B. BRAZELLE.

VARIABLE CUT-OFFS FOR DIRECT-ACTING ENGINES.

No. 183,446. Patented Oct. 17, 1876.

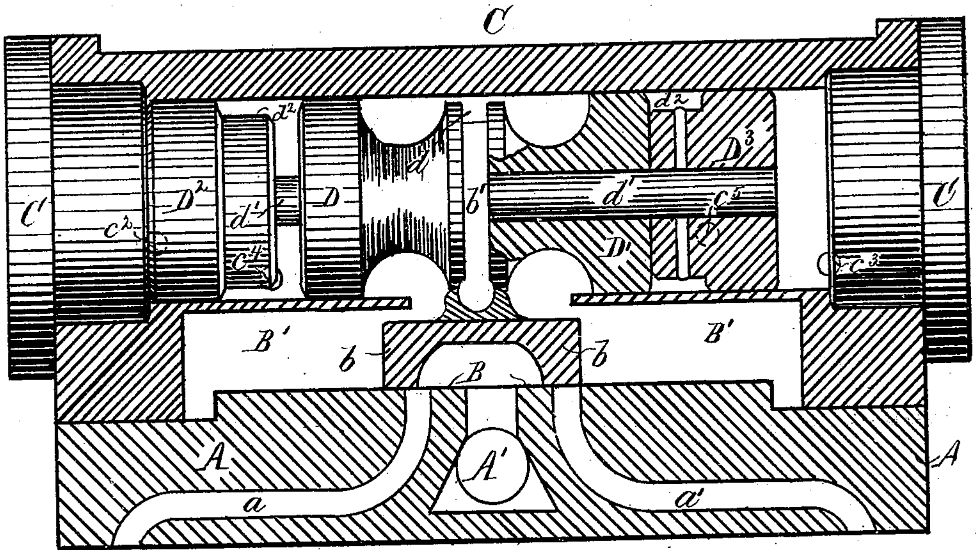

Fig. 1.

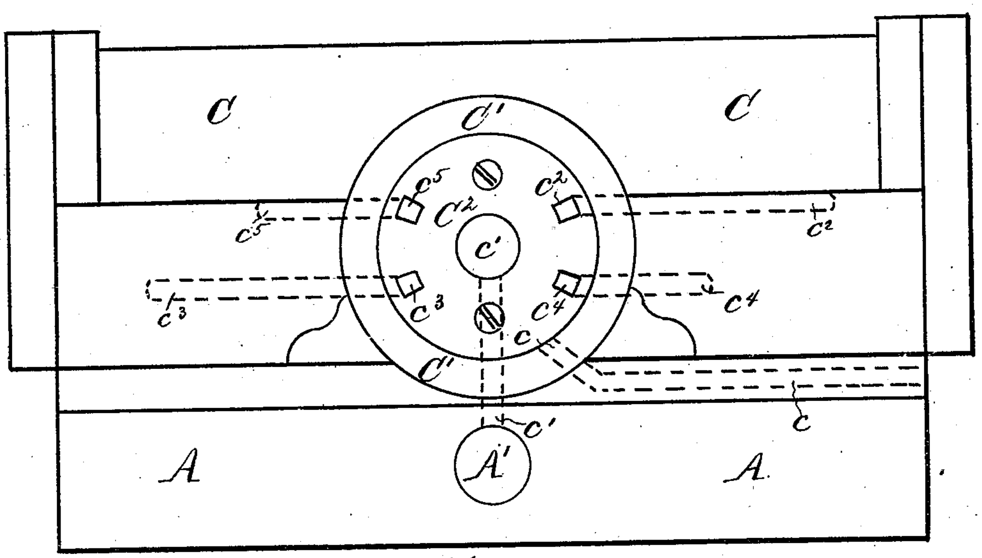

Fig. 2

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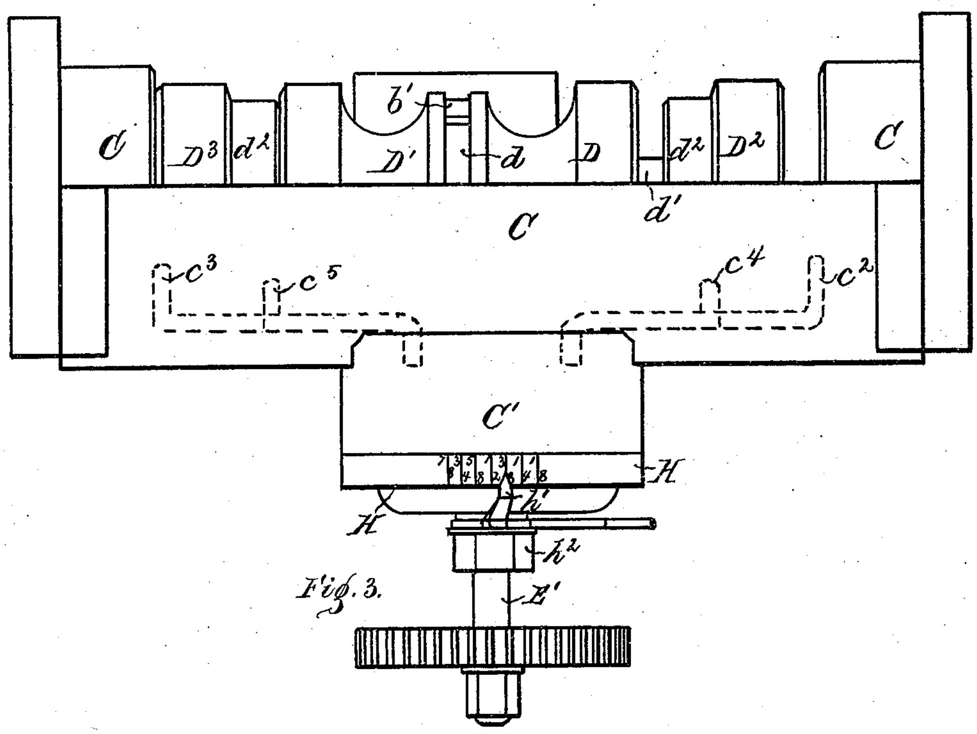

Fig. 3.

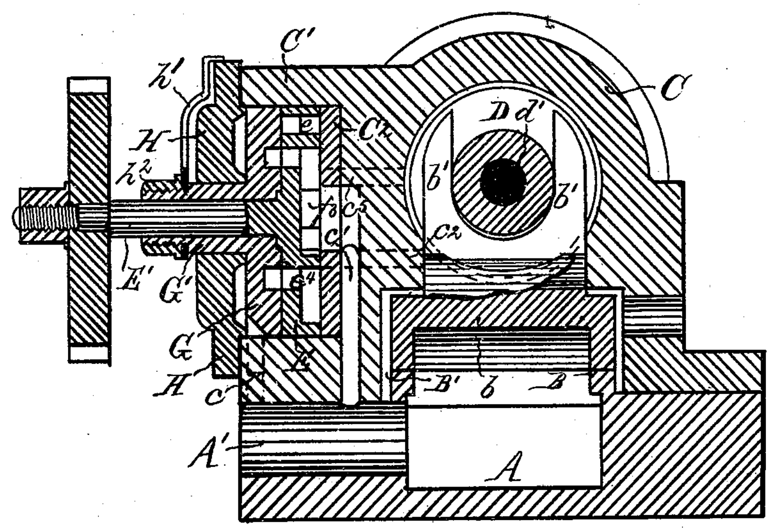

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Fig. 4

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3 Sheets—Sheet 3.

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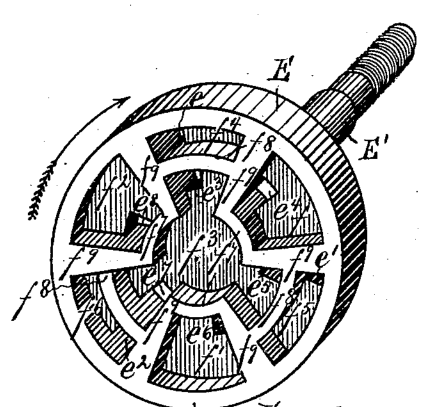

Fig. 5.

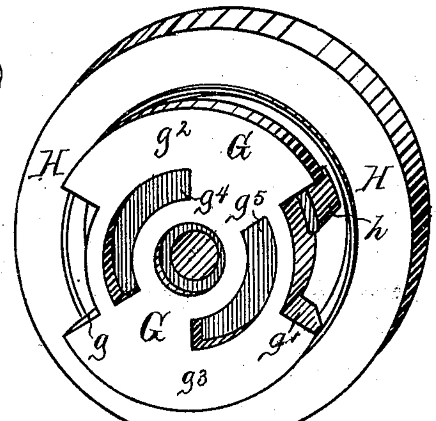

Fig. 6

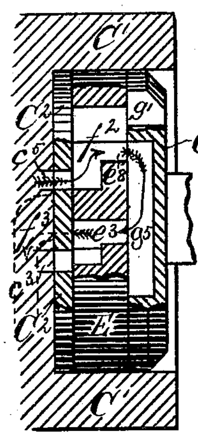

Fig. 8

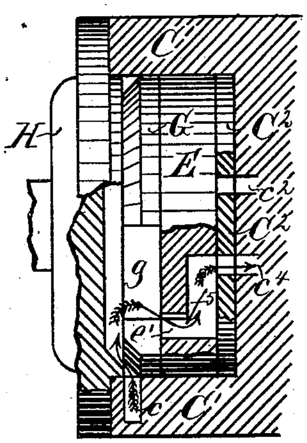

Fig. 7.

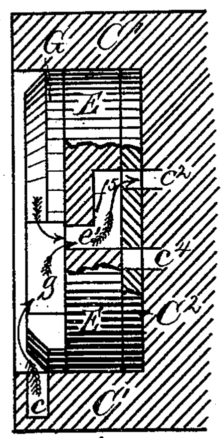

Fig. 9.

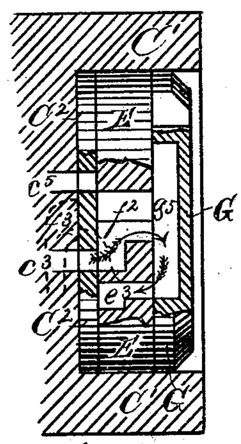

Fig. 10.

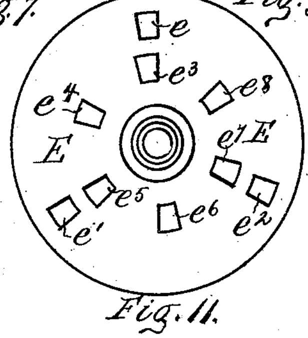

Fig. 11.

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UNITED STATES PATENT OFFICE

BENJAMIN BRAZELLE, OF ST. LOUIS, MISSOURI.

IMPROVEMENT IN VARIABLE CUT-OFFS FOR DIRECT-ACTING ENGINES.

Specification forming part of Letters Patent No. **183,446**, dated October 17, 1876; application filed January 26, 1876.

To all whom it may concern:

Be it known that I, BENJAMIN BRAZELLE, of St. Louis, Missouri, have invented an Improved Variable Cut-Off Steam-Engine, of which the following is a specification:

The improved features of this invention relate, first, in arranging within an auxiliary cylinder double stop-pistons, and the manner in which same are operated to control the slide-valve to establish wide-open induction and exhaust ports from the beginning to the end of cylinder-piston stroke, thereby admitting steam to act upon said cylinder-piston at full boiler-pressure, also avoiding back pressure; secondly, to the further arrangement of double carrier-pistons, and to the manner in which same are operated to control the slide-valve to cut off steam at any desired point of the piston-stroke, thereby utilizing the full expansive steam-power; thirdly, to the novel arrangement of inlet and exhaust steam passages, ports, and chambers, by which the steam-power shall operate the stop and carrier pistons at required times to cut off steam, as well as impart the required reciprocation to cylinder-piston; fourthly, to an improved construction of a rotary or disk valve for controlling the inlet to and exhaust from the pistons in auxiliary cylinder; fifthly, to an improved construction of a disk-cover or admission-plate, to control and regulate the admission of steam to the disk-valve and stop and carrier pistons; sixthly, to the combination of the disk-valve, also disk-cover, with relation to the steam-chest of the auxiliary cylinder, and its contained pistons; lastly, to certain detail construction of parts, all of which will now more fully appear.

Of the drawing, Sheet 1, Figure 1 is a longitudinal sectional elevation. Fig. 2 is a side elevation, with cut-off parts removed, showing valve-seat in the top cylinder, and its arrangement of high-pressure and cut-off ports and passages. Sheet 2—Fig. 3 is a top sectional plan. Fig. 4 is a transverse sectional elevation. Sheet 3—Fig. 5 is a perspective of rotary or disk valve. Fig. 6 is a perspective of disk-cover and the head of the top cylinder steam-chest. Figs. 7, 8, 9, and 10 are, respectively, sectional details, showing the port communications to admit and exhaust steam to and from the top cylinders, to operate the carrier-pistons as well as the outer stop pistons. Fig. 11 is a face view of my rotary valve.

A is the engine-cylinder. This has the usual steam-ports a a', which serve alternately as inductive and exhaust ports. A′ is the main exhaust. The ports or passages just mentioned communicate with the valve-seat B of a steam-chest, B′, in which operates an ordinary slide-valve, b. (See Figs. 1 and 4.) C is an auxiliary cylinder, which forms part of the steam-chest B′. Said cylinder has the cylinder steam-chest C^1, having the valve-seat C^2, as shown in Figs. 2 and 4. The inlet of steam to the steam-chest C^1 is by means of the inlet-port c, and c^1 representing the exhaust-passage leading from the steam-chest C^1 out of main exhaust. (See Figs. 2 and 4.)

From the valve-seat C^2 the steam-ports c^2 c^3 c^4 c^5 communicate to the interior of the top cylinder C, Fig. 2, as follows: c^2 c^3, the high-pressure ports, have their passages, as shown in dotted lines, Figs. 2 and 3, to communicate with each opposite interior end of the cylinder C; the cut-off ports c^4 c^5 have their passages to communicate with the cylinder C, as shown also in Figs. 2 and 3. Further, it will be noticed that the arrangement of all these ports is such that the high-pressure port c^2 is over the cut-off port c^4 on one side, while the high-pressure port c^3 is under the cut-off port c^5 on the opposite side, of the valve-seat C^2, and as shown in Fig. 2.

I call the ports c^2 c^3 "high-pressure ports" because their passages lead to the outer or stop pistons, to actuate thereby admission and exhaust of steam to reverse the stroke of the main piston, and the ports c^4 c^5 "cut-off ports" because they admit and exhaust steam alternately, and, as such, control the operations of the cut-off or carrier-pistons. The said arrangement of these ports just mentioned enables me to control the operations of the respective pistons, to achieve their independent functions of cutting off the steam, and changing the action or travel of the main piston at the end of every stroke thereof.

The pistons contained in the top cylinder are the carrier-pistons D D^1 and the stop-pistons D^2 D^3. (See Figs. 1 and 3.)

Γhe carrier-pistons D D^1 I construct of the plicate character shown in Figs. 1 and 3, ɜir outer piston-faces, in distance, being orter than the distance apart of the cut-off rts c^4 c^5, and so that the stroke or travel of id pistons shall be the relative distance re- ired to cause same to move the slide-valve o lap the induction-port, to cut off further mission of steam through said port to main linder. The hollow spaces either side of ɜ piston-heads serve to permit the steam to ualize the movements of said pistons. The nular groove d shown in the center of the :rier-pistons receives the slotted leg of the de-valve b, (see Figs. 1 and 3,) said valve ing, by universal coupling, secured to its ; b'. Lastly, the carrier-pistons have pass- ; through their center the stem d^1 that unites ɜ stop-pistons D^2 D^3. These pistons are also the duplicate character shown in Figs. 1 d 3; but at d^2 each piston is made smaller circumference to create a steam-chamber steam to enter and exhaust by means of ɜ cut-off ports c^4 c^5. The travel or stroke the stop-pistons D^2 D^3 is also relatively :h as to actuate the slide-valve b to cover ɜ ports of the main cylinder alternately, l when the change of its piston-stroke oc- :s.

Within the cylinder steam-chest C^1 I pro- le a rotary or disk valve, E, the construc- n of which, with its ports, chambers, &c., shown in Figs. 5, 11. This disk-valve, re specifically explained, I form to have the et-ports e e^1 e^2 and exhaust-ports e^3 e^4 e^5 e^6 e^7 (See Figs. 5 and 11.) These inlet-ports positioned in a circle near the periphery of valve, while the exhaust-ports are in a aller circle; also, each alternate exhaust- 't is diametrically in line with each inlet- 't. (See Figs. 5 and 11.)

.t can be here stated that the exhaust-ports further related in pairs, so as to establish ɪaust communication with main exhaust, such pairs, when the valve is rotating to left, are e^4 e^5 or e^6 e^7 e^8 e^3, and when said valve 'eversed the pairs to exhaust are e^8 e^7 or e^6 ^{4} e^3. Examining all the ports, as viewed the outer face of the valve, the Fig. 11 resents their position and arrangement. viewed from the inner face of the valve, ɜ Fig. 5,) it will be seen that the exhaust- 'ts e^4 e^6 e^8 further communicate with cored ımbers f f^1 f^2, respectively, while the re- ining exhaust-ports e^3 e^5 e^7 each communi- es with a center cored chamber, f^3. Like- e the inlet-ports communicate with cored ımbers f^4 f^5 f^6, respectively, the chambers ^{1} f^2 being separated from the center cham- f^3 by the walls f^7, and the chambers f^4 f^5 ılso separate from f^3 by the walls f^8, and, :ly, the exhaust-chambers are separate from inlet-chambers by the walls f^9—all shown 'ig. 5. The chambers f^4 f^5 f^6 are elongated ɜ Fig. 5) in order to establish communica- ı as soon as possible with the slide-valve, ıctuate this to cover a port of its main cyl- inder; also, the exhaust-chambers f f^1 f^2 are enlarged, (see Fig. 5,) and for the purpose to exhaust as soon as the inlet-steam communi- cation aforesaid with the valve is established. The disk-valve E has an arbor, E', (see Figs. 4, 5,) by means whereof it is connected to main shaft of the engine to derive its rotation.

In operative connection with the rotary valve E, I provide a disk plate or cover to control and regulate the admission of steam into inlet-ports of the said valve E, as this rotates, as well as to establish exhaust connec- tion between the pairs of exhaust-ports, and by means whereof the pistons in top cylinder operate the slide-valve to cut off steam at any point, as well as establish the reverse opera- tion of the engine-piston. G is therefore this disk plate or cover. Its construction is indi- cated in Fig. 6, having its opposite margin sides cut away to form inlet-steam spaces g g^1, leaving however its full margin faces at g^2 g^3.

The cut spaces g g^1 enable me to cut off steam earlier or later, according to the varia- ble points of cut-off desired, and the full faces g^2 g^3 are to prevent the admission of steam until the proper time of cut-off has arrived. Further, I provide in the face of the cover G' (contiguous to the valve) exhaust-chambers g^4 g^5. These chambers unite the exhaust-ports in pairs, as alluded to, to permit a free ex- haust, the blank face of said cover covering such exhaust-ports in the valve not acting as such. The disk-cover G has also forming part of it a sleeve, G', (see Fig. 4,) so that it can be turned on the arbor of the valve.

The operative relationship of the disk-cover G and the rotary valve E, so as to admit and exhaust steam in and from the top cylinder to operate the double pistons, is more fully illus- trated in Figs. 7, 8, 9, 10. The following is the description of said parts—first, however, to produce the result of cutting off steam, say at one-eighth of main piston-stroke: Suppos- ing the valve on its seat, the cover seated next to said valve, and in position so that its steam-space g will admit steam as soon as said valve has been turned to uncover its inlet- port e^1; then steam will enter same, pass along its cored chamber f^5, and into the cut-off port c^4, (see Fig. 7,) and operate the carrier-pistons D D^1 to one side, which cuts off steam by means of the slide-valve b covering the induc- tion-port of the main cylinder. At the same time the exhaust is taking place opposite the pistons D D^1 through the cut-off port c^5 into exhaust port and chamber e^8 f^2 of the valve E, thence into exhaust-port e^3 of same, and finally out of main exhaust. (See Fig. 8.) Thus the steam is admitted to pass into and exhaust from the auxiliary cylinder, and op- erate the cut-off pistons at the point of cut-off mentioned, and the same manner of establish- ing inlet and exhaust communications to said pistons takes place, no matter at what frac- tional point of the stroke the cut-off is desired.

The next operation of parts to be noticed is the manner in which the steam is admitted to and exhausts from the faces of the stop-pistons D^2 D^3. For this purpose I refer now to Figs. 9 and 10. The admission-cover G being in the same position as shown in Figs. 7 and 8, steam will be admitted through its open space g, and as the valve E uncovers the inlet-port e^1 the steam, entering its chamber f^5, passes into the high-pressure port c^2 to the outer face of one of the stop-pistons D^2 D^3, operating both to one side, and thus changes, by means of the slide-valve b, the entrance of steam to main cylinder to reverse the stroke of its piston. At the same time the exhaust from the opposite side of the stop-pistons takes place through the high-pressure port c^3 into exhaust port and chamber e^8 f^2, thence into chamber g^5 of the cover, returning by way of exhaust e^3 into center exhaust, and out of main exhaust. (See Fig. 10.) Thus the reverse operation of the stop-pistons is effected.

The disk-cover G, by its sleeve G′, is placed on the arbor of the disk-valve. Engaging the sleeve of the cover is the head H, which closes steam-tight the steam-chest C^1. (See Figs. 6, 4, and 3.) The head H has a stop, h, (see Fig. 6,) which limits the movement of the cover G according to the requirements of the points of cut-off, which I indicate on the periphery of said cylinder-head. Thus, as shown in Fig. 3, the variable points of cut-off are one-eighth, one-fourth, three-eighths, one-half, to seven-eighths.

h^1 represents an indicator, (see Figs. 3 and 4,) which is set to determine the point of cut-off. It is secured to the sleeve of the disk-cover by a nut, h^2. (See Figs. 3, 4.) It is by simply moving the index to the fraction indicated on the head E that changes the relative position of the disk-cover G, to allow steam to enter earlier or later, according to the set point of cut-off.

The connection of the disk-valve E to derive its rotary motion is made to the engine-shaft in any suitable way; but said motion of the valve should be in the ratio of one to every three revolutions of said shaft, since there are three inlet and six exhaust ports. The arm of the indicator, in cases of stationary engines, can also be attached to the governor for the same purpose of controlling the cut-off.

The complete operation of my variable cut-off is as follows: Say that the indicator has been set at one-half the stroke of the engine-piston. This sets the disk-cover G at the required point to prevent inlet of steam to the valve E until the main piston has made its half-stroke. Arriving at this point, the rotary valve uncovers an inlet-port to the steam, which, entering a cut-off port of the top cylinder, actuates the carrier-pistons D D^1 to one side, causing the slide-valve b to cover the induction-port leading to the main cylinder, and allowing steam to act expansively, the exhaust from the opposite side of the cut-off pistons just spoken of taking place at same time out of center exhaust. It should be here particularly noticed that while the foregoing operation takes place the eduction-port from the opposite end of main cylinder is open, allowing free exhaust from same to take place, and giving me the advantage of an open exhaust during the entire stroke, and preventing back pressure on the piston from steam or confined air. As soon as the piston has completed its stroke the admission of steam to and from the auxiliary cylinder to operate its stop-pistons will take place, so that said stop-pistons, by means of the slide-valve, will uncover the opposite engine-port for the new stroke of its piston. A full open exhaust-port at the commencement of the stroke, and before the induction is open, is thus had, which gives ample time for the steam to escape; also, an instantaneous and full open induction-port is thus obtained at the beginning of the stroke, which enables me to utilize full boiler-pressure.

Throughout its complete operation my variable cut-off admits, exhausts, and cuts off steam at any point of the stroke desired, and that with the use of a single slide-valve.

What I claim is—

1. The piston made in two parts—viz., heads D D^1 and D^2 D^3—the latter set having stem d^1 passing through the former set, when applied and operating within an auxiliary cylinder, as and for the purpose set forth.

2. The cut-off pistons D D^1, auxiliary cylinder C, having steam-chest C^1, and ports c c^1 c^4 c^5, in combination with slide-valve b and main ports of a steam-cylinder, to cut off steam from the latter, as and for the purpose set forth.

3. Within the auxiliary cylinder C, the stop-pistons D^2 D^3 and the steam-chest C^1, having the ports c c^1 c^2 c^3, in combination with slide-valve b and the main ports of a cylinder, whereby the piston of the latter is operated in the manner and for the purpose herein set forth.

4. The combination of the double piston D D^1 D^2 D^3, carrying slide-valve b, auxiliary cylinder C, and steam-chest B′, as and for the purpose set forth.

5. The relative arrangement of the inlet-ports e e^1 e^2, having cored chambers f^4 f^5 f^6, also exhaust-ports e^3 e^4 e^5 e^6 e^7 e^8 and cored chambers f f^1 f^2 f^3, in a rotary disk-valve E, in combination with steam-chest C^1, having ports and passages c c^1 c^2 c^3 c^4 c^5, and by means whereof the admission and exhaust of steam are had, in the manner and for the purpose set forth.

6. The rotary valve E, having inlet-ports e e^1 e^2, cored chambers f^4 f^5 f^6, exhaust-ports e^3 e^4 e^5 e^6 e^7 e^8, cored chambers f f^1 f^2 f^3, in combination with the high-pressure ports c^2 c^3, cylinder C, and its stop-pistons D^2 D^3, to operate as and for the purpose set forth.

7. The rotary valve E, having inlet-ports e e^1 e^2, cored chambers f^4 f^5 f^6, exhaust-ports e^3 e^4 e^5 e^6 e^7 e^8, cored chambers f f^1 f^2 f^3, in combination with cut-off ports c^4 c^5, cylinder C, and its carrier-piston D D^1, to operate as and for the purpose set forth.

8. The combination of the rotary valve E, having inlet-ports e e^1 e^2, cored chambers f^4 f^5 f^6, exhaust-ports e^3 e^4 e^5 e^6 e^7 e^8, chambers f f^1 f^2 f^3, the high-pressure ports c^2 c^3 and cut-off ports e^4 e^5, cylinder C, its valve-chest C^1, and the double pistons D D^1 D^2 D^3, said parts operating substantially in the manner and for the purpose set forth.

9. The disk-cover G, having steam-spaces g g^1, full faces g^2 g^3, and exhaust-chambers g^4 g^5, as and for the purpose set forth.

10. The disk-cover G, having steam-spaces g g^1, full faces g^2 g^3, exhaust-chambers g^4 g^5, in combination with a rotary valve, E, having inlet ports and chambers e e^1 e^2 f^4 f^5 f^6, and exhaust ports and chambers e^3 e^4 e^5 e^6 e^7 e^8 and f f^1 f^2 f^3, to operate as described.

In testimony of said invention I have hereunto set my hand.

BENJAMIN BRAZELLE.

Witnesses:
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CHAS. F. MEISNER.