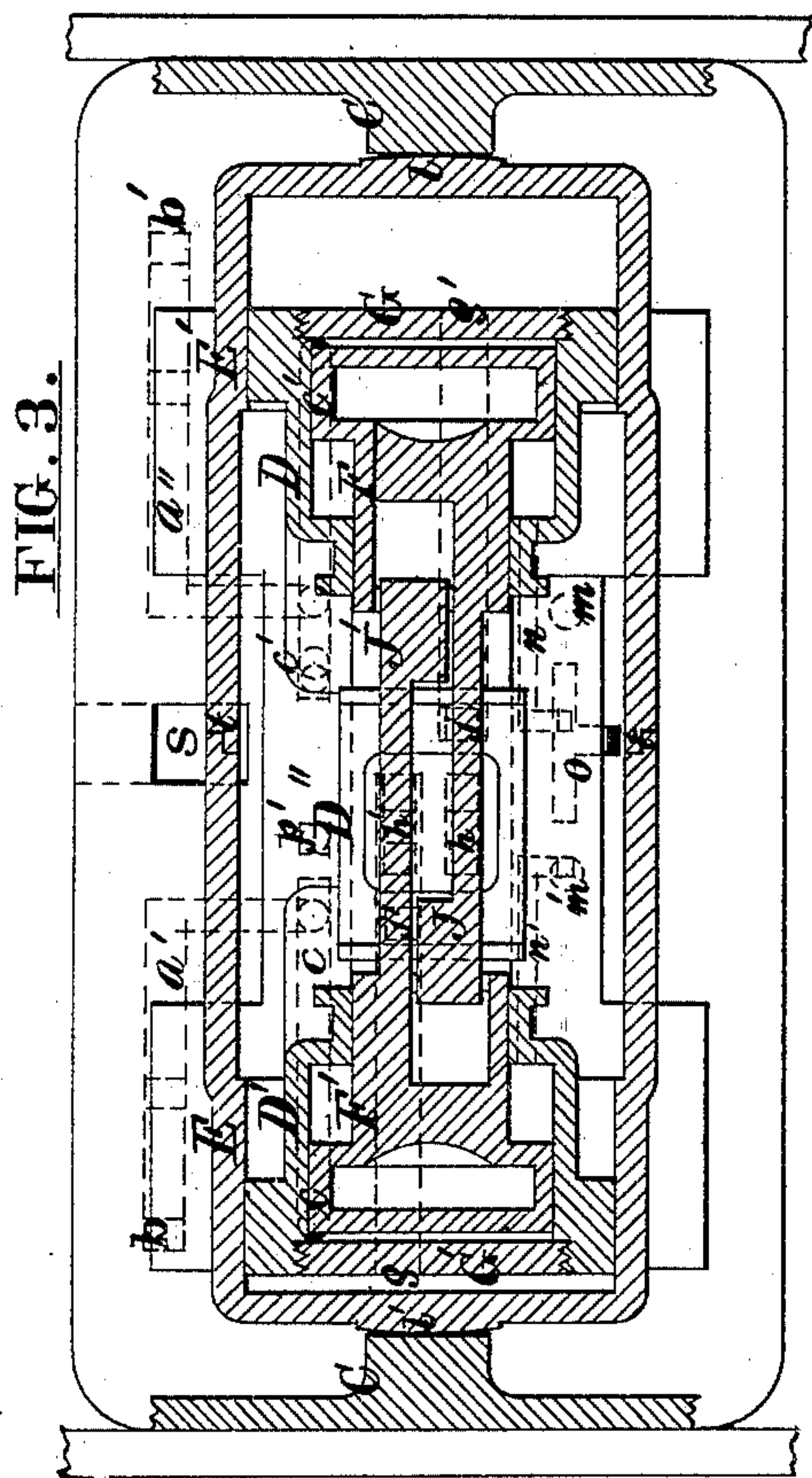
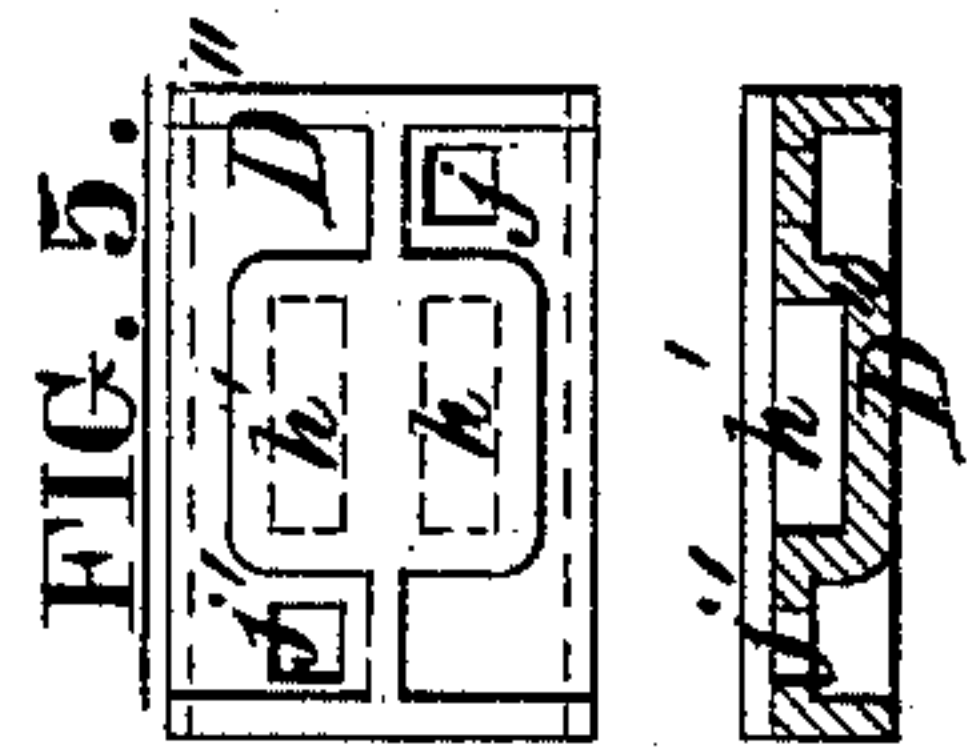
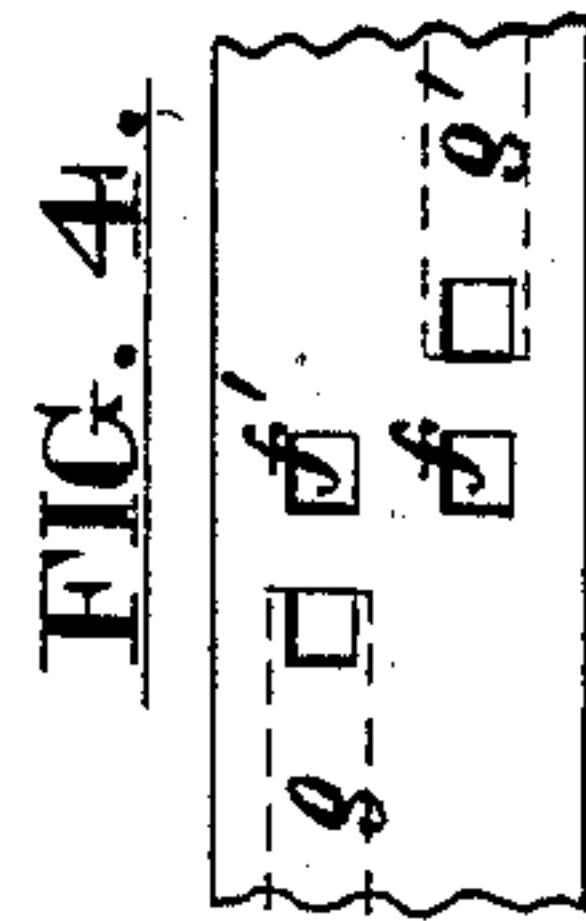
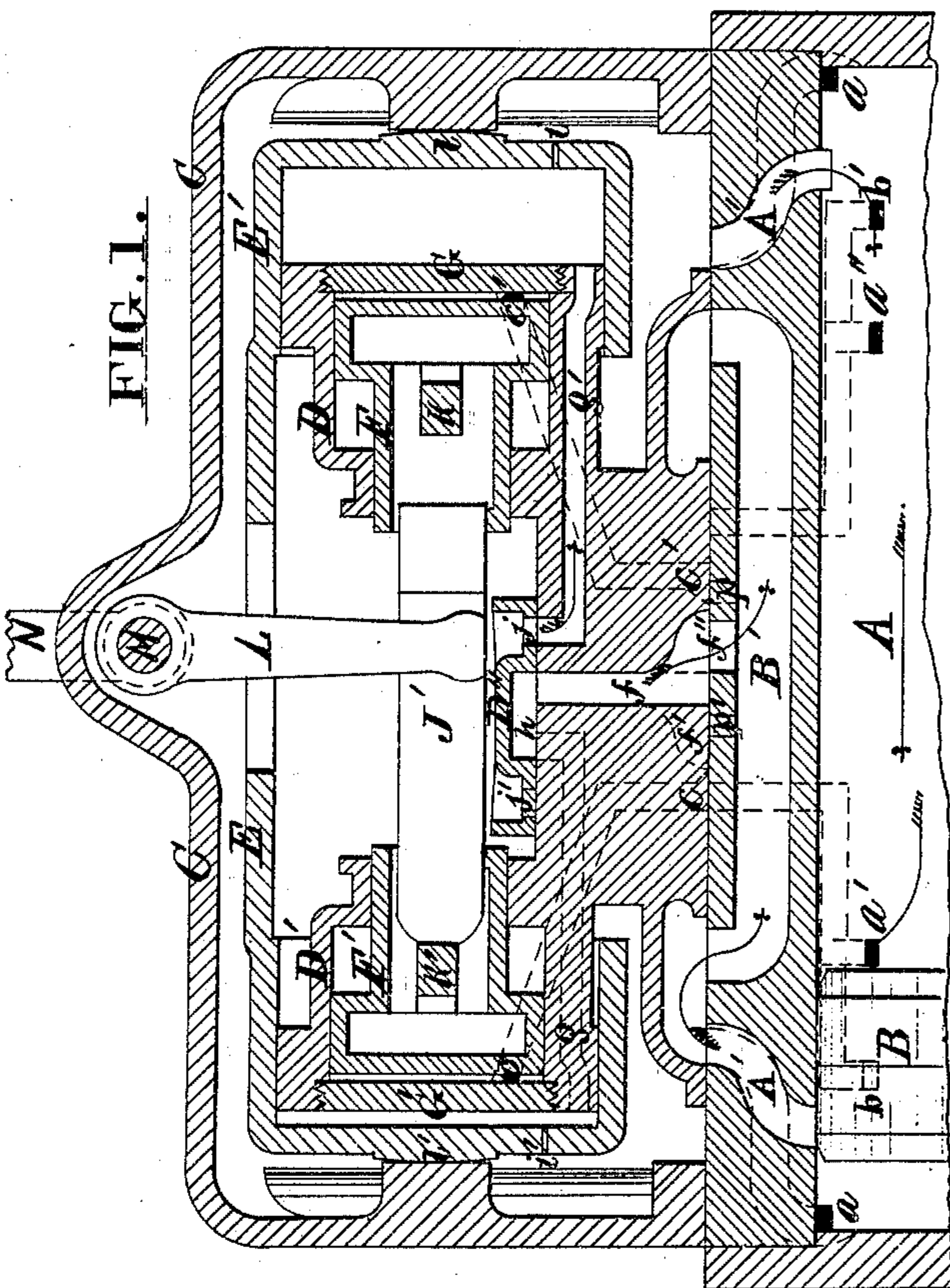
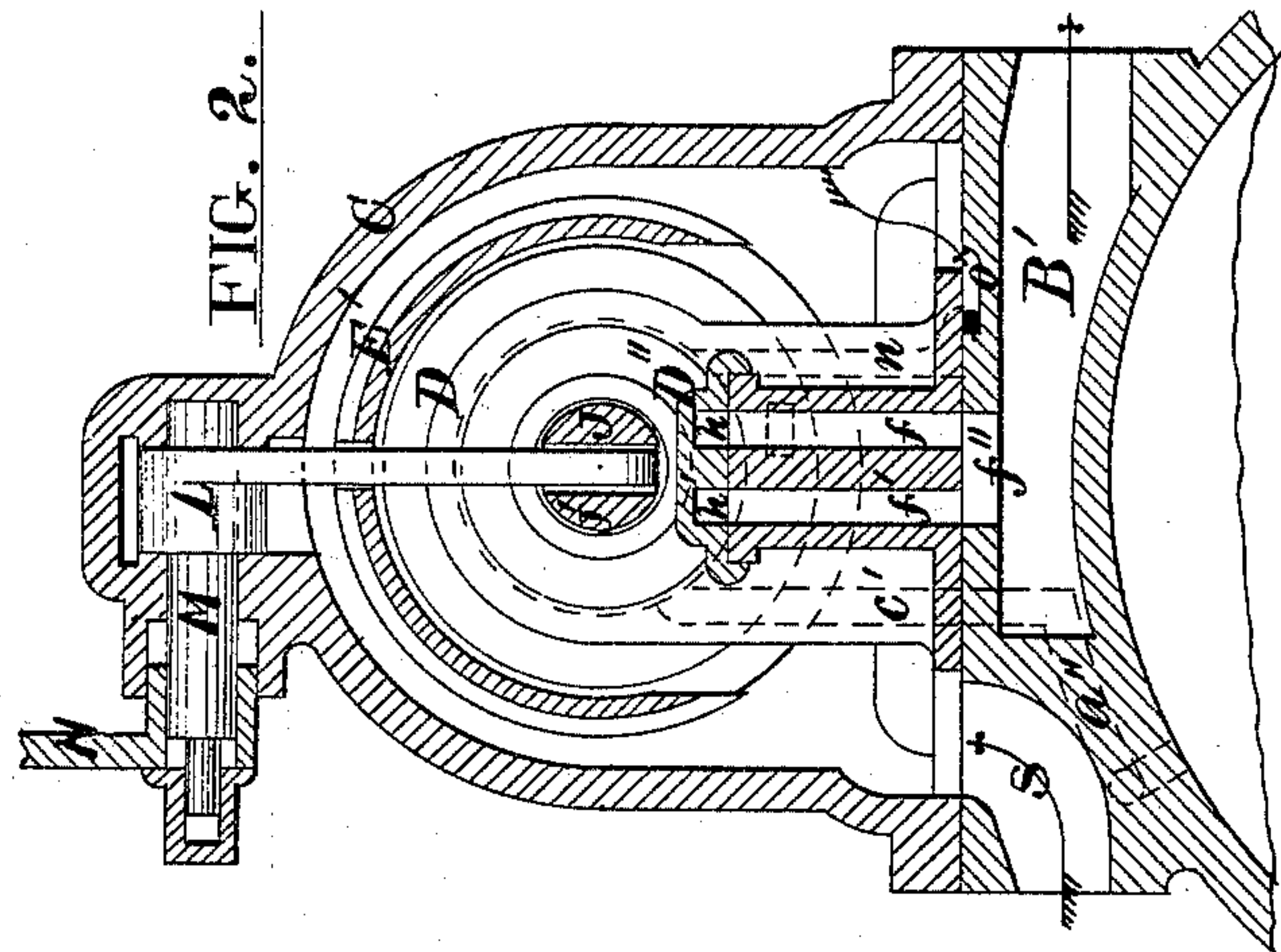


E. COPE & J. R. MAXWELL.

STEAM-VALVE.

No. 170,939.

Patented Dec. 14, 1875.



WITNESSES.

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FIG. 6.

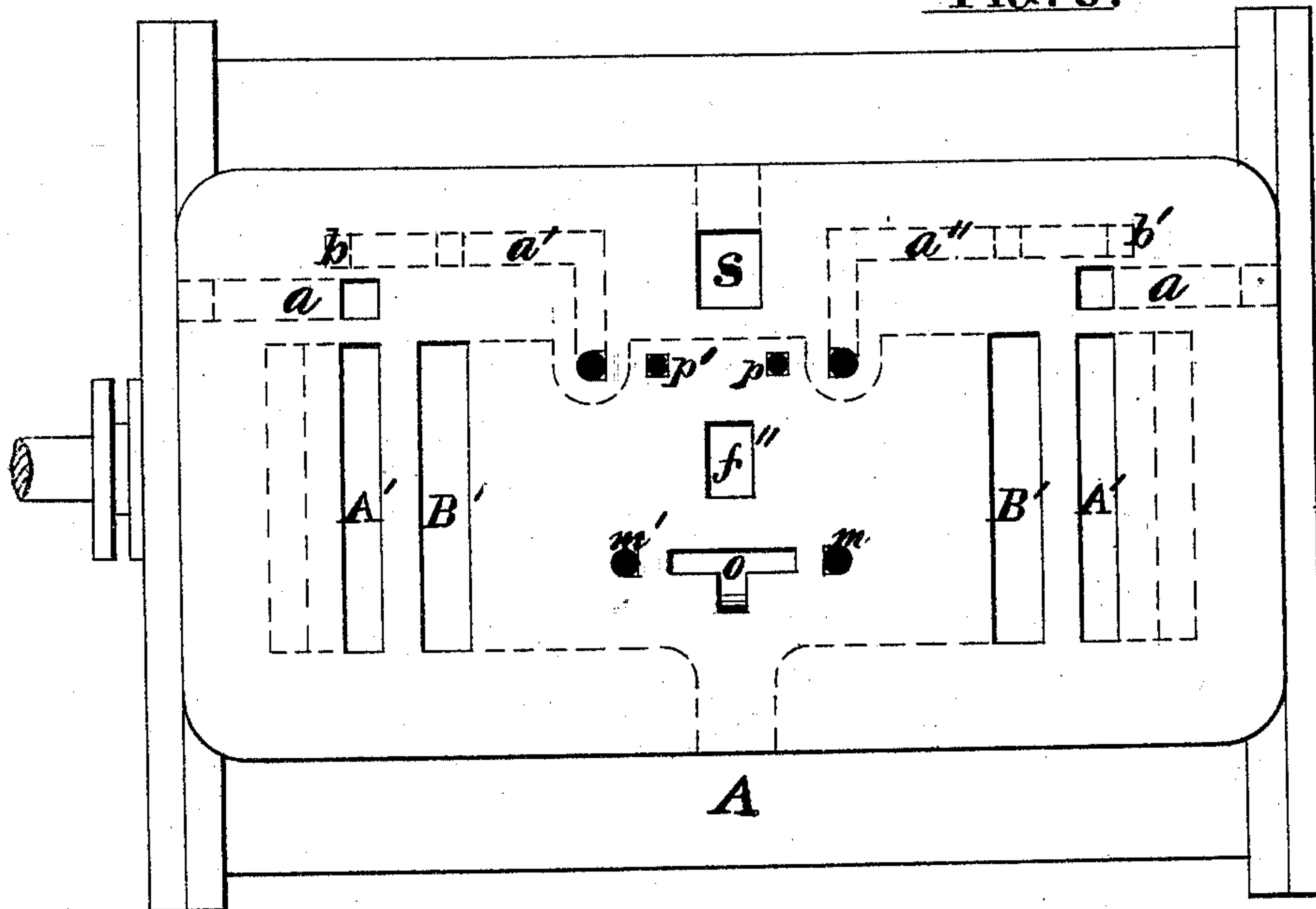
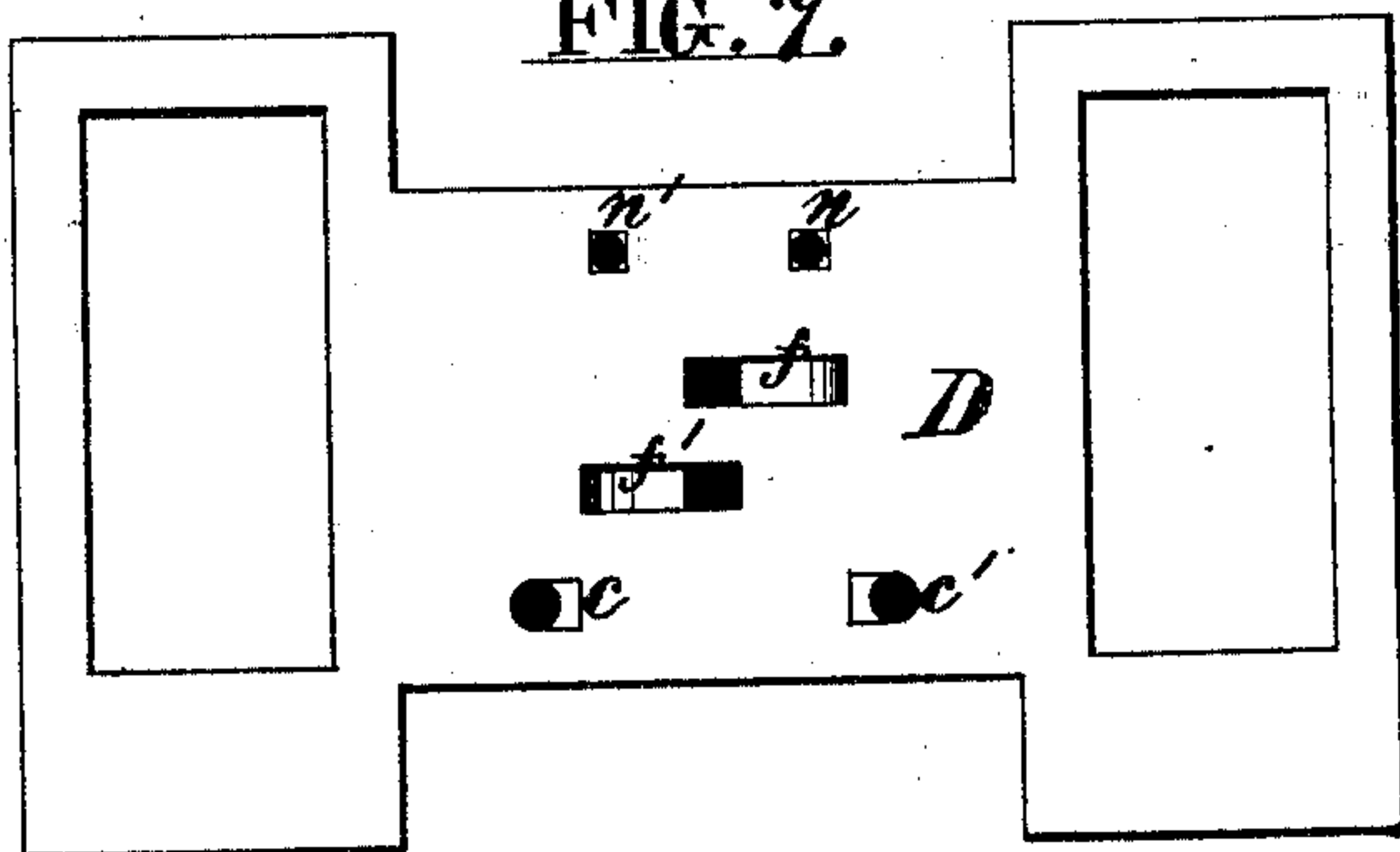


FIG. 7.



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UNITED STATES PATENT OFFICE.

EZRA COPE AND JAMES R. MAXWELL, OF HAMILTON, OHIO.

IMPROVEMENT IN STEAM-VALVES.

Specification forming part of Letters Patent No. **170,939**, dated December 14, 1875; application filed September 17, 1874.

To all whom it may concern:

Be it known that we, EZRA COPE and JAMES R. MAXWELL, of the city of Hamilton, county of Butler and State of Ohio, have invented certain new and useful Improvements in the Valves of Direct-Acting Engines; and we declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form a part of this specification.

The nature of our invention consists in improvements upon the valves of direct-acting engines, and the arrangement of ports and passages for actuating the same, whereby we secure simplicity of construction with the most prompt and positive action.

In the drawings like parts are indicated by the same letters, and arrows show the direction of the moving parts and the flow of steam.

Figure 1, Sheet 1, is a longitudinal section through the cylinder, steam-chest, and valve-gear. Fig. 2 is a transverse section through the same parts. Fig. 3 is a plan of the valve-gear. Figs. 4 and 5 are views of the supplementary slide-valve and its seat, showing the position of the ports. Fig. 6, Sheet 2, is a plan of the cylinder, showing the valve-seat face and the position of the ports. Fig. 7 is a bottom view of the main slide-valve, showing the position of its ports.

A is the main steam-cylinder; B, the main piston; and C, the steam-chest. D and D' are small cylinders, in which two small tappet-pistons of unequal areas, F F', work. These cylinders are cast and move with the main slide-valve, they themselves constituting a piston moving in the auxiliary cylinders E E'. D'' is a small auxiliary slide-valve, having its seat upon the back of the main slide-valve. It is actuated by the tappet-pistons F F' alternately. J J' are lugs extending from the tappet-pistons F F', between and against which the lever L acts. The lever L, shaft M, and handle N are an arrangement for moving the valves by hand. The auxiliary cylinders E E' are united by overlapping one another, as shown at *t*, Fig. 3, and are held firmly in position by the steam-chest at the points *l l*, where the cylinders are rounded, so that they, with the valve-gear, may always settle to their places.

The tappet-pistons F and F' are made of different areas at their ends, and are operated by the pressure of steam upon the larger area overbalancing that upon the smaller, while this latter pressure serves to keep them from fluttering, and forces them back to their positions as soon as the steam is exhausted from the larger area. The steam-passages A' A' and supplementary passages *a a* are arranged as has been described in a previous patent. The passages *a' a''*, in combination with *c* and *c'*, admit steam from the main cylinder to move the tappet-pistons F and F', and, in combination with the small ports *p* and *p'*, they exhaust the steam from these pistons. These passages *a* and *a''* are lengthened, and enter the cylinder a second time at *b* and *b'*, so placed that, when the main piston closes *a'* and *a''*, *b* and *b'* will be open and continue the exhaust from the tappet-pistons until the main piston has passed under and opened *a'* and *a''*, when *b* and *b''* will be closed. This arrangement of ports prevents the steam remaining in the passage *a'* or *a''* after they have been closed by the main piston, or any steam which may leak past the tappet-pistons from moving these pistons, and so reversing the valves before the main piston has made its full stroke. The ports and passages *m m'*, *n* and *n'*, and cavity *o* are also intended to prevent the fluttering or rebound of the tappet-pistons. The passages *n* and *n'* are alternately in communication with the ports *m m'* and the cavity *o*. When in communication with *m* or *m'* they slowly exhaust steam from the annular spaces surrounding the reduced portion of the tappet-pistons. When communicating with cavity *o* they admit high steam from the chest to the same annular spaces. The passages *g* and *g'* are brought into communication alternately with the passages *f* and *f'*, and, through them, with the exhaust, by the cavity *h* in the auxiliary slide-valve D'', and, with high steam in the chest, by the ports *j* and *j'* in the same valve D''. The ports *j* and *j'* may be dispensed with, the passages *g* and *g'* being used wholly as exhaust-passages, and the small ports *i* and *i'* continually open to the chest, furnishing high steam to move the main slide-valve.

The operation is as follows: In the drawings

the main slide-valve is at the left of its travel, admitting steam to the main cylinder through port A' on the right, moving the main piston B to the left. Upon passing under and opening port a^1 , steam from behind it passes through a' and c to the left of the tappet-piston F'. This being the larger area of the piston, the pressure of steam upon it overbalances that which acts continuously upon the smaller area, while that in the annular space surrounding the smaller end of this tappet-piston is exhausted through n' and m' . The piston F', therefore, moves to the right. In this motion it comes in contact with and carries on the auxiliary slide-valve D''. This valve D'' being moved to the right, the passages g' and f' are brought into communication through the cavity h , and passage g is brought into communication with the port j in the valve D''. Through the former passages g' and f' steam is exhausted from the auxiliary cylinder E', while through the latter, g and j' , high steam is supplied to the auxiliary cylinder E. The cylinders D D' and main slide-valve therefore move to the right. In this motion the passage c is brought into communication with the port p' , exhausting steam from the left of the tappet-piston F'. At the same time passage n and cavity o communicate, and high steam passes to the annular space around F. This piston F' is then thrown back to its former position. The passage c' is brought into communication with a'' , ready for the reception of steam, when the main piston shall have passed under and opened a'' on its return stroke. The passage f is carried over the port f'' , and the main slide-valve cushioned upon the remaining steam. The main slide-valve having been reversed, as we have seen, steam is admitted to

the main cylinder through the passage A' on the left, and exhausted through A' and B' on the right, so reversing the stroke of the main piston B. When the piston B, on its return stroke, has passed under and opened a'' , steam passes to the tappet-piston F, moving it to the left, and with it the supplementary slide-valve D'', and the same operations are repeated in a reverse order, and so on continuously while steam is supplied.

Having fully described the operation and construction of our invention, what we claim, and desire to secure by Letters Patent, is—

1. The tappet-pistons F F', constructed of two unequal areas, with a constant pressure of steam upon the smaller area, operated independently of each other, in combination with the cylinders D D' and the ports and passages $a' a'' b b' c c' m m' n n'$ and the cavity o , arranged to operate together in the manner described.

2. The auxiliary cylinders E E', with their outer ends closed, and inner ends united by an overlapping joint, t , supported by the main slide-valve and cylinders D D', and held in place at the points $l l'$ by lugs cast within the steam-chest, substantially as described.

3. The combination of the main slide-valve and cylinders D D', the auxiliary cylinders E E', the auxiliary slide-valve D'', the tappet-pistons F F', and the ports and passages $a' a''$, $c c'$, $g g'$, $j j'$, $f f' f''$, and $h h'$, arranged and operated substantially as described.

EZRA COPE.

JAS. R. MAXWELL.

Witnesses:

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