No. 631,164. Patented Aug. 15, 1899.

# G. R. HENDERSON.

## TWO CYLINDER COMPOUND LOCOMOTIVE.

(Application filed Jan. 11, 1899.)

(No Model.) 2 Sheets—Sheet 1.

*Fig. 1.*

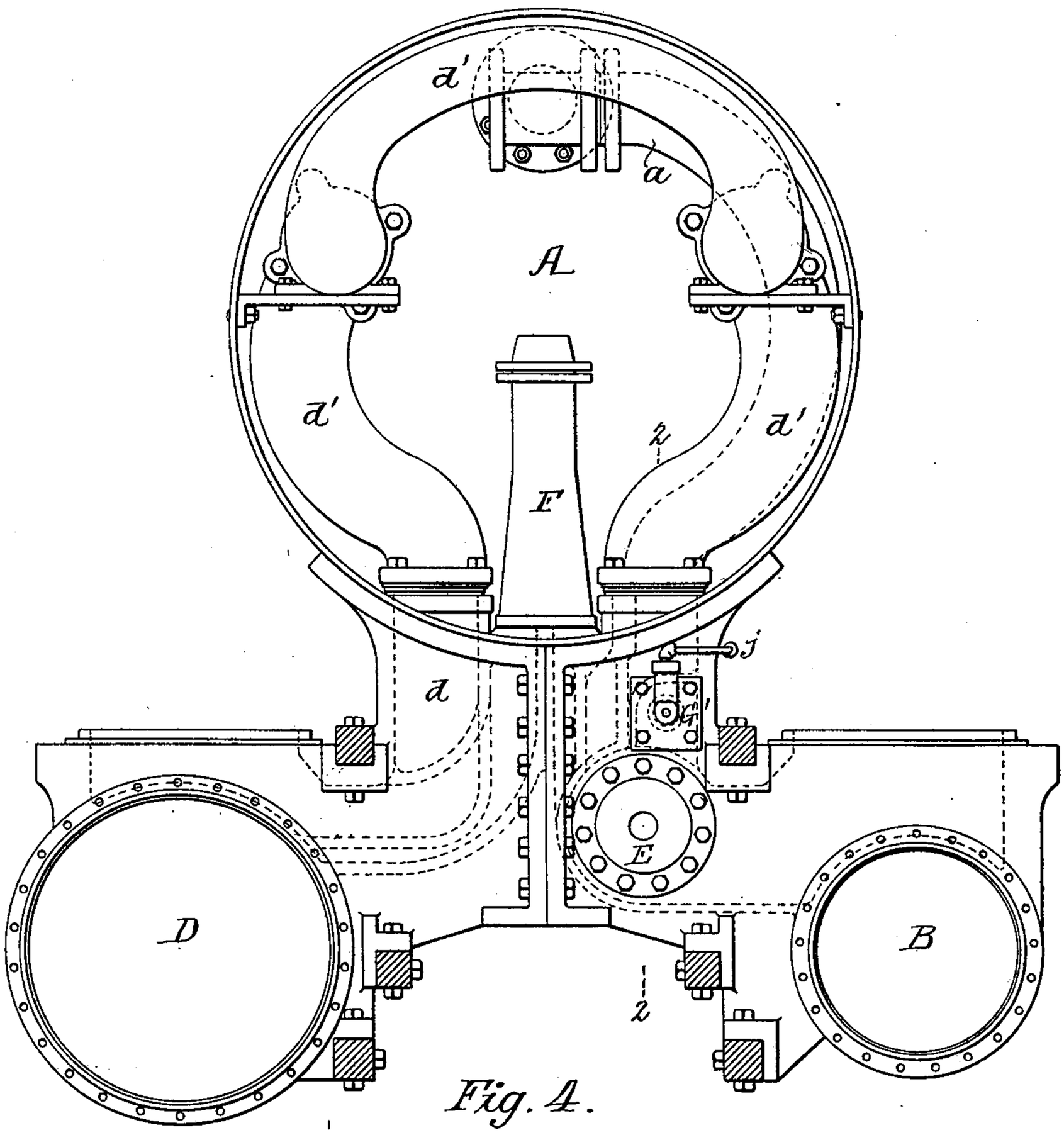
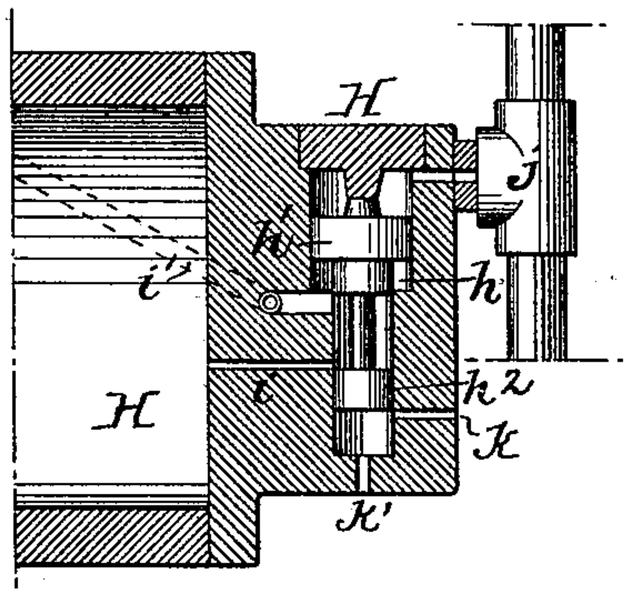



*Fig. 4.*

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(No Model.) 2 Sheets—Sheet 2.

*Fig. 2.*

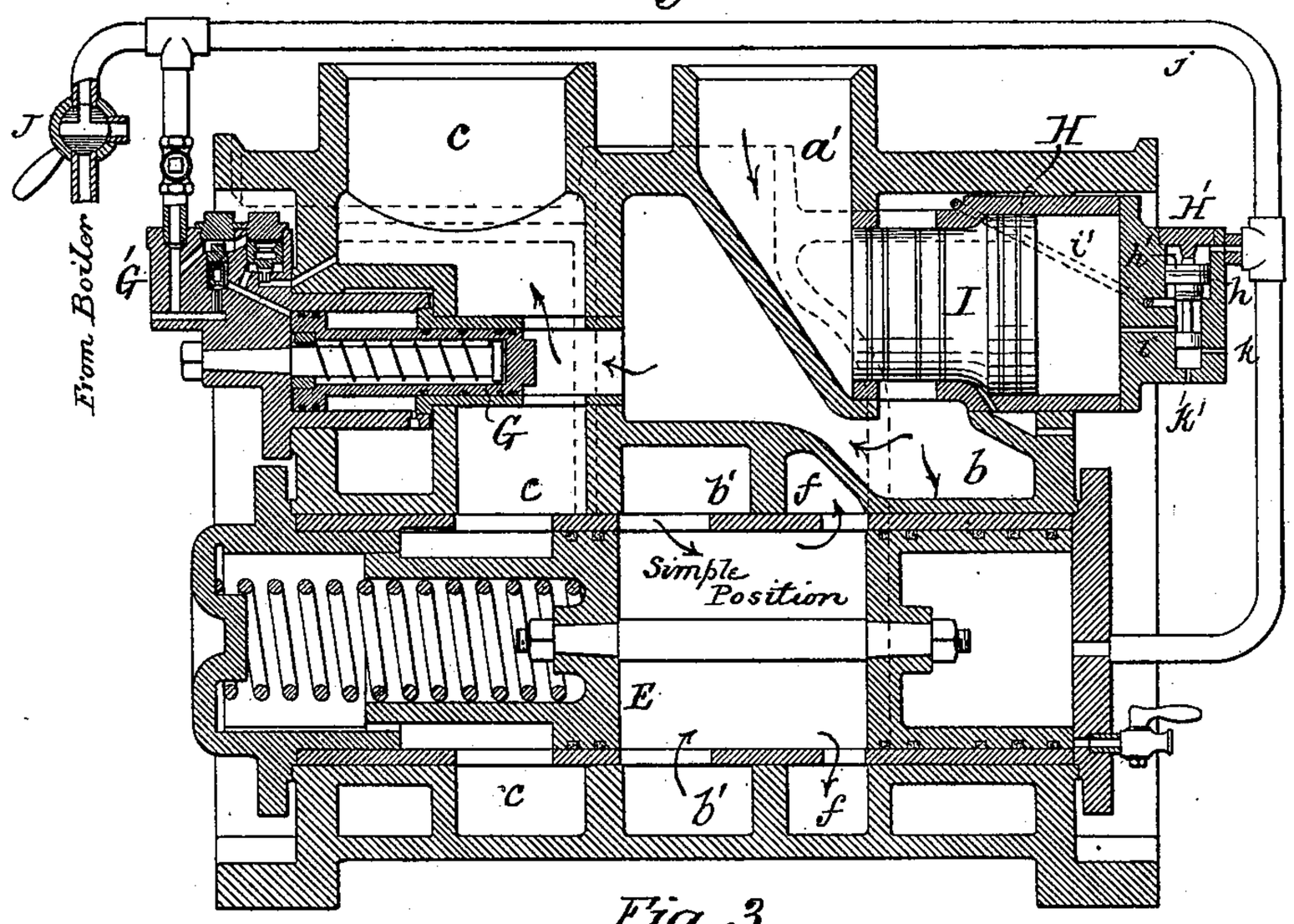
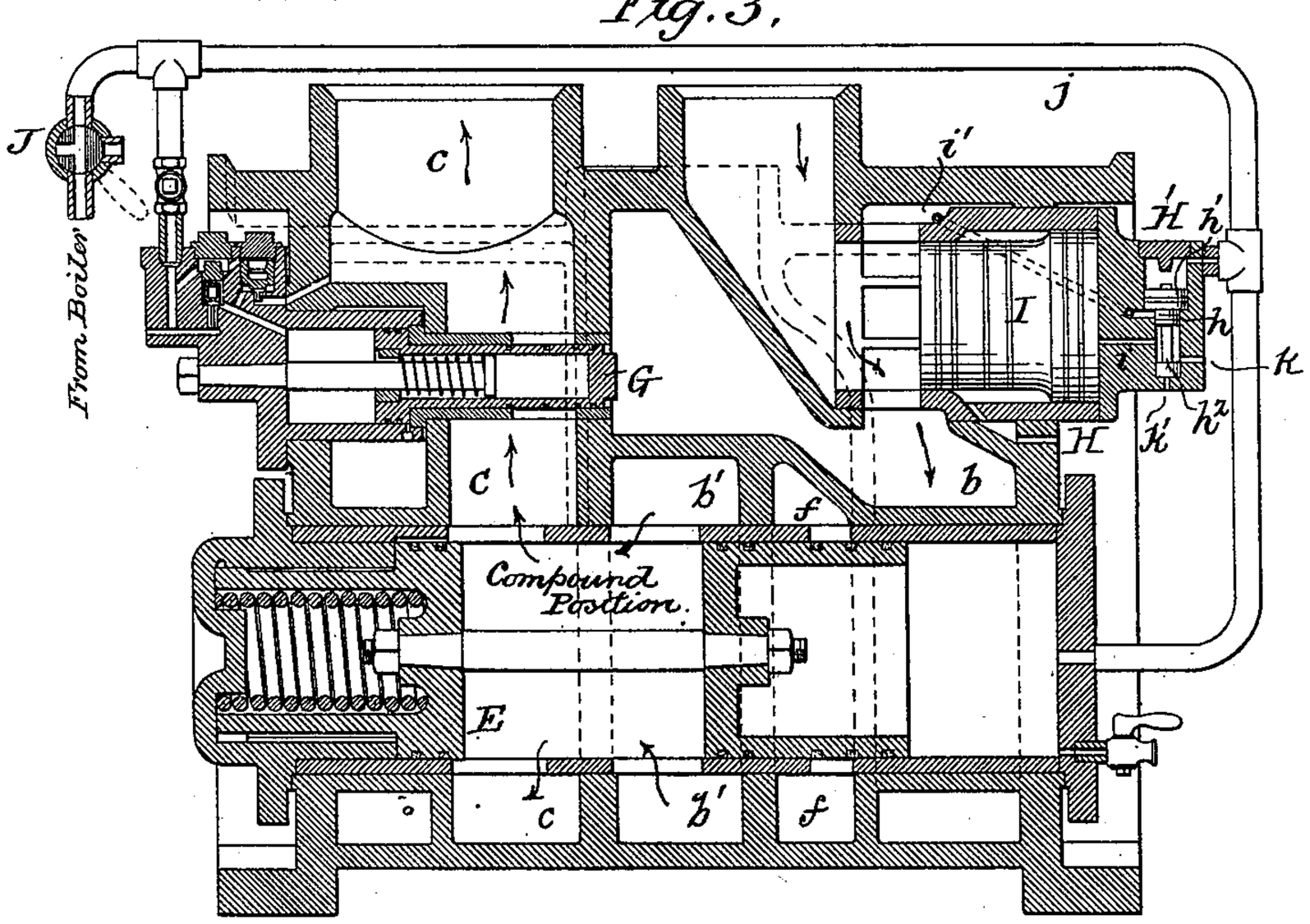



*Fig. 3.*

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Inventor:
George R. Henderson.
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# UNITED STATES PATENT OFFICE.

GEORGE R. HENDERSON, OF ROANOKE, VIRGINIA.

## TWO-CYLINDER COMPOUND LOCOMOTIVE.

SPECIFICATION forming part of Letters Patent No. 631,164, dated August 15, 1899.

Application filed January 11, 1899. Serial No. 701,840. (No model.)

*To all whom it may concern:*

Be it known that I, GEORGE R. HENDERSON, a citizen of the United States, and a resident of Roanoke, Virginia, have invented certain Improvements in Two-Cylinder Compound Locomotives, of which the following is a specification.

My invention relates to certain improvements in two-cylinder compound locomotives.

Heretofore two-cylinder compound locomotives were built in such a manner that when live steam was admitted to both cylinders simultaneously, so that the engine would run simple-acting, the total pressure on the pistons would not be greater than that of the ordinary two-cylinder simple-acting engine. Consequently when the same locomotive was used compounding the power exerted was a great deal less than that of the ordinary two-cylinder simple-acting engine. If the diameter of each cylinder is increased, so that the power exerted will be the same as that of the two-cylinder simple-acting engine, then when the engine is arranged so as to act as a simple-acting engine the pressure exerted is increased to such a degree as to cause the locomotive to slip and waste steam.

The object of my invention is to provide means whereby an engine can be built having a large cylinder-area, so that when acting compounding it will have a given pressure—say, about that of the ordinary simple-acting locomotive—and when acting simple to reduce the initial steam-pressure in both cylinders, so that the increase will be in proportion to the tractive force and the power exerted will be no greater than that for which the locomotive was designed. Consequently the locomotive can be run simple-acting economically, and the initial steam-pressure can be so reduced that little or no increase in power will be experienced over the engine working compound, but merely allow for the proper steam admission to both cylinders to enable the engine to start in any position of the cranks.

In the accompanying drawings, Figure 1 is a transverse sectional view of sufficient of a locomotive to illustrate my invention, the view illustrating the high and low pressure cylinders and the position of the valves. Fig. 2 is a section through the valves on the line 2 2, Fig. 1, with the reducing-valve in the initial steam-passage closed. Fig. 3 is a view similar to Fig. 2 with the valve open, and Fig. 4 is an enlarged view of a portion of Fig. 2.

A is the boiler.

B is the high-pressure cylinder, and D is the low-pressure cylinder.

*a* is the steam-pipe, leading from the boiler to the passage *a'* in the cylinder-casting, communicating with the passage *b*, leading to the valve-chest of the high-pressure cylinder B. This passage *b* also communicates, when the valves are shifted so that the engine will act simple-acting, with a passage *c*, which communicates with the passage *d* through the tubes or pipes *d'*. This passage *d* communicates in turn with the steam-chest of the low-pressure cylinder D.

E is the intercepting-valve, which either connects the high-pressure exhaust-passage *b'* with the exhaust-passage *f*, leading to the nozzle F, or connects said passage *b'* with the passage *c*, leading to the steam-chest of the low-pressure cylinder D. G is a reducing-valve usually placed between the high and low pressure cylinders, so as to cut off the passage of live steam from the passage *b* to the low-pressure cylinder or allow the steam to flow into the said passage *c* at a reduced pressure. The special construction of these valves is clearly illustrated in a prior patent granted to S. M. Vauclain on June 16, 1893, No. 499,065, and the special construction of valve mechanism G' for operating the reducing-valve G set forth and claimed in the application for patent in the names of Vauclain and Henderson, Serial No. 679,958.

It will be understood that any form of reducing and intercepting valve may be used in connection with my invention, which simply relates to a reducing-valve in the initial steam-passages.

H is a valve-chest in which is mounted the reducing-valve L. This reducing-valve can be projected so as to cut off the passage of steam from the initial supply-passage *a'* to the passage *b*, as shown in Fig. 2, and can be moved back, as shown in Fig. 3, so as to have an uninterrupted flow of steam to the passage *b*. This valve I is controlled from the engineer's valve J, which is a three-way valve open to steam or exhaust. A pipe *j* extends

from the engineer's valve J to a chamber H′ back of the valve-casing H. In this chamber is a small valve *h*, having a head *h′*, adapted to the chamber H′, and a grooved stem $h^2$, controlling the admission of steam from the chamber *b* to the space back of the valve I.

*i* is a port forming communication between the space back of the valve I and the valve-chest H′, and *i′* is a port forming a communication between the passage *b* and the valve-chest H′.

*k* is a port open to the atmosphere, and *k′* is a drip-passage.

When the engineer's valve J is moved into the position shown in Fig. 2, the space above the valve *h* is open to the atmosphere. Consequently the pressure in the chamber *b* will elevate the valve *h*, and thus communication will be formed between the passage *b* and the space at the rear of the valve I, through the ports *i′* and *i*, and the valve will be forced forward against the pressure in the initial steam-passage *a′*. If the pressure in the passage *b* is equal to the pressure in the passage *a′*, then the valve I will shut off communication between the two passages, as the area of the rear of the valve is greater than that subjected to the pressure of the initial steam in the passage *a′*; but as soon as the pressure in the passage *b* decreases then the valve will be moved back by the pressure in the passage *a′*, allowing steam to enter the passage *b*. Consequently when the engine in running single-acting the valve I will remain in a position that it will reduce the pressure of steam as it flows from the passage *a′* to the passage *b*, and the steam under reduced pressure will be admitted simultaneously to both the high and the low pressure cylinders, and the locomotive will run simple-acting; but the moment the engineer's valve is turned to the position shown in Fig. 3 and steam from the boiler is admitted to the pipe *j* and to the space in the valve-chest above the valve *h* the valve *h* will be moved to the position shown in Fig. 3, the port *i′* will be cut off, and the port *i* will communicate with the port *k*, and the space back of the valve *i* will be open to the atmosphere. Consequently the valve will be forced back to the position shown in Fig. 3, thus allowing the steam to freely flow without reduction from the passage *a′* to the passage *b*, and when the engineer's valve is in the position shown in Fig. 3 the intercepting-valve is shifted so that the engine will work compounding, the steam first entering the high-pressure cylinder and then to the low-pressure cylinder to exhaust. Thus it will be seen that by my construction I am enabled to increase the size of a two-cylinder compound engine, so that it will have the same power as the ordinary type of simple-acting engine, and yet when shifted so as to act simple the power will not be increased to such a degree as to make the engine slip, and the power will not be wasted.

I claim as my invention—

1. The combination, in a two-cylinder compound engine, of high and low pressure cylinders, steam-passages for said cylinders, a live-steam supply having a throttle-valve for controlling the flow of steam from said supply to the engine, an intercepting-valve and a reducing-valve between the high and low pressure cylinders having communication with the live-steam supply, and a reducing-valve in the initial steam-passage leading to the high-pressure cylinder and also having communication with the live-steam supply, substantially as described.

2. The combination, in a two-cylinder compound engine, of high and low pressure cylinders, steam-passages and valves for said cylinders, a live-steam supply having a throttle-valve for controlling the flow of steam from said supply to the engine, intercepting and reducing valves between the high and low pressure cylinders, having communication with the live-steam supply, an engineer's valve controlling said intercepting and reducing valves, a reducing-valve in the initial steam-passage leading to the high-pressure cylinder and also having communication with the live-steam supply, and an auxiliary valve communicating with the engineer's valve and controlling the position of said initial pressure-reducing valve, substantially as described.

3. The combination in a compound engine, of high and low pressure cylinders, valves therefor, intercepting and reducing valves in the passage between the high and low pressure cylinders, a steam-passage communicating with the high-pressure cylinder and with the low-pressure cylinder through the said reducing-valve, a reducing-valve in the initial steam-pressure passage, an auxiliary valve controlling the admission of steam to the space back of said reducing-valve, a port communicating with the chest of said valve and with the passage leading to the high-pressure cylinder, and a port communicating with the said valve-chest and the space back of the reducing-valve, with means for actuating said auxiliary valve so as to allow the space back of the reducing-valve to communicate either with the passage to the high-pressure cylinder or to exhaust, substantially as described.

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

GEORGE R. HENDERSON.

Witnesses:

R. H. PERSINGER,

JNO. A. PILCHER.