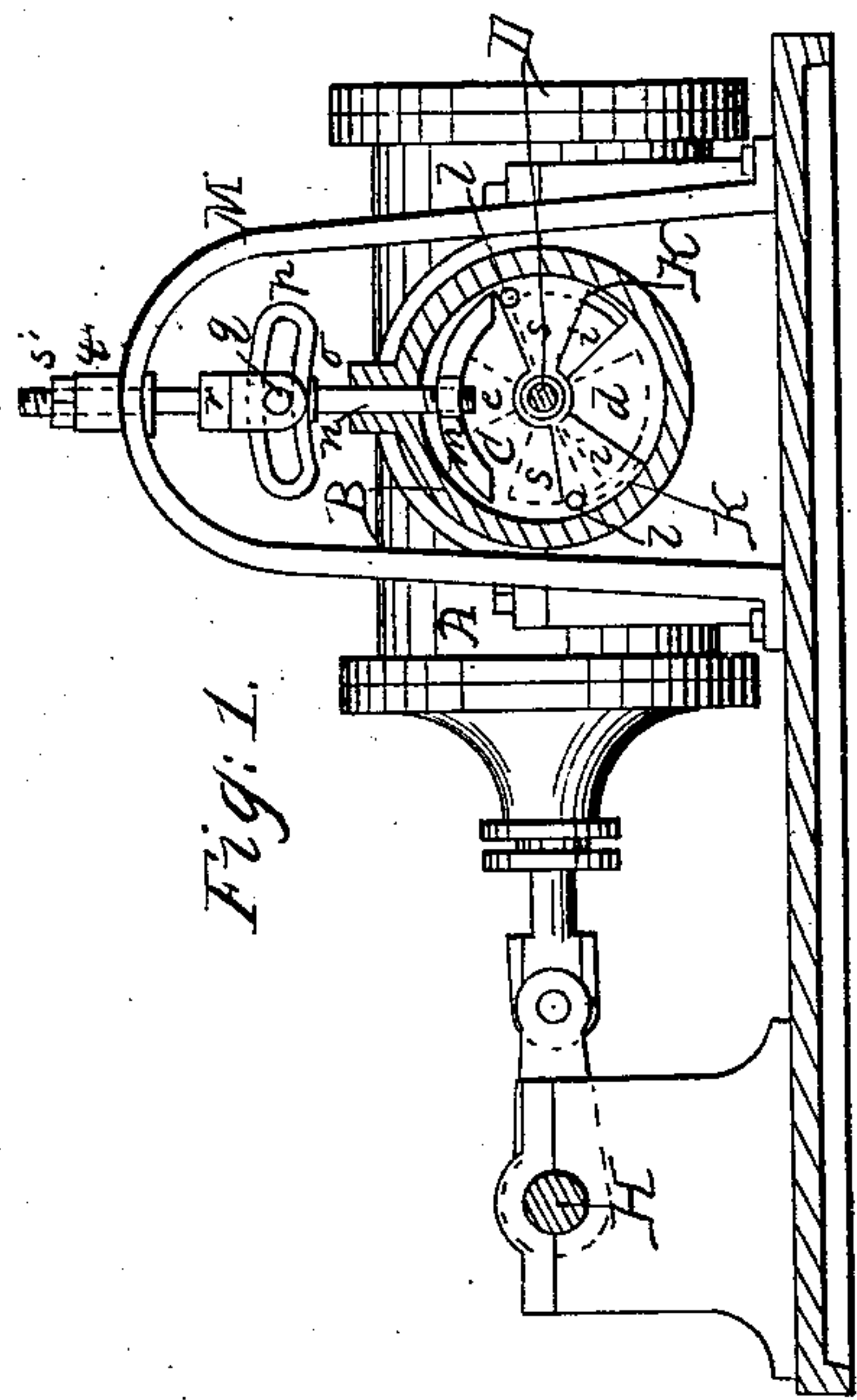
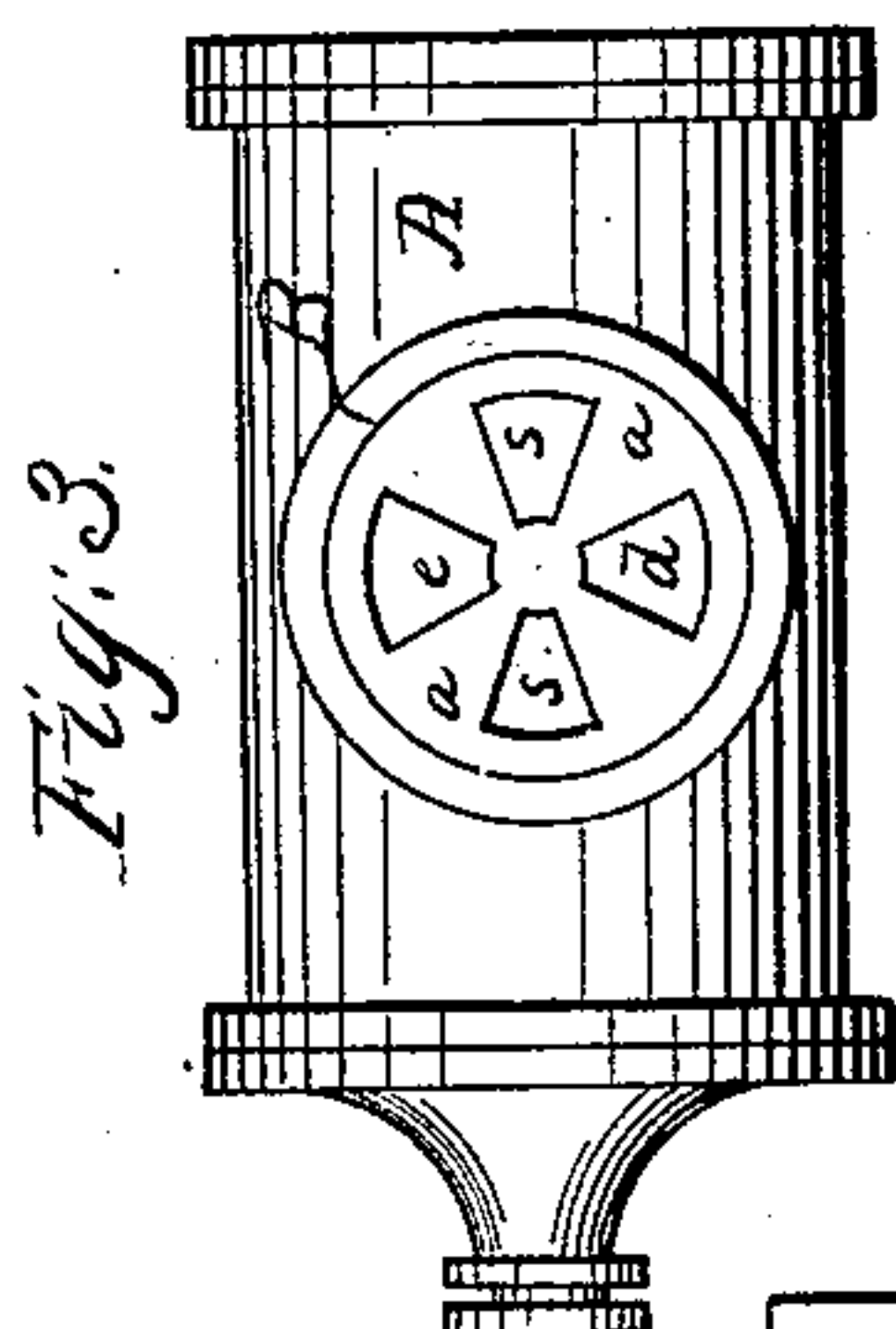


*W. Craig,*  
*Oscillating Steam Engine.*  
*N<sup>o</sup> 33,477.* *Patented Oct. 15, 1861.*



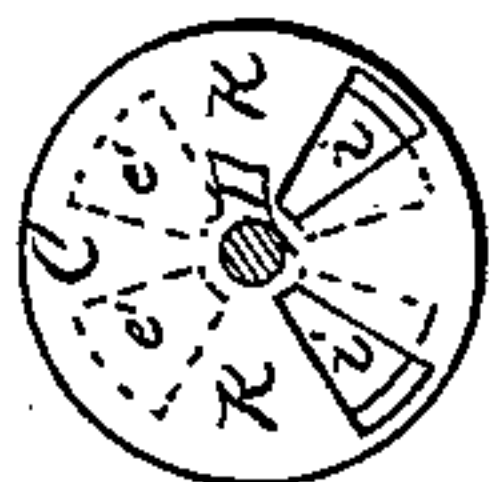
*Fig. 1.*



*Fig. 3.*



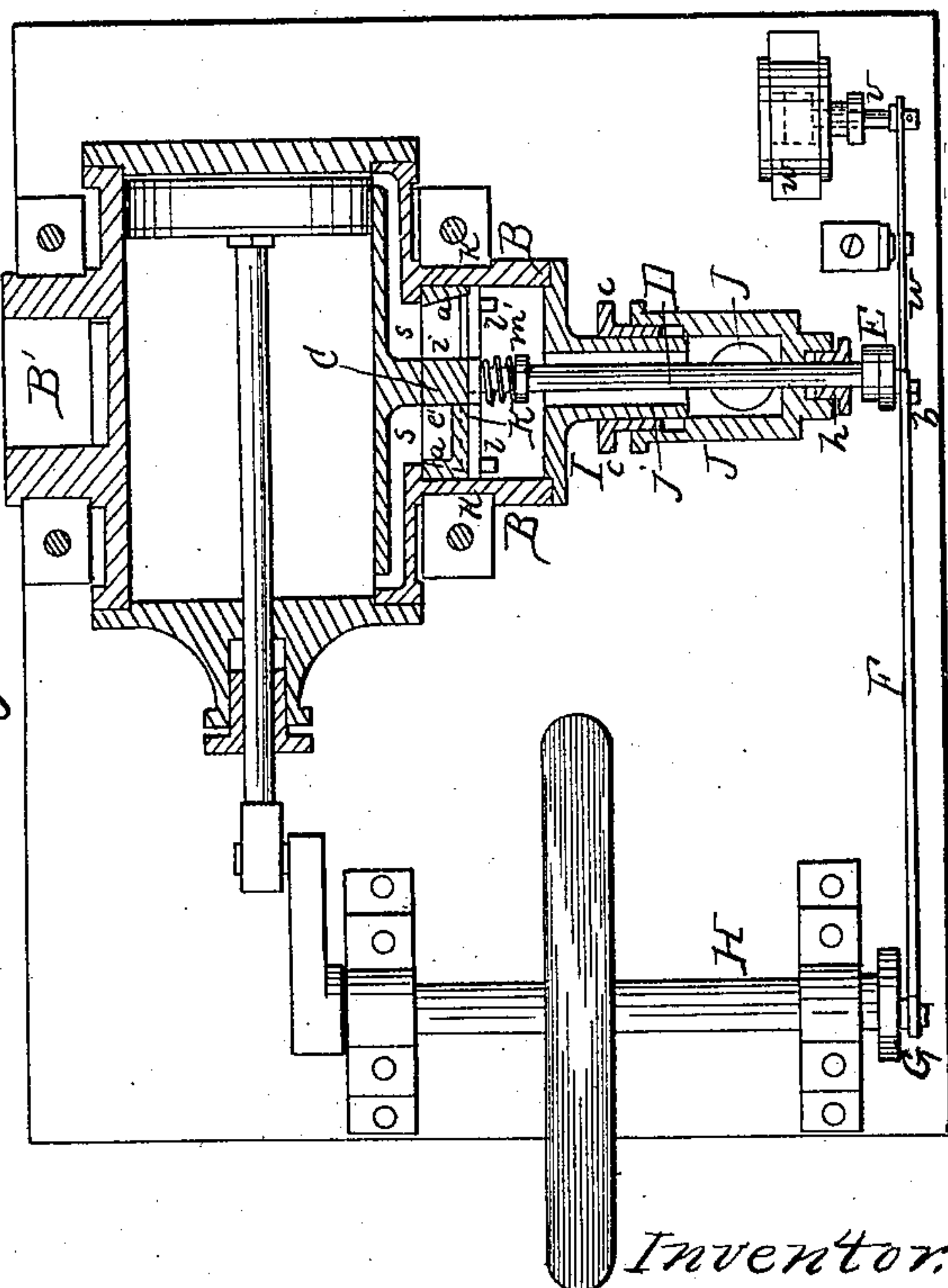
*Fig. 6.*



*Fig. 4.*



*Fig. 5.*



*Fig. 2.*

*Witnesses.*  
*C. W. Cowan*  
*James Laird*

*Inventor.*  
*William Craig*



# UNITED STATES PATENT OFFICE.

WILLIAM CRAIG, OF BINGHAMTON, NEW YORK.

## IMPROVED CUT-OFF FOR OSCILLATING ENGINES.

Specification forming part of Letters Patent No. 33,477, dated October 15, 1861.

*To all whom it may concern:*

Be it known that I, WILLIAM CRAIG, of Binghamton, in the county of Broome and State of New York, have invented a new and Improved Variable Cut-Off for Oscillating Steam-Engines; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side view of an engine with the steam-pipe and steam-chest cover removed to expose the slide-valve and cut-off. Fig. 2 is a horizontal section of the same. Fig. 3 is a side view of the cylinder, exhibiting the face of the valve seat. Fig. 4 is a face view of the valve. Fig. 5 is a back view of the same. Fig. 6 is a side view of the main-valve gear.

Similar letters of reference indicate corresponding parts in the several figures.

This invention consists in a cut-off valve applied and operated, substantially as hereinafter described, in combination with an oscillating induction and eduction valve working against a seat at the end of one of the trunnions in such a manner as to cause the steam to be cut off at various points, as may be desired, in the earlier portion of the stroke of the engine.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

A is the cylinder, having hollow trunnions B B', through the former of which the induction of steam to the cylinder is effected and through the latter the eduction from the cylinder. In the back of the trunnion B is the flat seat *a a* for the main valve C, by which the induction and eduction of steam are effected, said valve being furnished with a stem D, which protrudes through a stuffing-box *h* in an elbow formed in the stationary steam-pipe J. The end of the trunnion B is closed, to make it constitute a steam-chest, by a cap-plate I, which has a central socket *j*, which is fitted into the stationary pipe J with a stuffing-box joint *c c*, and which is furnished with a crank-arm E, whose wrist-pin *b* is connected by a rod F with a shorter crank G or an eccentric on the crank-shaft H, said crank-arm and crank or eccentric being so arranged as to give the valve C an oscillating movement independently of the cylinder in a direction

which is always the reverse of that of the valve-seat *a*, which oscillates with the cylinder.

The operation of the valve in combination with the seat in the trunnion thus produced is the same as that of the valve which constitutes the subject of Letters Patent granted to me bearing date September 12, 1854; but the valve and seat differ slightly in the arrangement of their steam and exhaust ports, and the valve differs in having a stem instead of being connected to a portion of the steam-pipe, the latter point of difference being necessary to provide a seat *k* on the back of the valve for the application of the cut-off valve.

The arrangement of the ports in the valve-seat *a a* and valve C is best illustrated in Figs. 3, 4, and 5.

*s s* are the steam-ports in the seat, and *e* the exhaust-port, of radial or sector form, the latter communicating by a half-band with the trunnion B', to which the exhaust-pipe is to be connected, the steam-ports being directly opposite each other and the exhaust-port midway between them.

*d* is a cavity, of corresponding area with the exhaust-port, arranged directly opposite, but having no outlet, its object being merely to equalize the surface of the seat on opposite sides of the center.

*i i* are the induction-ports of the valve, passing completely through it, and *e'* the eduction-port, consisting of a cavity similar to that in my patented valve and in a common slide-valve, but having a bridge *f* across it corresponding with the space *g* between the induction-ports. These ports *i i e'* are sector-shaped like the ports in the seat. The said ports *i i e'*, space *g*, and bridge *f* may be arranged and proportioned to give the valve lap and lead, to operate on the same principle as a common reciprocating lap slide-valve. The induction-ports *i i* are narrowed but elongated radially from the face toward the back or cut-off seat *k*, so that they present the same area throughout, but have such form in the seat *k* as is best adapted for the application of the cut-off.

K is the cut-off valve, consisting of a plate fitted to turn easily on the valve-stem D and faced to fit the seat *k* on the back of the main valve and having two radial or sector-shaped wings, each large enough to cover one of the



induction-ports *i i* of the main valve, but so arranged relatively to each other that when one port *i* is covered the other is wide open, as shown in Fig. 1. This cut-off is held to its seat *k k* by the pressure of the steam on the back of it; but I have represented a light spring *m'* applied round the stem *D* to keep it there when the steam is shut off from the engine.

*l l* are two projections on the back of the cut-off valve, one on each wing, and *m* is an arc-formed plate or bar of metal arranged within the trunnion *B* and attached to a stem *n*, which is arranged radially to the trunnion and works through a stuffing-box *o* in the same. The ends of this arc-formed piece *m* occupy such positions as to form stops against which the cut-off valve in oscillating about the axis of the valve-stem may bring its projections in contact. The stem *n* has at its upper or outer extremity an arc-formed slotted cross-head *p*, which is connected by a pin *q*, working in the said slot, with a rod *r*, which is fitted into a stand *M*, in which it is capable of being moved or adjusted longitudinally, such adjustment causing the arc piece *m* to be brought nearer to or farther from the center of the trunnion, and the arc-formed slotted cross-head *p* permitting the oscillation of the cylinder. As the main valve *C* is moved by the action of the crank or eccentric *G* on the crank-arm *E* on its stem the cut-off valve is caused to move with it by the friction produced between them by the pressure of steam on the cut-off valve so long as the projections *l l* are free of the arc piece *m*; but when in the oscillation of the cylinder and main valve the arc piece and either of the projections are brought in contact the continued movement of the cylinder and main valve causes the cut-off valve to move in the opposite direction to the main valve and to close one or other of the ports *i i*, according to the direction of the oscillation, and thus to cut off the steam from the main valve. The closing of the ports *i i* takes place sooner or

later in the stroke of the engine between the commencement and half-stroke, according as the arc piece *m* is nearer to or farther from the center of the trunnion, and in order to adjust the said arc piece to cut off permanently at such point as may be desired the rod *r* may be operated by a screw *s'* and nut *t*, or by any equivalent means; or, if it be desired to employ the cut-off as a means of regulating the speed of the engine under a varying load or steam-pressure, the said rod may be connected with a governor in such a manner as to cause the arc piece *m* to be moved toward the center of the trunnion as there is any tendency to increased speed, and vice versa.

To relieve the main valve of unnecessary pressure, I connect the outer end of its stem by a lever *u* with the rod *v* of a piston fitted to an independent steam-cylinder *w*, one end of which is open to the atmosphere and the other end closed. Steam admitted to the closed end of the cylinder presses against the piston, which is properly proportioned for the steam acting on it to balance as nearly as is practicable the pressure on the valve. The cylinder *w* may be placed in line with the valve-stem, which will then have a direct connection with the piston-rod *v*.

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

The cut-off *K*, applied to oscillate on the stem of and in contact with the back of an independently-oscillating slide-valve within one of the trunnions of an oscillating steam-engine, in combination with the adjustable arc piece or double stop *m*, also applied within the trunnion, but movable or adjustable under the control of a governor or other device on the exterior thereof, the whole operating substantially as herein set forth.

WILLIAM CRAIG.

Witnesses:

M. M. LIVINGSTON,  
C. W. COWTAN.