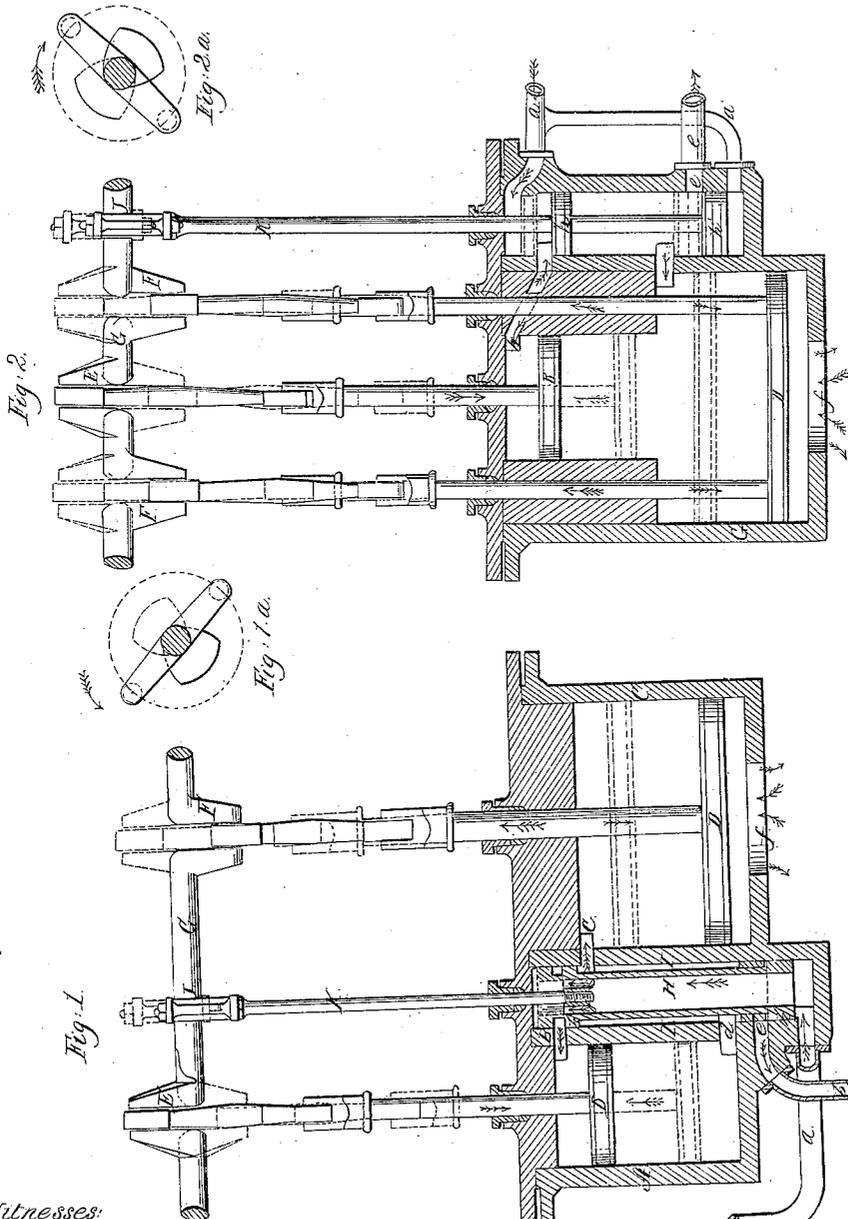


*G. I. Washburn,
Compound Steam Engine.*

N^o 62,711.

Patented Mar. 5, 1867.



*Witnesses:
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GEORGE I. WASHBURN, OF WORCESTER, MASSACHUSETTS.

Letters Patent No. 62,711, 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 to the accompanying drawings, which form a part of this specification, and in which—

Figures 1 and 2 are central vertical sections, differing in respect of the relative positions of the steam cylinders and in the arrangement of the valve, but agreeing in the main feature of the invention, which is as follows:

The steam, after acting directly upon one side of the piston in the smaller cylinder, is cut off from the boiler, and allowed to flow on both sides of the said piston, and expand against one side of the larger piston in the second cylinder.

By this arrangement the steam is used twice, and in connection with pistons in separate cylinders; the first time directly from the boiler, and the second time expansively; but when used upon the second piston it is not allowed to exert a back pressure upon the first piston, as is common in some engines which use the steam expansively in a second cylinder after using it directly in the first cylinder. In my improvement, after acting with full head, or directly upon the first piston, it is cut off and transferred to the second cylinder, flowing on both sides of the first piston, so as to deprive it of any active influence as to that piston in the stroke made by the second piston. It may be cut off at some time during the effective stroke of the first piston, and not employ a full head of steam to the conclusion of said stroke. This is an economical question, which does not affect the point of my invention, which consists in transferring the steam, after the effective stroke of the first piston, to both sides of the said piston, and to the second cylinder, where it acts expansively, the communication with the boiler being cut off. When the full head is used to the end of the stroke of the first piston no "cut-off" action is required; but the valve closes the communication with the boiler at the same time that it opens the port leading from the first to the second cylinder. The steam, by this arrangement, only acts effectively upon one side of each piston, and upon the pistons consecutively, the steam, during the effective stroke of the second piston, being balanced upon the respective sides of the first piston. A condenser may be attached to receive the steam from above the second piston; the atmosphere will then assist in making the return stroke of the latter while the direct action of the steam is making the effective stroke of the first piston. Steam is admitted above and below the valve either by making the valve hollow, so as to permit the flow of steam through it, (fig. 1,) or by opening the valve-chamber at each end to the steam, (fig. 2.)

In the drawings, A is the smaller cylinder, in which the steam directly from the boiler is admitted to the upper side of the piston B, which is shown descending, the crank having described one-quarter of its downward stroke. C is the larger cylinder, in which the piston D is ascending. The pistons B D are attached by means of their rods and pitmen to the cranks E F respectively, on the main shaft G, the cranks being opposite, as shown in the diagram, fig. 1, a. The valve H is tubular, having two annular disks *h h'*, one at each end, which fit the walls of the valve-chamber I, in which the valve reciprocates, as actuated by the eccentric J, on the main shaft G. K is the valve-rod, which is screwed into the upper end of the valve.

The operation is as follows: Steam is admitted by the pipe *a* to the valve-chamber I, and passing through the valve H, enters cylinder A through the port *b*, and acts upon the upper side of the piston B until it has reached the lower limit of its stroke, when the valve H is raised to the position shown in red lines, shutting off the boiler steam from port *b* and exhaust port *e*, and opening the port *b* to the annular space around the tubular valve, which space is bounded above and below by the disks *h h'*. Through this space the steam flows to the port *c*, which opens into the upper end of the cylinder C, and acts expansively upon the upper side of the piston D, making the return stroke, and lifting the piston B. Here is seen the distinguishing peculiarity in the operation of my invention, namely, as the steam flows from the space above the piston B in cylinder A through the port *b*, and around the valve to the port *c*, to the larger cylinder, it also flows through the port *d* underneath the piston B in cylinder A, so that no resistance is made by steam to the raising of the said piston, as the steam, being admitted above and below, is balanced in its action on the said piston, so that no back press-

ure is exerted upon the first piston while the steam is used expansively on the second. By the means described the piston B having arrived at the upper limit of its stroke, and the piston D at its lower limit, the valve is again depressed, assuming the position shown in dark lines in the figure, when the steam is admitted as before, the exhaust steam passing out of each cylinder by the ports *d e* respectively, and through the annular space around the valve, to the exhaust pipe *e*. As has been observed, the upward motion of the piston D, and the downward motion of piston B, may be assisted by a condenser connected to the exhaust. The air is admitted to the lower side of piston D through opening *f*. If any "cut-off" action is required in the use of the steam in the downward stroke of piston B, it is obtained by the adaptation of the eccentric to that duty in a manner familiar to experts. The downward motion of piston D is entirely due to the expansion of the body of steam admitted to cylinder A, to perform its duty on piston B after the said body of steam is cut off from the boiler. Fig. 2 shows the two cylinders, placed one above the other, the port *d* being dispensed with, and the piston D being connected to the shaft G by two piston-rods and two cranks F F. The action of the steam is the same in this arrangement as in the other, illustrated in fig. 1, the steam from the boiler being admitted through ports *a* and *b* to the upper face of the piston B in cylinder, and expanded from thence as the change of position of the valve occurs, through the port *e*, to the upper face of piston D in the enlarged lower cylinder C, at the same time bearing against the under side of piston B, and balancing the pressure exerted against its upper side. It will be observed that the valve in fig. 2 consists of two disks on a valve-rod, and that it differs from the valve H shown in fig. 1, the latter being tubular. The two disks agree in all respects with the disks on valve H, as boiler steam is constantly present on their respective outer surfaces, and the space between them is alternately a means of communication between the two cylinders and between the cylinders and the exhaust port *e*; the extra pipe *a'* is a steam pipe, introducing steam below disk *h'* so as to balance the pressure upon the upper disk *h*. It is of course possible to arrange two similar engines in relation to one crank so that one should be upon its dead centre while the other was at mid stroke.

Having described my invention, what I claim therein as new, and desire to secure by Letters Patent, is—
An arrangement of cylinders and steam ports, by which the steam, after being used on one piston, is permitted to flow to the other side of the same piston and to the other cylinder, to be used expansively, substantially as described.

I claim the arrangement of the double disk hollow valve H, operating substantially as described.

GEO. I. WASHBURN.

Witnesses:

S. P. MORSE,
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