(No Model.)

F. B. NICHOLS.

VALVE GEAR.

No. 266,714. Patented Oct. 31, 1882.

Fig. 1.

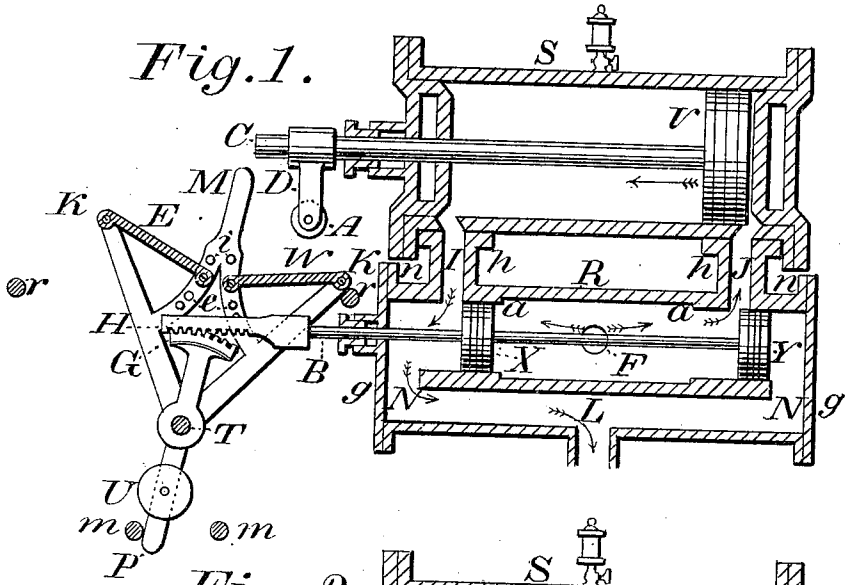


Fig. 2.

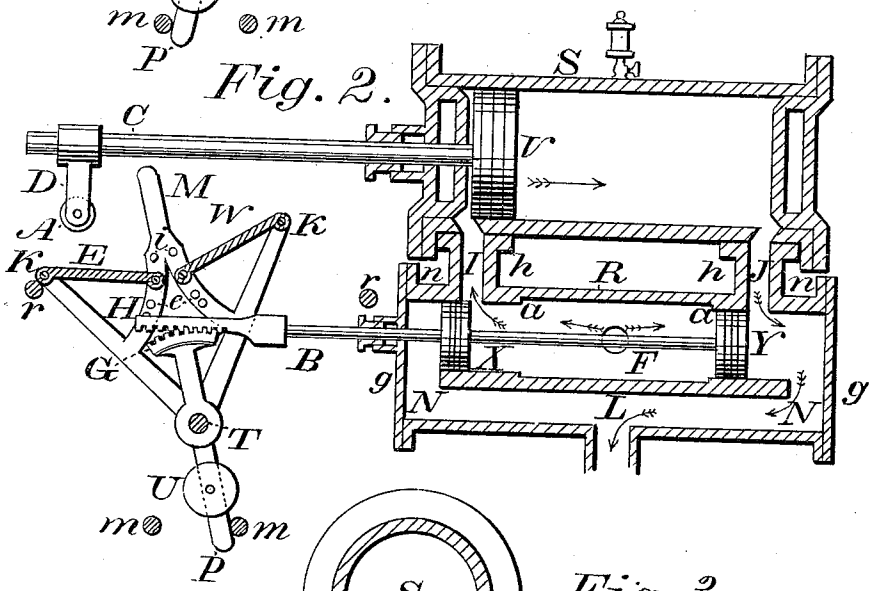
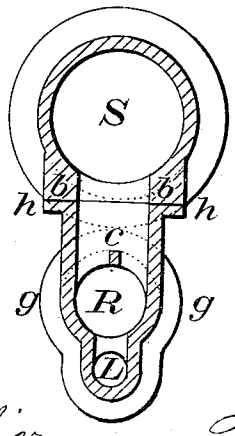


Fig. 3.



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UNITED STATES PATENT OFFICE.

FREDERIC BOOTH NICHOLS, OF HALIFAX, NOVA SCOTIA, CANADA, ASSIGNOR OF ONE-HALF TO CATHCART THOMSON, OF SAME PLACE.

VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 266,714, dated October 31, 1882.

Application filed January 16, 1882. (No model.)

To all whom it may concern:

Be it known that I, FREDERIC BOOTH NICHOLS, a citizen of the United States, residing at Halifax, in the county of Halifax and Province of Nova Scotia, Dominion of Canada, have invented new and useful Improvements in Valve-Gear, of which the following is a specification, illustrated in the accompanying drawings, in which—

Figure 1 is a vertical longitudinal section, showing the position of the valves and valve-gearing when the engine-piston is on its forward stroke. Fig. 2 is a corresponding section, showing the position of the valves and valve-gearing when the engine-piston is on its backward stroke. Fig. 3 is a cross-section or end view, showing the manner of bolting the cylindrical valve-chest to the engine-cylinder, and flanges for bolting the heads to the valve-chest.

My invention relates to improvements in valve-gear in which the valve-chest is a cylinder and the valves two pistons fitted to it, having the inlet for the pressure or live steam between them, and the outlet or exhaust on the outside of each. These piston-valves are joined together by a rod or stem that connects with the valve-gearing by passing through a stuffing-box. The valve-gearing consists of two flat cams fastened to frame-work, to which a rack made in segment of a circle is attached, the teeth of which mesh in gear with a straight rack fastened to the end of the valve-stem.

The cylinder R, forming the valve-chest, should be about one-half the diameter of the engine-cylinder S, and somewhat longer, and is in best position when placed immediately below, where it is bolted fast by the flanges *h h* on the projections forming the ports, to the flat projections of the engine-cylinder, one of which, *b b*, is seen in Fig. 3. Flanges *n n* on each end of the valve-chest serve for bolting on the heads *g g*. Outlet-ports N N for the exhaust-steam are connected by the pipe or conductor L, which is cast in connection with the valve-chamber R.

The valve cylinder or chamber R may be cast with larger internal diameter between *a a*, so as to avoid boring that portion. The ports I J should be quite large, fully double the usual size, and occupy nearly one-half of the circumference of the valve-cylinder, a division being made at *c*, Fig. 3, to keep the valves from working up and striking the edges. The piston-valves X Y fit the valve-cylinder steam-tight by means of packing, and should be about one and a half times the length of the width of the ports, and so adjusted that when the port on the exhaust side of the engine-piston is entirely uncovered the one on the inlet or pressure side is half covered, which leaves sufficient opening for the live steam, while leaving a large opening for the exhaust-steam, thus lessening the resistance of back-pressure. Steam being admitted into the valve chest through pipe F and between the piston-valves presses equally on each, and the exhaust passing out through the outlet or exhaust ports N N, and being connected by the pipe or conductor L, equalizes the tendency to a vacuum on the outside of the valves, thus completely balancing them, so, there being no resistance other than inertia and ordinary friction to overcome, but little force is required to move them.

Two frames, made in the form seen in Figs. 1 and 2, terminating above in a handle at M and a projection, P, below, are placed one on each side of rack G and fastened to it, the whole oscillating on the pivot T at the radius of the rack G, the pivot T being secured in the frame that contains the engine. The cams E W are inclined planes pivoted between and to the frames at K K, and fastened at the desired angle by screws or bolts to the arcs that form a portion of the frame. The pivots K K may be made as screw-bolts that can be screwed up, so as to fasten the cams more securely to the frames. An arm, D, carrying a roller, A, to reduce friction, is fastened near the end of the piston-rod C.

The mode of operation is as follows: With the engine-piston in the position seen in Fig. 1 the port J is half open to admit live or pressure steam behind the engine-piston V. At the same time port I on the exhaust side of the engine-piston V is wide open. On admitting steam into the valve-chest R through pipe F it passes through port J, moving engine-piston V forward, the exhaust-steam passing out of port I and outlet or exhaust port N through pipe or

conductor L, as seen by the arrows. When the engine-piston has made eleven-sixteenths of its stroke roller A on arm D strikes cam E, tips it forward, and by its connection with racks G and H draws the piston-valves X Y forward, and, arriving at thirteen-sixteenths of stroke, valve Y covers port J and cuts off steam. Port I will then be half open to exhaust. When at fifteen-sixteenths of the stroke valve X will cover port I, and before the stroke is entirely completed port J will begin to open to the exhaust side of valve Y, relieving the pressure and checking the forward movement of the engine-piston. The cams, with their containing-frames and rack G, having then passed beyond their center of gravity and acquired a slight momentum, fall quickly to the stop-piece *r*, which limits the length of movement of the piston-valves. This brings them into the position shown in Fig. 2, when, port I being half open for live steam to enter behind the engine-piston V and port J wide open to exhaust, engine-piston V makes the back-stroke, moving the cam W, and thereby the piston-valves X Y, in the same manner as when on the forward stroke, returning the valves to the position seen in Fig. 1, and again ready for the forward stroke, and so on continuously.

Instead of the stops for limiting the length of movement of the valves being in the position shown at *r r*, they may be placed below, at *m m*, so that the projection P will strike them, and they may be made as springs or buffers secured to the engine-frame.

A weight, U, is made adjustable to the projection P by its sliding on it through a hole or slot in it, and is fastened by a set-screw or bolt at a suitable distance from the pivot T to properly counterbalance the cams and containing-frames and rack G and prevent striking the stop-pieces too heavily. If desirable, two weights—one on each side—may be used. The weight or weights should not be heavy enough, when placed at any position on P, to overbalance a slight preponderance being in the cams when past the center of gravity.

The length of stroke at which steam is cut off can be varied by altering the angle of the cams. When screwed or bolted fast at the holes *i i* cut-off occurs sooner, or at eleven-sixteenths of the stroke, leaving the exhaust-port open until fifteen-sixteenths of the stroke is made. When the cams are fastened at the holes *e e* cut-off will be made later, or at seven-eighths stroke, exhaust closing at the same point as before mentioned. By fastening the cams to the holes below *e e* cut-off will occur still later. By thus adjusting the angle of the cams considerable range of cut-off can be readily made to suit different purposes by having more screw-holes than shown in the drawings.

When the handles M stand upright both ports will be entirely closed by the valves covering them, and by seizing one of these handles and holding it in this position the engine will instantly stop without shutting off steam, which, for some purposes, especially in sudden emergencies, will be found advantageous.

The piston-valves and gearing above specified are as well adapted to compressed-air or fluid motors as to steam, the only difference in arrangement being to largely increase the width of the ports and correspondingly the length of the valves, as well as the inlet and outlet pipes, and outlet-ports N N being correspondingly enlarged, and giving greater length of movement to the valves by lengthening the radius of rack G to allow of more teeth on an arc of the same angle, with other parts to correspond, when used for fluid-motors; also adjusting the cams so as not to cut off until the stroke of the working-piston V is nearly completed, having air-chambers at each end of the working or engine cylinder, as in steam-pumps, and one in pipe F, to give elasticity.

An oil-cup at the top of the cylinder S lubricates the piston V, and the waste from it working down sufficiently lubricates the piston-valves X Y. The oil-cup may be dispensed with in fluid-motors.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The adjustable cams E W and rack G, oscillating on pivot T, in combination with reciprocating rack H, valve-stem B, attached to valves X Y, stops *r r*, and counterbalance-weight U, all in combination in the manner and for the purpose herein specified.

2. The arm D and roller A on piston-rod C, in combination with the adjustable cams E W, racks G and H, valve-stem B, and valves X Y, all in the manner herein set forth.

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Witnesses:

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