

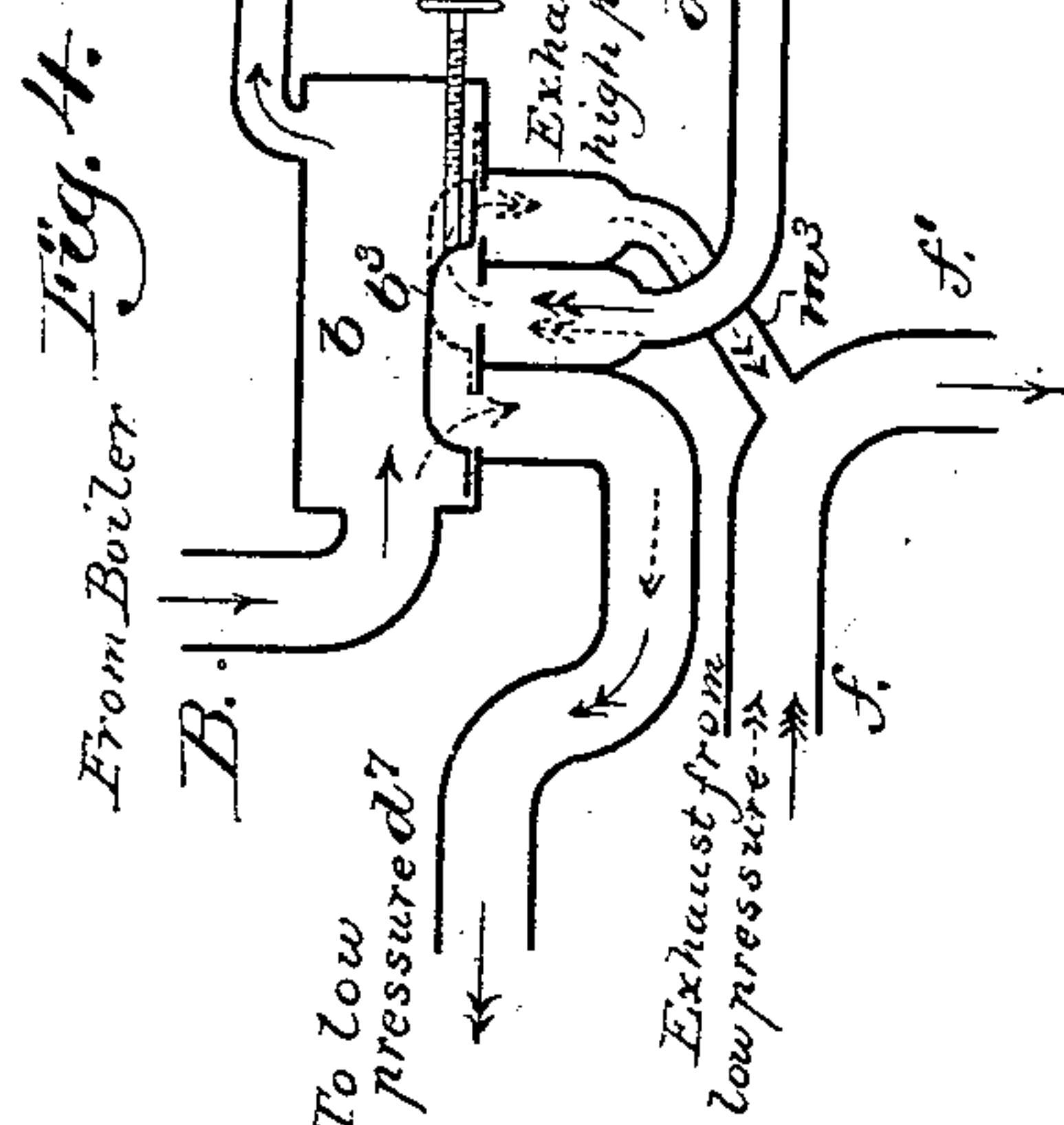
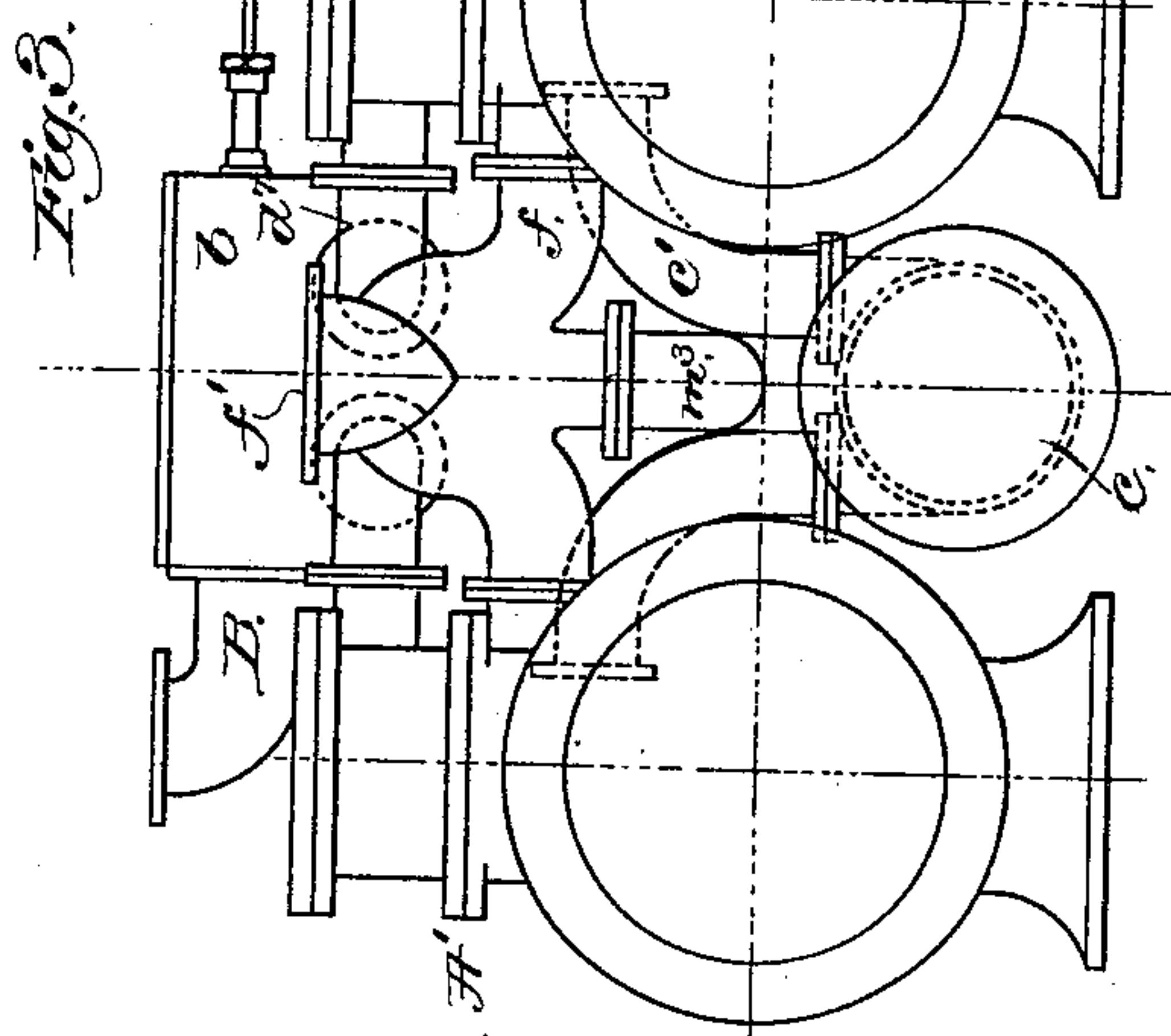
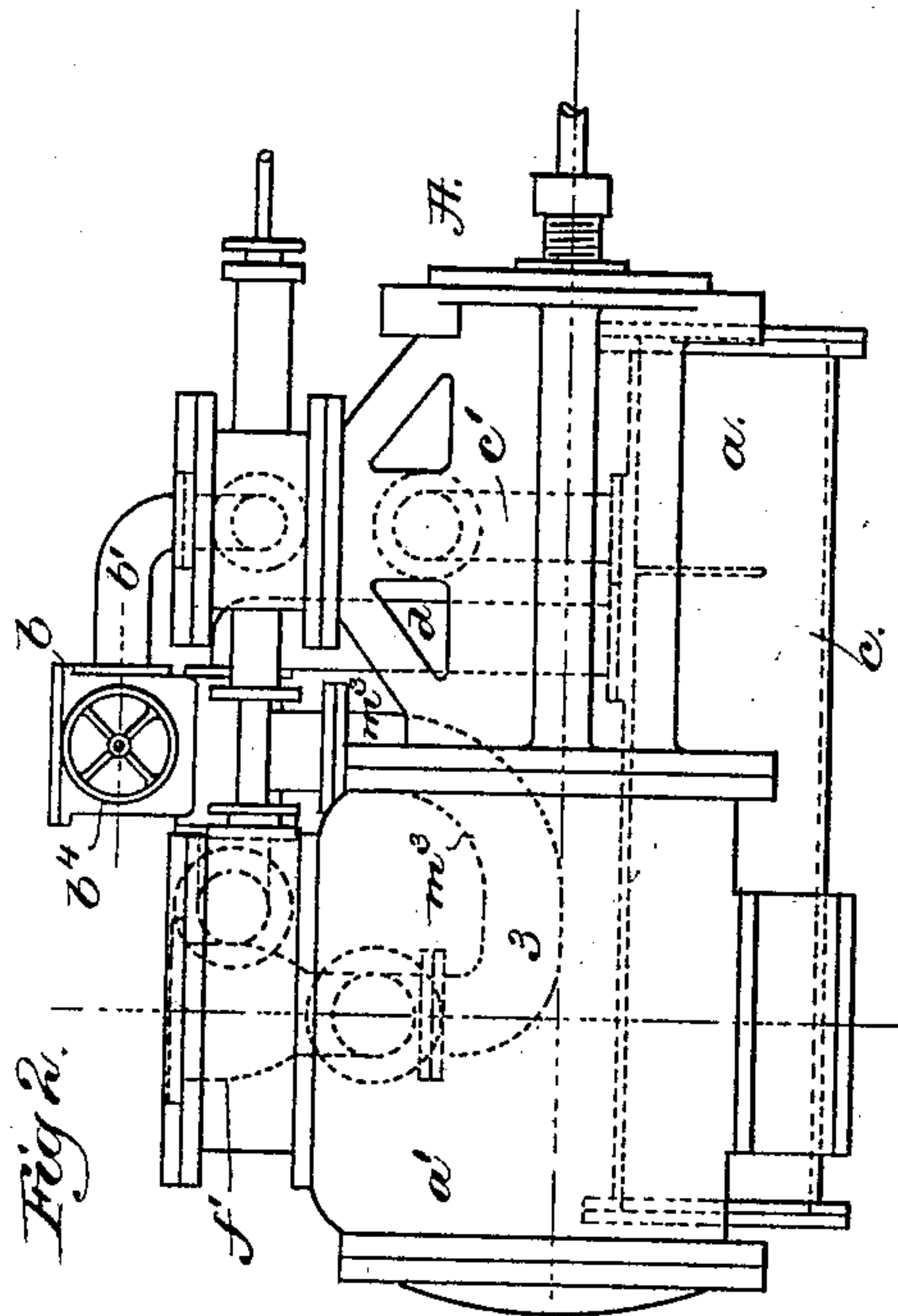
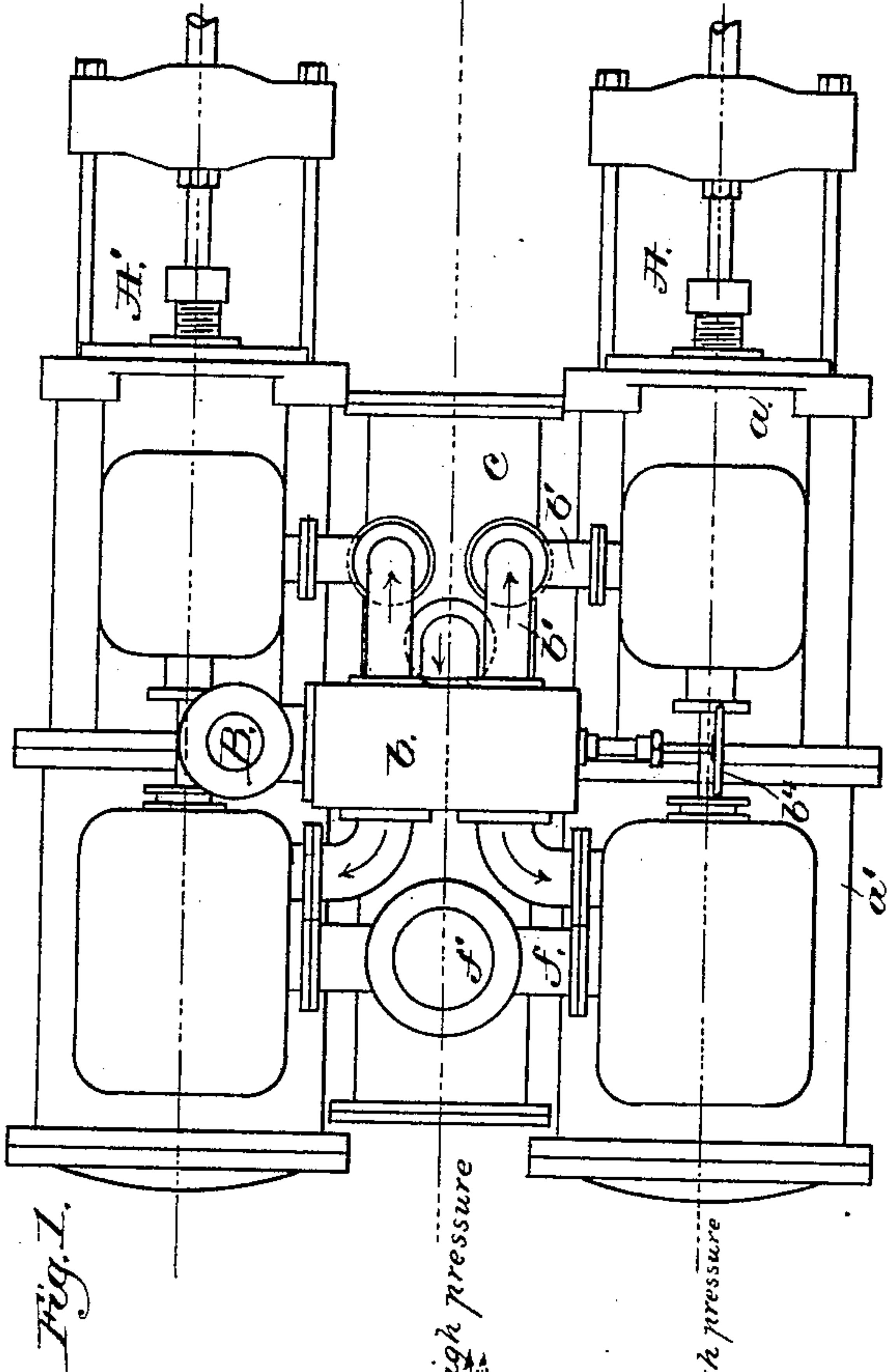
(No Model.)

3 Sheets—Sheet 1.

A. F. HALL.
STEAM ENGINE.

No. 350,736.

Patented Oct. 12, 1886.



Witnesses.
And L. Emery.
John F. C. Prinslerk

Inventor.
Albert F. Hall.
by Crosby & Gregory attys.

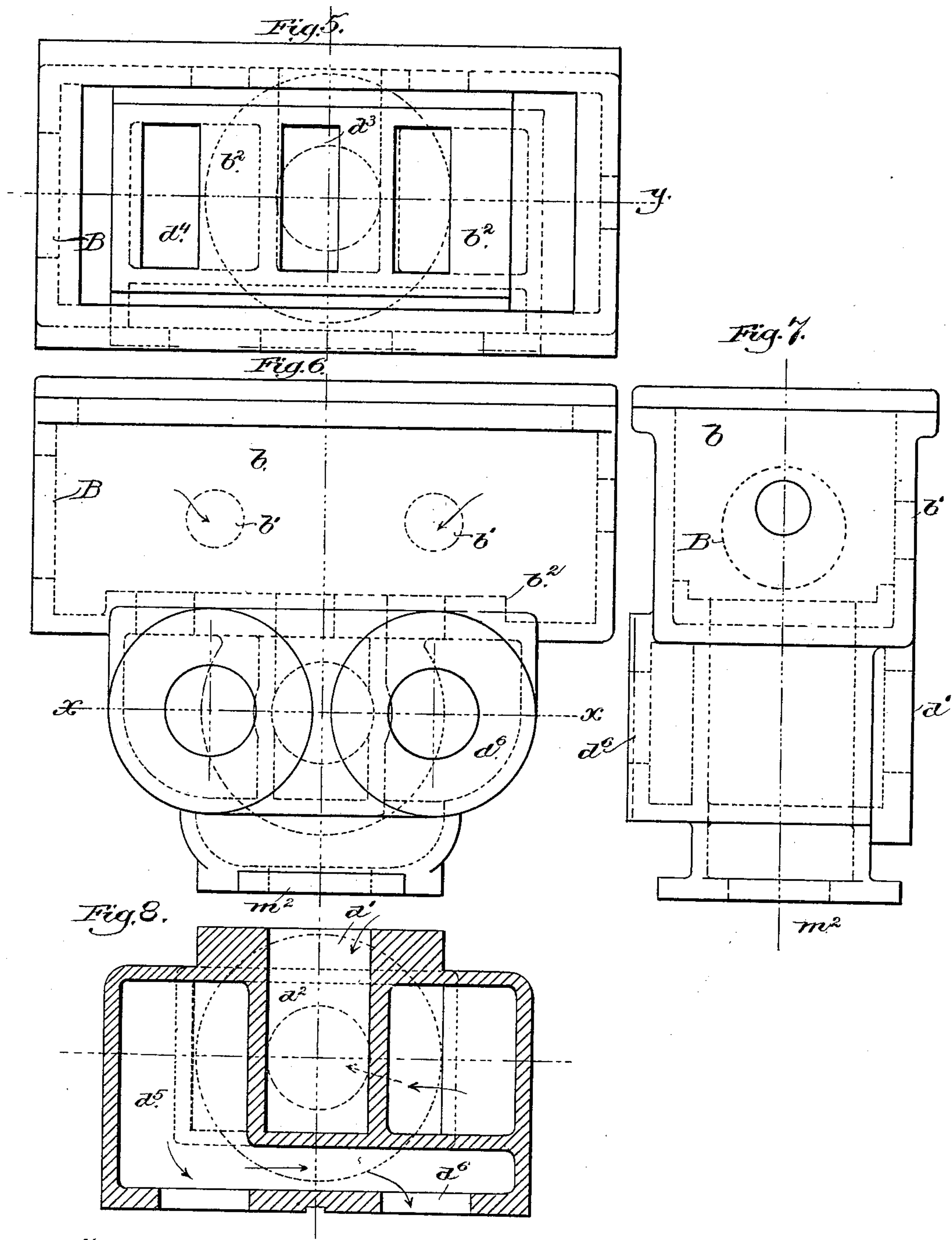
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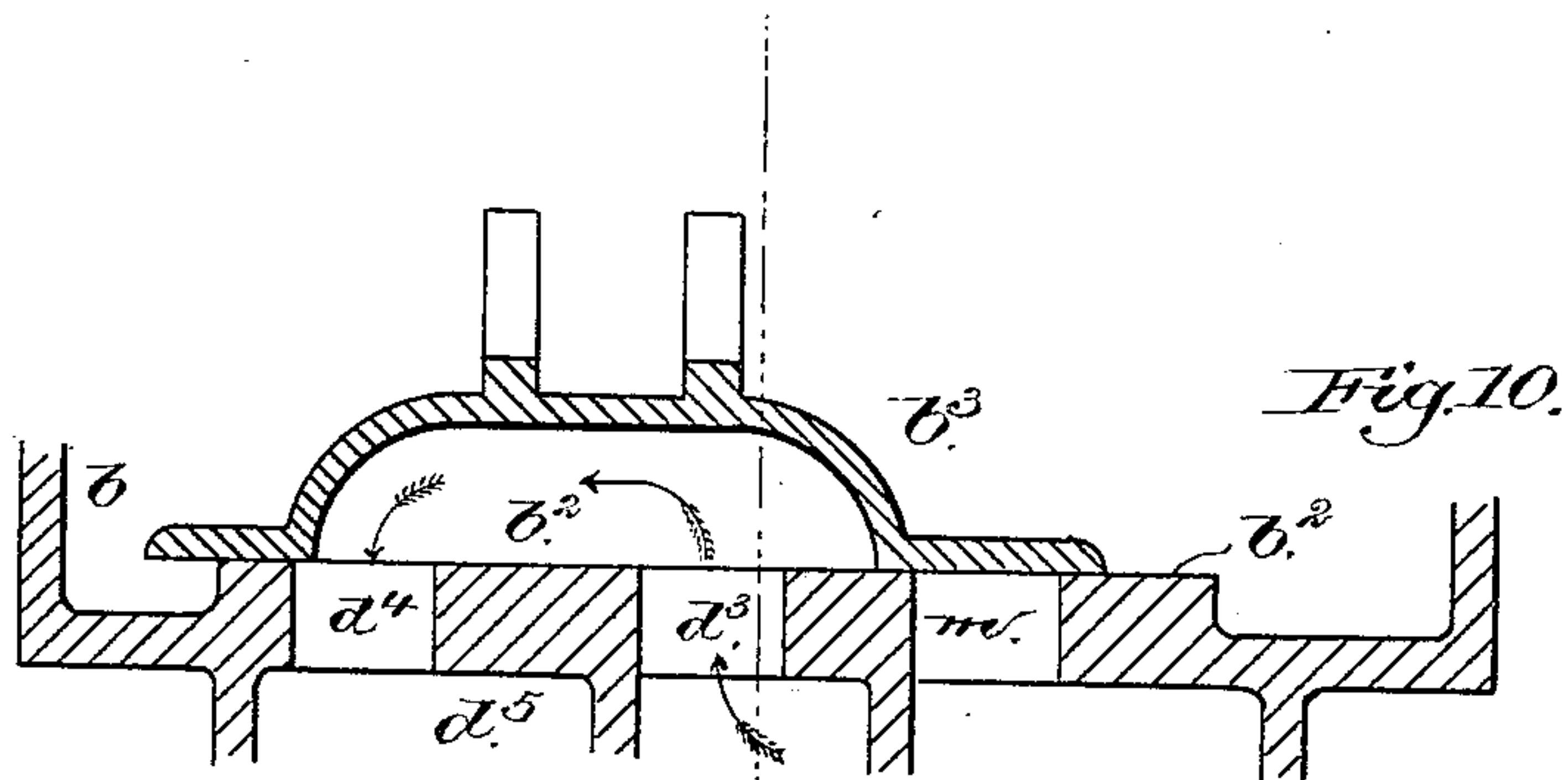


Fig. 10.

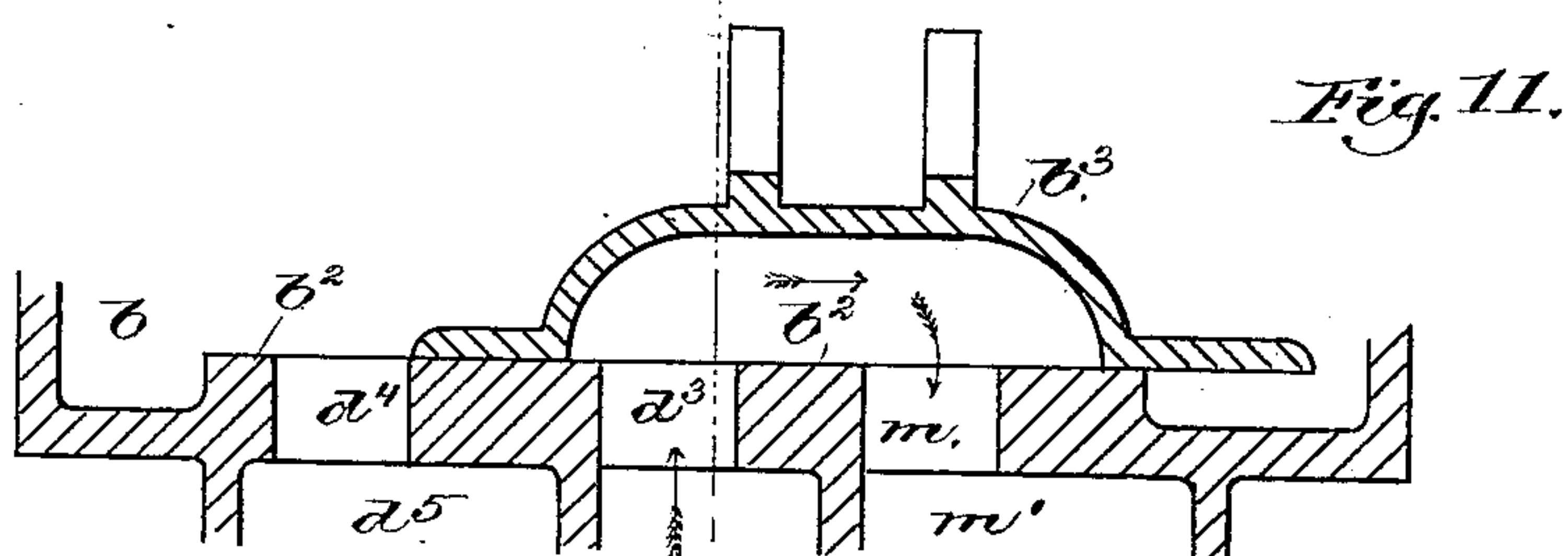


Fig. 11.

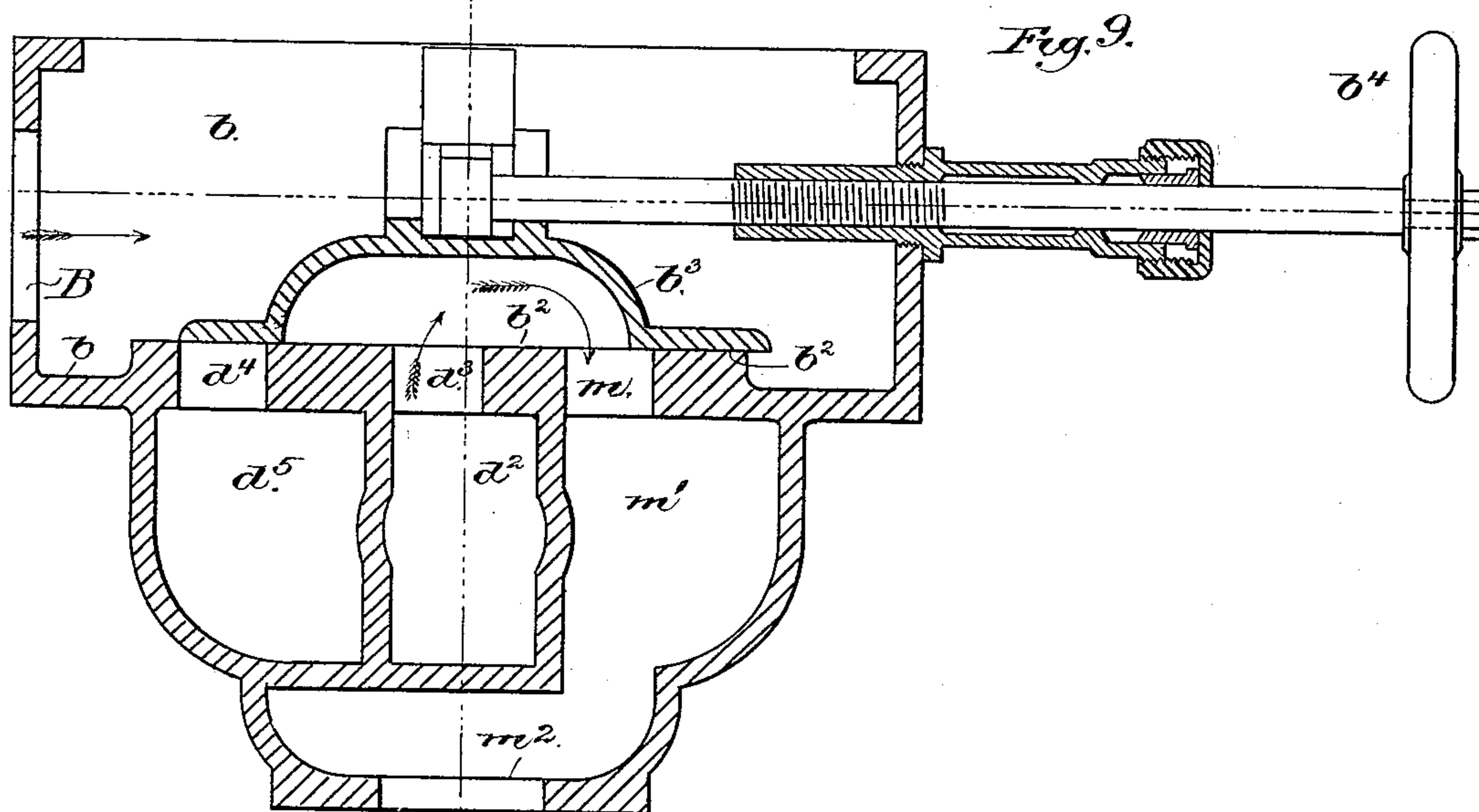


Fig. 9.

Witnesses.

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UNITED STATES PATENT OFFICE.

ALBERT F. HALL, OF BOSTON, MASSACHUSETTS.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 350,736, dated October 12, 1886.

Application filed December 14, 1885. Serial No. 185,599. (No model.)

To all whom it may concern:

Be it known that I, ALBERT F. HALL, of Boston, county of Suffolk, and State of Massachusetts, have invented an Improvement in Steam-Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relating to steam-engines is shown embodied in a duplex compound direct-acting pumping-engine, the object of the invention being to provide increased power when needed without necessarily increasing the initial pressure of the actuating-fluid.

In another application, filed December 14, 1885, Serial No. 185,600, I have shown and described an engine comprising two cylinders of different diameters, normally operating as a compound engine, the actuating-fluid at initial pressure, which will, for convenience, be spoken of as "live steam," being admitted to the smaller cylinder and the exhaust from the smaller cylinder operating in a larger cylinder, which exhausts into the atmosphere or into a condenser, in the usual manner, together with passages and valves therein, by which live steam may be admitted directly to the large cylinder and the exhaust from the small cylinder cut off from the large cylinder and directed into the atmosphere or condenser, so that each cylinder becomes a simple engine operating practically independently of the other, although in conjunction with it.

The present invention consists, mainly, in a novel arrangement of the passages connecting the different cylinders of the duplex engine together and with the main steam-inlet and exhaust pipes, and in the combination, with the said passages, of a single valve or controlling device governing the direction of the flow of the fluid through the said passages, whereby the two cylinders may be made to work together as a compound engine, or may be made to work separately, each receiving and exhausting steam independently of the other.

Figure 1 is a plan view of a compound duplex pumping-engine embodying this invention; Fig. 2, a side elevation thereof; Fig. 3, an end elevation thereof; Fig. 4, a diagram illustrating the relation of the passages and the flow of steam therethrough; Fig. 5, a plan

view of the chest into which the live steam is received from the boiler, the cover of the said chest being removed; Fig. 6, a rear elevation of said chest; Fig. 7, an end elevation thereof; Fig. 8, a horizontal section on line *x x*, Fig. 6; Fig. 9, a longitudinal section on line *y y*, Fig. 5; and Figs. 10 and 11, details showing the controlling-valve in different positions.

The engines *A A'* are of any suitable or usual construction, being shown as such as used in duplex pumps, the piston of one engine controlling the valve of the other, although the present invention is applicable equally to a single engine, and the operation of the parts governing the application of motive-fluid to the two cylinders of either engine would be the same whether one or both engines were used, and will, for convenience, be described in connection with one only of the said engines. Each engine, as *A*, has two cylinders, *a a'*, the one of smaller diameter than the other, normally intended to co-operate together as a duplex engine, live steam being admitted to the smaller or high-pressure cylinder, *a*, and the exhaust from the said cylinder *a* passing into a receiver, *c*, or other passage which supplies or is connected with the inlet to the larger or low-pressure cylinder, *a'*, from which the steam is finally exhausted through the main exhaust-passage *f f'*.

In order to control the flow of steam with relation to the cylinders *a a'*, so that it may pass to the smaller cylinder and then to the larger cylinder, as previously described, or so that, if desired, the live steam may pass directly to each cylinder and the steam be exhausted from each independently of the other, the engine is provided with a controlling apparatus included in a chest, *b*, into which live steam is admitted directly from the boiler through the main inlet-passage *B*, and from which it passes directly through the chest *b* to the smaller cylinder, *a*, the exhaust from which passes through pipes *c'* into the receiver *c*. The floor of the chest *b* is provided with a valve-seat, *b''*, (best shown in Figs. 9, 10, and 11,) having three ports controlled by a valve, *b'''*, of proper construction to connect the middle one of the said ports with the one at either side of it, according to the position of the said valve on its seat, the valve being operated by a handle, *b⁴*. The ports communicate

with chambers in the casting below the valve-seat. (Best shown in Figs. 8 and 9.) The receiver *c* communicates, through pipe *d* and passage *d'*, (see Fig. 8,) with the middle chamber, *d*², below the valve-seat, which chamber has no outlet, except the port *d*³ in the valve-seat. The port *d*⁴, at one end of the valve-seat, communicates with a chamber, *d*⁵, below it, the only outlet from which, for engine A, is through passages *d*⁶ and pipe *d*⁷, (see Fig. 3,) said pipe being the inlet to the steam-chest of the larger cylinder, *a'*, of the engine. Normally, when the engine is to operate as a compound engine, the valve *b*³ is in the position shown in Fig. 10, separating all the ports from the interior of the chest *b*, so that the live steam is not admitted to any of them and connecting the ports *d*³ and *d*⁴, so that the exhaust from the smaller cylinder, *a*, passes through the passage *d* into the chamber *d*², thence through the port *d*³ and pocket of the valve *b*³ into the port *d*⁴ and chamber *d*⁵, and thence by passage *d*⁷ to the larger cylinder, *a'*, from which, after having acted on the piston in the usual manner, it is exhausted through the pipe *f**f'*. (See Fig. 3.) When, however, it is desired to admit steam at full initial pressure to the larger cylinder, *a'*, in order to increase the power of the engine, the controlling-valve *b*³ is moved to the position shown in Fig. 11, first disconnecting the port *d*⁴ from the one *d*³, as shown in Fig. 9, so that the exhaust of the small cylinder can no longer pass to the large cylinder, and then in its further movement uncovering the port *d*⁴, as shown in Fig. 11, so that the live steam will pass directly into the chamber *d*⁵, and thence through pipe *d*⁷ to the large cylinder.

In order to provide for the independent exhaust from the small cylinder when it no longer enters the large cylinder, the third port, *m*, in the valve-seat communicates with the chamber *m'* below, connected through passage *m*² with a pipe, *m*³, leading to the main exhaust-passage *f*, and in the movement of the controlling-valve *b*³ from the position shown in Fig. 10, where the cylinders operate as a compound engine, to the position shown in Fig. 11, where the cylinders operate independently, the port *d*³, taking exhaust from the receiver *c* and small cylinder *a*, is connected by the valve *b*³ with the port *m* and main exhaust passage before its connection with the port *d*⁴ is cut off; or the valve may be so constructed that the port *m* is opened at the same time that the port *d*⁴ is closed, and when the valve *b*³ is in the position shown either in Figs. 9 or 11, the small cylinder exhausts directly through the passages *d* *d'* *d*² *d*³ into the passage *m* *m'* *m*² *m*³, and finally into the main exhaust-pipe *f*. When the valve *b*³ is in the position shown in Fig. 9, the large cylinder neither receives the exhaust from the small cylinder nor live steam from the chest

b, and in this position the small cylinder would operate alone as a single engine, and in moving the valve from the position shown in Fig. 9 to that shown in Fig. 11, the opening of the port *d*⁴ will be varied so that the amount of live steam admitted to the large cylinder may be regulated without interfering with the proper independent exhaust of the small cylinder.

In the diagram, Fig. 4, the full-line arrows represent the direction of flow of steam when the two cylinders are operating together as a compound engine, and the dotted arrows represent the flow of steam when the engines are each operating independently, the double-headed arrows in each case representing exhaust-steam once, and the triple-headed arrows steam that has expanded twice.

I claim—

1. A duplex compound direct-acting steam pumping-engine comprising two small or high-pressure and two large or low-pressure cylinders, a main steam-inlet passage, and the main exhaust-passage, combined with connecting-passages between the said cylinders and the main inlet and exhaust passages and the single controlling-valve governing the said passages, which valve in one position connects the exhaust of the high-pressure with the inlet-passage of the low-pressure cylinders, and in another position connects the inlet-passages of the low-pressure cylinders with the main inlet for the engine, and disconnects the exhaust-passages from the high-pressure cylinders from the inlet to the low-pressure cylinders and connects them with the main exhaust-passage, substantially as described.

2. The combination, with a duplex compound direct-acting steam-engine comprising two high-pressure and two low-pressure cylinders, of a chest receiving the actuating-fluid at full pressure and communicating with the inlet to the high-pressure cylinders, the said chest having a valve-seat with three ports and three independent chambers below them, and a slide-valve which may cover or uncover one of the end ports, and may connect the middle port with the one at either side of it, the chamber below the middle port receiving the exhaust from the high-pressure cylinders, and the chamber at one side of it being connected with the inlet to the low-pressure cylinders, and the chamber at the other side of it being connected with the main exhaust-passage to the engine, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ALBERT F. HALL.

Witnesses:

F. L. EMERY,
B. J. NOYES.