

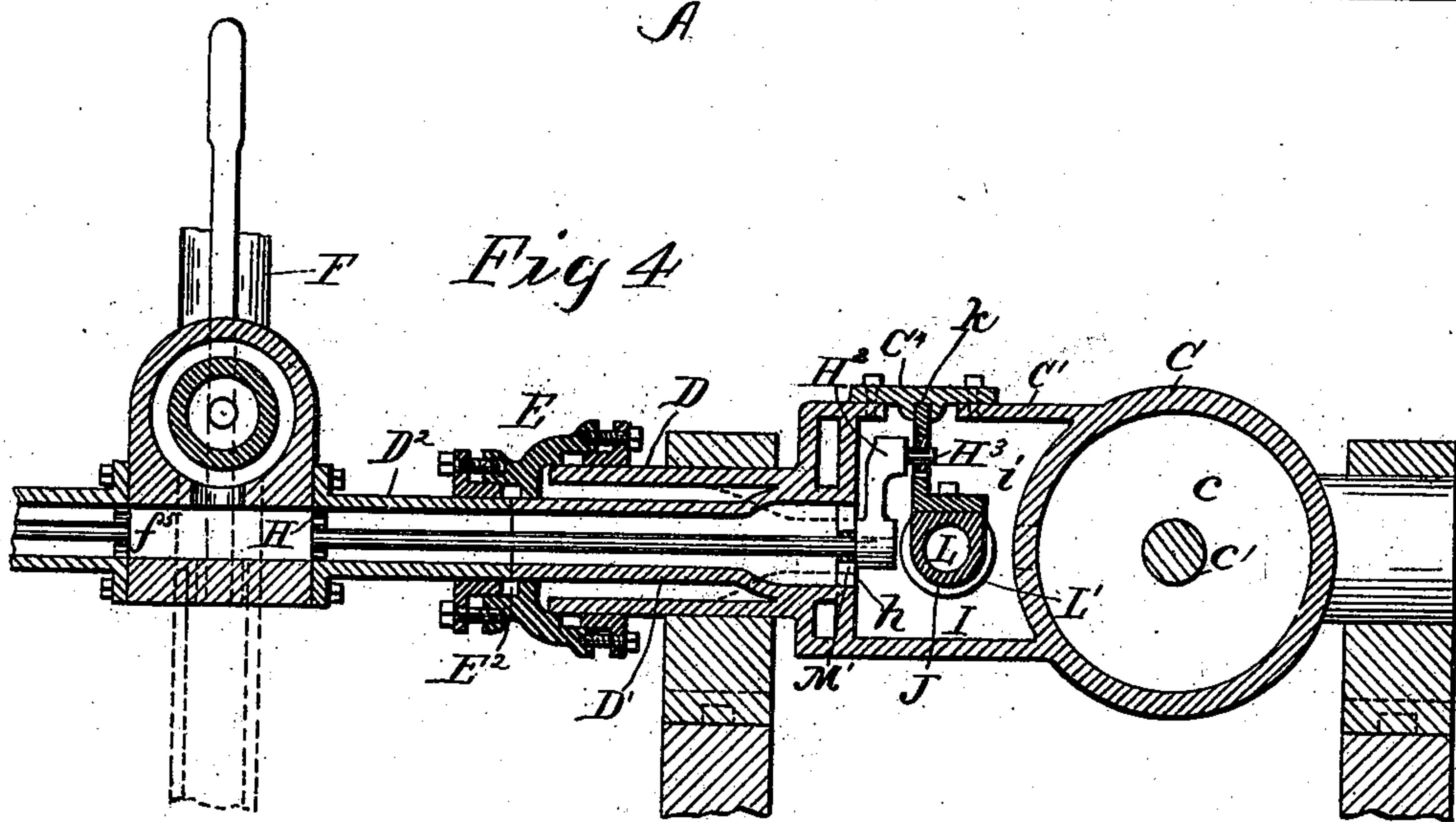
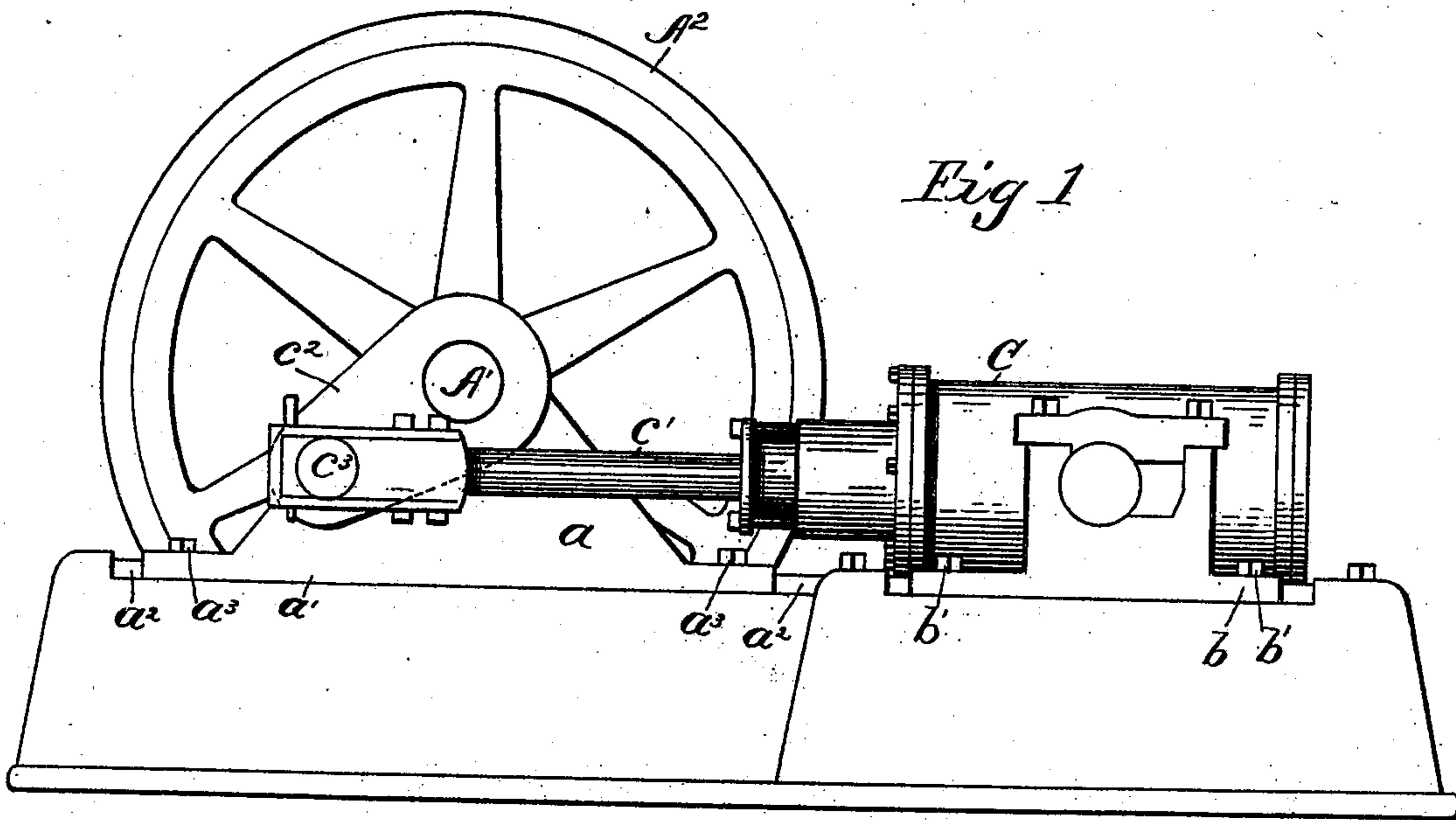
(No Model.)

4 Sheets—Sheet 1.

F. M. DAVIS.
STEAM ENGINE.

No. 502,707.

Patented Aug. 8, 1893.



WITNESSES:

C. C. Burdine
I. B. Owens.

INVENTOR

Frank M. Davis

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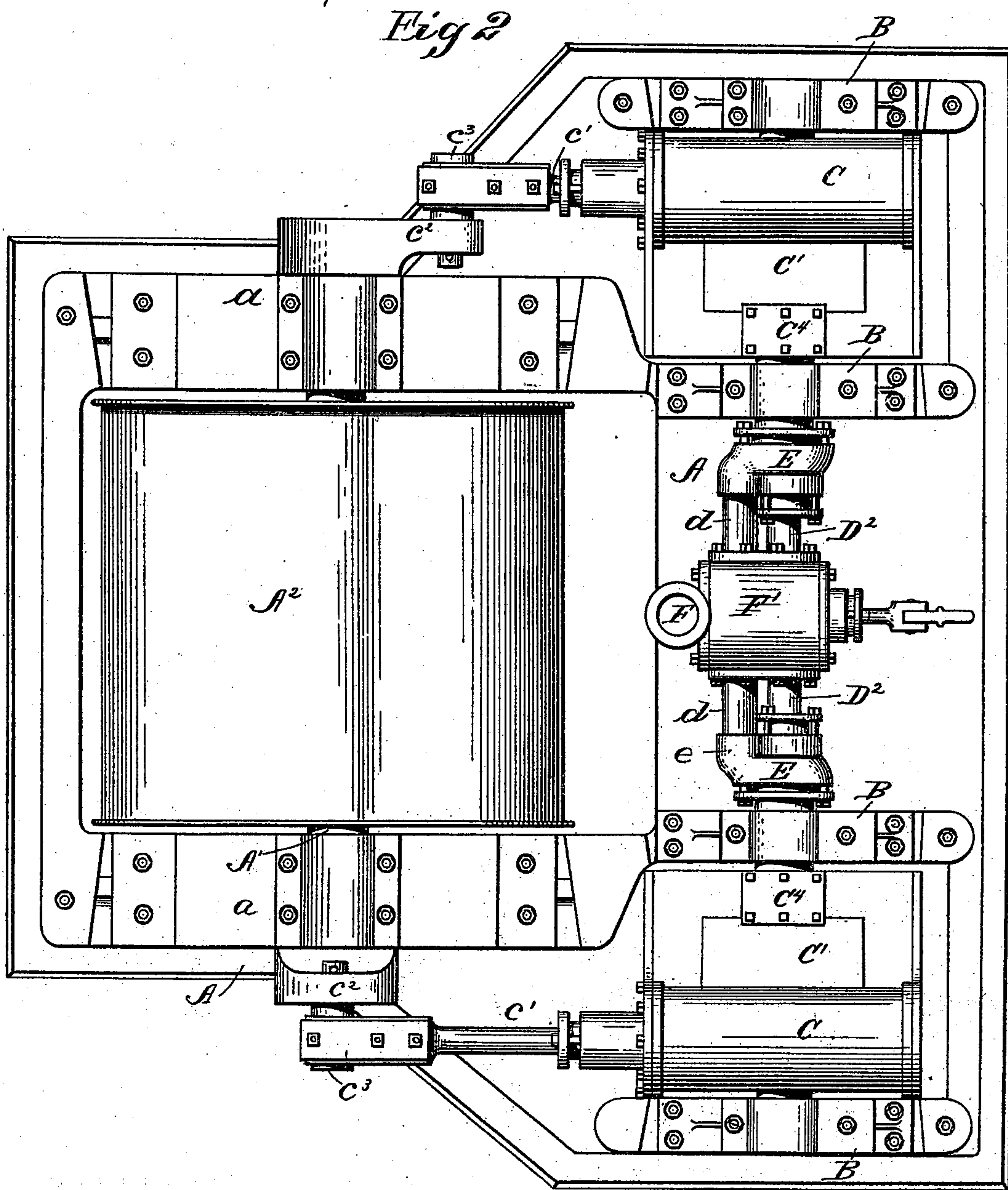
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WITNESSES:

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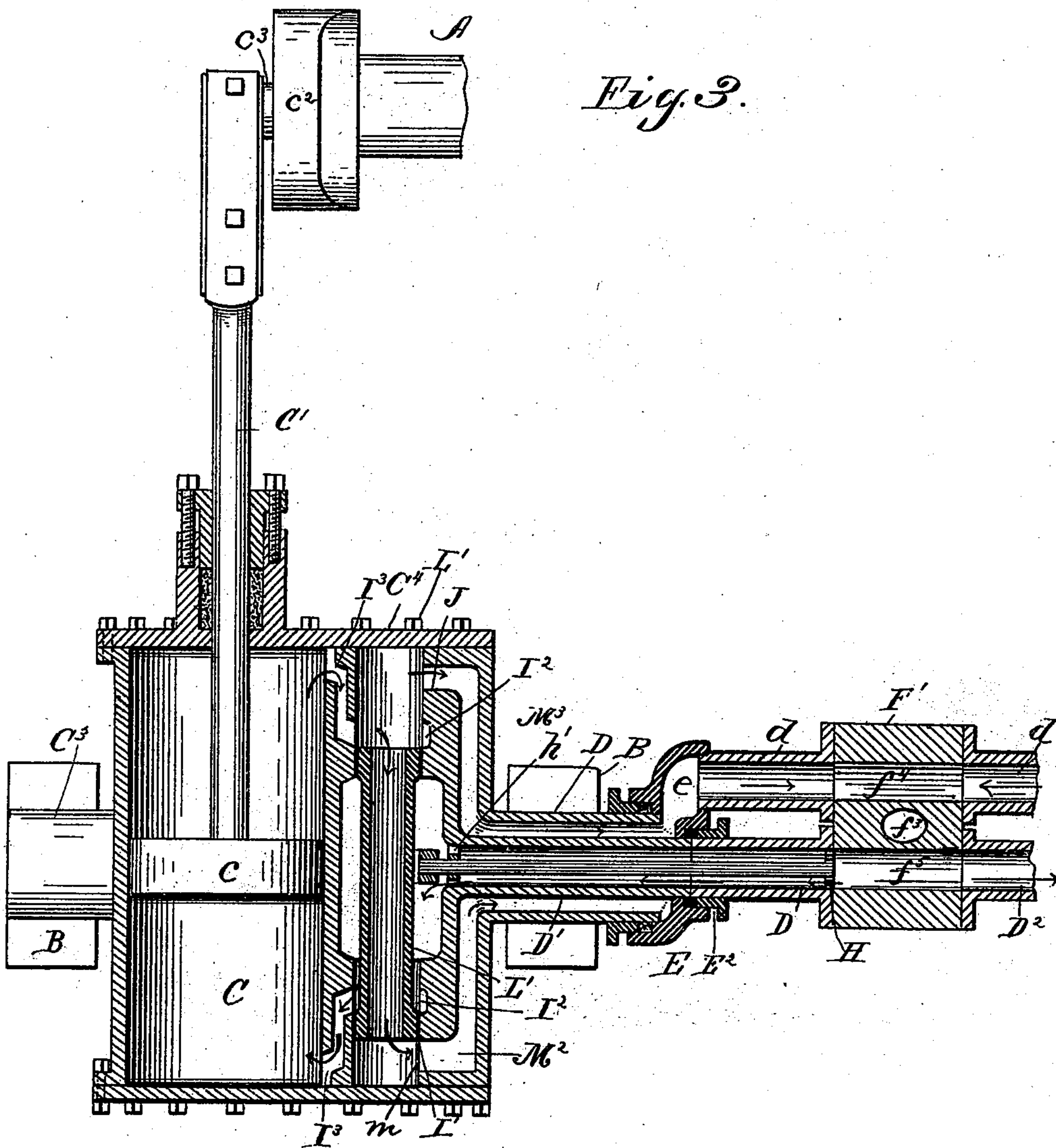
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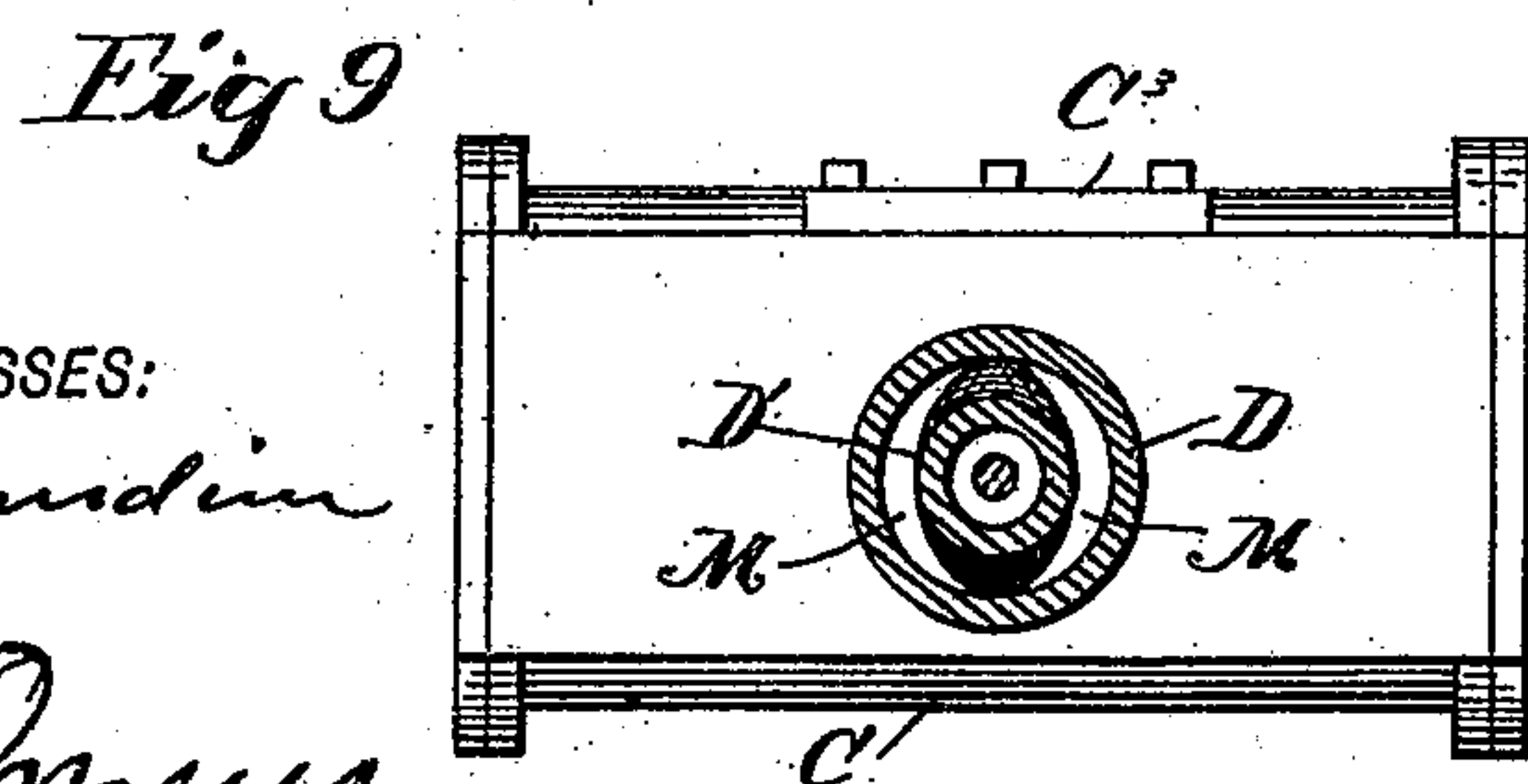
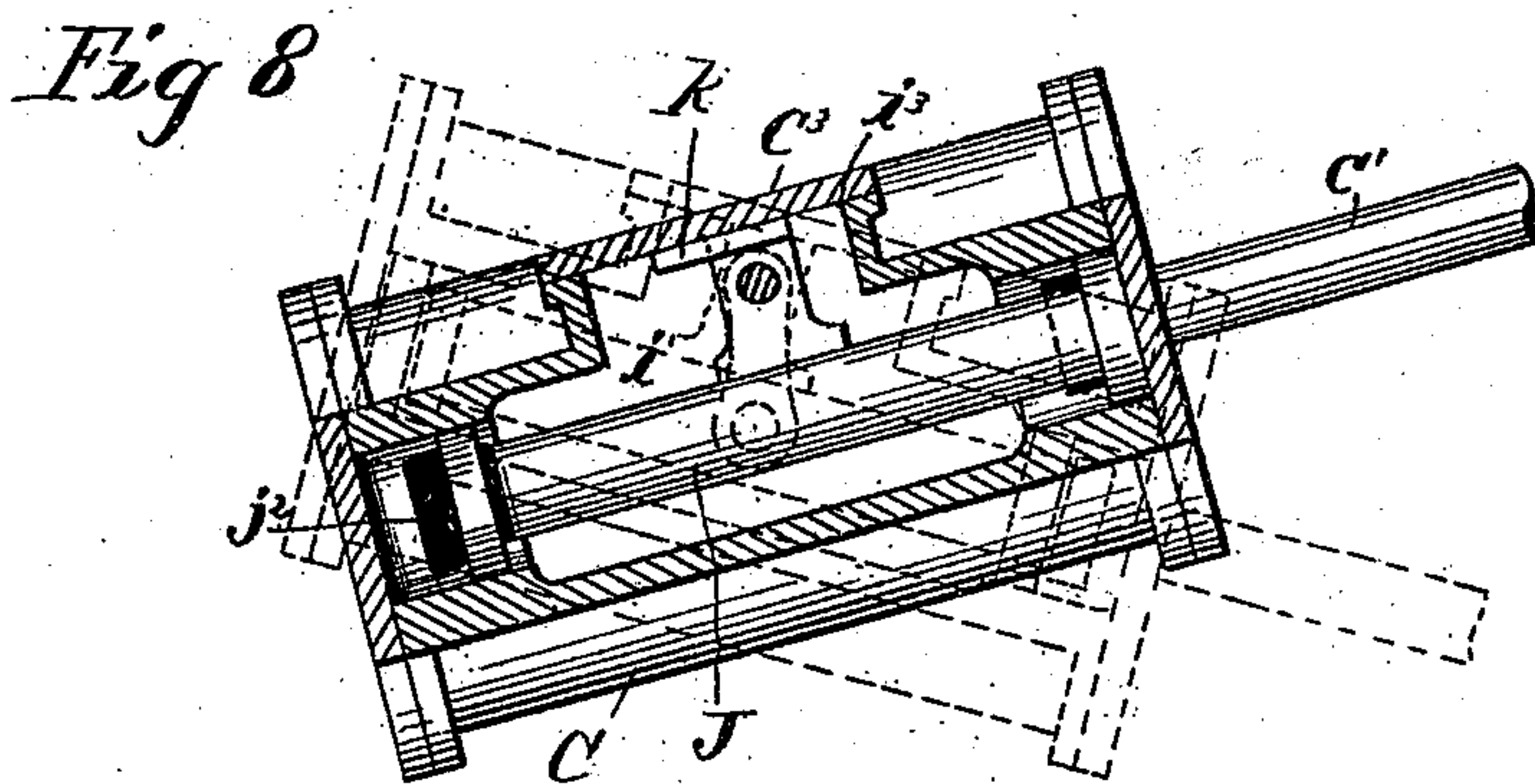
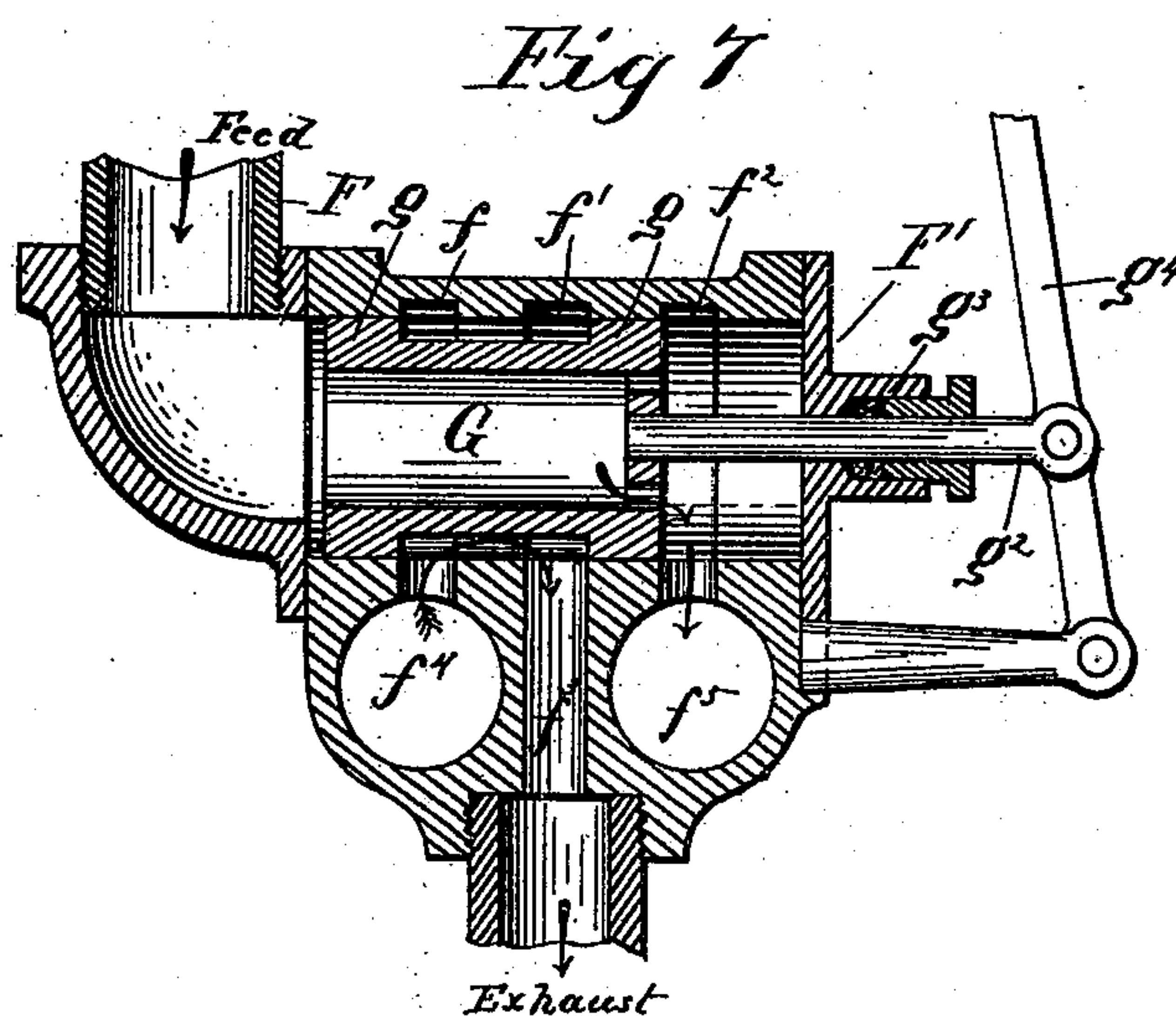
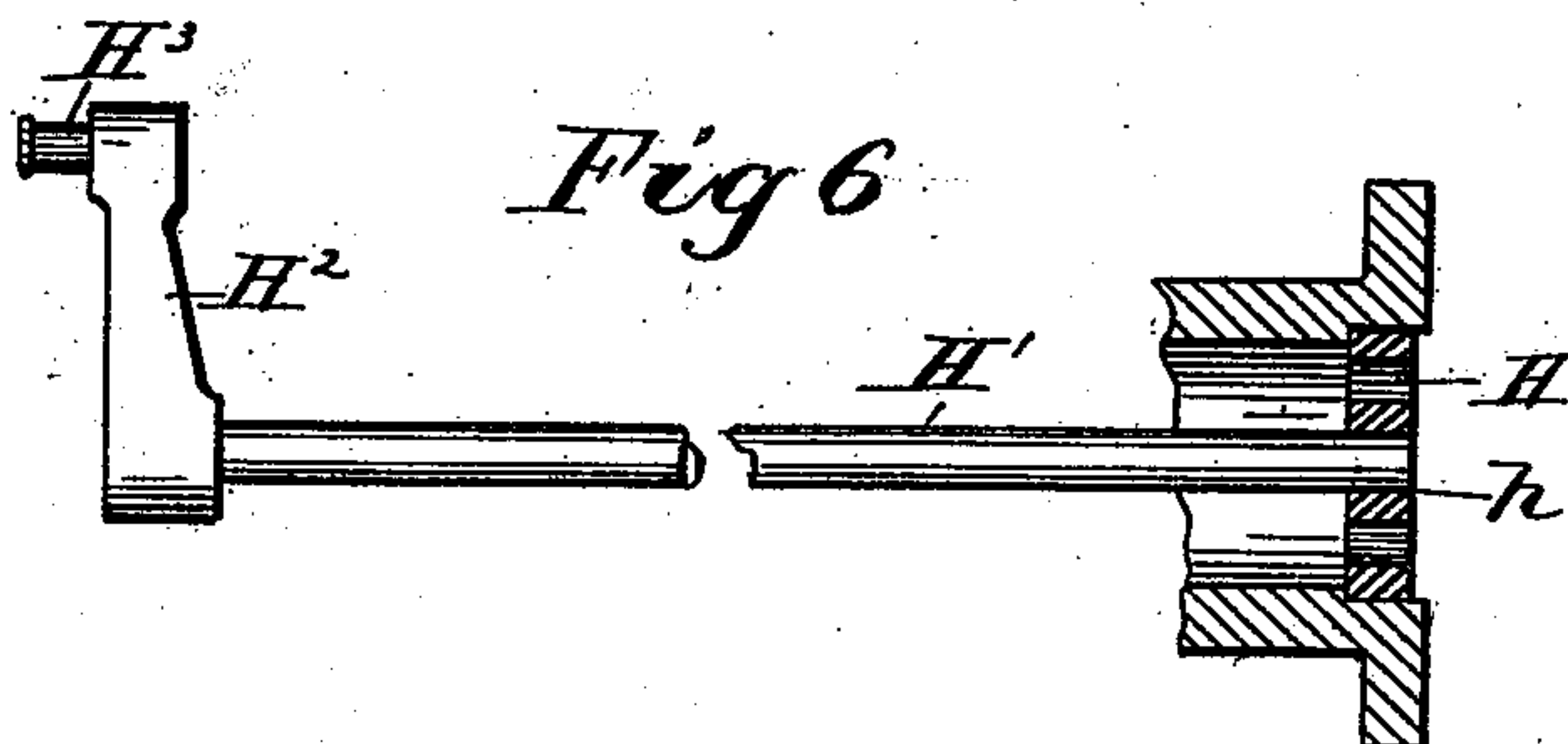
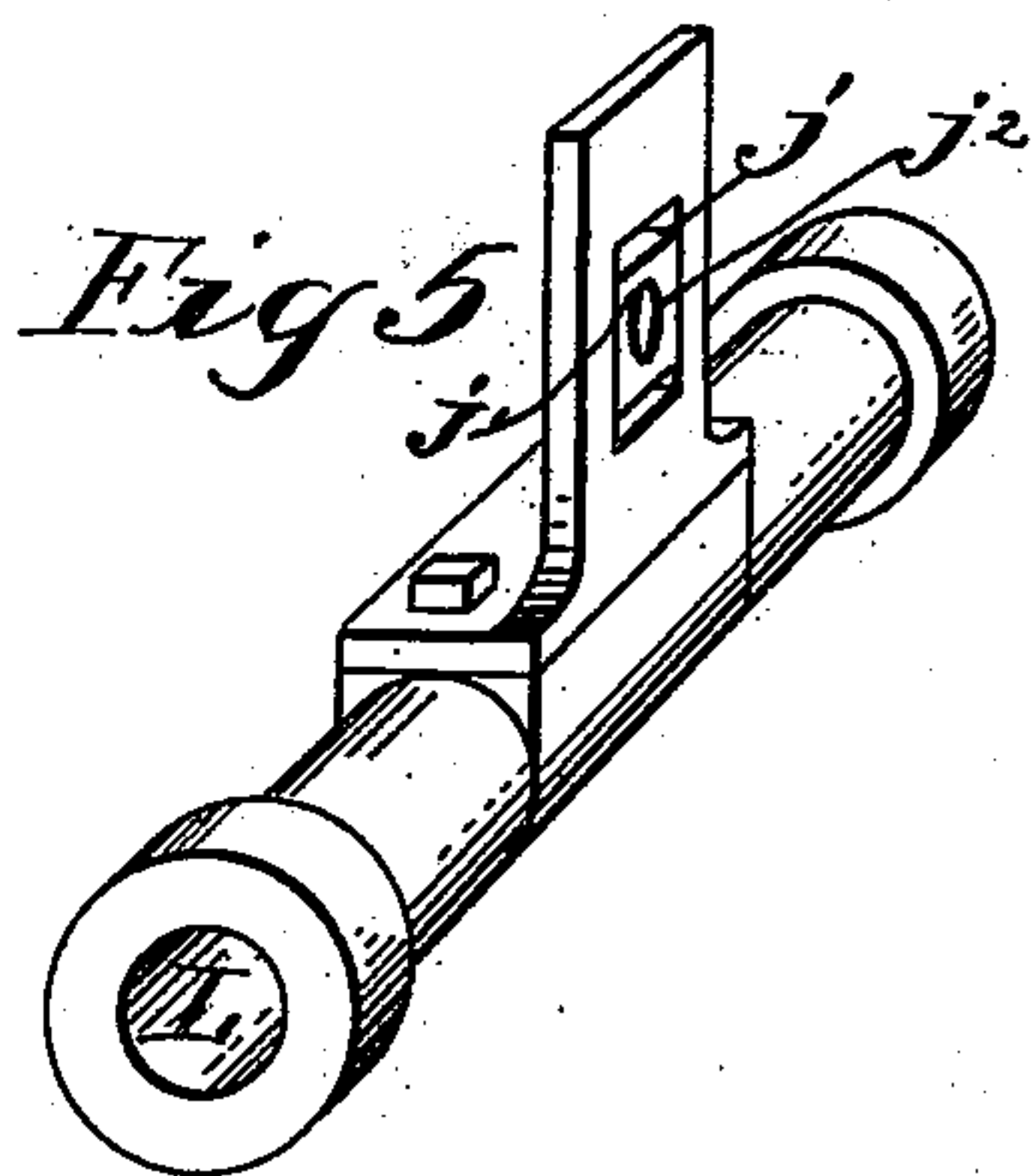
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4 Sheets—Sheet 4.

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STEAM ENGINE.

No. 502,707.

Patented Aug. 8, 1893.



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UNITED STATES PATENT OFFICE.

FRANK. M. DAVIS, OF OSKALOOSA, IOWA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 502,707, dated August 8, 1893.

Application filed March 10, 1893. Serial No. 465,401. (No model.)

To all whom it may concern:

Be it known that I, FRANK. M. DAVIS, a citizen of the United States, residing at Oskaloosa, in the county of Mahaska and State of Iowa, have invented certain new and useful Improvements in Steam-Engines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to that class of steam engines in which the cylinders are adapted to oscillate, and my object is to provide a double-acting or compound engine which will be more effective in operation, economical and simple.

To this end my invention consists in the peculiar construction and arrangements of parts more fully described hereinafter and pointed out in the claims.

Referring to the accompanying drawings: Figure 1 represents a side elevation of an engine embodying the essential features of my invention; Fig. 2 a plan view; Fig. 3 an enlarged lateral section of a portion of the engine; Fig. 4 a cross-section of a portion of the engine; Fig. 5 an enlarged detail perspective view of one of the valves; Fig. 6 a detail view of the valve-stem and adjoining parts. Fig. 7 a longitudinal section of the reversing valve and adjoining parts; Fig. 8 a diagrammatical view of the valve showing its mode of operation; Fig. 9 a detail view of the hollow trunnion at its inlet into the cylinder.

The reference letter A indicates the bed upon which my improved engine is mounted. This may be of any preferred construction or kind, the form shown being however preferred. On the front portion of the bed A is journaled the engine-shaft A', in the pillow-blocks or bearings *a*, guided and rendered movable toward and from the cylinder by the dove-tailed base-portion *a'* working in a corresponding bead or rib *a²* on the bed, and held in position by the bolts *a³*. Upon the shaft A' is mounted the balance-wheel and power-drum A².

The rear or main portion of the bed A is adapted for the reception of the engine-cyl-

inders. To this end two sets of pillow blocks or bearings B, B are provided, being duplicates of each other. These, like the bearings *a* are arranged to be adjusted by the movable base-portion *b* and bolts *b'*. By reason of these adjustable bearings both the engine-shaft and cylinders may be adjusted to compensate for wear and to provide for the different classes of work to be performed.

Mounted between the bearings B, B are the cylinders C, C provided with the usual pistons *c* and rods *c'*, the outer ends of said rods being connected to the engine-shaft A' through the medium of the crank *c²* and wrist-pin *c³*. The cylinders C, C are, as previously stated, of the oscillatory type and formed by casting integral with the valve-chest C' and steam-pipes or trunnions D and D'. Formed integral with the outer side of each cylinder is a trunnion C³ of the ordinary construction and arranged to bear in the boxes B, B, which are on the outer edge of the bed A. Constructed to be integral with the valve-chest C' are the pipes D, D' of different sizes and fitting one within the other. These pipes or the pipe D which is the outer one, form the trunnion for the inner side of the cylinder and its attachments. The inner pipe D' projects to the left slightly beyond its companion D, and is arranged to abut against a registering or matching pipe D² held there-against by the casting E and packing-gland E², which gland also insures a steam-tight joint between the pipes D' and D². The outer pipe D has its end fitted in a portion of the casting E and rendered steam-tight by the packing gland E³. This pipe D communicates with a branch *e* of the casting E, which is in turn connected with a pipe *d* extending parallel with the pipe D², the two forming a continuous passage for the steam. From the above description it will be seen that the pipes D, D' being the cylinder trunnions, are arranged to rock or oscillate in unison with the engine-cylinder, while the casting E and pipes *d* and D² are adapted to remain stationary. The pipes D, D are journaled in the inner boxes B at a point between the casting E and the steam-box C². This forms the remaining trunnion for each of the cylinders.

The reference letter F indicates the steam-feed pipe or conduit, which is connected at

its lower end to a chest F' . This chest communicates with the pipes d and D^2 of each cylinder, and is provided with a reversing valve as shown by Fig. 7. Formed in the cylindrical interior of the chest F' are three openings f, f', f^2 , the opening f' being in connection with the exhaust pipe f^3 , and the openings f, f^2 in connection with the passages f^4 and f^5 which are open at both ends and communicate thereat with the steam-pipes d and D^2 of each cylinder respectively. The openings f, f', f^2 of the steam-chest F' extend around the entire interior surface of the chest and on the same or an even plane to admit of the operation of the reversing-valve G , which is adapted to reciprocate over its seat, or that portion of the chest in which the aforesaid openings are formed. The reversing valve G is cylindrical in shape and formed with a hollow interior to permit the circulation of steam. Formed at each end of the valve G is a flange or rib g , which operates in conjunction with the openings f, f' and f^2 . The valve is operated by a stem g^2 connected to it and extending through the chest F' by way of the packing-gland g^3 , its outer end being pivotally connected to the operating-lever g^4 on the outer portion of the chest. When the valve is in the position shown in Fig. 8, the live steam will be made to pass into the pipe D^2 and the exhaust to pass from the pipe d through the opening f and into the exhaust opening f' , from whence it goes to the exhaust. By shifting the valve G to the right, it will be obvious that the conditions will be reversed and with them the movement of the engine.

The cylinder-valve mechanism will now be described. Arranged to be immovable in the stationary pipe D^2 is a skeleton disk H , having in addition to its openings for the passage of steam, a central opening h into which is fixed one end of the rod H' . This rod extends through the pipe D^2 and through the rocking pipe D' , but has no connection with the latter except by way of the bearing-box h' which is formed integral with the pipe D' , and is arranged with the rod H' so that the said rod will have a bearing therein; but the box h' will be movable irrespective of the said rod. From this point the rod H' extends into the steam-chest C' , where its end is provided with an arm H^2 having at its end a wrist-pin H^3 . This crank extends vertically from the rod H' and is, as is also the rod, immovable in relation to the steam-chest C' within which it is located, the interior construction of the chest C' being of a character that will admit locating the crank therein and of the rocking motion of the chest.

The pipe D is formed or divided at the point of inlet into the valve-chest, into two outlets M, M . These outlets are arranged on the same horizontal plane and communicate with particular parts of the valve-chest as will be fully described hereinafter. The dividing of the pipe D is effected by the smaller pipe or the pipe D' which is flattened vertically at

its outlet and is divided into two outlet orifices m', m' on a vertical plane with each other. The space occurring in the center of the openings of pipe D' has formed in it the bearing-box h' for the stem or rod H' referred to before. As previously explained the valve-chest C' and the cylinder C , are cast integral with each other, together with the seat for the valve. The letter I indicates the valve-seat which is adapted for a cylindrical valve and formed with the circular openings I' at each end. In these openings the steam-ports or passages I^2 are formed, which communicate with the induction or eduction ports I^3 . The seat is enlarged into a closed chamber at i , and with this chamber the orifices m', m' of the pipe D' communicate; the crank H^2 is also arranged in this chamber. As shown in Fig. 3, both ends of the cylinder and valve-chest when cast, are left open through which openings the piston and valve respectively may be inserted. By this means the valve J is seated by pushing it through the opening provided therefor. When this has been done, and the cylinder also in position, the plate C^4 is secured over the open ends of the valve-chest and cylinder and the opening made airtight. The arm J' of the valve J , is secured to the valve by bolts and inserted in position by means of an opening i^2 formed in the top of the valve-chest C' , which opening is hermetically sealed by the lid or plate C^3 bolted or otherwise removably secured over it. Formed on the under side of the lid C^3 directly over the arm J' so as to embrace its upper end, is a groove k by which regular movement is insured and the valve J prevented from rolling laterally. The arm J' has formed in it near its upper end, a vertically elongated slot j in which the block j' fits so that it will be capable of vertical movement therein, but incapable of any further movement; or in other words, not able to fall out of its bearings. In the opening j^2 of the block j' , the wrist-pin H^3 of the crank H^2 fits loosely, so that the arm J' can swing thereon, the crank being stationary. The valve J , is as before stated, cylindrical in shape and provided with a longitudinal passage L and end flanges L' , which latter co-operate with the ports I^2 and I^3 , so as to admit and receive steam respectively, while the passage L serves similar functions, all of which will be fully described.

The orifices M, M of the pipe D communicate with the separate passages M^2 and M^3 of the valve-chest, which extends toward its outer ends and thereat connect with the chamber i by way of the openings m, m therein; while the orifices M', M' both open directly into the said chamber. By referring to the drawings it will be seen that when the steam enters the valve-chest, say by way of the pipe D' , it will pass directly into the cylinder by way of the left-hand ports I^2 and I^3 , and that the exhaust will pass through the right-hand ports by way of the passages M^3 and $L-M^2$ to the pipe D .

The moment the valve is shifted the conditions will be reversed; the live steam entering the cylinder by way of the right-hand port I^2-I^3 and the exhaust escaping by the left.

5 The preferred construction of my invention having now been described, I will proceed to describe its mode of operation, reference being had to the drawings. The steam on entering the chest F passes, according to the position of the valve G, into one of the pipes d or D^2 of each cylinder; say for example D^2 , from whence it passes along the pipe D' and into the valve-chest C' . Assuming that the parts of the valve are in the position shown
15 by Fig. 3, the steam on passing from the pipe D' will proceed around the valve J and into the cylinder by way of the openings I^2-I^3 to the right. Thence a portion goes through opening L of valve J and along the passage M^2 to the pipe D, while the remainder passes directly through the passage M^3 to the pipe D as indicated by dotted lines and arrows. When the valve J is reversed the course of the steam changes in accordance there-
25 with. From the pipe D it passes out of the chest F and is thrown into the exhaust by the valve G, as previously explained. The parts of the cylinder and valve are so adjusted and timed that when the piston has made, say for example half of its in-stroke, the valve J will, by reason of the oscillations of the valve-chest, slide on its seat so as to change its relation to the ports I^2-I^3 , thereby reversing the valve so as to direct the live steam through the
35 opening which previously carried off the exhaust and vice versa.

The operation of the valve is clearly shown in the diagrammatical view in Fig. 8. It must be kept in mind that the rod H' remains in

all cases stationary, and that the valve is 40 swung or operated only by the oscillatory motion of the cylinder and valve-chest. It will also be remembered that the castings E, E' and chest F are immovable.

Having thus described my invention, what 45 I claim is—

1. In an oscillating steam-engine, the combination with a cylinder, of a hollow steam-conducting trunnion, an immovable valve stem extending through the same, and a valve 50 pivotally connected to the stem so as to oscillate thereon, the conditions of the valve being changed by the oscillations of the cylinder.

2. In an oscillating steam-engine, the combination with the cylinder, of a hollow steam- 55 conducting trunnion having two passages for the live and exhaust steam respectively, an immovable valve-stem extending through the said trunnion, and a valve pivotally secured to the stem so as to oscillate thereon, the con- 60 ditions of the valve being changed by the oscillations of the cylinder.

3. In an oscillating steam engine the combination of a cylinder, two steam conducting pipes fitting one within the other and arranged 65 for the live and exhaust steam, formed integral with or rigidly fastened to the cylinder and forming the cylinder trunnion, and a stationary socket into which the steam conducting pipes are fitted and adapted to oscillate, 70 the steam being fed to the sockets and thence to the pipes substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK. M. DAVIS.

Witnesses:

WM. J. ARNOLD,
JOHN LANDERS.