam from above piston D is above the valve and not through it, and when the valve M is raised the induction of steam below piston B is below the valve and not through it; with these exceptions the induction of steam is through the valve and ports *o*, and the eduction of steam is around the valve between the annular disks *m' m''*. I have mentioned that the motions of the valve are controlled by the constant pressure of steam below and by the downward pressure of the cam, which is eccentric, a revolution of the cam corresponding to a complete round of motions of the pistons in their cylinders. The variations in the radius of the perimeter of the cam answer to the desired vertical positions of the valve M; by a proper conformation of the face of the cam it may be made to exert a variable action on the valve as it is slipped longitudinally on the shaft to bring a different portion of its periphery in contact with the friction-roller on the upper end of the valve-rod.

Diagrams 1 and 2 will illustrate the construction of the eccentric.

Diagram 1 shows an eccentric, arranged to make a quick cut-off, the circular portions 4 representing the cut-off middle position of the valve, at which it rests, excepting at the opposite points 5 6, which represent, respectively, the upper and lower positions of the valve admitting steam below and above the piston in a given cylinder. At these points the valves make a sudden motion up and down, respectively, opening for a short time the steam induction port of a given cylinder.

Diagram 2 shows an eccentric arranged for full steam, the valve resting in its lower position, while the surface 1 is in contact with the valve-rod, and in its upper position, when the surface 2 is, under like contacting circumstances, making its up and down motion by the inclined planes 3 3.

Now, if on an eccentric with a wide face, such as is represented in figs. 6 and 7, one edge be made to correspond with diagram 1 and the other edge with diagram 2, by shifting the eccentric longitudinally on its shaft so that the friction-roller on the upper end of the valve-rod may be in contact with one or the other of these portions of the surface of the cam, a variability of steam induction may be attained—a quick cut-off or full steam.

The respective edges of the cam being thus shaped, it remains to unite the two by oblique lines, one of which is indicated by 7, (see figs. 6 and 7;) thus the position of the valve indicated by the radius 1 being maintained for about half a revolution of the cam, in fig. 2, and but momentarily at 6, in fig. 1, by an oblique line uniting the two the time during which the valve shall be in the lower position due to this radius, 1 or 6, may be varied from the quick cut-off of 6, fig. 1, to the full steam of 1, fig. 2. The same is true of the counterpart depression 5 of fig. 1, and the curve of small radius 2, fig. 2, when the valve is at its highest and the cylinder receives its steam below the piston. To repeat, one edge of the cam gives one motion and the other edge the other motion. The face of the cam is dressed off from one edge to the other, so as to give all the mediums these two extreme effects. In regard to the arrangement of the disks and ports so as to permit a cut-off of the steam without closing the exhaust simultaneously therewith, may be accomplished by making a variation in the respective distances between the disks and the ports, so that the steam would be cut off before the exhaust port was entirely closed, the disks being brought a little nearer together; so that when one covers a steam-induction port the other does not quite cover an exhaust port; or the distances between the disks may be a little greater than that between ports, as the case requires. In figs. 4 and 5 is shown a modification of the arrangement, differing in two respects from that shown in figs. 1 and 2, namely:

First. The cylinders in figs. 4 5 are arranged upon different levels, which shortens the steam passages from them to the valve-chamber, while the length of the latter is increased.

Second. The valve, instead of being hollow, with three disks at different heights fitting the walls of the chamber, consists of a stem with three disks upon it; and the stem is admitted at two points into the valve-chamber between the upper and middle disk and below the lower one. Thus, the space between the upper and middle disk and the space below the lower disk are constant steam-spaces, and the space above the upper disk and that between the middle and lower disk are constant exhaust-spaces. The said steam and exhaust-spaces being consecutively brought into correspondence with the ports leading to the respective ends of the cylinders.

In the drawings, figs. 4 5, S is the steam pipe. Proceeding from the boiler *t t* are two steam-ports leading to the valve-chamber. *a b* are the ports to the upper and lower ends, respectively, of the cylinder A; and *c d* are the ports leading to the upper and lower ends, respectively, of the cylinder C. *h h* are ports leading from the valve-chamber to the exhaust pipe *g*. With the exceptions referred to, the action of the steam is similar to that described in figs. 1 2, and the action on the pistons is identical.

Having described my invention, what I claim therein as new, and desire to secure by Letters Patent, is—

1. The arrangement of the cylinders A C, with their double-acting pistons B D, and valve with three disks reciprocating in the chamber between the cylinders and controlling the ports, substantially as described.

2. I claim a steam-valve, when arranged to be operated by a pressure from below and an eccentric above, substantially as described.

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Witnesses:
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EDWARD MELLEN.