(No Model.)

2 Sheets—Sheet 1.

# A. C. RAND.

## Valve Gear.

No. 230,336.

Patented July 20, 1880.

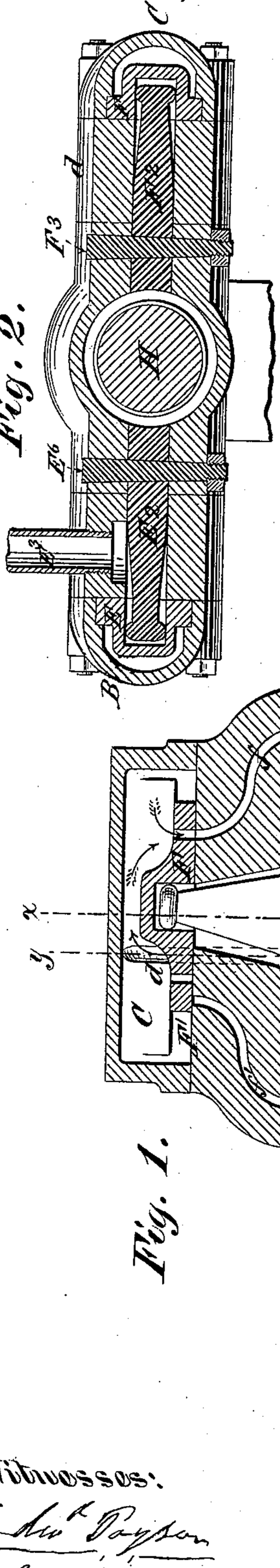

Fig. 2.



Fig. 1.



Fig. 4.



Fig. 3.

Witnesses:

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(No Model.) 2 Sheets—Sheet 2.

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## Valve Gear.

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Fig. 5.

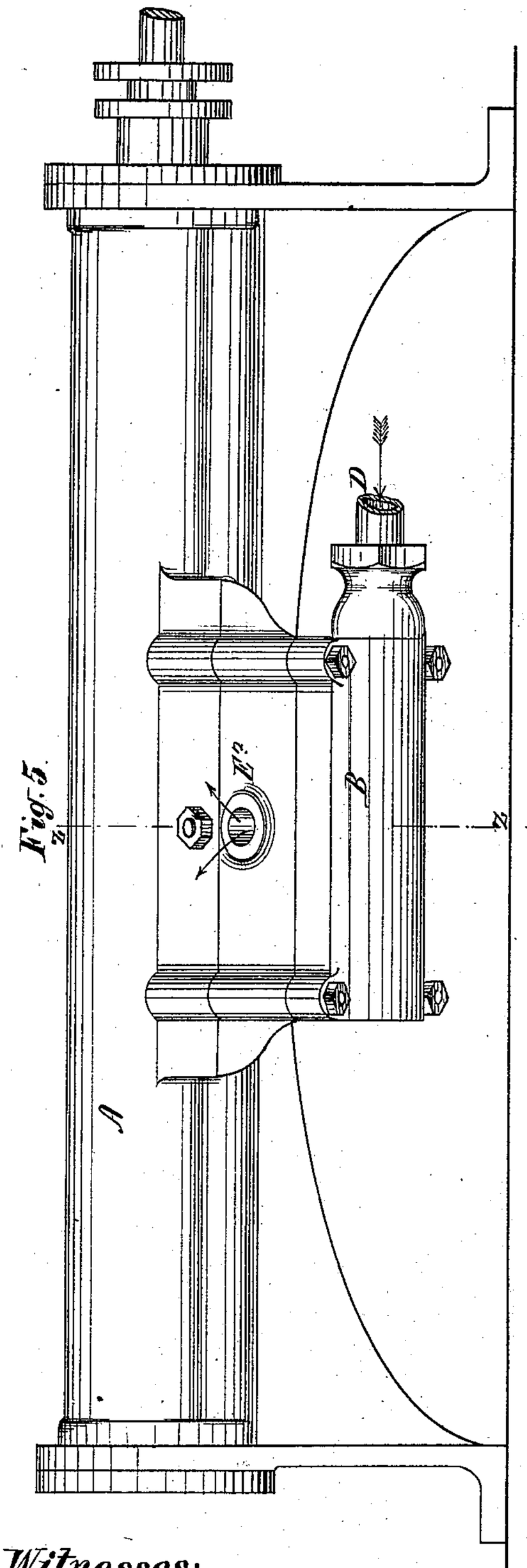



Fig. 7.

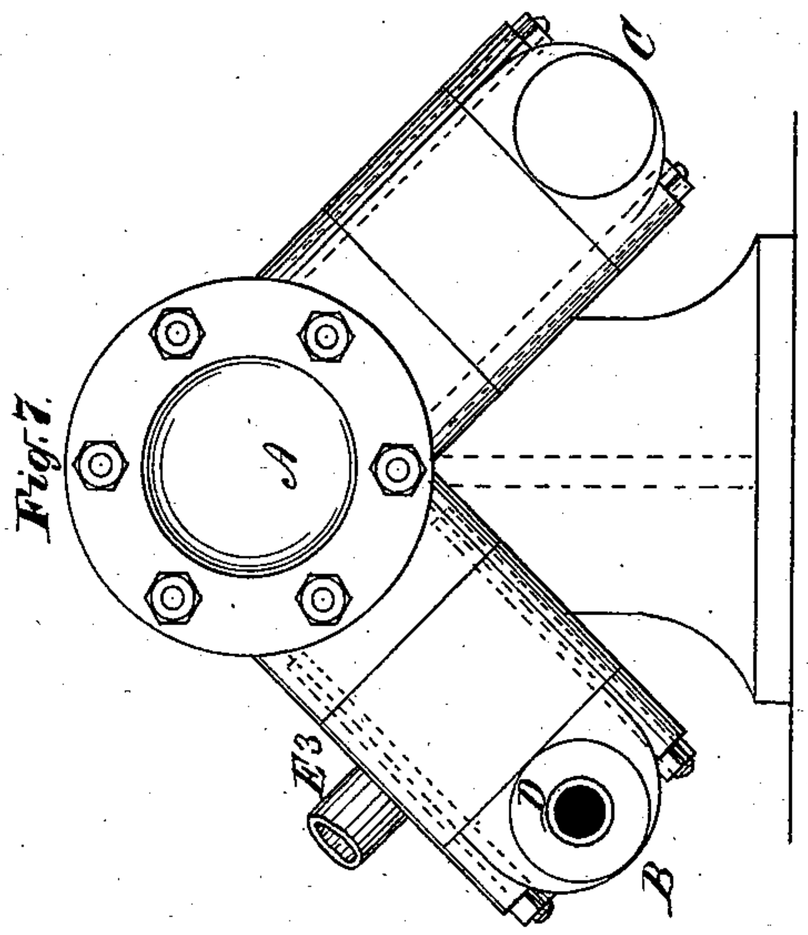
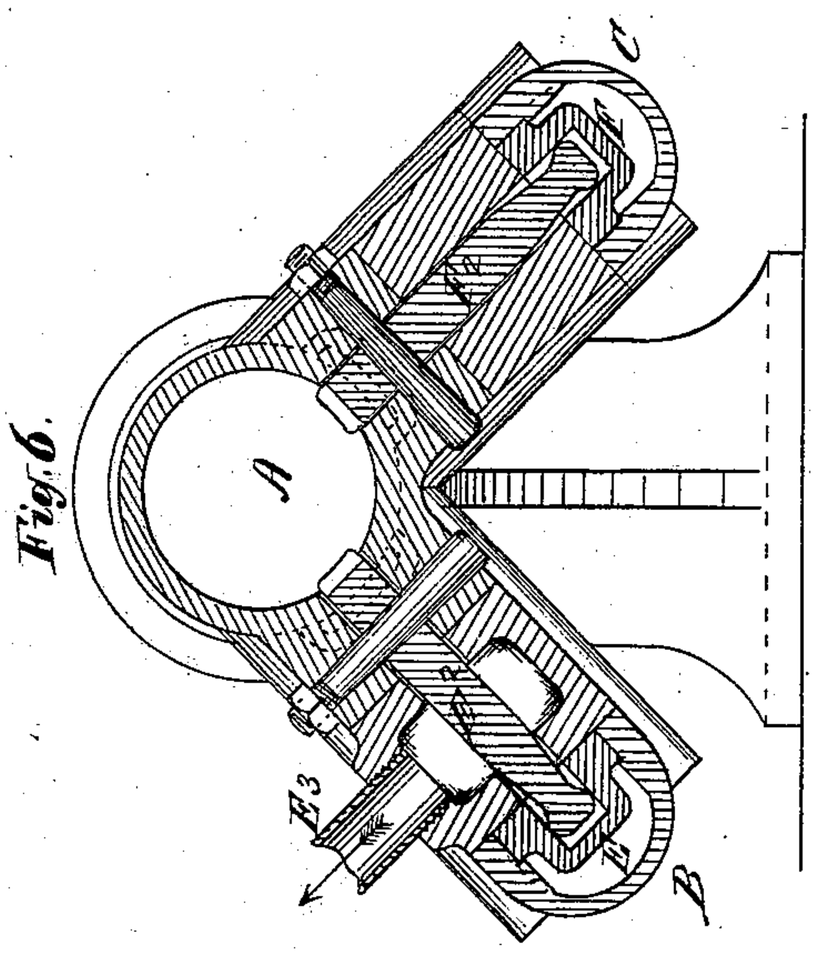



Fig. 6.




Witnesses:
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# UNITED STATES PATENT OFFICE.

ADDISON C. RAND, OF NEW YORK, N. Y.

## VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 230,336, dated July 20, 1880.

Application filed April 2, 1880. (No model.)

*To all whom it may concern:*

Be it known that I, ADDISON C. RAND, of the city and State of New York, have invented certain Improvements in Valve-Gears for Steam-Engines, Steam-Stamps, Steam-Drills, &c., of which the following is a specification.

My improvements relate to that class of valve-gear in which the valve is operated by a motion derived from the piston.

It is the object of my improvements to adapt this class of valve-gear for employment in an engine in which steam is used expansively; and the main feature of my invention consists in giving to the piston the capacity of imparting to the steam-valve an intermittent motion in each direction, whereby each complete movement of the valve, whether oscillatory or reciprocatory, is effected by two successive steps, the first step serving to impart sufficient range of motion to the steam-valve to enable it to close the previously-open steam-port and cut off the supply of steam, thus leaving the steam in one end of the cylinder to act expansively, and the second step serving to continue the throw of the steam-valve sufficiently to enable it to open the other steam-port and admit steam into the opposite end of the cylinder, steam being admitted into the appropriate port at the close of each stroke, and being cut off at any predetermined part of the stroke, the exhaust-valve, also operated by the piston, remaining open during each stroke until the instant before the final movement of the steam-valve admits steam into the cylinder.

The accompanying drawings represent my invention embodied in that form of valve-gear in which the valve is reciprocated by the action of a T lever or rocker, the free ends of which penetrate the cylinder and are oscillated by collisions alternately with the opposite inclined end walls of a recess in the periphery of the piston.

In these drawings, Figure 1 is a central longitudinal section of the cylinder and valve-chests, exhibiting the piston in elevation, showing the steam-passages and the steam and exhaust valves and the T-levers by which the valves are respectively operated. Fig. 2 is a transverse section through the line *x x* on Fig. 1. Fig. 3 is a view of the exhaust-valve seat. Fig. 4 is a transverse section through the line *y y* on Fig. 1. Figs. 5, 6, and 7 illustrate a modification in the arrangement of the valve-chests with relation to the cylinder, Fig. 5 being an elevation, Fig. 6 a transverse section through the line *z z* on Fig. 5, and Fig. 7 an end elevation thereof.

The drawings represent a steam-cylinder, A, provided on one side with an exhaust-valve chest, B, and upon the other side with a steam-valve chest, C.

Steam is admitted into the exhaust-valve chest through the steam-pipe D, and by its pressure holds the exhaust-valve E against its seat E′. From the exhaust-valve chest steam is conducted through the steam-passage *d* into the chest C of the steam-valve F, by the operation of which steam is admitted alternately into the opposite ends of the cylinder through the inlet-passages *f* and *f′*. The exhaust-steam escapes through the passages *e* and *e′* alternately, and through the exhaust-valve into the space surrounding the exhaust-valve lever $E^2$, from which it is discharged through the exhaust-pipe $E^3$, the mouth of which is shown in dotted lines in Fig. 1. The steam-valve F is held upon its seat F′ by the pressure of the steam in the chest C, and is reciprocated by the oscillation of the T-lever $F^2$ upon its pivot $F^3$.

The free ends $E^4$ and $E^5$ of the exhaust-valve lever $E^2$, which oscillates upon the pivot $E^6$, are alternately projected into the path of the piston, from which they are thrown by collisions, respectively, with the inclined end walls, G and G′, of a recess formed in the periphery of the piston H.

As represented in Fig. 1, the free end $E^5$ of the T-lever $E^2$ has just been so thrown out of the path of the piston by collision with the inclined end wall, G′, of the recess, and in operation will remain in the position shown until the other free end, $E^4$, is brought by the inward movement of the piston into collision with the opposite inclined end wall, G, of the recess, the parts being so proportioned that the collision of the free end $E^4$ with the inclined end wall, G, will immediately precede the collision of the same end wall, G, with the free end $F^4$ of the T-lever $F^2$, which operates the steam-valve, the object of this order of operation being to close the mouth of the ex-

haust-passage immediately before steam is admitted into the inlet-passage to effect the stroke in either direction.

In the position shown in Fig. 1 the free end $F^5$ of the T-lever $F^2$ is represented as bearing upon the periphery of the largest portion H of the piston, having been thrown into that position by collision with the inclined end wall, G′, while the free end $F^4$ is represented as resting upon the bottom of the deep central recess, I.

By the inward movement of the piston in the direction shown by the arrow *i* the free end $F^4$ of the T-lever $F^2$ will be brought into collision with the inclined end wall, J, of the deep recess I, and, riding over the inclined end wall, J, will be brought to a bearing upon the bottom of the shallower recess K. At the same time the free end $F^5$ will be rocked inward until it bears upon the bottom of the opposite end portion, K′, of the shallower recess, thus holding the T-lever $F^2$ stationary. There will thus be effected a positive movement of the inlet or steam valve of the precise range required to enable it to close the inlet-passage *f* without opening the inlet-passage *f′*.

By the continued inward movement of the piston the free end $F^4$ of the T-lever will be brought into collision with the inclined end wall, G, of the shallower recess, and, riding up over that, will bear upon the largest diameter, H, of the piston, and by the consequent further oscillation of the T-lever $F^2$ the valve F will be thrown sufficiently far to open the inlet-passage *f′* and admit steam into the bottom of the cylinder. In this position the free end $F^5$ of the T-lever will rest upon the bottom of the deep recess, I, and by the return movement of the piston will be at first brought into collision with the inclined end wall, J′, of the deep recess, and subsequently with the inclined end wall, G′, of the shallower recess, first closing the inlet-passage *f′*, then, by its further movement, opening the inlet-passage *f*.

In the drawings the central portion of the piston is represented as being turned down to form annular recesses in its periphery, thus adapting the structure for employment in rock-drills, in which the piston, in addition to its reciprocating movement, is made to rotate intermittently upon its longitudinal axis.

It will of course be understood that in those cases where a rotary movement of the piston is not required a narrow longitudinal groove may be formed in the periphery of the piston, having its central portion deeper than its end portions, and that such a groove, being provided with inclined end walls, will answer the same purpose in operating the T-lever $F^2$ as the annular recesses shown in the drawings.

The part of the stroke at which steam is cut off depends upon the length of the deep central recess, I. The shorter that recess the earlier in the stroke will the cutting off be effected, and in practice the length of the deeper recess I, and consequently the part of the stroke at which the steam is cut off, will be determined with reference to the character of the work which the engine is to be employed to perform.

That part of my invention which consists in the provision of bearing-places at three different distances from the longitudinal axis of the piston may be employed to operate various kinds of valve-gear in cut-off engines. If desired, these bearing-places may be formed in the periphery of a collar affixed to the piston-rod outside the cylinder, for the purpose of working a valve provided with a stem or shaft projecting outside the valve-chest, this part of my invention being present in any engine in which the steam-valve is given a two-step movement by mechanism actuated by the piston.

I claim as my invention in a steam-engine in which the inlet or steam valve is operated by the piston—

1. The combination of the steam-valve F and the T-lever $F^2$ with a piston the periphery of which is recessed to variable depths, substantially as and for the purpose set forth.

2. The T-lever $F^2$, for operating the steam-valve F, provided with the free ends $F^4$ and $F^5$, in combination with the bearings K and K′, formed by the relatively shallower part of the recess I in the periphery of the piston, whereby the valve is held stationary at the conclusion of the first step of its movement in either direction, substantially as set forth.

3. The combination of the steam-valve F and its actuating mechanism with the exhaust-valve E and the T-lever $E^2$, operated by a recess in the periphery of the piston, substantially as set forth.

4. The exhaust-valve E and the exhaust-valve chest B, in combination with the steam-pipe D and the conducting-passage *d*, whereby the exhaust-valve is held upon its seat by the pressure of the live steam, substantially as described.

5. In combination with a valve and suitable intervening mechanism, the piston H H, having formed in its periphery recesses of variable depths, substantially as and for the purpose set forth.

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