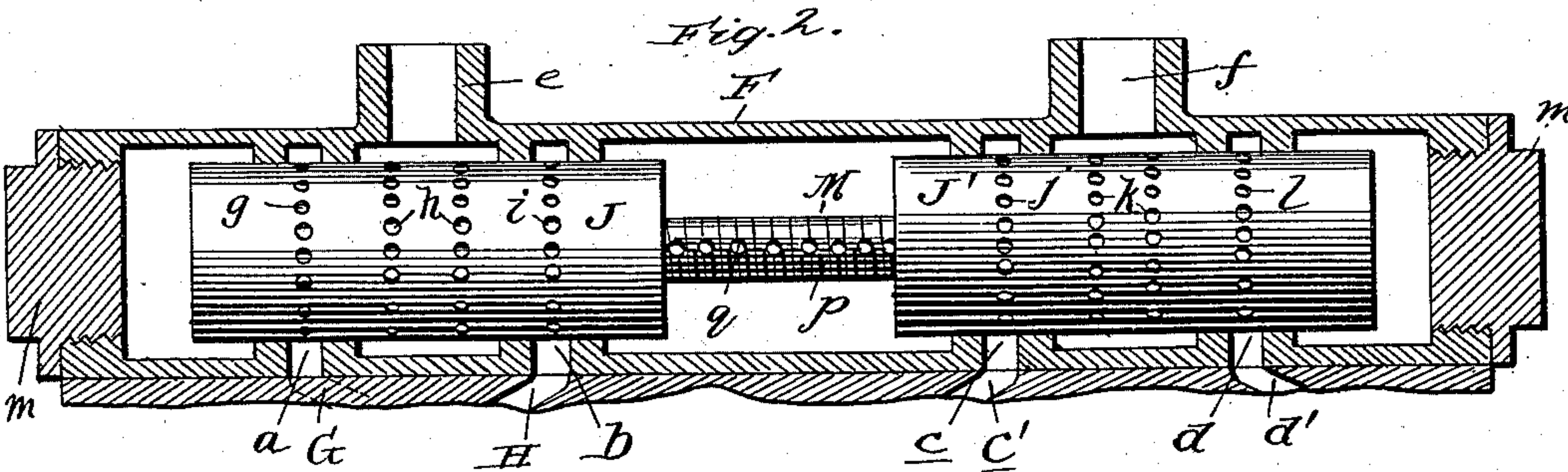
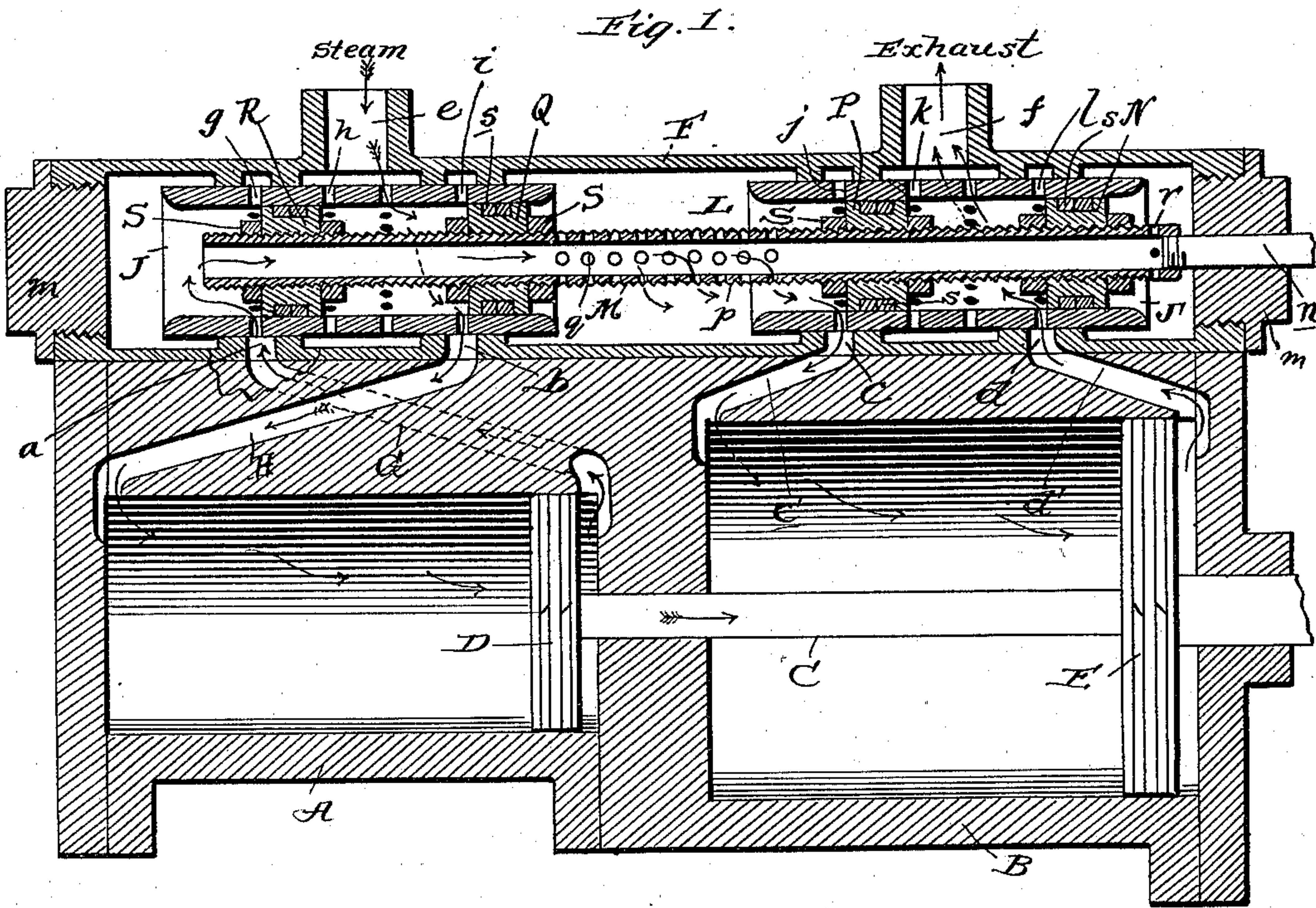


(No Model.)

J. BONNER.
RECIPROCATING VALVE.

No. 547,413.

Patented Oct. 8, 1895.



Witnesses:

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RECIPROCATING VALVE.

SPECIFICATION forming part of Letters Patent No. 547,413, dated October 8, 1895.

Application filed May 15, 1895. Serial No. 549,414. (No model.)

To all whom it may concern:

Be it known that I, JOHN BONNER, a citizen of the United States, residing at Tiburon, in the county of Marin and State of California, have invented certain new and useful Improvements in Reciprocating Valves; and I do declare the following to be a full, clear, and exact description of the invention, such as it appertains to make and use the same.

My invention relates to improvements in reciprocating valves and the manner in which they are connected with the high and low pressure or primary and secondary cylinders of compound steam-engines; and it has for one of its objects to provide a connection which will admit of a valve having a comparatively small number of pistons being employed and will enable the said valve to thoroughly control communication between the two cylinders of a compound engine.

Another object of the invention is to provide a reciprocating valve for the purpose mentioned, embodying an exceedingly cheap and simple construction, and one in which the pistons or enlarged portions may be readily adjusted on the valve-body or may be readily removed and replaced by others, when necessary.

With the foregoing ends in view the invention will be fully understood from the following description and claims, when taken in connection with the annexed drawings, in which—

Figure 1 is a sectional view illustrating my improved valve and connection in conjunction with a compound engine, and Fig. 2 is a view showing the valve-casing in section and the valve in elevation.

Referring by letter to said drawings, A B indicate the high and low pressure cylinders, respectively, of a compound engine.

C indicates the piston-rod, which is provided in the cylinders A B with pistons D and E, and F indicates the casing of my improved valve. This casing F is provided with ports *a b*, which communicate with passages G H, leading to opposite ends of the high-pressure cylinder A, and is also provided with

ports *c d*, which communicate with passages *c' d'*, leading to opposite ends of the low-pressure cylinder B, which passages *c' d'* are arranged in the ordinary manner. The casing-ports *a* and *b* are each connected to the end of the cylinder that is farthest from them by the crossed connecting-passages G H, and in consequence of this a valve having but four pistons or enlargements may be employed to control communication between the high and low pressure cylinders A B, as presently described.

The valve-casing F is further provided with live-steam and exhaust ports *e f* and with annular grooves which communicate with the ports *a, b, c, d, e*, and *f*, and in it are arranged the bushing-sections J J', of which two are employed, the section J being arranged to cover the ports *a b e*, and the section J' to cover the ports *c d f*, as better illustrated in Fig. 1. The bushing or lining section J is provided with four circular series of apertures *g h i*, which communicate with the casing-ports *a, e*, and *b*, respectively, as better shown in Fig. 2, and the bushing or lining section J' is provided with four circular series of apertures *j, k*, and *l*, which communicate with the casing-ports *c, f*, and *d*, respectively. Said bushing or lining sections J J' may be secured against movement in any suitable manner, and the ends of the casing F may be closed by heads *m* or other suitable means.

L indicates the reciprocating valve, which is arranged and adapted to slide in the bushing-sections J J' and may have its stem *n* connected with valve-gearing (not illustrated) in the ordinary manner. This valve L comprises a tubular body portion M, which has one end closed and connected to the stem *n* and has its opposite end open and is provided throughout its length with exterior threads *p* and at its middle with apertures *q*, and adjacent to its closed end with apertures *r*, the four pistons or enlarged portions N, P, Q, and R, which are interiorly threaded to engage the exterior threads of the body M, and may have packing-rings, as *s*, and the nuts S, which are arranged on the body M on opposite sides of the pistons and are designed and adapted to

hold the said pistons against movement on the body. This construction of valve is highly advantageous, inasmuch as when the valve is removed from its casing the several
 5 pistons may be adjusted and adjustably fixed in position and may, when desired, be readily removed with the aid of a wrench and be replaced by new pistons or enlarged portions. As the pistons or enlarged portions of the
 10 valve are the only parts of the same subjected to frictional wear, it will be readily observed that the usefulness of the valve may be indefinitely prolonged by renewing the said pistons when they are worn.

15 The peculiar connection between the valve-casing and the high-pressure cylinder before described admits of the employment of but four valve-pistons, which is an important advantage, as a valve having but four pistons
 20 may be more cheaply manufactured and may be more easily kept in repair than one which has a greater number of pistons. The employment of a valve having but four pistons is also advantageous, inasmuch as it is adapted
 25 to conduct the steam in a more direct course than one which has a greater number of pistons. For instance, with the valve in the position shown in Fig. 1, it will be seen that steam entering through the casing-port *e* is
 30 enabled to pass through the bushing-ports *h* and *i*, casing-port *b*, and passage *H* to the high-pressure cylinder *A* and move the piston *D* in the direction indicated by arrow, while the steam back of said piston is enabled to pass through the passage *G*, casing-
 35 port *a*, bushing-ports *g*, valve-body *M*, apertures *q*, bushing-ports *j*, casing-port *c*, and passage *c'* to the low-pressure cylinder *B* and move the piston *E* therein in the direction
 40 indicated by arrow. The steam back of said piston *E* is enabled to pass through the passage *d'*, casing-port *d*, and bushing-ports *l* and *k* to the exhaust-port *f*. When the position of the valve is changed by the valve-
 45 gear, (not illustrated,) direct communication will be established between the steam-inlet port *e* and the right-hand end of the high-pressure cylinder, between the left-hand end of said high-pressure cylinder and the right-
 50 hand end of the low-pressure cylinder, and between the left-hand end of the low-pressure cylinder and the exhaust, and in consequence the pistons *D* *E* will be moved in the direction opposite to that indicated by arrow.

55 Having described my invention, what I claim is—

1. The combination of the high and low pressure cylinders of a compound engine, pistons arranged in said cylinders and connected
 60 together, a valve casing having the ports *a*, *d*, adjacent to its opposite ends, the ports *b*, *c*, at points between the ports *a*, *d*, and its middle, the induction port *e*, arranged in a plane between the planes of the ports *a*, *b*, and the

exhaust port *f*, arranged in a plane between 65 the planes of the ports *c*, *d*, the passages connecting the ports *c*, *d*, and the opposite ends of the low pressure cylinder, the passage *H*, connecting the port *a*, and the end of the high
 70 pressure cylinder farthest from said port, the passage *G*, connecting the port *b*, and the opposite end of the high pressure cylinder and crossing the passage *H*, and the valve arranged in the casing and comprising the hol-
 75 low tubular body provided with openings at its ends and at an intermediate point of its length, pistons *R*, *N*, mounted on said body adjacent to the ends thereof, and the pistons *P*, *Q*, mounted on the tubular body at points
 80 between the pistons *N*, *R*, and the intermediate openings in said tubular body, substantially as and for the purpose set forth.

2. The combination of the high and low pressure cylinders of a compound engine, pistons arranged in said cylinders and connected 85 together, a valve casing having the ports *a*, *d*, adjacent to its opposite ends, the ports *b*, *c*, at points between the ports *a*, *d*, and its middle, the induction port *e*, arranged in a plane between the planes of the ports *a*, *b*, and the
 90 exhaust port *f*, arranged in a plane between the planes of the ports *c*, *d*, the passages connecting the ports *c*, *d*, and the opposite ends of the low pressure cylinder, the passage *H*, connecting the port *a*, and the end of the high
 95 pressure cylinder farthest from said port, the passage *G*, connecting the port *b*, and the opposite end of the high pressure cylinder and crossing the passage *H*, and the valve arranged in the casing and comprising the hol-
 100 low tubular body provided with openings at its ends and at an intermediate point of its length and exteriorly threaded, the pistons *N*, *P*, *Q*, and *R*, having threaded apertures receiving the tubular body and engaging the
 105 threads thereof and nuts mounted on the threaded body on opposite sides of the pistons, substantially as and for the purpose set forth.

3. The combination of the high and low 110 pressure cylinders of a compound engine, pistons arranged in said cylinders and connected together, a valve casing having the ports *a*, *d*, adjacent to its opposite ends, the ports *b*, *c*, at points between the ports *a*, *d*, and its mid-
 115 dle, the induction port *e*, arranged in a plane between the planes of the ports *a*, *b*, and the exhaust port *f*, arranged in a plane between the planes of the ports *c*, *d*, the passages connecting the ports *c*, *d*, and the opposite ends
 120 of the low pressure cylinder, the passage *H*, connecting the port *a*, and the end of the high pressure cylinder farthest from said port, the passage *G*, connecting the port *b*, and the opposite end of the high pressure cylinder and
 125 crossing the passage *H*, bushings arranged in the casing and having ports communicating with the casing ports *a*, *b*, *c*, *d*, *e*, and *f*, and

the valve arranged in the casing and comprising the hollow tubular body provided with openings at its ends and at an intermediate point of its length, pistons R, N, mounted on said body adjacent to the ends thereof, and the pistons P, Q, mounted on the tubular body at points between the pistons N, R, and the intermediate openings in said tubular

body, substantially as and for the purpose set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN BONNER.

Witnesses:

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JAMES L. KING.