

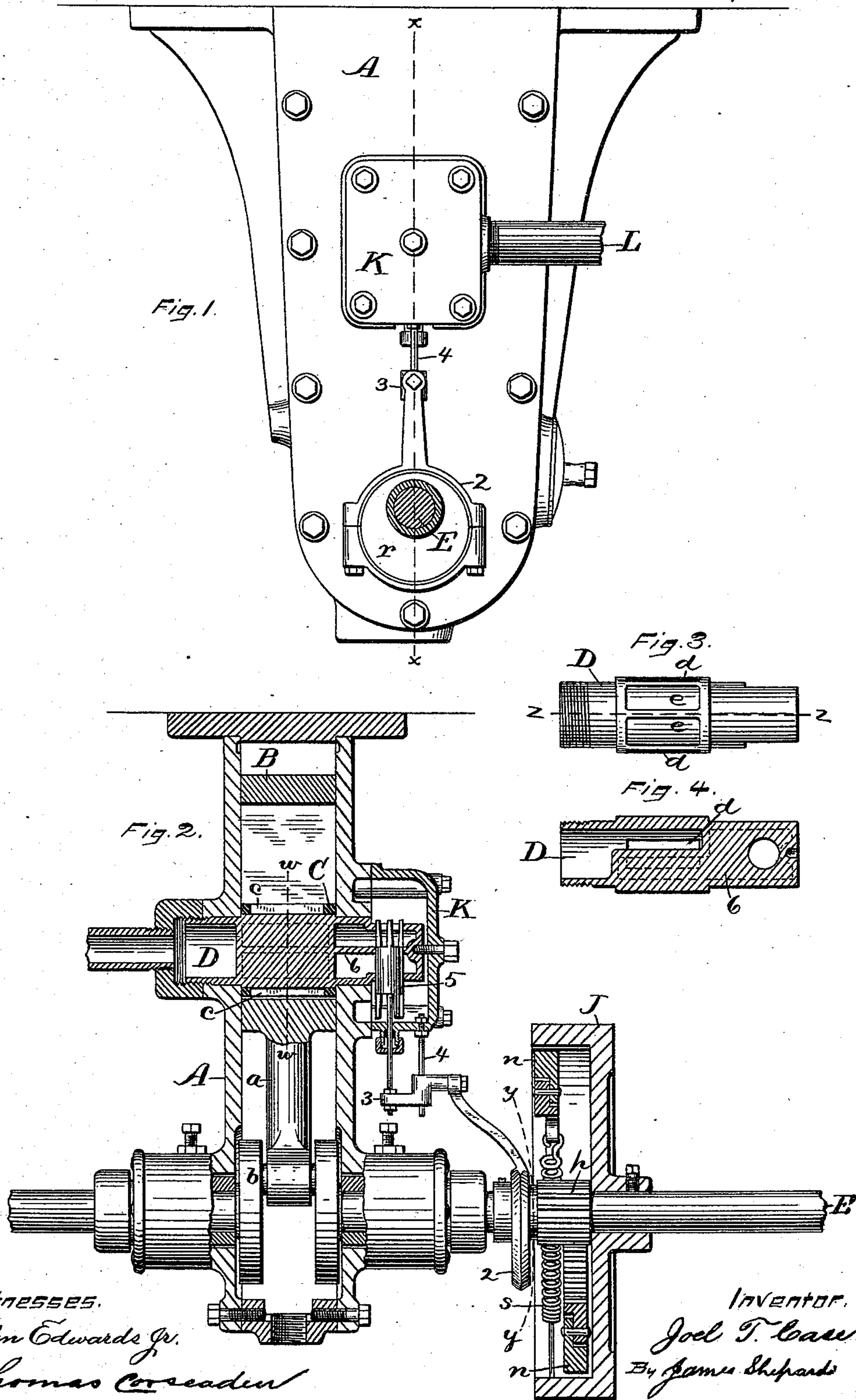
(No Model.)

3 Sheets—Sheet 1.

J. T. CASE.  
STEAM ENGINE.

No. 412,465.

Patented Oct. 8, 1889.



Witnesses.

John Edwards Jr.  
Thomas Corradini

Inventor.

Joel T. Case.  
By James Shipard

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(No Model.)

3 Sheets—Sheet 2.

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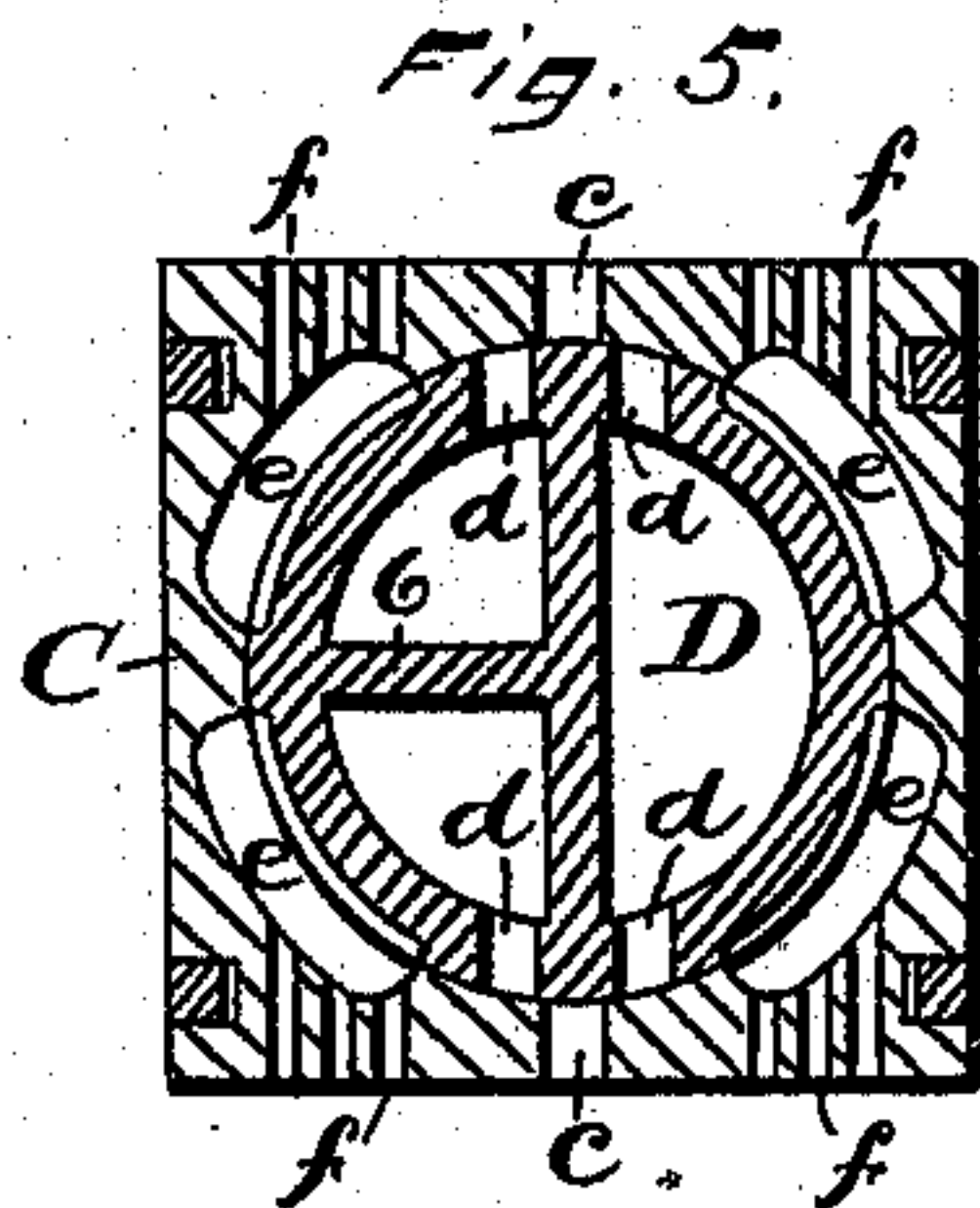


Fig. 6.

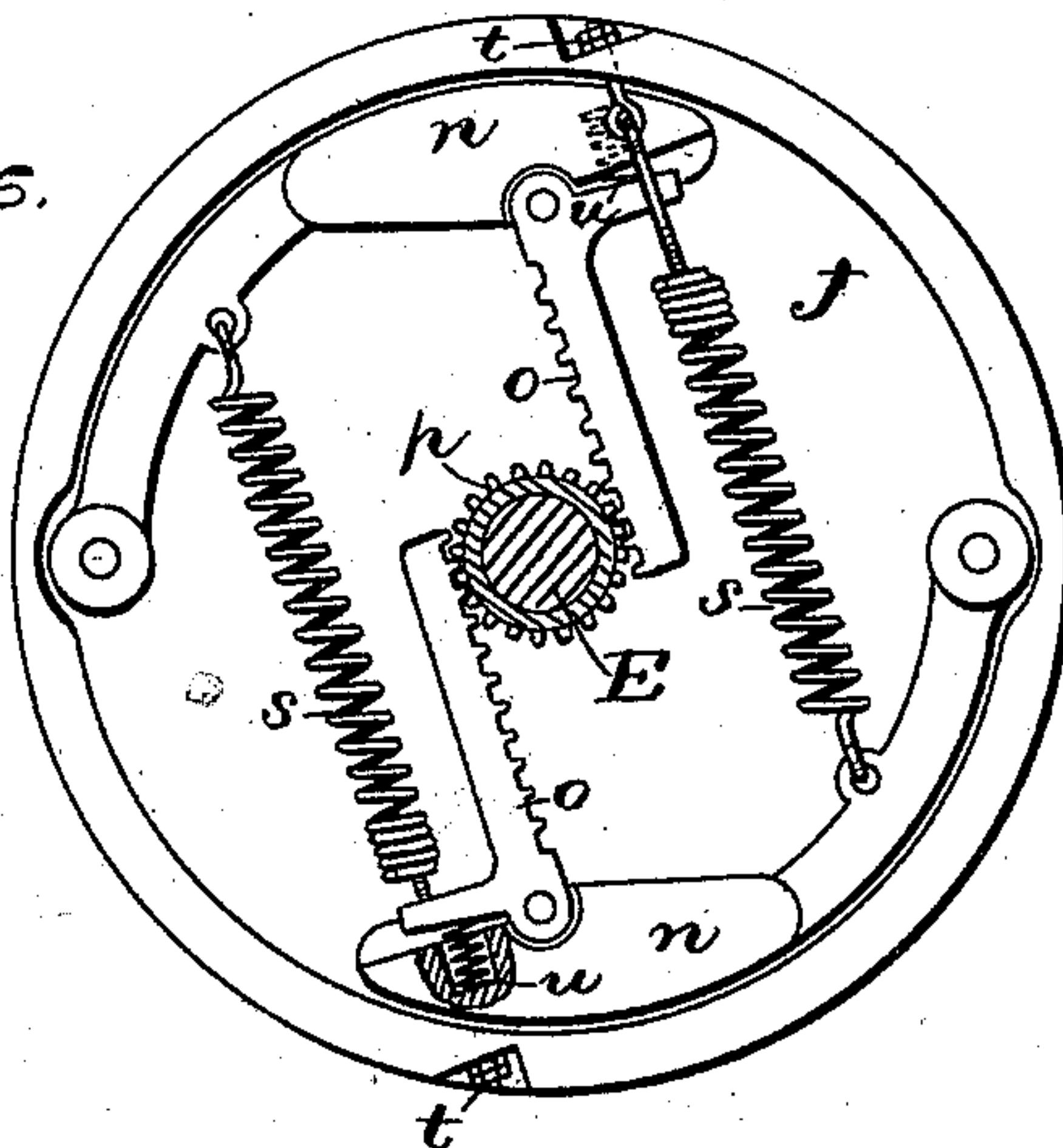


Fig. 7.

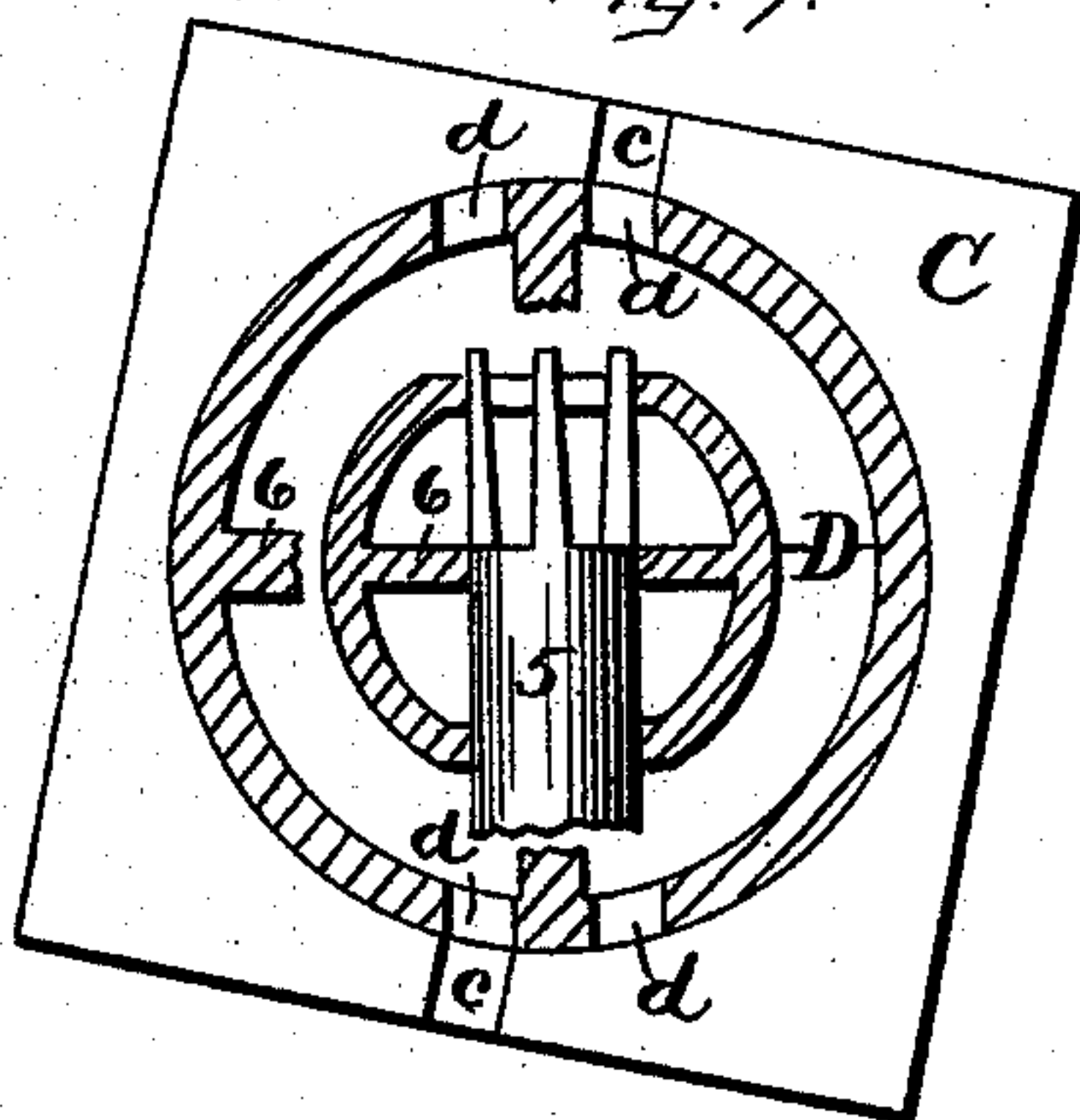


Fig. 8.

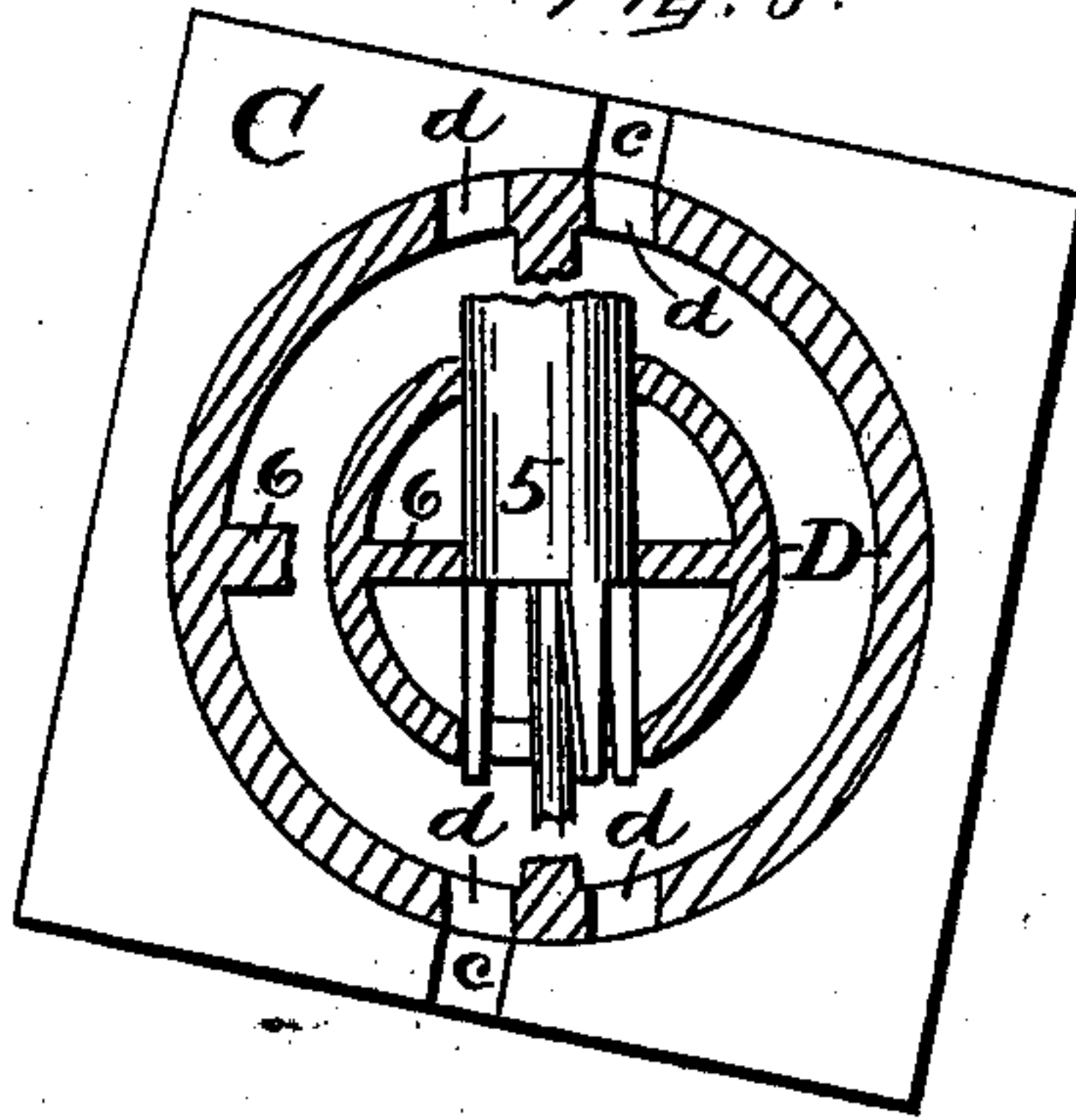
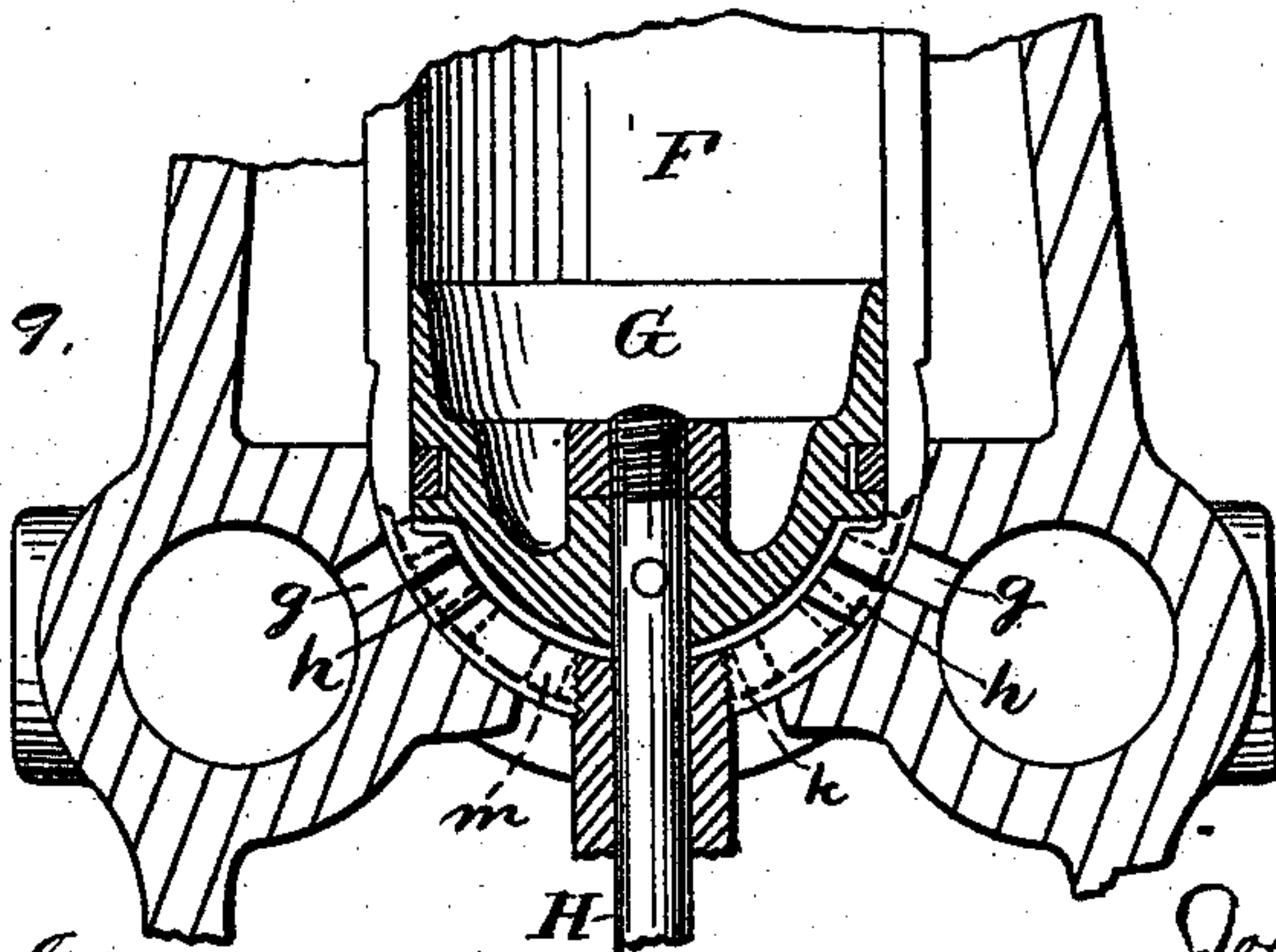


Fig. 9.



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(No Model.)

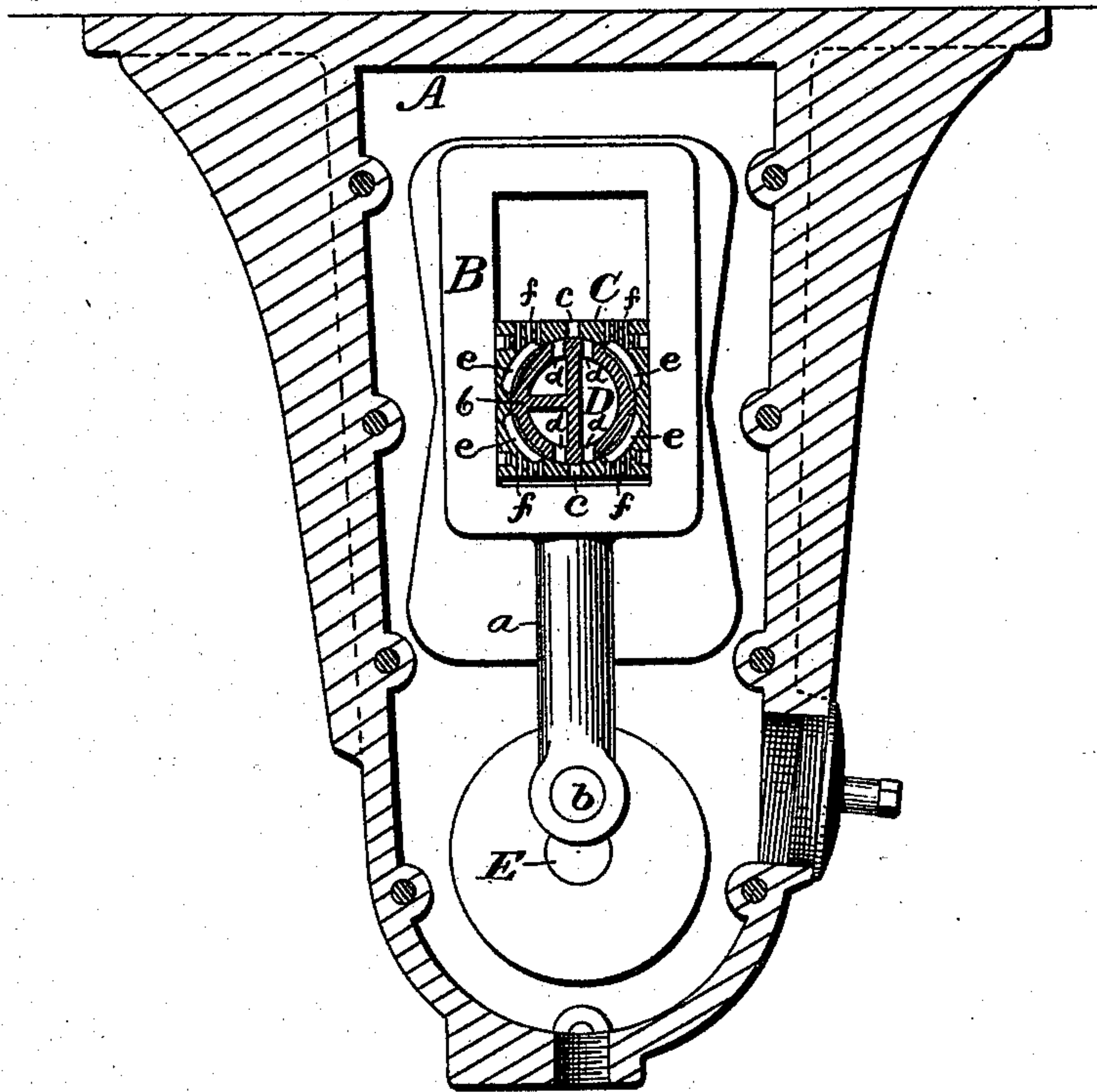
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Fig. 10.



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# UNITED STATES PATENT OFFICE.

JOEL T. CASE, OF BRISTOL, ASSIGNOR TO THE J. T. CASE ENGINE COMPANY,  
OF NEW BRITAIN, CONNECTICUT.

## STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 412,465, dated October 8, 1889.

Application filed February 14, 1888. Serial No. 263,973. (No model.)

*To all whom it may concern:*

Be it known that I, JOEL T. CASE, a citizen of the United States, residing at Bristol, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

My invention relates to improvements in steam-engines; and the objects of my improvement are to balance the pressure of the contacting surfaces in the parts having the steam-ports which act as valves, and also to provide an automatic cut-off to regulate the admission of steam to the valves proper of the engine.

In the accompanying drawings, Figure 1 is a side elevation of my engine, the shaft and sleeve of the governor being shown in section on the line *y y* of Fig. 2. Fig. 2 is a vertical section, partly in elevation, on the line *x x* of Fig. 1. Fig. 3 is a side elevation of the hollow axle of my engine. Fig. 4 is a longitudinal section of said axle on line *z z* of Fig. 3. Fig. 5 is a vertical section of said axle and piston on line *w w* of Fig. 2, the same being on a larger scale than the preceding figures. Fig. 6 is a side elevation of the governor, the shaft and a portion of the governor being shown in section on the line *y y* of Fig. 2. Figs. 7 and 8 are diagrams showing the relative positions of the cut-off and the valves proper. Fig. 9 is a vertical section, partly in elevation, of another style of engine to which my improvements are applicable; and Fig. 10 is a vertical section of my engine on the plane of the line *w w* of Fig. 2.

The main portion of the engine herein described is the same as that patented to me November 29, 1887, No. 373,880, and therefore need not be described in detail.

A designates the case; B, the reciprocating and oscillating cylinder; C, the piston; D, the hollow axle; *a*, the connecting-rod connected by crank *b* to the main shaft E. The piston or rocking block is provided with the radial ports *c*, and the hollow axle with radial ports *d*, which by the oscillating motion of the piston on said hollow shaft act as the valves proper of the engine, in the manner fully

shown and described in my aforesaid patent. In order to relieve the contacting faces of the two parts bearing these ports from undue pressure, I form between said faces a chamber or chambers *e*, Figs. 3 and 5, which chambers communicate with the interior of the cylinder, on opposite sides of the piston, by means of perforations or passages *f*, so that the pressure on the ends of the piston may be nearly or quite balanced by the pressure in the balancing-chambers *e* between the contacting faces of the piston and hollow axle. I have shown these chambers in Fig. 5 as formed partly by sinking into the inner face of the piston and partly by sinking into the face of the hollow axle; but said chambers may be formed by sinking into one only of these faces.

In Fig. 9 I have shown another style of engine with a balancing-chamber. (Indicated by broken lines.) This particular form of engine is made the subject of another application, Serial No. 264,463, filed February 18, 1888. In this engine F designates the cylinder, the lower end of which is of a semi-cylindrical form, and is fitted to and rocks within a correspondingly-shaped cylinder-seat having radial ports *g*, which lead from the steam-chambers on each side, the end of the cylinder being also provided with radial ports *h*, said ports acting as the valves proper of the engine during the oscillating movement of the cylinder under the influence of the piston G and piston-rod H, which is connected to a crank-shaft. Although this cylinder is represented in section, I have omitted the ordinary sectional lines in order that I may indicate by the circular broken line the balancing-chamber *k* and by the parallel and radial broken lines the perforations *m*, which lead from said balancing-chamber to the interior of the cylinder. The balancing-chamber and perforations thus indicated by broken lines are in the rear of the central section of the piston and cylinder; hence the necessity of showing them in broken lines. The effect of this balancing-chamber is the same as that before described, and differs from that first described only in the fact that it is formed wholly in one of the contacting surfaces and



is between the end of the cylinder and its seat instead of between the interior of the piston and its seat, said seat being the periphery of the hollow axle. In both cases the balancing-chamber is between the contact-  
5 faces of the two parts in which the ports that serve as valves are formed, one part being stationary, while the other rocks and operates the valves by the oscillating motion of  
10 the cylinder.

Attached to the shaft E is the governor, consisting of a head J, secured to the shaft E and having on its interior two weighted arms  
15 *n n*, hinged or pivoted to said head near its periphery and provided with racks *o*, having teeth, which engage the pinion or gear wheel *p*, formed on the hub or sleeve of the eccentric *r*. Said eccentric and sleeve are loosely  
20 fitted on the shaft E, and are caused to revolve with said shaft only by means of the racks and gear. Each of these weighted arms has attached to it a spring *s*, the other end of which spring is secured to the head J by  
25 means of the nut *t*, whereby the tension of the springs may be adjusted as desired. The racks *o o*, being straight, are pivoted to the weighted arms and provided with a spring *u*, (shown most clearly at the lower side of Fig. 6,) to keep said racks into engagement with  
30 the gear *p*. A similar governor having the eccentric connected with the weighted arms by means of links is older than my invention.

By the employment of the rack and gear  
35 instead of the link-connection the swinging movement of the weighted arms, acting upon the eccentric, gives a much more uniform leverage than is the case with the link-connection.

40 Upon the eccentric *r*, I arrange the yoke 2, the upper end of which is pivoted to the slide 3, mounted to move vertically on the rod 4 or other suitable support, to which slide I connect, by means of a rod, the cut-off 5. One  
45 end of the hollow axle D is flattened a little upon its upper and lower sides and is projected somewhat beyond the side of the case proper. Surrounding the projecting end of this hollow axle is a steam box or chamber  
50 K, supplied by steam through the pipe L, Fig. 1. The hollow axle D is also provided with a horizontal middle partition 6, which is of the full width of the hollow axle at the cut-off end, but only half the width of said axle  
55 through the middle portion, where the steam-ports are formed, the axle at this point being divided by another partition at right angles to the diaphragm 6 to separate the live-steam and exhaust ports of said axle, as in my before-mentioned patent. The end of the hollow axle D which enters the steam-chamber K is bored through transversely to receive the cut-off 5, which cut-off is cylindrical for  
60 a distance about equal to the throw of the eccentric, and the remainder of its length is skeletonized, so as to admit steam and at the

same time to furnish a bearing for the cut-off. As in an ordinary governor, the springs  
70 *s* have a tendency to draw the moving end of the weighted arms toward the shaft, while the revolution of the shaft has a tendency to throw said arms outwardly. The governor should  
75 be so secured to the main shaft that when the weighted arms are thrown outwardly to their fullest extent the eccentric will be in such position as to close the cut-off on one side of the diaphragm 6, as shown in Fig. 2, at a time  
80 when the valve proper leading from that part of the hollow axle is fully open. This position is illustrated by the diagram Fig. 7, in which the middle portion represents a transverse section of the hollow axle through the cut-off, while the outer portion of said figure  
85 represents, on an enlarged scale, the piston and a transverse section of the hollow axle on a line passing through the steam-ports, which serve as the valves proper of the engine. This figure shows the valve proper to be fully open, while at the same time the cut-off 5 is in such a position as to cut off all the  
90 steam leading to said valve. The expansive power of the steam within the hollow axle can then act until the oscillating movement of the piston closes the valve proper. Fig. 8 is a similar diagram with the valve  
95 proper in the same position, but with the cut-off in the reverse position—that is, fully opened, so as to admit the full pressure of the steam to the valve proper. While the  
100 eccentric on the governor will always throw the cut-off a given distance, the time of this throw may be varied according to the variation in speed of the governor, so that the cut-off may be either fully opened or fully  
105 closed at a time when the valve proper is fully opened, or it may be at any intermediate position. By this arrangement the steam which supplies the valves proper is automatically regulated by the cut-off at such times  
110 relatively to the opening and closing of the valves proper as to impart to the engine a uniform speed, which may be varied at pleasure by the adjustment of the springs of the regulator.

Inasmuch as the engine shown is a double-  
115 acting one, the cut-off is necessarily arranged for cutting off at each end; but it is evident that if a single-acting engine is employed one end only of the cut-off would work in precisely the same manner, as herein shown  
120 and described.

I claim as my invention—

1. In an engine having a piston and oscillating cylinder, the herein-described balanced valve, consisting of a movable part  
125 which rocks with the oscillating movement of the cylinder and is provided with radial ports, and a stationary part having radial ports, and which serves as the seat or bearing for said rocking part, the confronting walls of  
130 said stationary and moving parts being also provided with the balancing-chamber com-



municating with the interior of said cylinder, substantially as described, and for the purpose specified.

2. In an engine, the combination of the hollow axle having radial ports and the rocking block or piston fitted thereon, having ports acting in connection with the ports of said hollow axle as valves, said axle and piston having between their confronting faces the balancing-chamber, substantially as described, and for the purpose specified.

3. In an engine having a piston and oscillating cylinder, the valves consisting of a movable part which rocks with the oscillating movement of the cylinder and is provided with radial ports, and a stationary part having radial ports, in combination with a cut-off in the steam-passage leading to said ports,

and a governor connected with said cut-off for varying the time of operating said cut-off relatively to the opening and closing of the valves proper, substantially as described, and for the purpose specified.

4. The combination of an engine of the class described with the steam-chamber K, a pipe inclosed in said chamber—as, for instance, the end of hollow axle D—the middle partition 6 within said pipe; the cut-off 5, sliding in said pipe and partition, and the governor for operating said cut-off, substantially as described, and for the purpose specified.

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