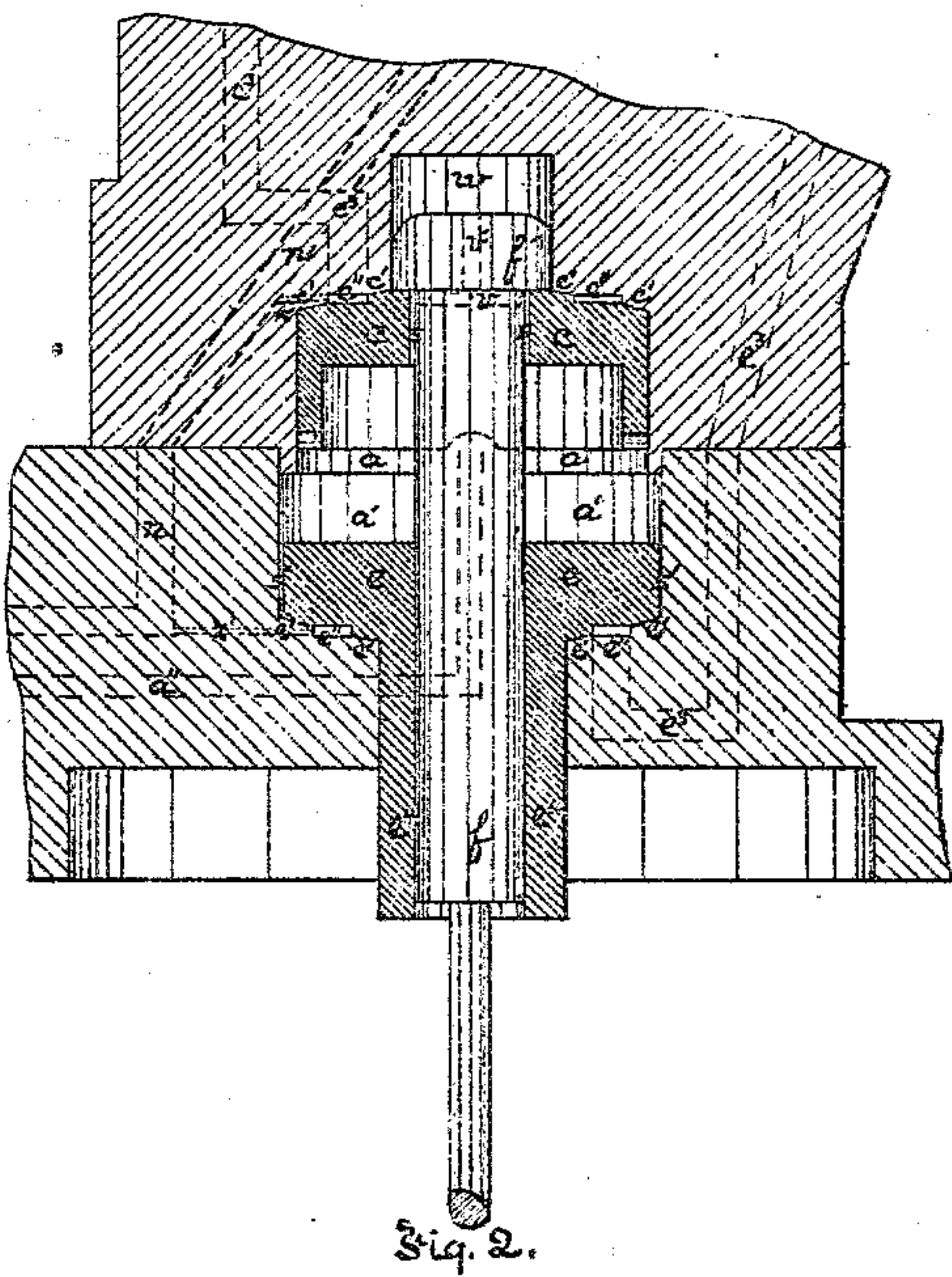
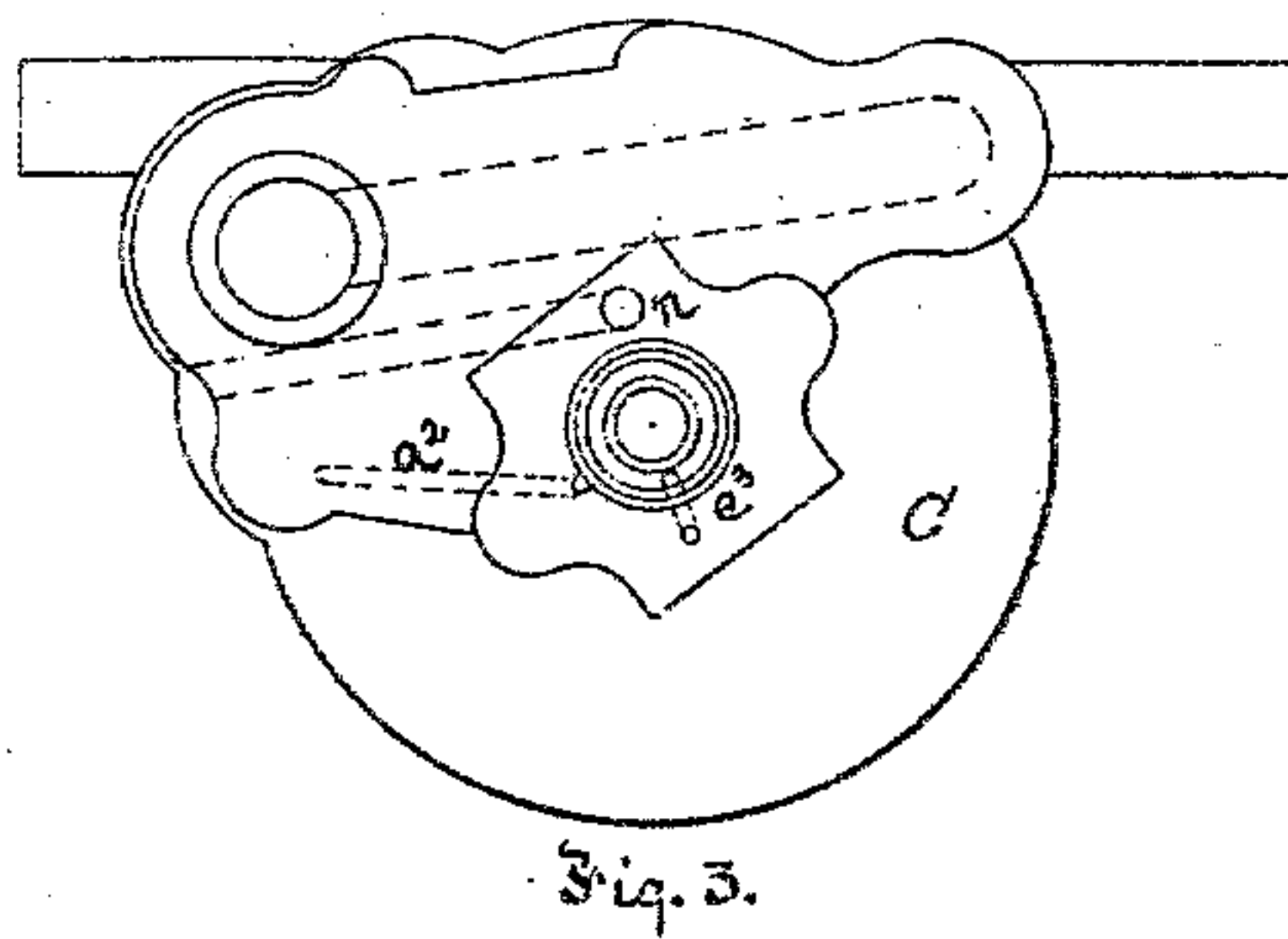
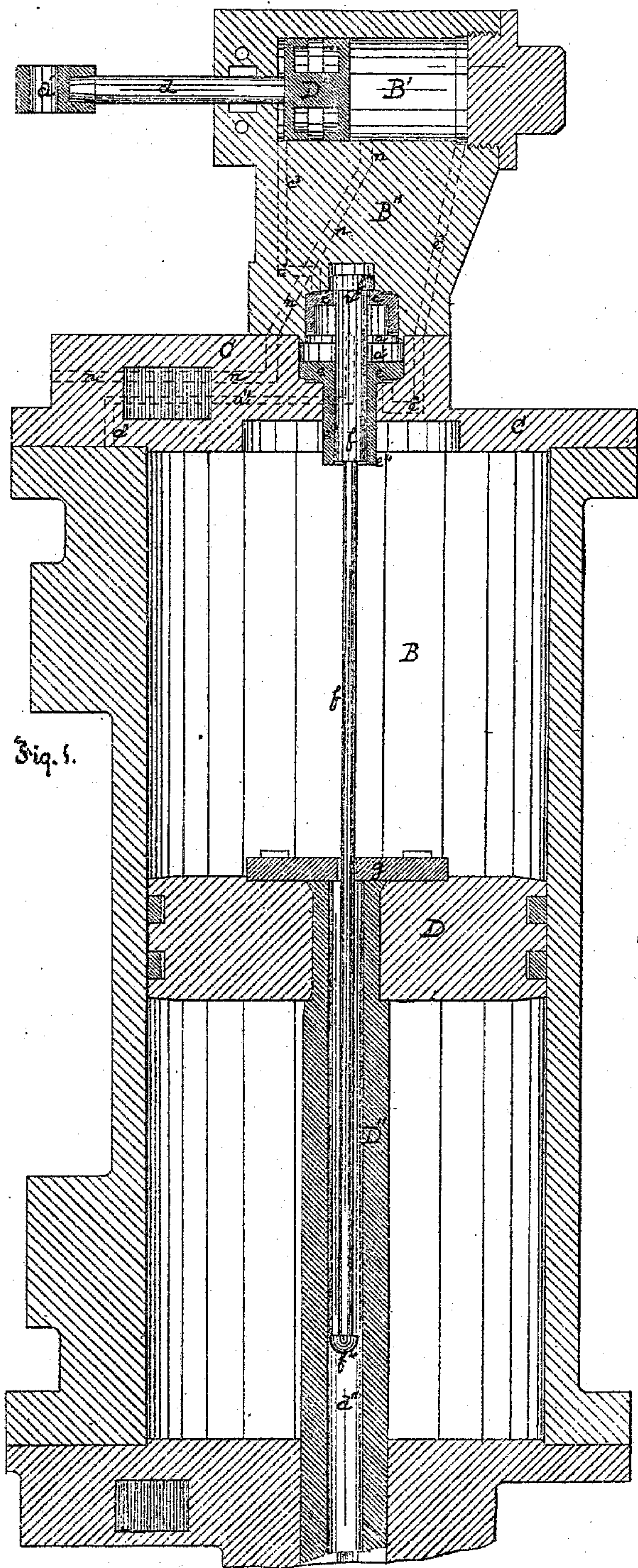


GEORGE WESTINGHOUSE, Jr.

Improvement in Steam Engine Valves and Ports.

No. 115,668.

Patented June 6, 1871.



Inventor:
George Westinghouse Jr.
by Bakewell, Christy & Kerr,
his Attys

Witnesses.

R. C. Marshall
James I. Key.

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

IMPROVEMENT IN STEAM-ENGINE VALVES AND PORTS.

Specification forming part of Letters Patent No. 115,668, dated June 6, 1871.

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Steam-Engine Valves and Ports; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawing forming part of this specification, in which—

Figure 1 is a longitudinal section of a main and auxiliary steam-cylinder illustrative of my improvement. Fig. 2 is an enlarged sectional view of the valves and valve-chambers employed in operating the auxiliary or reversing engine, and Fig. 3 is a plan or end view of the main cylinder-head and illustrative of the arrangement of the steam-ports.

Like letters of reference indicate like parts in each.

The construction of steam-engine to which my present improvement is particularly applicable is that shown and described in Letters Patent No. 106,899, granted to me 30th August, 1870, and relates more particularly to the construction of the valves and ports, and the devices operating in connection therewith, by which steam is admitted alternately into the opposite ends of the auxiliary or reversing cylinder.

To enable those skilled in the art to make and use my improvement, I will proceed to describe its construction and mode of operation.

The main steam-cylinder B, auxiliary or reversing cylinder B', main piston D, and reversing-piston D' are constructed as described in the Letters Patent above referred to. The main cylinder B is furnished with a steam-chest, valves, valve-seats, valve-stem, and steam and exhaust ports, as described in said patent. The reversing-stem *d* and slot or oblong eye *d'* have a like construction as there set forth, and for a like use. The reversing or auxiliary steam-cylinder B' is made in the upper end of or rests on a metallic base, B'', and the lower face of this base rests on the outer main cylinder-head C. In the lower face of the base B'' is a cylindrical valve-chamber, *a*, and in the outer face of the cylinder-head C is a like valve-chamber, *a'*. Both these valve-chambers have an axial line in common,

and which is also the prolongation of the axial line of the main cylinder B. Each valve-chamber contains a cylindrical valve, the upper one, *c*, being seated by two annular seats, as at *c'*, on two like seats in the upper end of the valve-chamber *a*, and so that an annular groove or space, *c''*, shall be included between the seats, as shown in Fig. 2. The lower valve *e* is similarly seated, as at *e'*, in the lower end of the lower valve-chamber *a'*, and also so as to leave an annular groove, *e''*, between the seats, as also shown in Fig. 2. These valves, when seated, are far enough apart to have a little vertical play. From the upper groove *c''* a steam-port, *c³*, (shown in dotted lines,) leads to one end of the reversing-cylinder B', and from the lower groove *e''* a like port, *e³*, leads to the opposite end, (also shown in dotted lines.) By a steam-port, *a''*, (similarly shown,) steam is admitted from the main steam-chest into the reversing valve-chamber *a a'*, but between the valves *c* and *e*. The pressure of the steam so admitted tends to keep both valves to their seats. To lift these valves alternately from their seats and allow the steam to pass alternately into and through the annular grooves *c''* and *e''*, and by the ports *c³* and *e³* into the reversing-cylinder B', is the next feature to be described. For this purpose both valves *c* and *e* are placed loosely on a common valve-stem, *f*. By means of a knob, *f'*, on the upper end of this stem *f*, above the upper valve *c*, provision is made for depressing this valve from its seat. The lower valve *e* has, projecting from its lower face inside its annular seats, a sleeve, *e⁴*, which passes over the valve-stem *f* and through a cylindrical hole in the main cylinder-head C, and into the main cylinder B, a distance equal or about equal to the lift desired in that valve. The main piston-stem D'' is hollow as at *d''*, and the valve-stem *f* extends down into it, with a knob, *f''*, on its lower end. On the upper end of the main piston D is a plate, *g*, through a hole in which the valve-stem *f* passes, the hole being too small for the knob *f''* to pass through. Then, as the main piston D approaches the end of its downward stroke, and the time comes for the reversal of the main valves, the plate *g* engages the knob *f''* and depresses or lowers

the upper valve *c*. This valve is fitted on the stem *f* somewhat loosely, so as to leave a small annular space, *s*, between the valve and stem. Steam then passes from between the reversing-valves *c e*, through the space *s*, between the valve *c* and stem *f*, over the upper end of the valve *c* into the annular groove *c''*, and through the port *c³* to one end of the reversing-cylinder *B'*. This gives the reversing-piston *D'* the desired throw in one direction, so as to shift the position of the main valves, as described in the Letters Patent above referred to. As soon as the reversing-piston *D'* has passed over and uncovered the exhaust-port *n*, (shown in dotted lines,) its motion will cease, the steam will be exhausted out, and the pressure of steam between the reversing-valves *c e* will seat the upper valve *c*, and so cut off the supply of steam to the reversing-cylinder *B'*. The construction of the piston *D'*, its operation, and the arrangement with reference thereto of the exhaust-port *n*, are substantially as described and shown in the Letters Patent already mentioned. The valves *c e* then remain seated till the main piston *D* approaches the end of its upward stroke. Then the plate *g* will strike the lower projecting end of the sleeve *e⁴* and lift the valve *e* from its seat. This valve is made a very little smaller than its chamber, so as to leave a small annular steam-passage, *s'*, between them. Hence steam will pass from the space between the valves *c e*, down around the valve *e*, through the annular space *s'*, under the valve and into the annular groove *e''*, and thence, by the port *e³*, into the opposite end of the reversing-cylinder *B'*. This will give the reversing-piston *D'* a reverse motion, and, of course, a reverse oscillatory throw to the main valves.

The annular steam-passage *s*, instead of being made between the valve *c* and stem *f*, may be made around the valve, between it and the sides of chamber, though the former construction is on some accounts preferable. With the latter construction the valve *c* may be made fast on the stem *f* instead of loose, as described.

As the cylindrical faces of the valves *c e*, working against the sides of the chamber inclosing them, become worn, they are liable to "leak" a little, as it is called. To prevent this leakage from interfering with the perfect operation of the valves I open a port, *x*, of a comparatively small opening from the upper groove *c''* to the exhaust-port *n*, and a like groove, *x'*, from the lower groove *e''* to the same exhaust-port. But these ports *x x'* are made so small, relatively, to the supply-port *a''*, that they will not, when steam is admitted above and below the valves *c e*, as described, exhaust it off sufficiently to prevent or interfere with the operations described. The relative diameters of these ports may be about as one-sixteenth to one-eighth, more or less.

As the knob *f* is shown in the drawing to rest neatly on the top of the valve *c*, it will

be obvious that some means should be employed to permit the flow of steam from the annular space *s* into the chamber *a* above the valve *c* when the latter is depressed. For this purpose a groove or grooves may be made in the lower face of the knob *f'*, extending radially out from the stem *f*; or similarly-arranged grooves may be made in the upper end of the valve *c*. As another means of effecting the same object I make a horizontal port, *v*, through the stem *f*, (shown in dotted lines,) and from that port *v* a vertical port, *v'*, to the upper end of the knob *f'*. The latter works loosely in its chamber *w*, so that steam may now pass from the annular space *s*, through the ports *v v'*, and when the valve *c* is depressed from its seat, into the groove *c''*, and thence to the cylinder *B'*, as already described.

If so preferred, the valves *c e* may be held to their seats by a spring arranged between them, instead of by steam, though I consider the latter mode of keeping them to their seats, on some accounts, the better.

Instead of the annular spaces *s s'*, other suitable forms of steam-ports leading from between the valves to the annular grooves, above and below, may be substituted; and if the valves are so constructed and arranged in their chambers that they cannot rotate, then the grooves *c'' e''*; as annular grooves, may be dispensed with, and a simple recess, covering each the mouth of its respective port, will suffice.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A pair of valves arranged in a valve-chamber, intermediate in the line of steam communication between a main and a reversing or auxiliary steam-cylinder, substantially as set forth.

2. A pair of independently and alternately acting valves, in combination with a steam-port which admits steam between them and a pair of ports which conduct steam alternately from the seating-face of each valve to an auxiliary steam-cylinder, substantially as described.

3. The valves *c e* inclosing a steam-space between them for the admission of steam, which keeps both to their seats, in combination with ports which lead from such inclosed steam-space to the opposite faces of the valves, whereby, when either valve is lifted from its seat, the steam is free to pass by a port or ports so uncovered to the steam-cylinder *B'*.

4. The valve *c*, pressed to or toward its seat by steam or other suitable pressure, in combination with a stem, *f*, for lifting it from its seat and uncovering the port *c³*, arranged substantially as described.

5. The valve *e* having a sleeve, *e⁴*, projecting into the cylinder *B*, arranged to be lifted from its seat against the pressure by the action of the piston, and so as to uncover the port *e³*, substantially as set forth.

6. The valves *c e*, seated as described, in

combination with annular grooves $c'' e''$, port $a'' c^3 e^3$, and stem f , arranged substantially as set forth.

7. The valves $c e$ operated by and in combination with a hollow piston-stem, substantially described.

8. The construction and arrangement of the ports $x x'$ with reference to the port a'' , and in combination with the valves $c e$, substantially as described.

In testimony whereof I, the said GEORGE WESTINGHOUSE, Jr., have hereunto set my hand.

GEORGE WESTINGHOUSE, JR.

Witnesses:

A. S. NICHOLSON,
G. H. CHRISTY.