

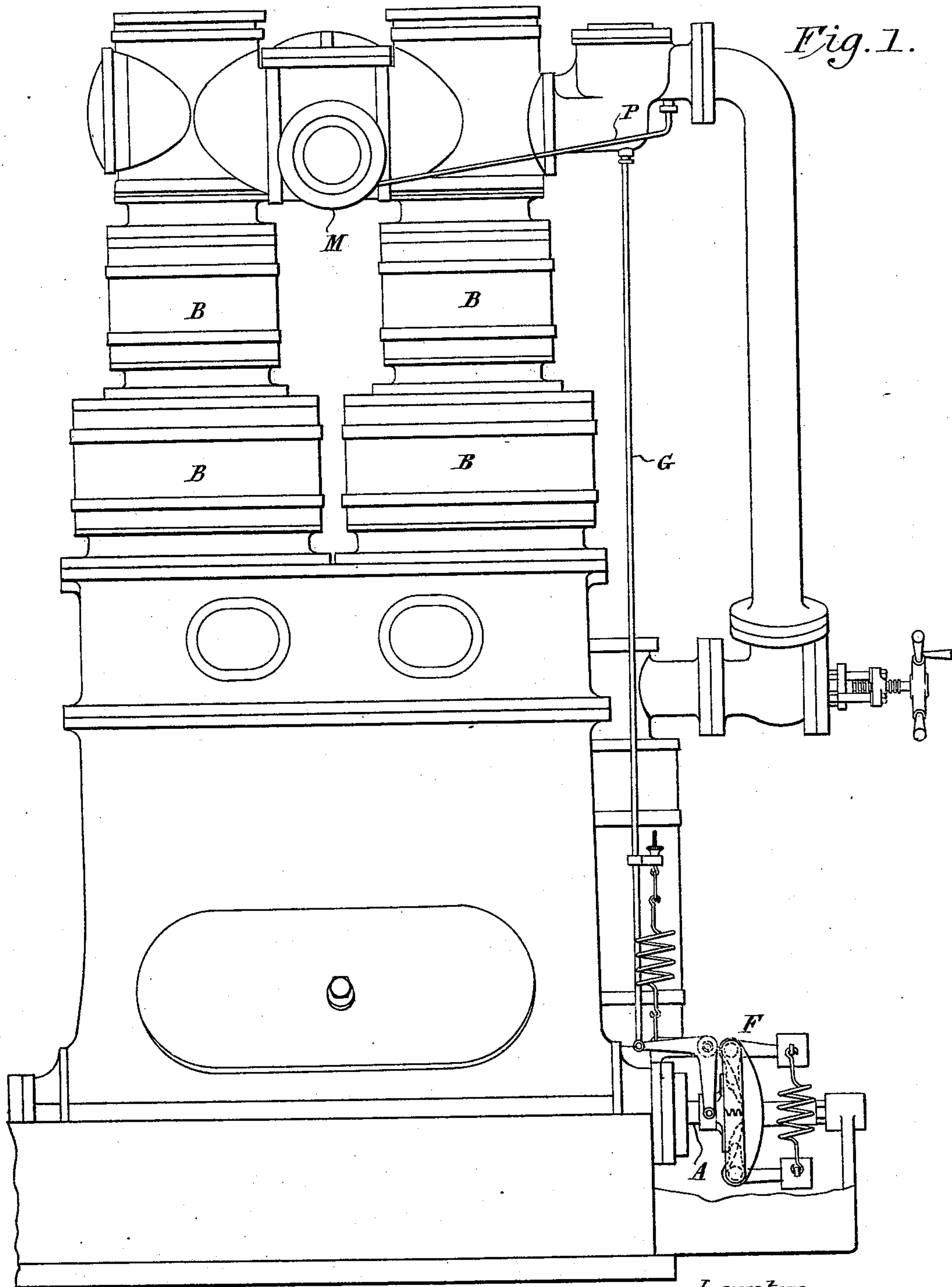
(No Model.)

3 Sheets—Sheet 1.

M. H. ROBINSON.  
EXPANSION GEAR FOR ENGINES.

No. 521,573.

Patented June 19, 1894.



*Fig. 1.*

Witnesses  
B. W. Miller.  
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Inventor  
Mark H. Robinson,  
By his Attorneys,  
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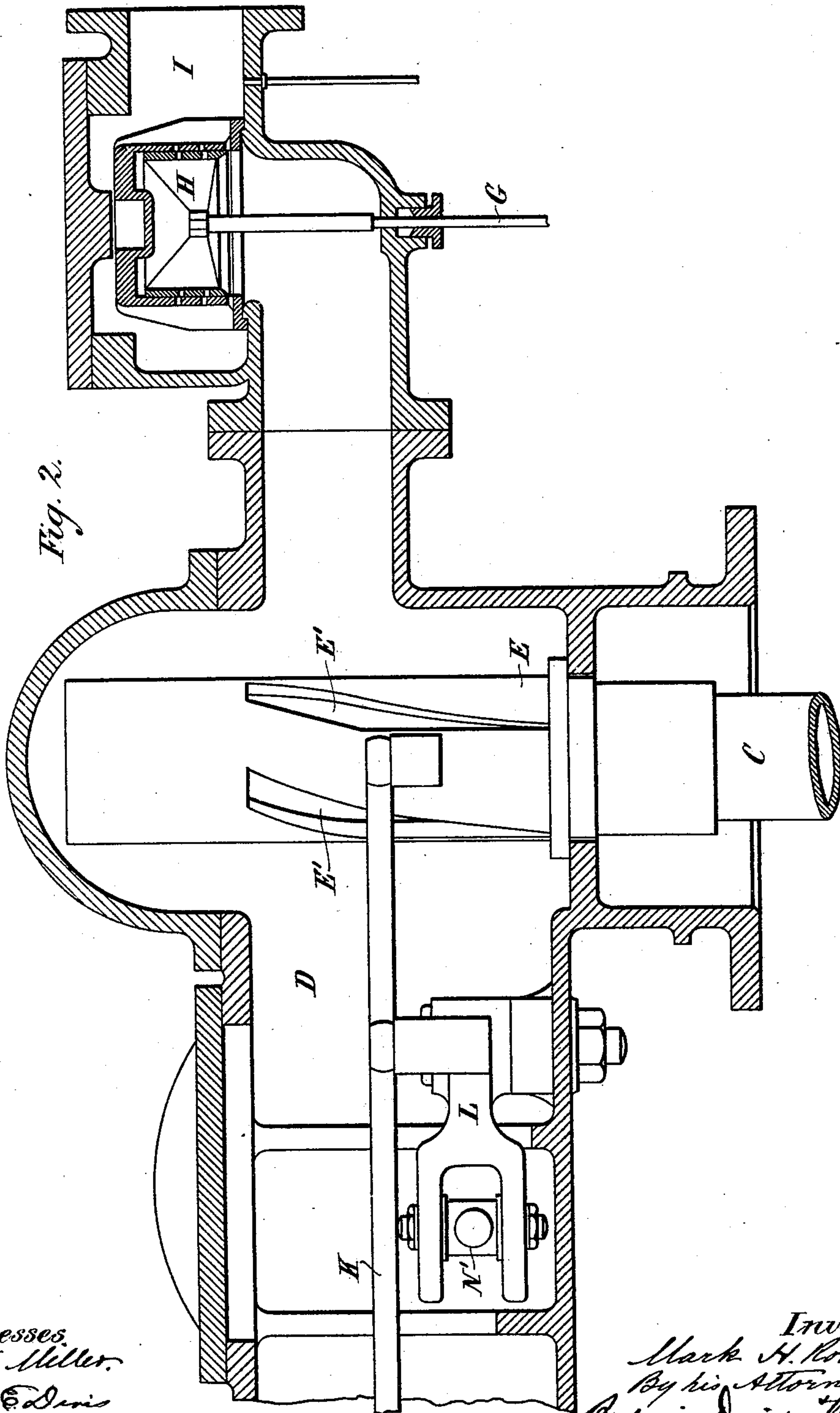
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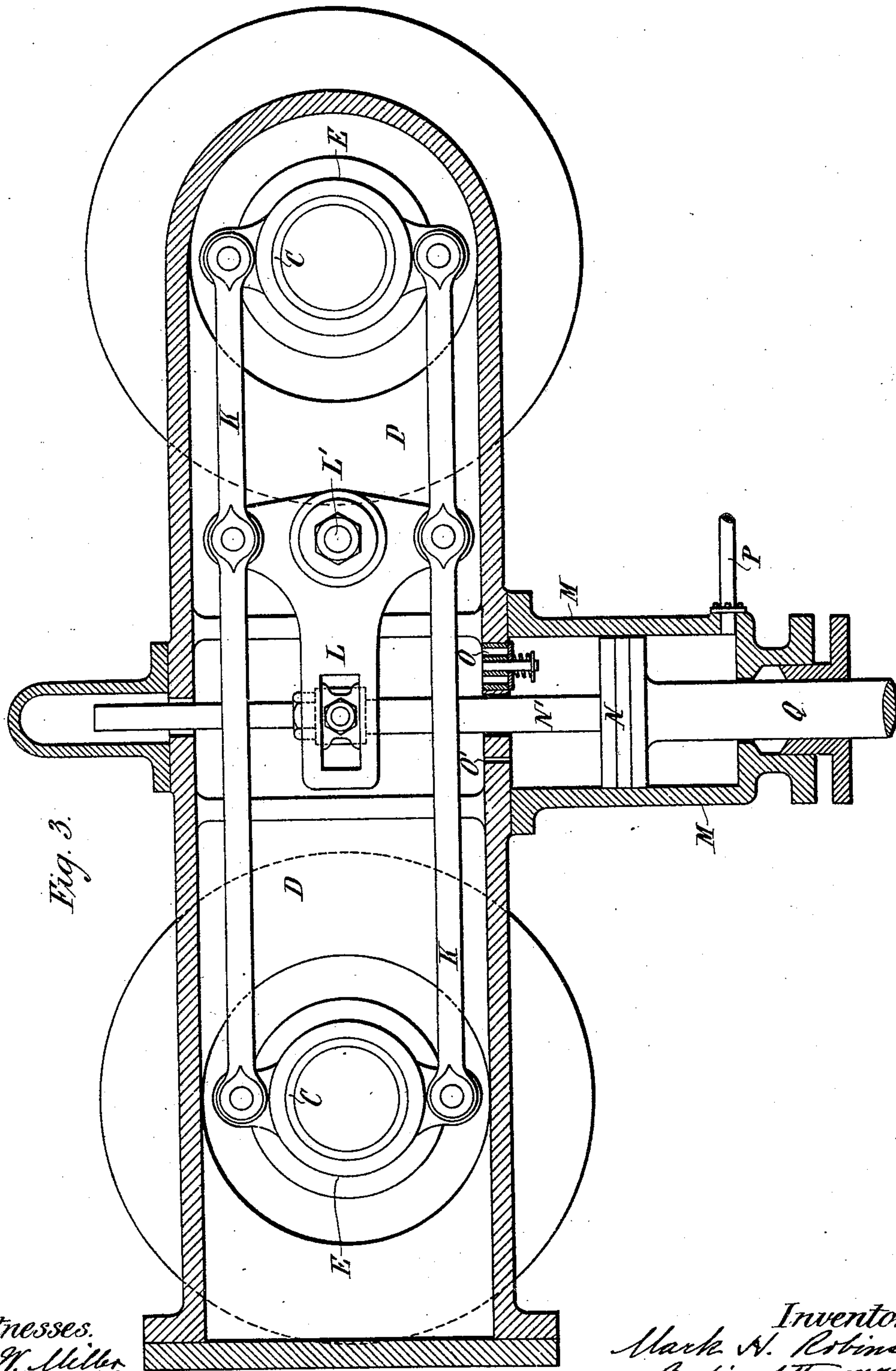
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# UNITED STATES PATENT OFFICE.

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WILLANS & ROBINSON, LIMITED, OF SAME PLACE.

## EXPANSION-GEAR FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 521,573, dated June 19, 1894.

Application filed March 5, 1894. Serial No. 502,432. (No model.)

*To all whom it may concern:*

Be it known that I, MARK HEATON ROBINSON, engineer, a subject of the Queen of Great Britain, residing at Ferry Works, Thames Ditton, in the county of Surrey, England, have invented certain new and useful Improvements in Automatic Variable-Expansion Gear for Steam and other Fluid-Pressure Engines, of which the following is a specification.

First. In automatic variable expansion gear constructed according to this invention the governor acts by any ordinary mechanism upon a throttle valve, and the point of cut off is varied by the change in the steam chest pressure following upon the closing or opening of the throttle valve. The rod which controls the cut off gear is attached to a piston working in a cylinder; one end of the cylinder is open to the steam chest, the other is normally exposed to the boiler pressure; in fact the two ends of the cylinder are normally in communication with the two sides of the throttle valve. The effective area of the piston is greatest on the side next to the steam chest; the effective area of the other side being reduced by a trunk or tail rod, or equivalent device. The cut off gear is so arranged that cut off is made earlier by the piston moving toward the steam chest: later when it moves in the contrary direction.

Second. The action is as follows:—Suppose the engine to be loaded to normal full load, the passage through the throttle valve being fully open, and the cut off gear in the desired position for normal full load. On a reduction of load taking place the increase of speed and consequent opening of the governor balls, closes the throttle-valve, and thereby controls the engine; the pressure in the steam chest falls at the same time, and if the change is sufficiently great, the piston above referred to, being exposed to boiler pressure, upon one side and to the now reduced steam chest pressure upon the other, moves toward the steam chest, and by suitable mechanism makes the cut off earlier; this motion, by well understood means which need not be described, may, if desired, be caused to take place slowly. As the cut off becomes earlier the speed tends to diminish, and the governor then opens the throttle valve wider, thus increasing the steam

chest pressure and again making the cut off later, and when the alteration in the cut off ceases, owing to comparative equalization of pressure upon the two sides of the piston, the throttle valve and the governor balls, will be nearly in their original position, the only change being that the throttle valve has to be a little more closed than before, on account of the smaller quantity of steam required by the engine per unit of time. Owing to the difference in the effective areas of the two sides of the piston, the latter will not move toward the steam chest, unless there is a substantial preponderance of pressure on the boiler side of it. The same difference of area insures that the piston shall move away from the steam chest though the preponderance of pressure is still on the other side, if that preponderance is only small. There is of course a difference of pressure (extending through a range of a few pounds per square inch) which fails to overcome the friction of the piston and cut off gear. Hence when the preponderance of the boiler pressure over that of the steam chest exceeds a certain amount, the cut off is made earlier; when it falls below a certain other (and lower) amount the cut off is made later. It is obvious that the necessary tendency to move away from the steam chest may be given by other means than by a difference of effective area between the two sides of the piston, as by the action of a spring or weight.

Third. Suppose the engine to be running with a light load and with of course, an early cut off, the difference of pressure upon the two sides of the piston being such that it moves in neither direction. Imagine now an increase of load to take place; the consequent closing of the governor balls opens the throttle valve wider and the pressure in the steam chest is increased; as soon as it becomes nearly the same as that on the farther side of the piston, the latter is driven away from the steam chest, and the cut off is made later. The cut off may now be too late, but this is not a source of trouble, because the engine is controlled by throttle valve which by reducing the pressure in the steam chest gradually brings the cut off back to a point as late as is consistent with the throttle valve returning



to an approximately full open position. In a single acting engine of the central valve type such as is described in the specification of a prior patent, No. 339,242, issued on the 6th of April, 1886, in which the valves work within a hollow piston rod which itself moves up and down within a hollow sleeve in the steam chest the sleeve may be made free to rotate. If ports inclined on one side edge be cut in the sleeve and corresponding ports in the hollow piston rod of the engine the admission of steam from the steam chest to the hollow piston rod can be cut off earlier or later by turning the sleeve and this turning movement may be given to the sleeve by coupling it to the rod hereinbefore mentioned which is moved to and fro by the variations of pressure in the steam chest.

The drawings annexed show the invention applied to a single acting engine of the central valve type such as is described in the above mentioned patent.

Figure 1 is a front elevation of the engine. Fig. 2 is an elevation partly in section and on a larger scale of the steam chest and Fig. 3 is a horizontal section of the same.

A is the crank shaft of the engine.

B B are two sets of cylinders the cylinders in each set being one above the other.

C (see Fig. 2) is the upper end of the hollow piston rod of one set which as described in the above mentioned patent rises up into the steam chest D.

E is a sleeve surrounding the upper end of the piston rod, it is free to turn but not to move up or down. In it are oblique ports E'—corresponding oblique ports are also cut in the hollow piston rod.

F is a governor which may be of any ordinary construction acting on a rod G which at its upper end carries the throttle valve H.

I is the steam supply pipe.

K K (see Fig. 3) are links connecting arms on the sleeves E to a crank lever L which can be rocked on its fulcrum L'.

M is a cylinder extending outward from the steam chest.

N is a piston working therein—the piston rod N' of this piston has projections standing out from it which enter radial slots in one of the arms of the lever L.

O is a valve through which steam can pass freely from the steam chest to the inner end of the cylinder M but which stops all passage of steam in the reverse direction.

O' is a small passage which allows steam to pass slowly from the cylinder M to the steam chest when the pressure in the steam chest is lower than in the cylinder.

P is a pipe admitting steam from the steam supply pipe I to the outer end of the cylinder M.

Q is a trunk or tail rod from the piston N passing through the cylinder cover.

When the oblique ports in a sleeve E and hollow piston rod C are opposite to one another steam is admitted to the interior of the pis-

ton rod and thence by other ports in the rod to the cylinders B of the engine as described in the above mentioned patent but when through the descent of the piston rod the ports in it have passed below the ports E' in the sleeve steam is cut off.

It is obvious that the point of cut off may be varied by rotating the sleeve upon its axis thus causing the ports in the hollow piston rod to pass below the oblique lower edges of the ports E' either earlier or later in the stroke according as the sleeve is rotated one way or the other. When the piston N moves toward the steam chest the sleeve is thereby turned in a direction to make the cut off become earlier and as it moves away to become later. The outward movement to make the cut-off later can take place quickly as steam can pass quickly from the steam chest to the inner end of the cylinder M through the valve. An inward movement to make the cut off earlier takes place slowly as the steam in the inner end of the cylinder M can only pass from it into the steam chest through the small passage O'.

Any equivalent device for controlling the motion of the piston N so that the outward movement of the piston may be quick and the inward movement slow may be used instead of the above arrangement.

What I claim is—

1. The combination of a steam (or other fluid) engine cylinder steam chest, pipe supplying steam thereto, throttle valve and governor acting thereon—valve for controlling passage of steam to cylinder—cut off valve for controlling passage of steam to first valve—a cylinder open at one end to steam chest—and at the other to steam supply pipe—a piston working therein and connections from piston to cut off valve whereby an inward movement of the piston toward the steam chest shifts the cut off valve in a direction to make the cut off earlier and an outward movement in a direction to make it later.

2. The combination of a steam (or other fluid) engine cylinder, steam chest—pipe supplying steam thereto, throttle valve and governor acting thereon, hollow piston rod of piston working in cylinder extending into the steam chest—sleeve in steam chest surrounding the end of the hollow piston rod—oblique ports in sleeve and in piston rod—a cylinder open at one end to steam chest and at the other to steam supply pipe—a piston working therein and connections from the piston to the sleeve whereby an inward movement of the piston turns the sleeve in a direction to make the cut off earlier and a movement in the opposite direction to make it later.

3. The combination of a steam (or other fluid) engine cylinder, steam chest—pipe supplying steam thereto, throttle valve and governor acting thereon, hollow piston rod of piston working in cylinder extending into the steam chest—sleeve in steam chest surround-



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5 ing therein and connections from the piston  
to the sleeve whereby an inward movement  
of the piston turns the sleeve in a direction  
to make the cut off earlier and a movement

in the opposite direction to make it later and  
means for causing any inward movement to  
take place slowly while the outward move-  
ment is left free to take place quickly.

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