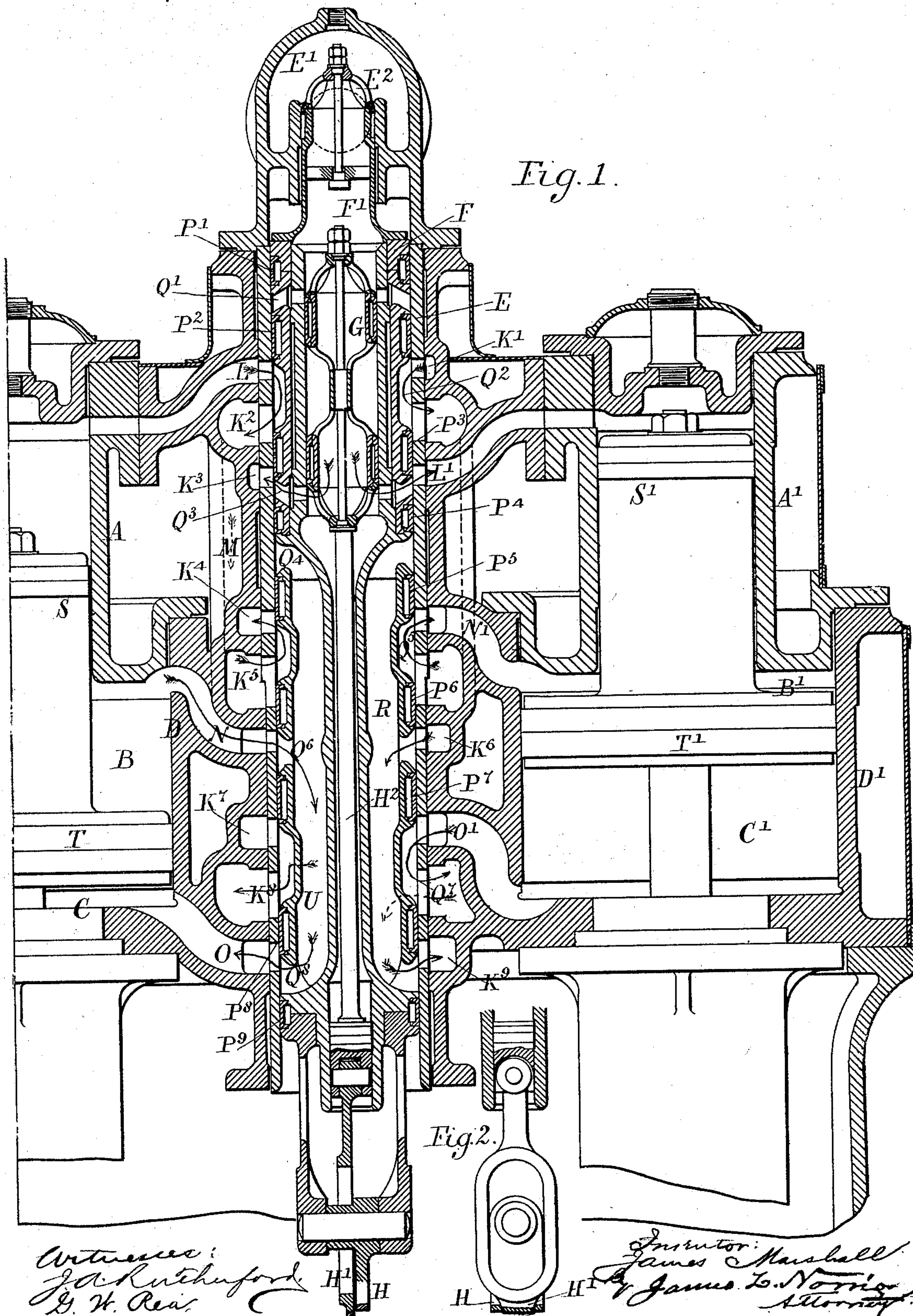


(No Model.)

J. MARSHALL.  
TRIPLE EXPANSION ENGINE.

No. 509,752.

Patented Nov. 28, 1893.





# UNITED STATES PATENT OFFICE.

JAMES MARSHALL, OF LEEDS, ENGLAND.

## TRIPLE-EXPANSION ENGINE.

**SPECIFICATION** forming part of Letters Patent No. 509,752, dated November 28, 1893.

Application filed August 31, 1892. Serial No. 444,680, (No model.) Patented in England September 2, 1891, No. 14,857.

*To all whom it may concern:*

Be it known that I, JAMES MARSHALL, a citizen of England, residing at the Steam Plow Works, Leeds, in the county of York, England, have invented certain new and useful Improvements in Triple-Expansion Engines (for which I have obtained a patent in Great Britain, No. 14,857, dated September 2, 1891,) of which the following is a specification.

In the specification to Patent No. 462,149 is described a construction of cylindrical tubular slide valve with packed piston parts and internal expansion valve for governing a pair of parallel cylinders of a compound or twin engine.

My present invention has for its object to provide a novel adaptation of a cylindrical tubular slide valve with an internal expansion valve of a construction similar to that described in the patent alluded to, to the regulation of the flow of steam into and out of a triple expansion engine.

To accomplish this object, my invention consists in the features of construction and the combination or arrangement of parts hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a vertical sectional view of twin single acting triple expansion engines with tandem cylinders showing the valve apparatus applied thereto; and Fig. 2 is a detail side view of the slide rod connections.

In order to enable those skilled in the art to make and use my invention, I will now describe the same in detail, referring to the drawings, wherein the letters A A' indicate two single acting high pressure cylinders, with trunk pistons S S', and D D' are cylinders arranged tandem with the high pressure cylinders, in which the annular spaces B B' on the upper side of the pistons T T' form the intermediate pressure cylinders, while the spaces C C' on the under sides of the pistons form the low pressure cylinders. Between the two sets of cylinders is arranged the cylindrical valve chamber E in which is first the cylindrical main slide valve F, in the tubular upper part of which works the cylindrical expansion valve G, the former being worked by

a rod H from the main eccentric on the engine shaft while the expansion valve is worked by the rods H' H<sup>2</sup> arranged as shown at Fig. 2 from the expansion eccentric. The closed upper end E' of the valve chamber E communicates by a branch opening E<sup>2</sup> with the high pressure steam supply, and the high pressure steam passes thence through the tubular extension F' of the main valve F into the tubular upper end of the latter. The lining of the valve chamber is formed with a series of circles of round holes or slots which communicate respectively with an annular passage K' leading to the port L of the high pressure cylinder A, an annular passage K<sup>2</sup> leading to a chamber M for receiving the high pressure steam from the cylinders A. A'; an annular passage K<sup>3</sup> leading to the port L' of the high pressure cylinder A'; an annular passage K<sup>4</sup> leading to the port N' of the intermediate cylinder B'; an annular passage K<sup>5</sup> also leading into the chamber M; an annular passage K<sup>6</sup> leading to the port N of the intermediate cylinder B; an annular passage K<sup>7</sup> leading to the port O' of the low pressure cylinder C'; an annular passage K<sup>8</sup> constituting the exhaust port of the two low pressure cylinders and leading to the exhaust pipe U and lastly an annular passage K<sup>9</sup> leading to the steam port O of the low pressure cylinder C. The main valve E is formed with a number of piston-like projections with spring packing P' P<sup>2</sup> P<sup>3</sup>, &c., and between these are formed annular passages Q' Q<sup>2</sup> Q<sup>3</sup>, &c. Of these the passages Q' Q<sup>3</sup> lead into the tubular interior of the valve, and being governed by the expansion valve G, serve to admit high pressure steam to the cylinders A A'; the passage Q<sup>2</sup> serves to establish a communication between the steam port L of high pressure cylinder A and the receiving chamber M; the passage Q<sup>4</sup> establishes a communication between the steam port N' of intermediate cylinder B', and the annular chamber R in the valve; Q<sup>5</sup> establishes a communication between the steam ports N and N' of cylinders B and B' with the chamber M; Q<sup>6</sup> establishes a communication between steam port N of cylinder B with chamber R and also a communication between the steam port O' of low pressure cylinder C'



and chamber R; Q<sup>7</sup> establishes communication between steam ports O O' of C C' and exhaust port K<sup>8</sup>, and Q<sup>8</sup> establishes a communication between port O of cylinder C and the chamber R.

From the above arrangement of the ports and passages it will be seen that when the valves F G are in the position shown on the drawings, cylinders A and B being filled respectively with high pressure and intermediate steam while C' is filled with low pressure steam, the steam from A is passing through Q<sup>2</sup> and K<sup>2</sup> into chamber M, while high pressure steam is passing from below the expansion valve through Q<sup>3</sup> and L' into cylinder A', and steam is also passing from chamber M through K<sup>5</sup> Q<sup>5</sup> and N' into intermediate cylinder B', and lastly, intermediate steam is passing from cylinder B through N, Q<sup>6</sup>, R Q<sup>8</sup> and O into low pressure cylinder C, so that pistons S' T' will now perform their down strokes, while S T, will perform their up strokes. On the consequent reversal of the positions of the slides F and G, the passage Q' will come opposite port L of cylinder A and will for a time be uncovered by the slide G, so as to admit high pressure steam to this cylinder during a certain portion of the stroke. Q<sup>2</sup> will connect L' with M so as to exhaust cylinder A'. Q<sup>4</sup> will connect N' with R so as to exhaust B' through R, Q<sup>6</sup> and O' into C', Q<sup>5</sup> will connect M with B through K<sup>5</sup> and N so as to admit the steam thereto which is coming from A', and Q<sup>7</sup> will connect C with the exhaust port K<sup>8</sup>.

It will be evident that engines constructed as above described may be arranged either vertically, horizontally or inclined.

The present invention is a triple expansion engine using the steam chambers M, into which the steam from the high pressure cyl-

inders exhausts before passing to the intermediate low pressure cylinders, in which respect my present invention differs from my application, Serial No. 444,679, filed of even date herewith.

Having thus described the nature of my invention and the best means I know for carrying the same into practical effect, I claim—

In triple expansion engines, the combination of a cylindrical main slide valve F having ports Q' Q<sup>3</sup> controlled by a central cylindrical expansion valve, and communicating respectively with the port L of the high pressure cylinder A and with the port L' of the high pressure cylinder A', a port Q<sup>2</sup> communicating with the ports L and L' of cylinders A and A' and with the steam chamber M, ports Q<sup>4</sup>, Q<sup>6</sup>, Q<sup>8</sup> connected by annular passage R, and communicating respectively with ports N' of cylinder B', port N of cylinder B, port O' of cylinder C', and port O of cylinder C, port Q<sup>5</sup> communicating with port N of cylinder B, port N' of cylinder B', and chamber M, and port Q<sup>7</sup> communicating with port O of cylinder C, port O' of cylinder C', and with port K<sup>8</sup> leading to exhaust U, and a cylindrical valve chamber E having ports K' to K<sup>9</sup> inclusive communicating respectively with cylinders A A', B B' C C', steam chamber M, and exhaust U, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 8th day of August, A. D. 1892.

JAMES MARSHALL.

Witnesses:

HERBERT MARCH,  
*Leeds, Solicitor.*

CHAS. JNO. BRICE,  
*Messenger at U. S. Consulate, Leeds.*