

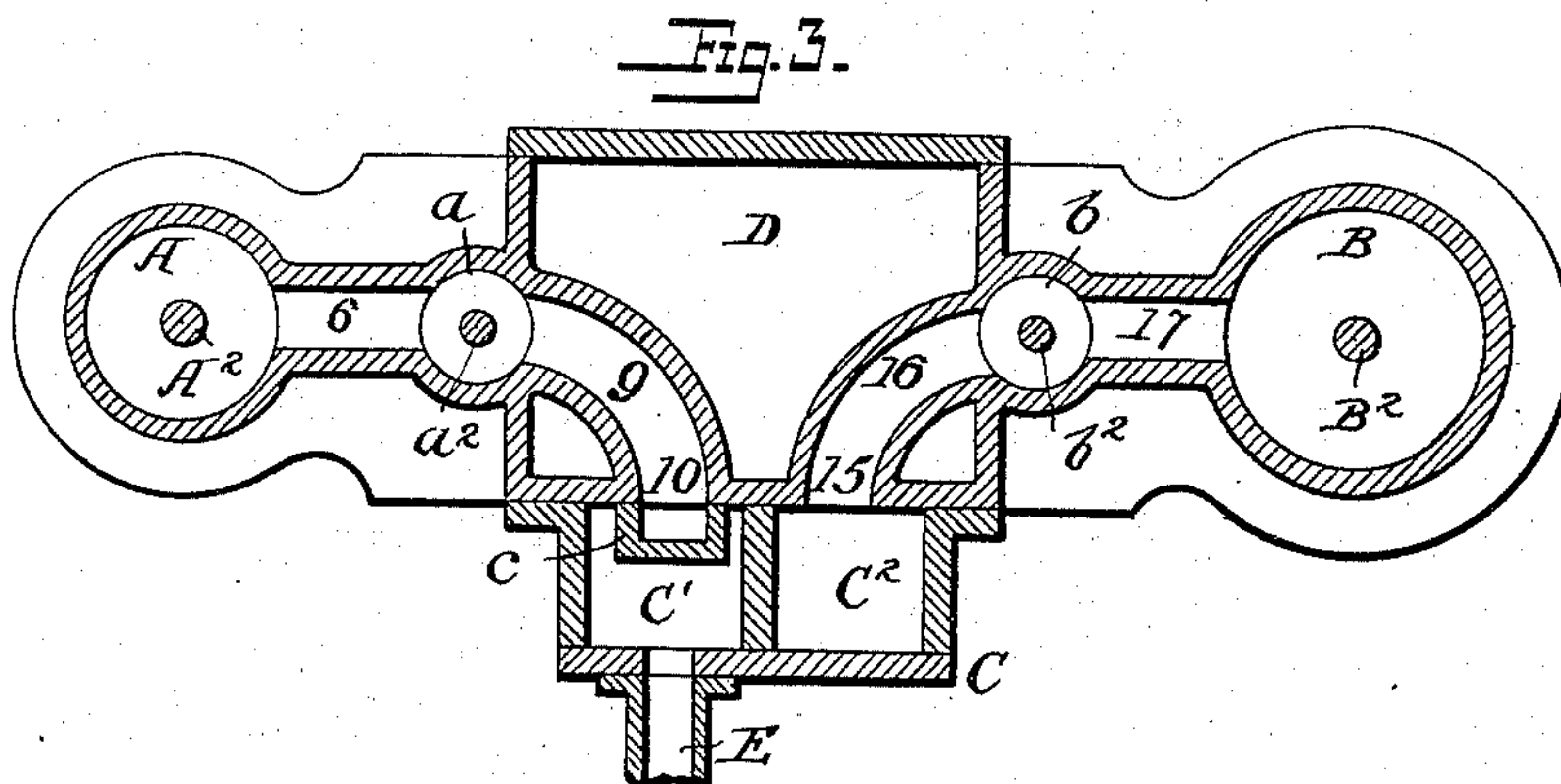
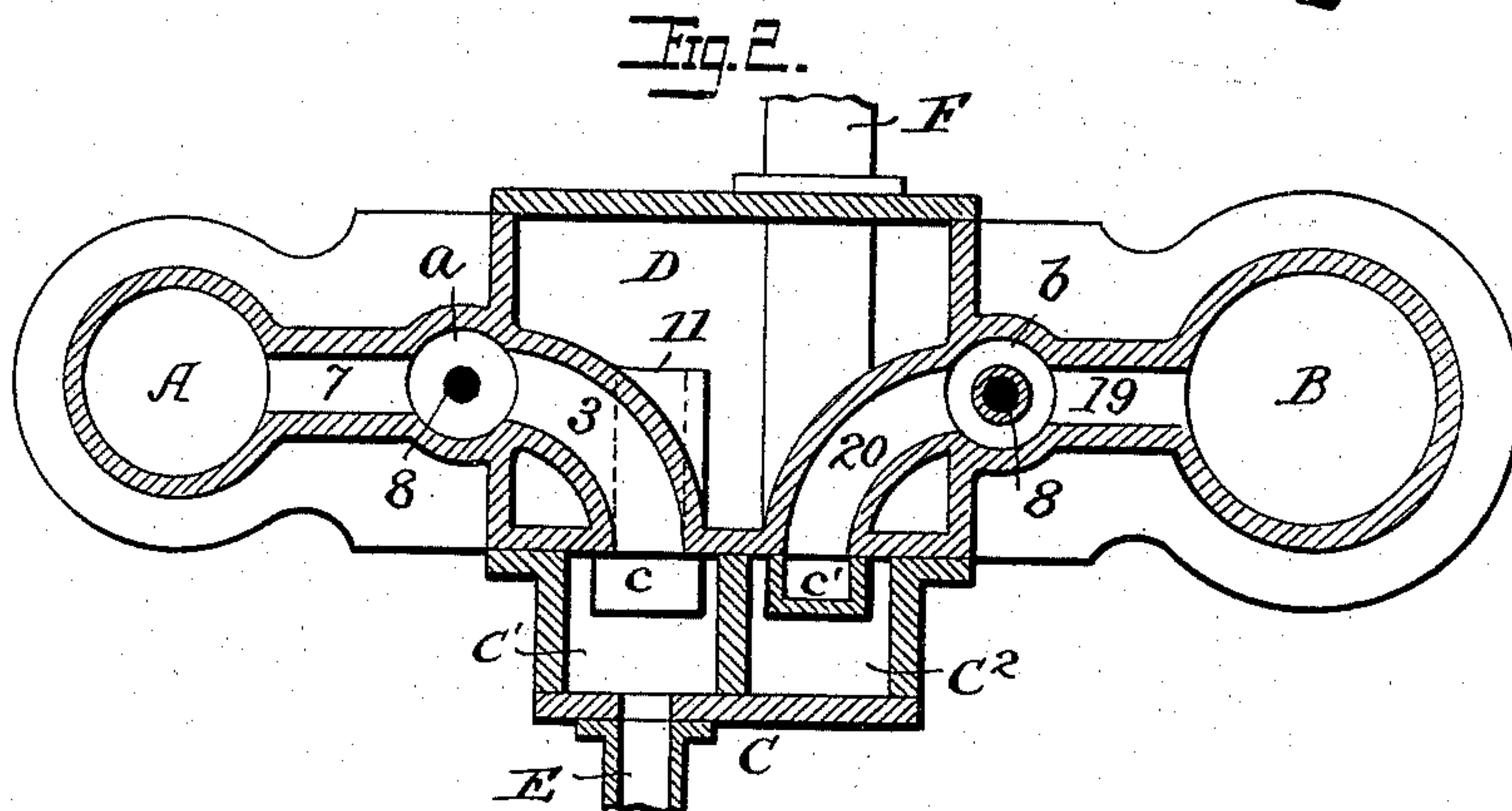
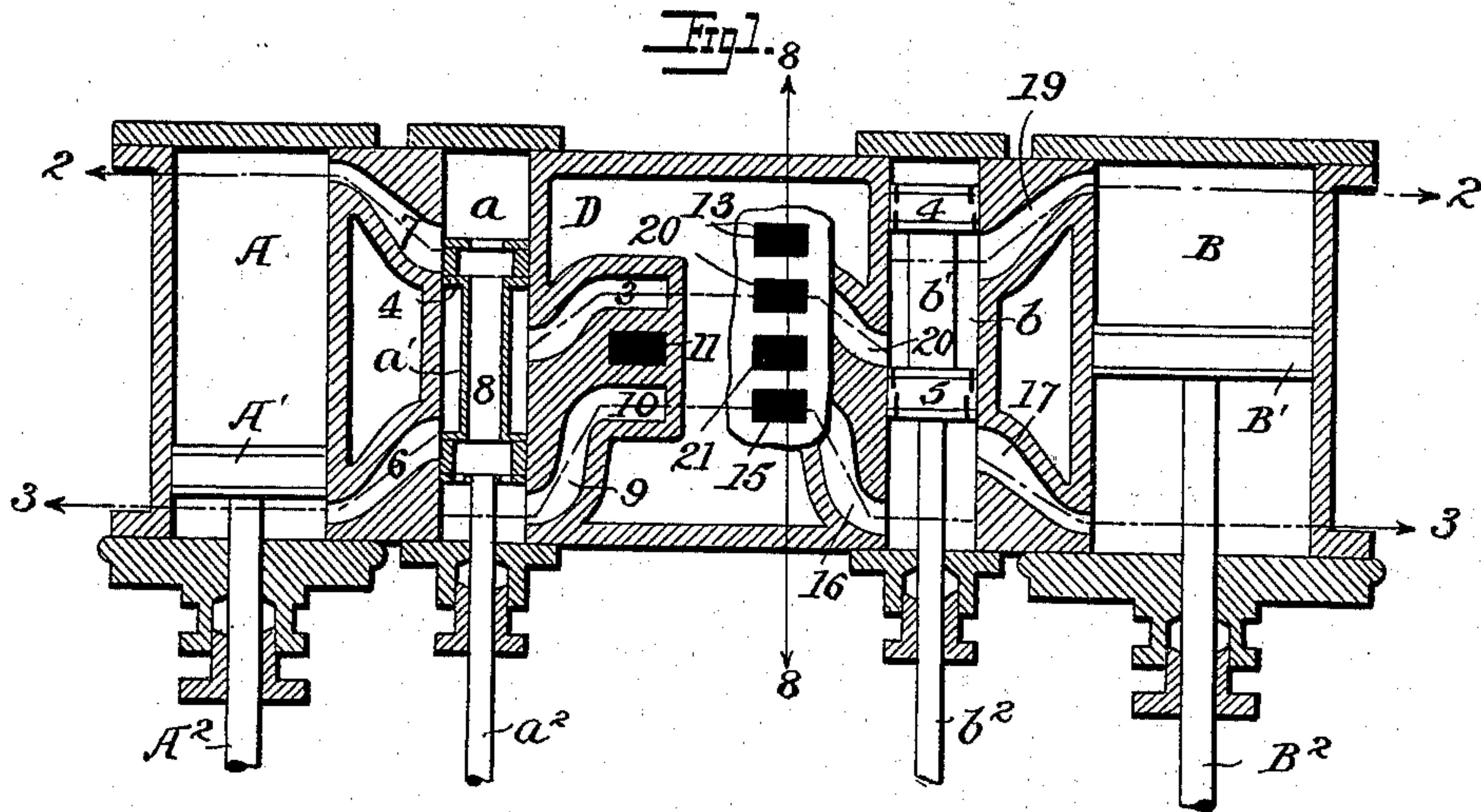
(No Model.)

2 Sheets—Sheet 1.

R. C. SMITH.
COMPOUND ENGINE.

No. 565,697.

Patented Aug. 11, 1896.



Witnesses

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(No Model.)

2 Sheets—Sheet 2.

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Fig. 4.

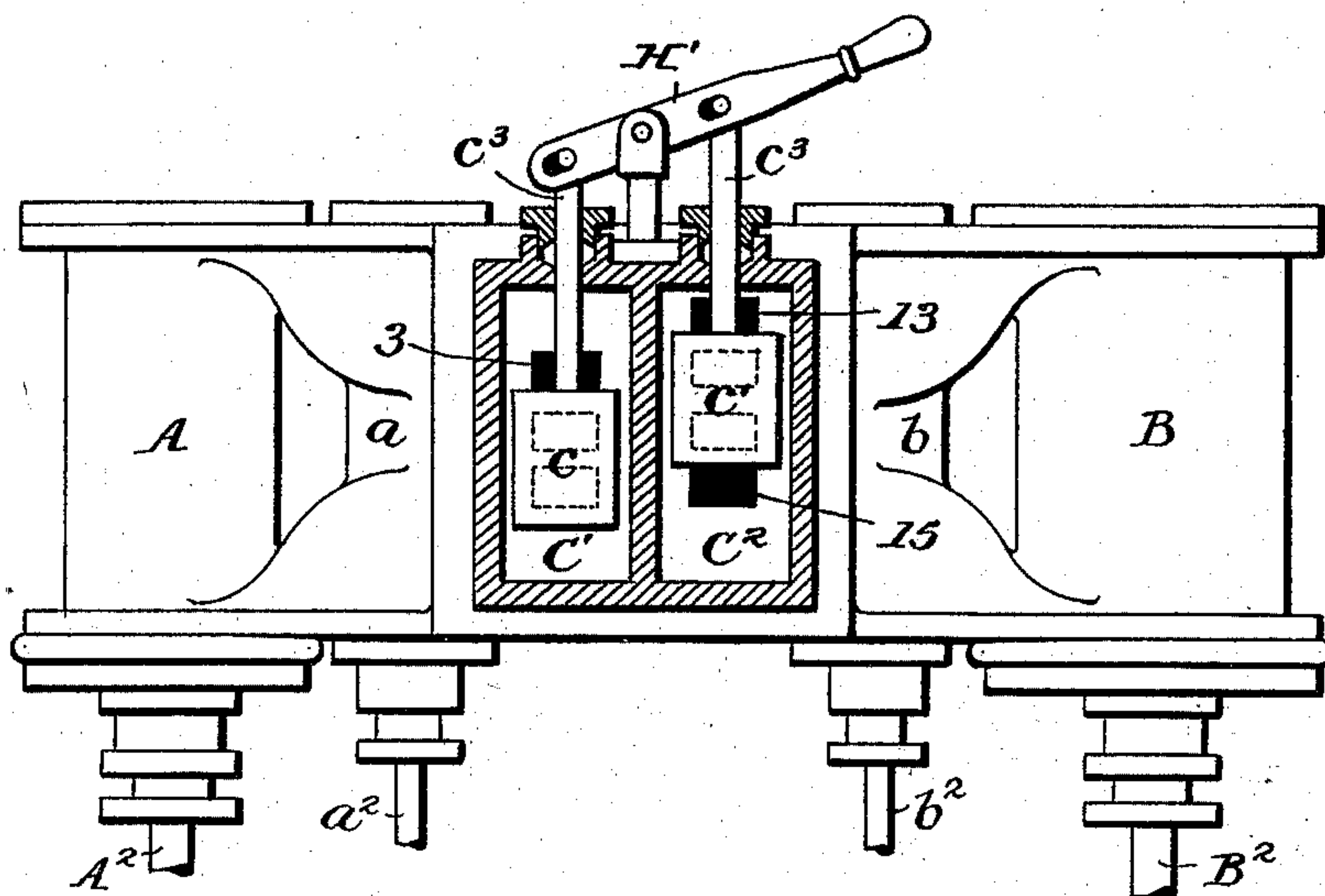


Fig. 5.

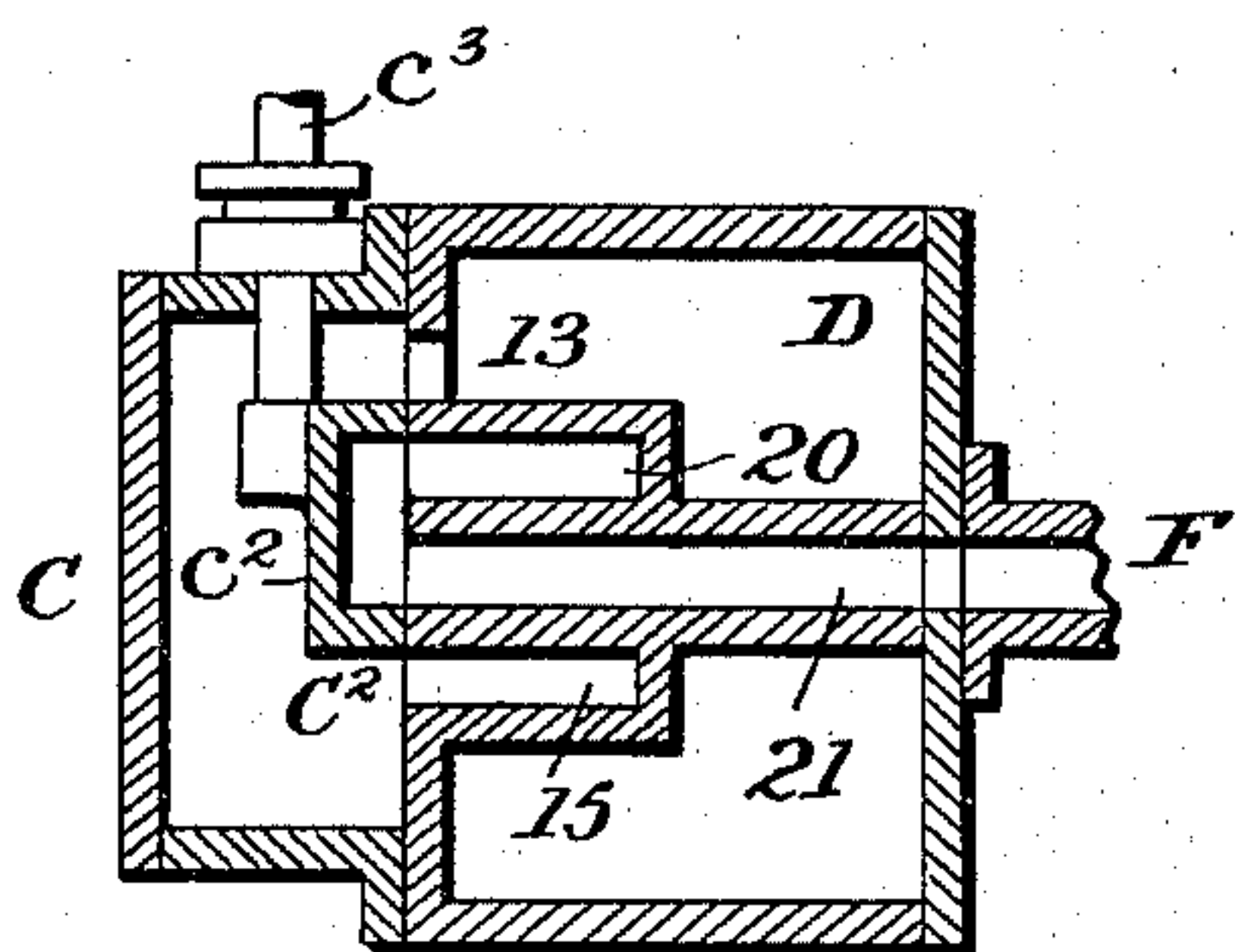
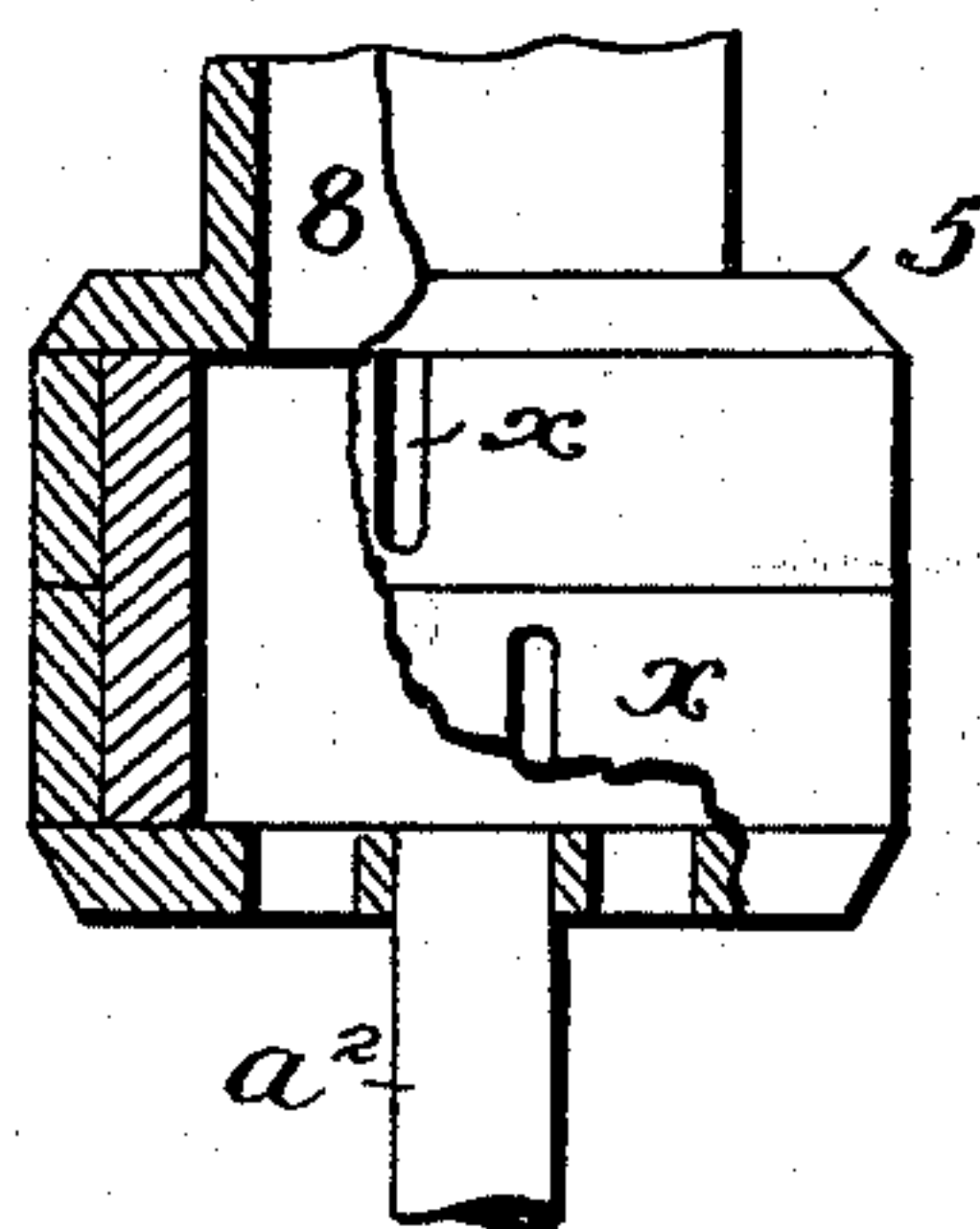


Fig. 5.



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UNITED STATES PATENT OFFICE.

RUDOLPH C. SMITH, OF YONKERS, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE NATIONAL COMPANY, OF CHICAGO, ILLINOIS.

COMPOUND ENGINE.

SPECIFICATION forming part of Letters Patent No. 565,697, dated August 11, 1896.

Application filed March 14, 1892. Serial No. 424,919. (No model.)

To all whom it may concern:

Be it known that I, RUDOLPH C. SMITH, a citizen of the United States, residing at Yonkers, Westchester county, State of New York, have invented certain new and useful Improvements in Compound Engines, of which the following is a specification.

My invention relates to compound engines, and while it may be applied to many and various forms of engines adapted for different purposes it is especially applicable to engines used in hoisting apparatus; and it has for its object to provide means whereby the engine can be worked as an expansive compound engine to rotate a shaft or move a device in opposite directions, the construction and arrangement being such that whichever way the engine is running the steam is used expansively.

My invention consists in the various features of construction and arrangement, substantially such as is hereinafter more particularly pointed out.

Referring to the accompanying drawings, Figure 1 is a vertical section of a compound engine embodying my invention. Fig. 2 is a horizontal section taken on the line 2 2, Fig. 1, through the upper channels. Fig. 3 is a similar horizontal section taken on the line 3 3, Fig. 1, through the lower channels. Fig. 4 is a side view of the cylinders, the valve casing being in section. Fig. 5 is a section on the line 8 8, Fig. 1; and Fig. 6 is a side view, partly in section, of the valve-pistons.

In order to explain the principles of my invention and illustrate their mode of operation, I have shown it embodied in an ordinary hoisting-engine, having shown sufficient of such an engine to enable its operations to be understood; but it is evident that the invention may be applied to many and various forms, the arrangement and construction of the parts being modified to suit the exigencies of any particular case, while the general principles of the invention remain the same.

In the drawings the engine is shown as having two cylinders A and B, in which are the pistons A' B', connected to the piston-rods A² B², which are intended to be connected to the crank-shaft in the usual way, with their crank-pins at right angles to each

other. Connected with each of the pistons are the valve-chests a b, in which are arranged the valves a' b', connected to the rods a² b², which are arranged to be connected to the eccentrics or other valve-gear connected and driven by the crank-shaft or otherwise, so that they will move in proper relations to carry out the mode of operation hereinafter set forth. Also arranged in connection with the cylinders is a main valve-case C, divided into two portions C' C², in which are mounted, respectively, the valves c c', and these are connected to rods c³ c³, which are connected to an arm c⁴, by means of which their positions can be varied to start, stop, or reverse the engine, the whole constituting a double revolving valve-reversing device H'. In the present instance I have shown this arm c⁴ as in the form of a hand-lever, but of course when used in connection with elevating apparatus this valve may be connected to be operated from the cage or from any other position in the usual way, it not being deemed necessary to show these connections in this instance, as they are well known and form no essential part of my invention. Also arranged with relation to the cylinders A and B, and preferably mounted in the same frame, is a steam-receiver D, and this is connected by suitable ports and passages with the various valve devices in the manner hereinafter set forth. E is the inlet-pipe for the live steam, and F is the exhaust-pipe.

It will be noticed that the cylinders A and B differ in size, A being smaller than B, and this is the preferred arrangement, and in the specification I shall term the cylinder A the "high-pressure cylinder," and the cylinder B "the low-pressure cylinder."

In describing the operation we will assume the parts to be in substantially the position indicated in Fig. 1, and the live steam enters the pipe E in the valve-box C', and the valve c being in the position shown in Fig. 4, it passes through the port or passage 3 to the valve-chest a. Each valve a' b' is provided with two piston-heads 4 and 5 and with a longitudinal passage 8, and the steam from the passage 3 enters the valve-chest a between these heads, and from thence through the passage 6 it enters the high-pressure cylinder A

beneath the piston. This of course causes the piston A' to move upward, and the exhaust-steam from the upper portion of the cylinder A passes through the port 7 into the valve-chest *a*, and thence through the passage 8 in the piston-valve *a'* to the other end of the chest *a*, and thence by a passage 9 to a port 10, through the valve *c* to the exhaust-port 11 of the chest *c'*, and thence into the receiver D. From the receiver the steam passes through an end port, as the port 13, into the valve-chest C², and thence, through the other end port, as the port 15, and a passage 16, it reaches the lower portion of the valve-chest *b*, and thence by the passage 17 it enters the cylinder B' at the lower side of the piston B', and of course forces the piston upward. The exhaust-steam of this cylinder leaves by the passage 19 and enters the valve-chest *b* between the piston-heads 4 and 5 of the valve *b'* and thence by the passage and port 20 through the valve *c'* and out through the exhaust-port 21 to the exhaust-pipe F. It will be seen that in this way the exhaust-steam from the high-pressure cylinder passes first into the receiving-cylinder and thence into the low-pressure cylinder, and from there it is exhausted in the usual way, and it will be understood that at a proper time the valves are shifted so that live steam will pass to the upper end, and the exhaust-steam from the lower portion will pass through the receiver, the valve devices, and into the upper portion of the low-pressure cylinder B, and the engine works positively as a compound expansive engine in both directions.

It is desirable to provide means whereby the engine can be started in either direction, regardless of the position it assumes in stopping, and this is especially necessary in the use of my invention in connection with elevators, as the engine has to be started and stopped in all positions, and its direction reversed from such positions, and in order that this may be done I provide means connected with the piston-valves *a b*, by which it may be accomplished. Thus in Fig. 6 I have shown an enlarged view, partially in section, of one end of one of these valves, and the head at this end is provided with grooves *x x*, extending from each side toward and nearly to the central line of the piston-head, and form leaks for the steam to pass into the cylinders of the receiver when either piston-valve is at about its central position.

Suppose, for instance, that the engine stops with the high-pressure cylinder on the dead-center. To start the engine, it is necessary to admit live steam from the chest *a* to the receiver D and thence allow it to pass into the low-pressure cylinder B. The piston-heads 4 and 5 of the valve *a* under these circumstances would just cover the ports 6 and 7 and prevent the steam passing into the cylinder A, but the grooves *x x* are so arranged as to admit of steam-leaking by the piston-heads into the cylinder A, where the

piston is not in a position to be acted on and also into the receiver D, and thence it would pass into the low-pressure cylinder and operate on its piston, which would be in the most favorable condition for starting. It will be seen that in this position both heads of the valve *b'* of the low-pressure cylinder would be full off the ports, and consequently there can be no leak of live steam to the exhaust. To start with the low-pressure cylinder on the center, of course the steam would be admitted to the high-pressure cylinder in the usual way, which would be in position to be moved, but in order to prevent back pressure, it is desirable that the receiver should be empty, and it will be noticed that under these conditions the piston-valve of the low-pressure cylinder will be in position to allow the steam to leak to the exhaust.

After the engine gets under way, moving rapidly, as it is intended to, this leakage of the valves is of so small amount that it does not in any way interfere with the operation of the engine, the steam only leaking past a piston-head when the piston-valve is at or about the center of its stroke.

It will thus be seen that by the use of a construction and arrangement of parts substantially as indicated I am enabled to use the steam expansively to operate the engine in both directions and to start and stop it and change the direction of the engine in any position and to overcome all difficulty of the engine stopping on a dead-center.

What I claim is—

1. In a compound engine, the combination with the high and low pressure cylinders, steam-chests, passages connecting the steam-chests and cylinders, and piston-valves in the steam-chests having their faces provided with grooves or recesses extending from both faces of each piston-valve, said grooves being less in length than the piston-valve is in width substantially as described.

2. In a compound engine, the combination of the high and low pressure cylinders, their pistons, valve chests and valves and passages connecting the steam-chests with their respective cylinders, the faces of said valves being provided with passages arranged to permit the steam to pass through the high-pressure cylinder into the low-pressure cylinder when the high-pressure piston is stopped at either terminal of its stroke, substantially as described.

3. In a compound engine, the combination with the high and low pressure cylinders of the steam-chests and piston-valves arranged therein, each piston-valve comprising two separated heads connected to leave an intermediate chamber between them, an opening extending through each piston-valve, and grooves or recesses in the faces of each piston-valve head extending from each side thereof to form leaks, said grooves being shorter in length than the piston-valve head is in width, substantially as described.

4. In a compound engine, the combination with the high and low pressure cylinders, their pistons, steam chests and valves, of reversing-valves and chambers, a receiver communicating with the reversing-valve chambers through ports controlled by the reversing-valves, said receiver also communicating with the high-pressure cylinder and low-pressure cylinder communicating with the exhaust substantially as described.

5. In a compound engine the combination with the high and low pressure cylinder and the receiver, of the piston-valves arranged between the high and low pressure cylinders and the receiver, the pistons being provided with grooves or recesses in their faces providing leaks whereby the engine can be started from any position, substantially as described.

6. In a compound engine the combination with the high and low pressure cylinders, their pistons, steam chests and valves, of reversing mechanism comprising two valves, each having a separate chamber, means for moving said valves simultaneously in opposite directions, a receiver communicating with the reversing-valve chambers through ports controlled by the reversing-valves, said receiver also communicating with the high-pressure cylinder and the low-pressure cylinder communicating with the exhaust substantially as described.

7. In a compound engine the combination with the high and low pressure cylinders, the intermediate receiver, and the reversing-valve, of the piston-valves between the receiver and cylinders, the pistons being provided with grooves or recesses in their faces forming links, substantially as described.

8. In a compound engine the combination of the high and low pressure cylinders, intermediate receiver and reversing-valve, of the

piston-valves arranged between the cylinders and receiver and provided with recesses or grooves forming leaks, and ports and passages substantially as described, the arrangement being such that when the high-pressure cylinder is on the dead-center the live steam can leak through to the receiver, and thence to the low-pressure cylinder for starting the same, while the exhaust is closed against the passage of the said live steam, substantially as set forth.

9. In a compound engine, the combination with the high and low pressure cylinders, their pistons, steam chests and valves, of reversing mechanism comprising two valves, each having a separate chamber, an inlet-pipe communicating with one reversing-valve chamber, and an exhaust-pipe with the other, a receiver communicating with the reversing-valve chambers through ports controlled by the reversing-valves, said receiver also communicating with the high-pressure cylinder and the low-pressure cylinder communicating with the exhaust substantially as described.

10. In a compound engine, the combination with the high and low pressure cylinders, their pistons, independent valve-chests and valves and passages connecting the valve-chests with their respective cylinders, the said valves being provided with passages arranged to permit the steam to pass through the high-pressure cylinder into the low-pressure cylinder when the high-pressure piston is stopped at either terminal of its stroke and a reversing-valve, substantially as described.

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

RUDOLPH C. SMITH.

Witnesses:

HUGO A. HENKEL,
HENRY L. BRANT.