

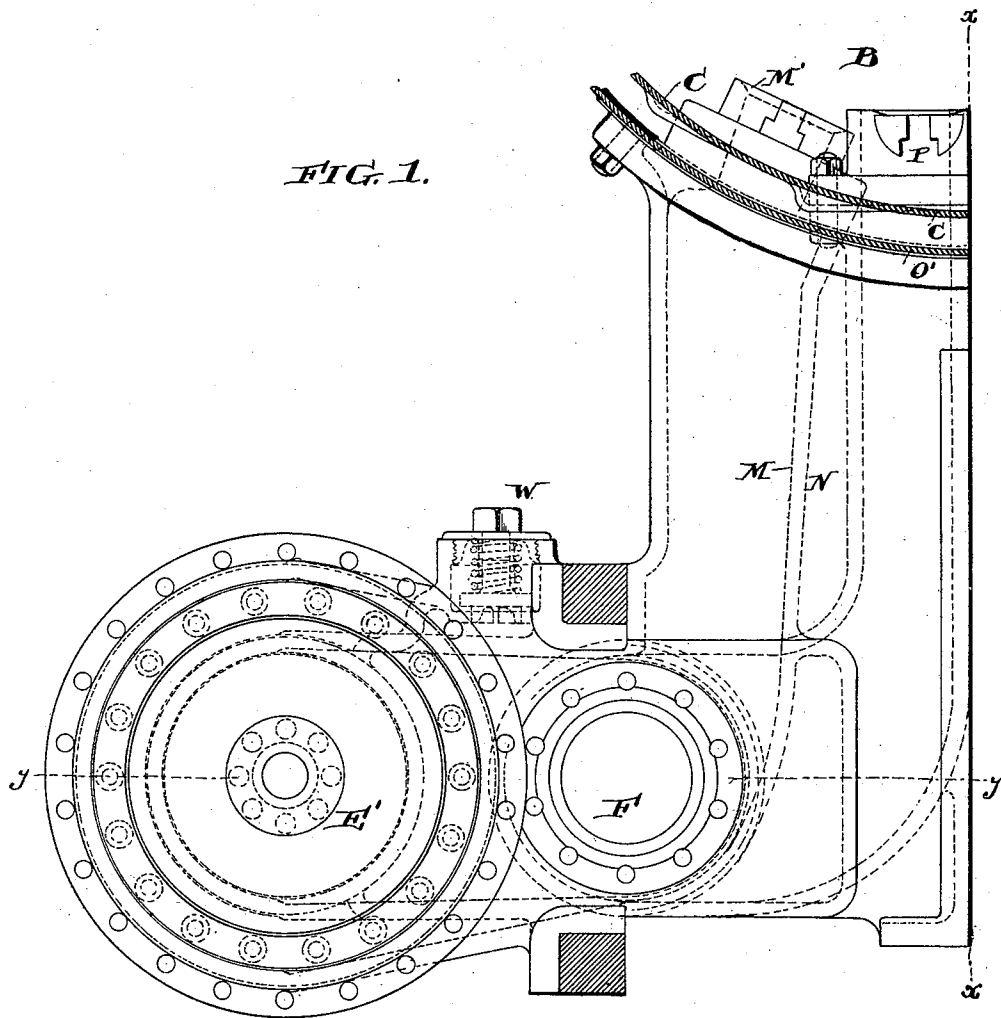
(No Model.)

6 Sheets—Sheet 1.

G. S. STRONG.  
COMPOUND ENGINE.

No. 477,279.

Patented June 21, 1892.



Witnesses:  
Henry D. ...  
Joshua ...

Inventor:  
George S. Strong  
by his atty.  
James T. Chambers

(No Model.)

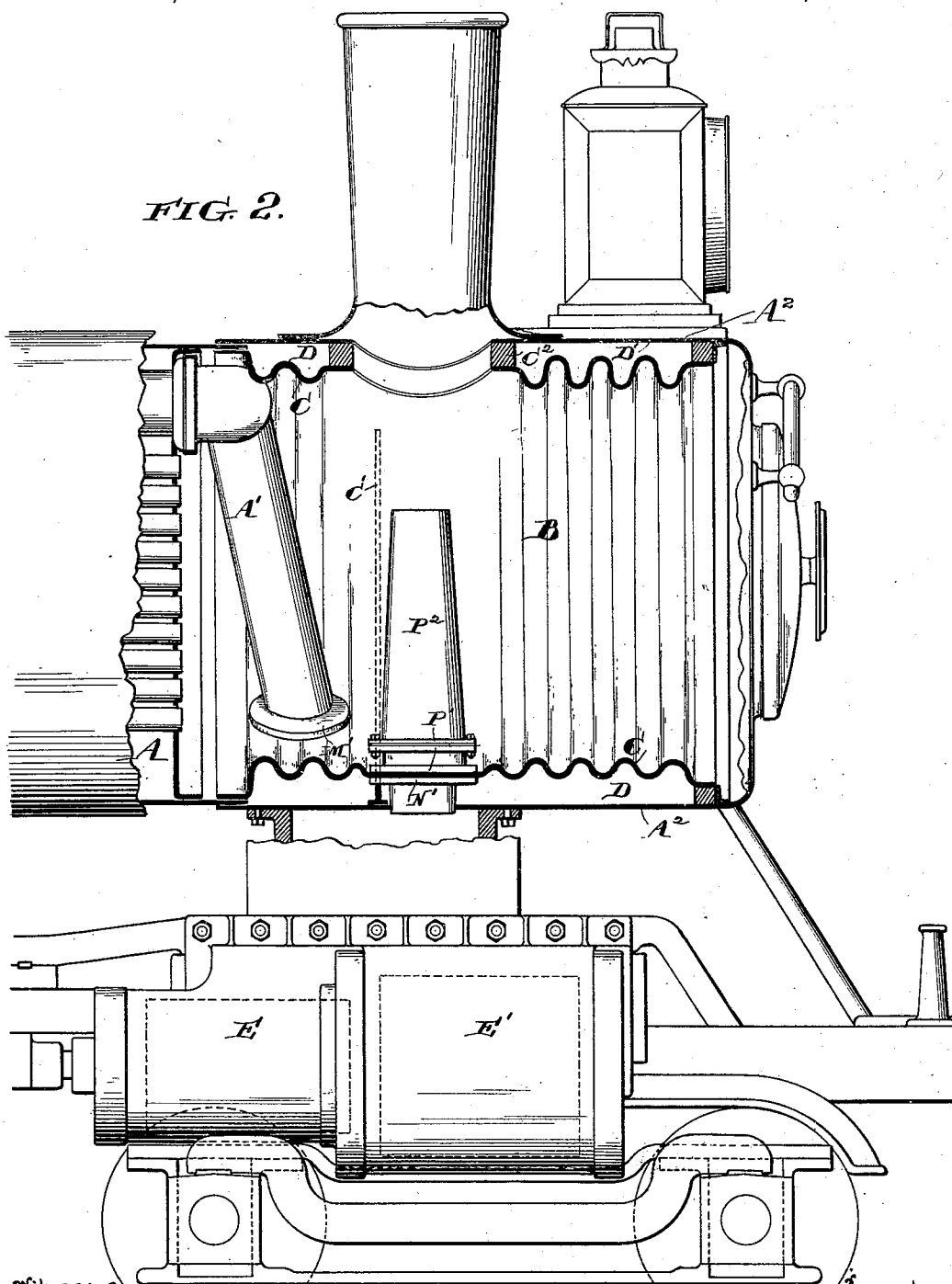
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G. S. STRONG.  
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Patented June 21, 1892.

FIG. 2.



Witnesses:

Henry D. Strong  
Joshua M. Hatch, Jr.

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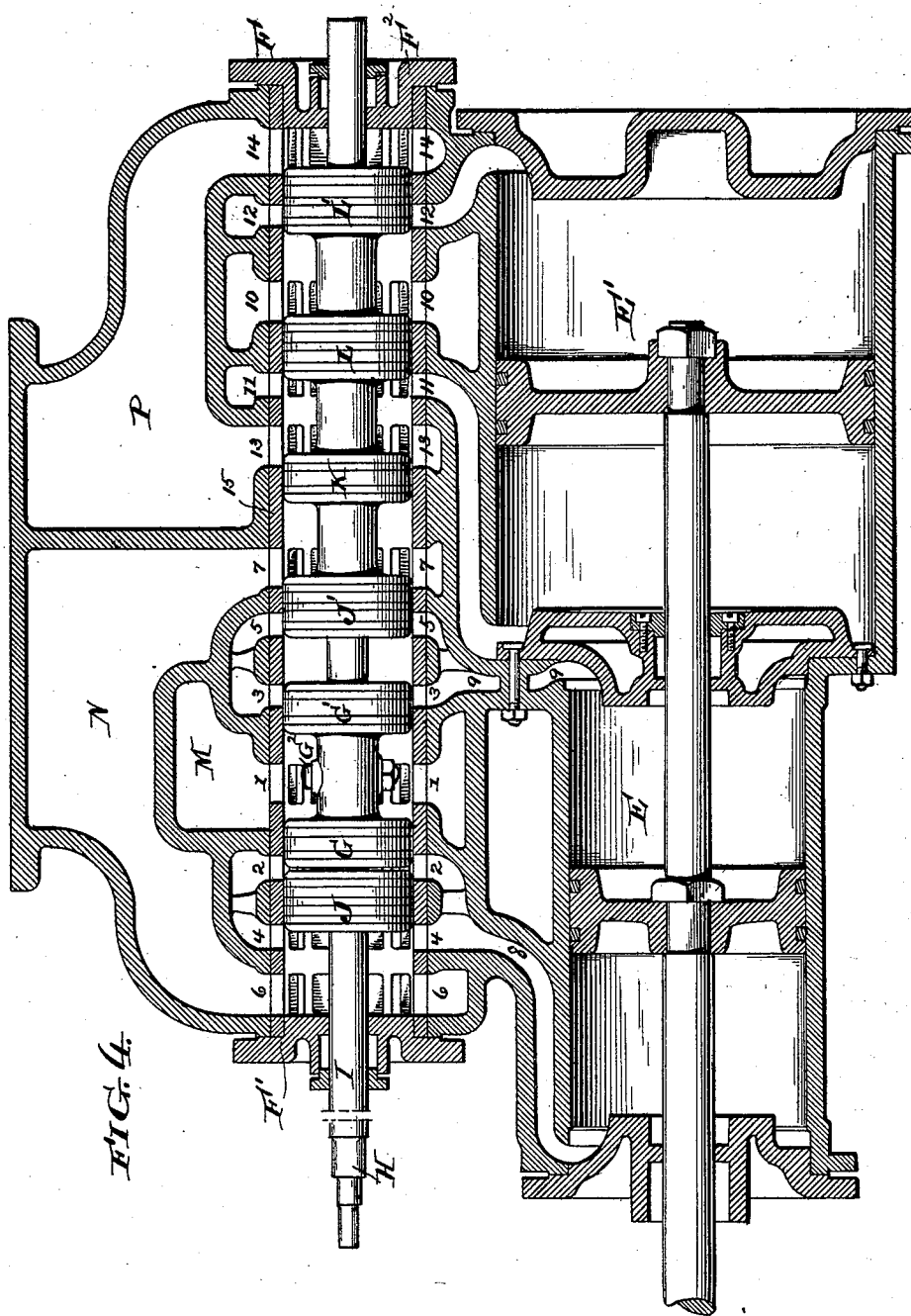
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G. S. STRONG.  
COMPOUND ENGINE.

No. 477,279.

Patented June 21, 1892.



Witnesses:  
Henry D. May  
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(No Model.)

6 Sheets—Sheet 5.

G. S. STRONG.  
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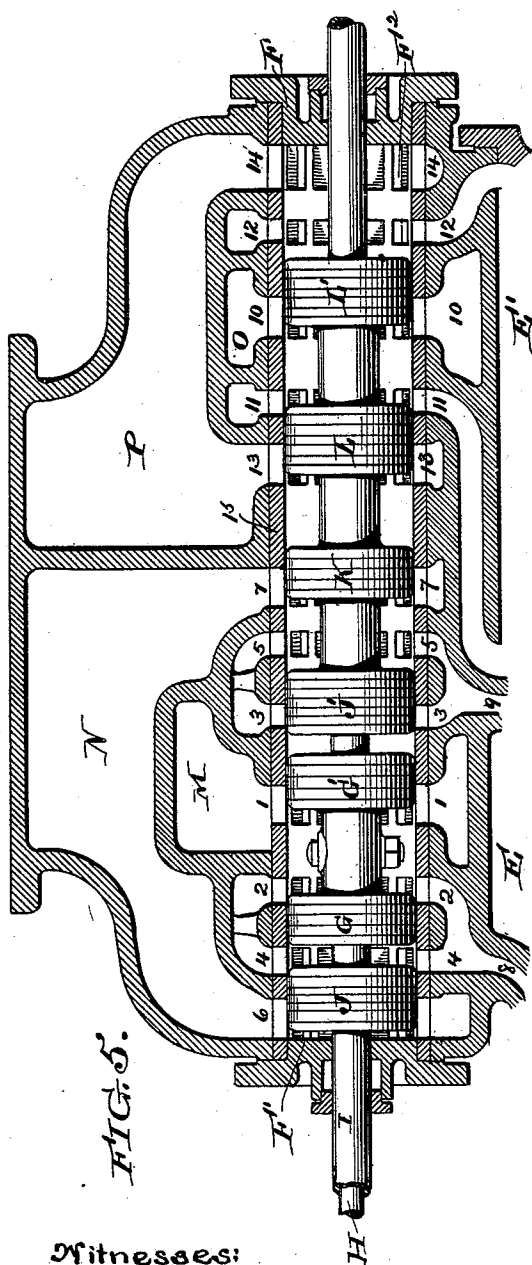


FIG. 5.

Witnesses:  
*Henry D. ...*  
*Joshua M. ...*

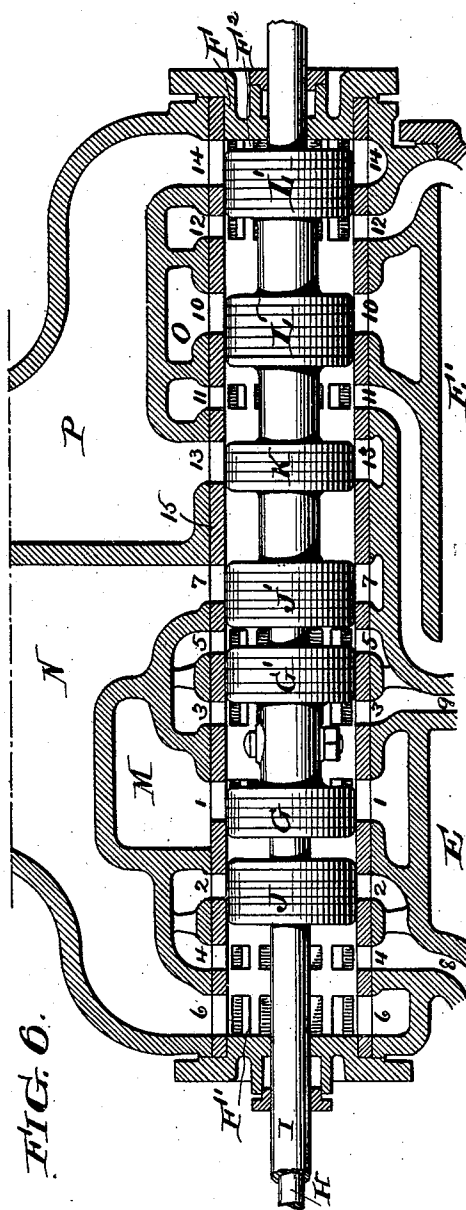


FIG. 6.

Inventor:  
*George S. Strong*  
*by his atty.*  
*Francis T. Chamber*

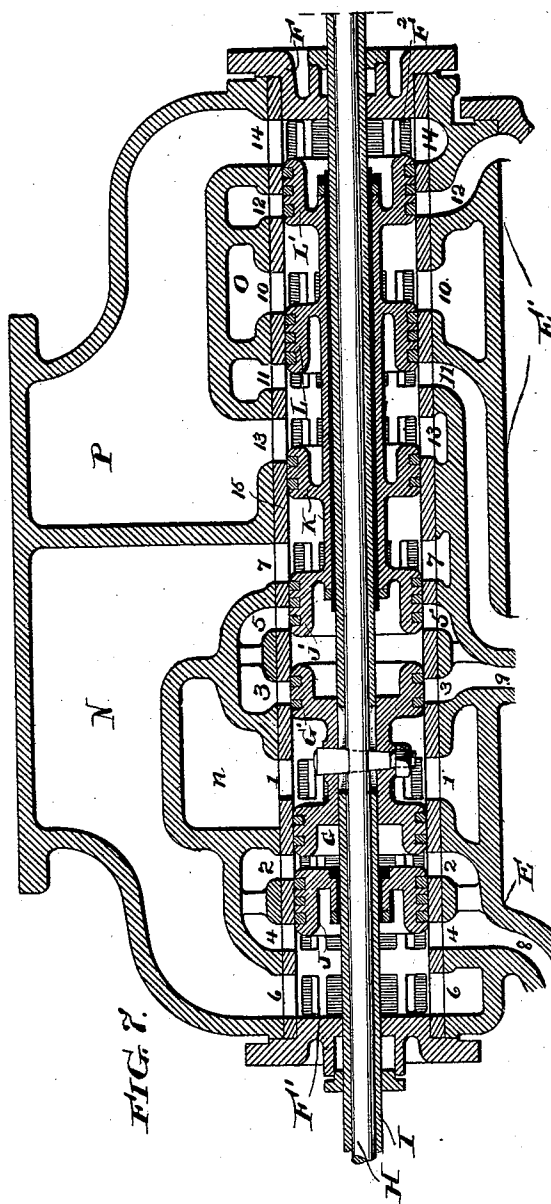
(No Model.)

6 Sheets—Sheet 6.

G. S. STRONG.  
COMPOUND ENGINE.

No. 477,279.

Patented June 21, 1892.



Witnesses:

Henry D. Dwyer  
Joshua M. Kach, Jr.

Inventor:

George S. Strong  
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# UNITED STATES PATENT OFFICE.

GEORGE S. STRONG, OF NEW YORK, N. Y., ASSIGNOR TO JAMES N. GAMBLE,  
OF CINCINNATI, OHIO.

## COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 477,279, dated June 21, 1892.

Application filed July 7, 1891. Serial No. 398,669. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE S. STRONG, of the city and county of New York, State of New York, have invented a certain new and useful  
5 Improvement in Compound Engines, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part of this specification.

10 My invention relates to the construction and operation of compound engines, and has for its object to simplify at once the construction and operation of such engines.

15 The nature of my improvement will be best understood as described in connection with the drawings in which they are illustrated, and in which—

Figure 1 is a front elevation of my improved device adapted for use in connection with a  
20 locomotive. Fig. 2 is a side elevation showing the front end of the locomotive on a central longitudinal section, so as to exhibit the receiver interposed between the high and low pressure cylinders. Fig. 3 is a plan view of  
25 the casting embodying the two cylinders, valve-chamber, &c. Fig. 4 is a cross-sectional view taken on the line *y y* of Fig. 1, the valves being shown in their central position, so as to exhibit the amount of lead given to them.  
30 Figs. 5, 6, and 7 are views of the valves and valve-chambers, taken on the same sectional plane as in Fig. 4, but exhibiting the valves in various positions.

A indicates the locomotive-boiler.

35 A' is the steam-supply pipe leading from the boiler to the engine-cylinder.

A<sup>2</sup> is the shell surrounding the smoke-box at the front end of the boiler.

40 B is the smoke-box proper, into which open the tubes of the boiler and from which leads the smoke-stack of the engine.

C is a corrugated cylinder, the inside of which forms the smoke-box B and between which and the shell A<sup>2</sup> is formed the annular chamber D D', the two portions of this chamber being separated by a partition C', extending nearly to the top of the annular chamber, but between which and the ring C<sup>2</sup> at the bottom of the smoke-stack a passage is formed  
50 leading from the chamber D to the chamber D'.

E and E' are respectively the high and low pressure cylinders constituting the compound engine and which, as shown, are set in line with each other or tandem, the pistons in each  
55 cylinder being secured to the same piston-rod, as shown in Fig. 4. I may here note that the construction of the common cylinder-head and its combination with the two cylinders, as shown in Fig. 4, forms the subject-matter  
60 of another application for Letters Patent filed by me May 5, 1891, Serial No. 391,473.

F is a piston-valve chamber, or rather two chambers, (indicated by the letters F' and F<sup>2</sup>), formed in the same casting as the cylinders  
65 E and E', the two chambers being divided by the cylindrical portion 15, the one marked F' pertaining to the high-pressure cylinder and the one marked F<sup>2</sup> to the low-pressure cylinder, but both in my preferred construction  
70 forming, essentially, a single cylinder-chamber together with the interposed cylindrical portion 15. The chamber F' is provided with the steam admission or entrance port 1, connecting the chamber with a passage M, formed  
75 in the casting, and which passage is connected at M' with the steam-pipe A'. On each side of the passage or port 1 chamber F' has steam-ports 2 and 3, connecting, respectively, with the passages 8 and 9, leading to the ends of  
80 the low-pressure cylinder, and outside of the two passages 2 and 3 are the exhaust-passages 4 and 5, also connecting with the passages 8 and 9, as shown.

Outside of the ports 4 and 5 are what I may  
85 call the "supplemental" exhaust-ports 6 and 7, both leading into the chamber or passage N, which connects at N' with the receiver D D', and in effect forms a part of the said  
90 receiver.

The chamber F<sup>2</sup> has a steam admission or entrance port 10 in its center connected with a passage O, leading from the receiver D D' and the side D'. On each side of port 10 lie the admission-ports 11 and 12, leading, respectively, to the two ends of the low-pressure cylinder, and outside of the ports 11 and 12 are the ports 13 and 14, leading into the exhaust-passage P, which at P' enters the smoke-box B through the blast-pipe P<sup>2</sup>, situated beneath and in line with the smoke-stack  
100 of the engine.

In the chamber F' is a spool-admission valve G G', secured to a spindle H, and on each side of said valve are other valves J and J', secured to a sleeve-spindle I, which surrounds the spindle H, and I prefer that the said valves should be thus independently secured to independent spindles, because by this construction a variation in the cut-off of the high pressure can be effected without changing the motion of the valves J and J', which regulate the exhaust.

In Figs. 5 and 6 the valves are shown in the respective positions they occupy in admitting steam to the left and right hand ends of the high-pressure cylinder, and in Fig. 7 I have shown the central admission-valve G G' as having cut off the admission of steam to the right-hand end of the high-pressure cylinder at a point in advance of that where the cut-off would occur where all the valves move together, as shown in Figs. 5 and 6.

To the extent above described and with the exception of its connection with a receiver the valve-chamber F' and the valves working in it are also described in another application for Letters Patent filed by me July 7, 1891, Serial No. 398,670, and the novel features of the said arrangement are not claimed in this application because they are covered by claims made in my other case.

Referring now to the valve-chamber F<sup>2</sup>, L L' is a spool-admission valve by which the port 10 is connected alternately with the ports 11 and 12, and reciprocally the ports 11 and 12 connected with the exhaust-passages 13 and 14. The steam entering valve-chamber F<sup>2</sup> through port 10 is the exhaust-steam from the high-pressure cylinder, being drawn from the receiver already described into which the said exhaust opens, and the valve L L' is connected with the valves J J', so as to move with them, because the admission to the low-pressure cylinder should take place simultaneously with the exhaust from the high-pressure cylinder and in the same direction that the high-pressure steam is admitted to the high-pressure cylinder. Preferably the valve L L' is secured to the same valve-spindle I as the valve J J', and although, of course, a fixed partition could be set up between the chambers F' and F<sup>2</sup>, I prefer to use what I may call a "partition-valve" K, also attached to the sleeve-spindle I and moving in the cylindrical portion 15, which separates the chambers F' and F<sup>2</sup>, the length of the cylinder 15 being such as to permit the full travel of valve K without making any opening between the two chambers or between the ports 7 and 13.

The receiver of the engine may be said to consist of the passage N, the annular chamber or chambers D D', and the passage O. I am aware that it is not new with me to so arrange the receiver that it shall receive heat from the gases issuing into the smoke-box; but I believe the construction I have shown

and described and by which the annular connected chambers D D' surround the smoke-box is new and an improvement. The steam enters the bottom of chamber D, passes up around cylinder C to the top of the partition C', over which it passes to the top of chamber D', in which chamber it passes down around cylinder C to the admission-port of the low-pressure cylinder, the function of the partition C' being to compel the exhaust-steam to pass over the whole surface of the cylinder C before it reaches the admission-port of the low-pressure cylinder, and of course the fact that by my arrangement of the cylinders, valve-chambers, and ports they can all be formed in a single casting and cheaply and readily prepared for service will be apparent and is the construction which I have illustrated.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In combination with the two cylinders of a compound engine, the piston-valve chambers F', having a steam-admission port 1, delivery-ports 2 and 3, leading to the high-pressure cylinder, and exhaust-ports 4 and 5, connected with the delivery-ports, as described, valves G G' and J J', operating in valve-chamber F', as described, a receiver connected with the exhaust of the high-pressure cylinder, a piston-valve chamber F<sup>2</sup>, having a steam-admission port 10, connected with the receiver and ports 11 and 12, leading to the ends of the low-pressure cylinder, and a valve L L', working in said chamber F<sup>2</sup>, substantially as and for the purpose specified.

2. In combination with the two cylinders of a compound engine, the piston-valve chambers F', having a steam-admission port 1, delivery-ports 2 and 3, leading to the high-pressure cylinder, and exhaust-ports 4 and 5, connected with the delivery-ports, as described, valves G G' and J J', operating in valve-chamber F', as described, a receiver connected with the exhaust of the high-pressure cylinder, a piston-valve chamber F<sup>2</sup> in line with chamber F', having a steam-admission port 10, connected with the receiver and ports 11 and 12, leading to the ends of the low-pressure cylinder, and a valve L L', working in said chamber F<sup>2</sup> and attached to the same valve-spindle as valves J J', substantially as and for the purpose specified.

3. In combination with the two cylinders of a compound engine, the piston-valve chambers F', having a steam-admission port 1, delivery-ports 2 and 3, leading to the high-pressure cylinder, and exhaust-ports 4 and 5, connected with the delivery-ports, as described, valves G G' and J J', operating in valve-chamber F', as described, a receiver connected with the exhaust of the high-pressure cylinder, a piston-valve chamber F<sup>2</sup>, forming a continuation of chamber F' and separated therefrom by a cylindrical connection 15, said chamber having a steam-admission port 10, connected

with the receiver and ports 11 and 12, leading to the ends of the low-pressure cylinder, a valve L L', working in said chamber F<sup>2</sup> and attached to the same valve-spindle as valves J J', and a partition-valve K, also attached to the same spindle and working in cylinder 15, all substantially as and for the purpose specified.

4. In combination with the two cylinders of a compound engine arranged in line or tandem, the continuous piston-valve chamber F, comprising portions F' F<sup>2</sup>, separated by a plain cylindrical portion 15, a steam-admission port 1 in the center of portion F', delivery-ports 2 3, one on each side of port 1, exhaust-ports 4 5, lying outside of ports 2 3 and connected like said ports with ports 8 and 9, leading to each end of the high-pressure cylinder, exhaust-ports 6 7, lying outside of ports 5 6 and connecting with a receiver, a steam-admission port 10, midway of chamber F<sup>2</sup> and connected with the receiver, ports 11 and 12

on each side of said port 10 and leading to the respective ends of the low-pressure cylinder, exhaust-ports 13 and 14, lying outside ports 11 and 12, an independently-actuated admission-valve G G' in chamber F', valves J J', situated on each side of said admission-valve, valves L L' in chamber F<sup>2</sup>, and a partition-valve K, working in cylinder 15, said valves G, G', L, L', and K working together as described, all substantially as and for the purpose specified.

5. In a locomotive-engine having compound cylinders, a receiver consisting of the outer shell A<sup>2</sup> of the locomotive, and an inner corrugated cylinder C, forming the smoke-box and divided by a partition C', as and for the purpose specified.

GEORGE S. STRONG.

Witnesses:

J. W. BEACH,

JOSHUA MATLACK, Jr.