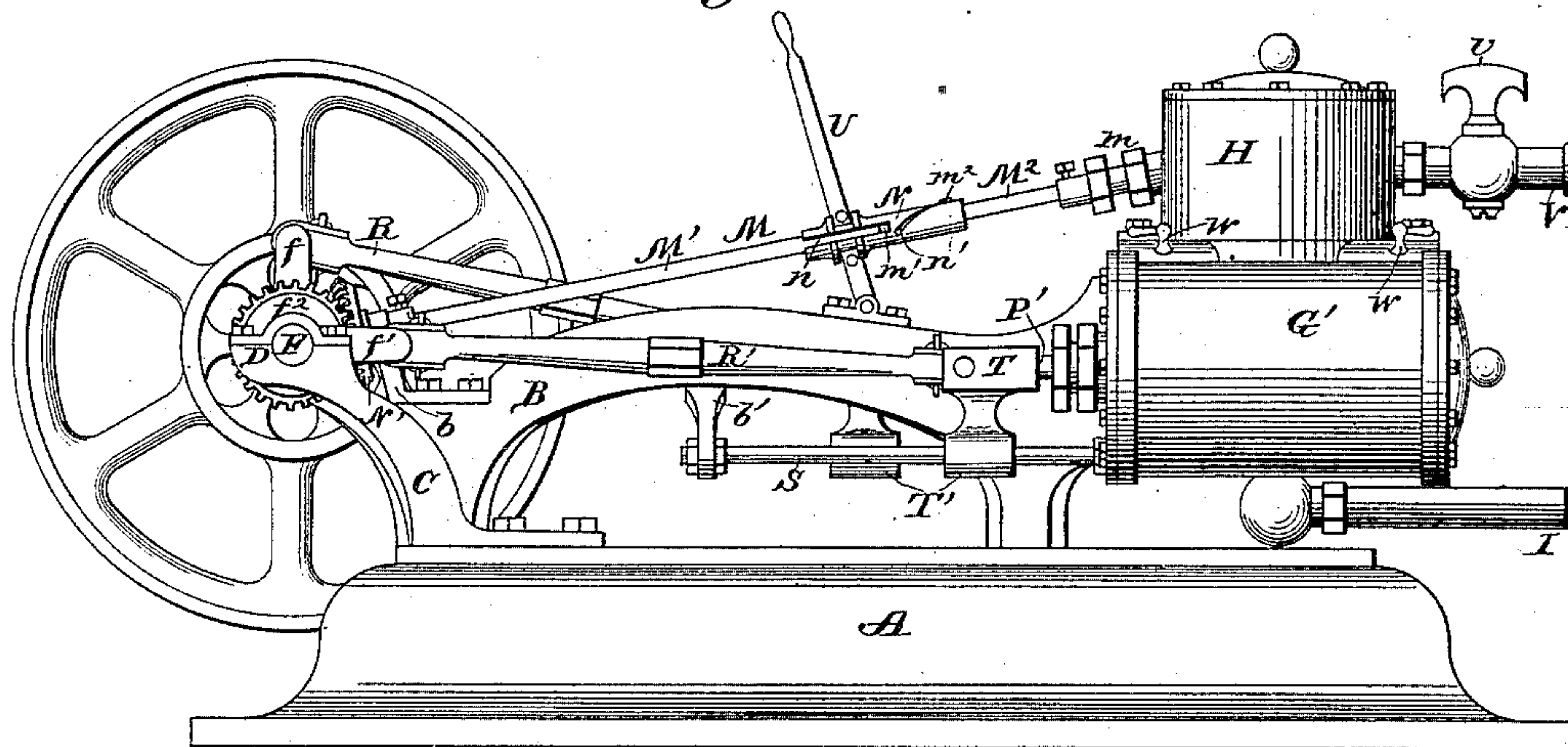


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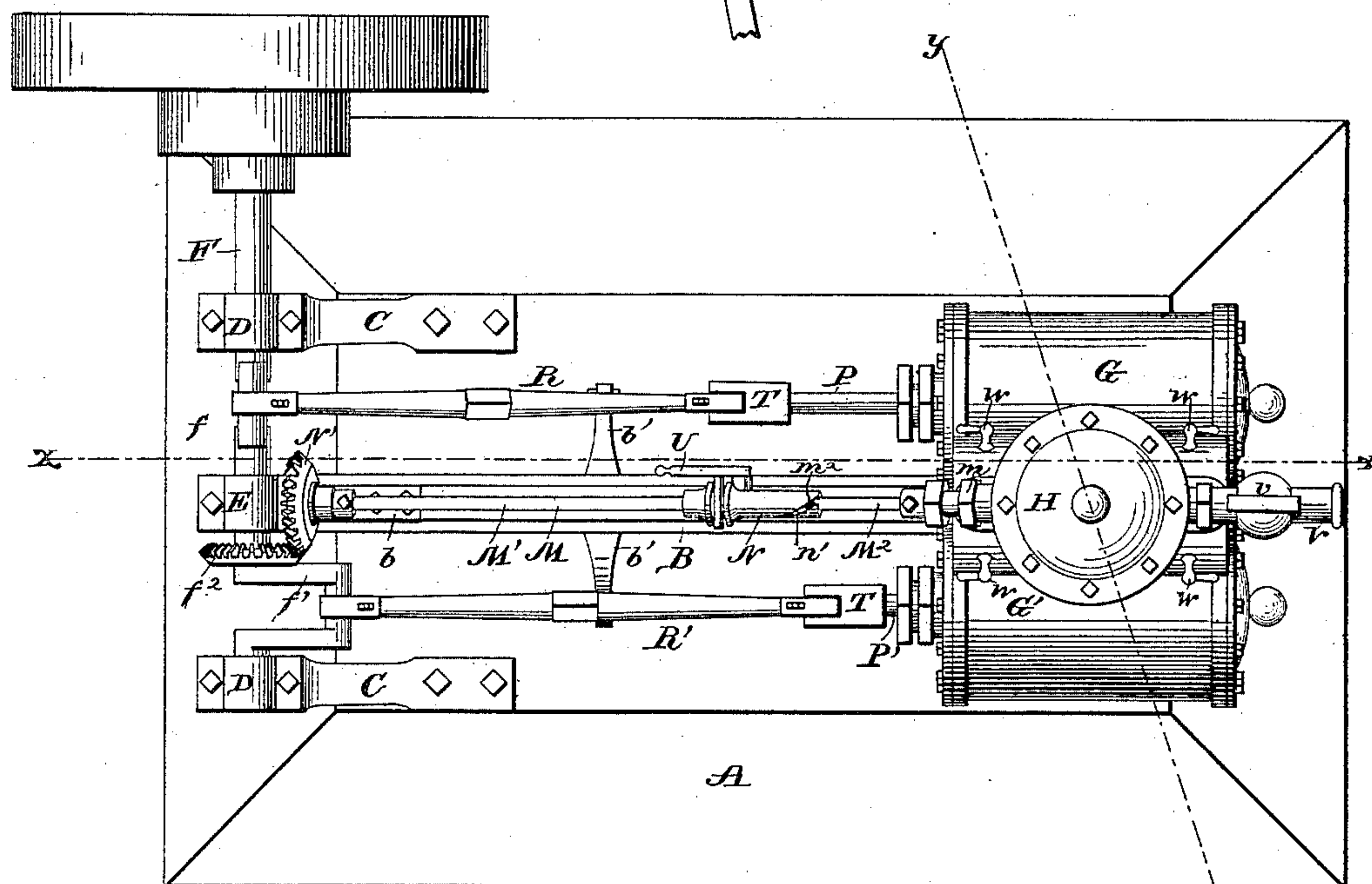
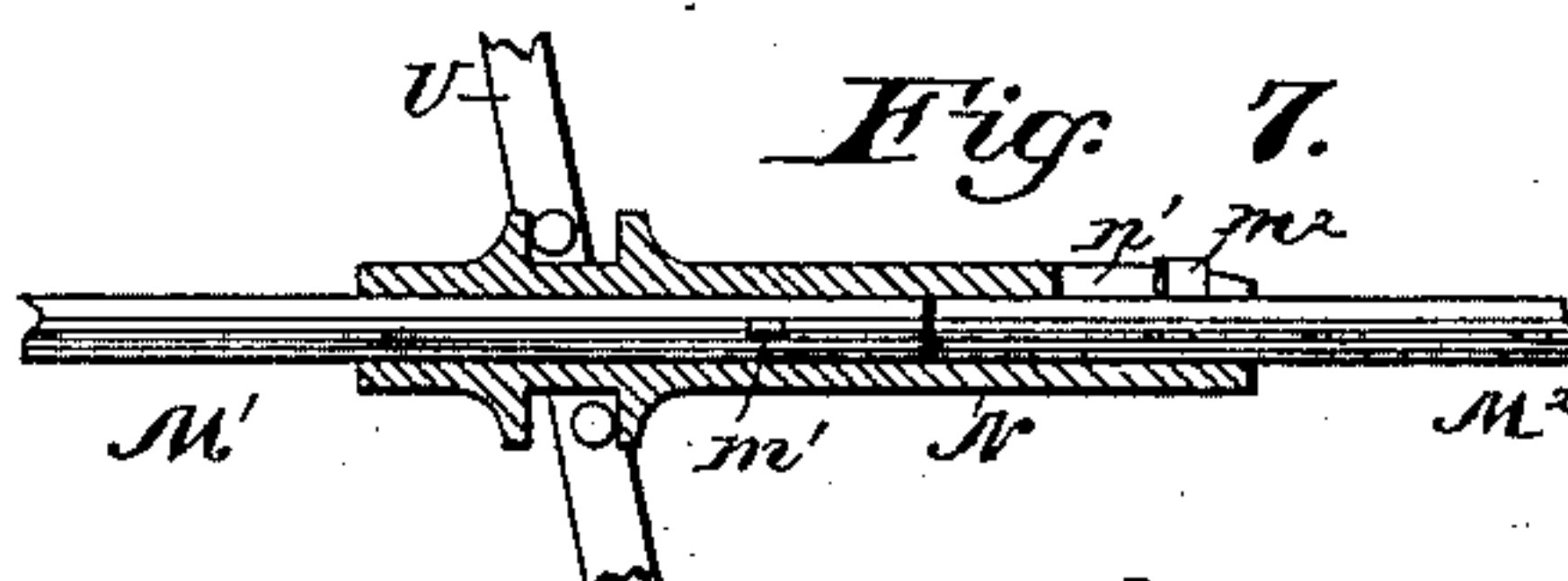
## STEAM ENGINE.

Patented Mar. 30, 1886.

*Fig. 1.*



*Fig. 7.*



*Fig. 2.*

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(No Model.)

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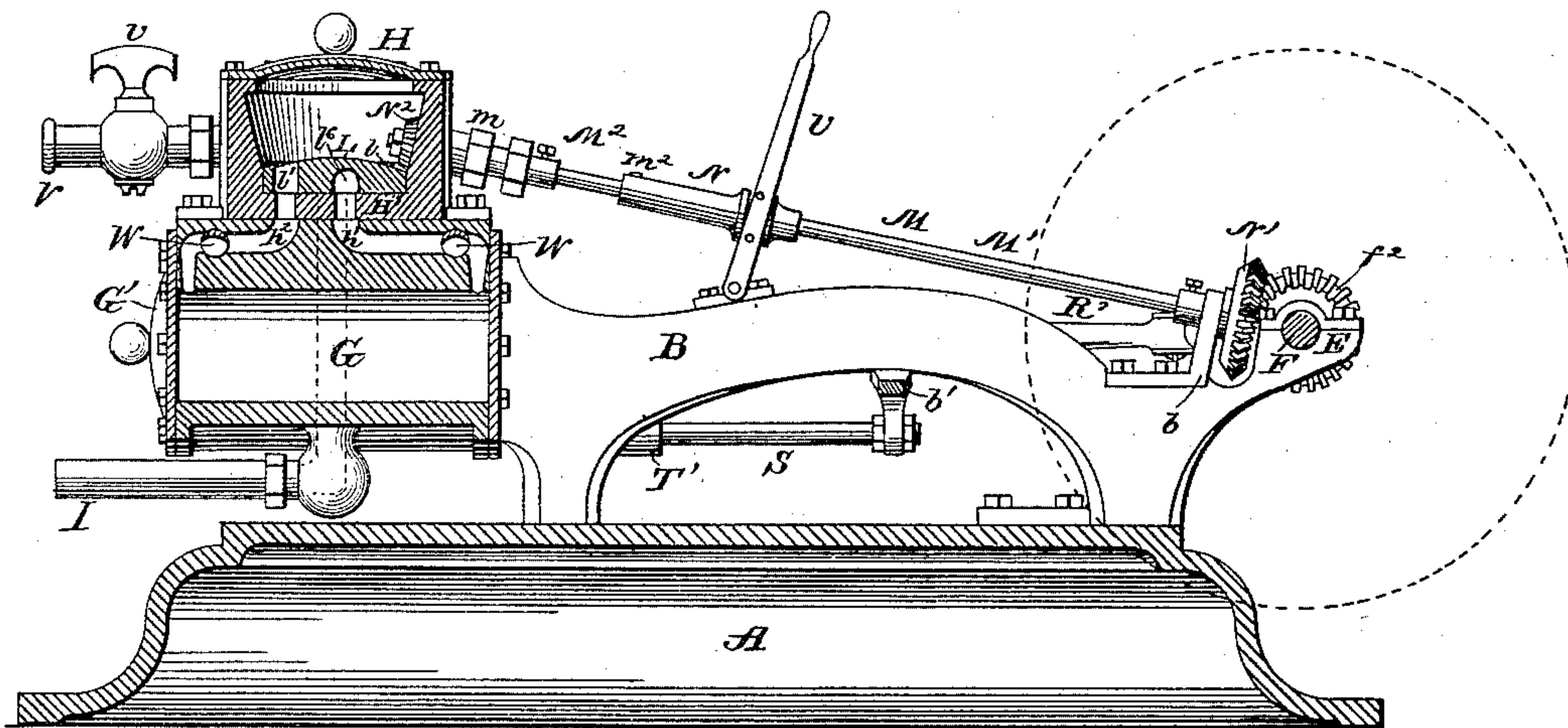
O. F. RODEHAVER.

STEAM ENGINE.

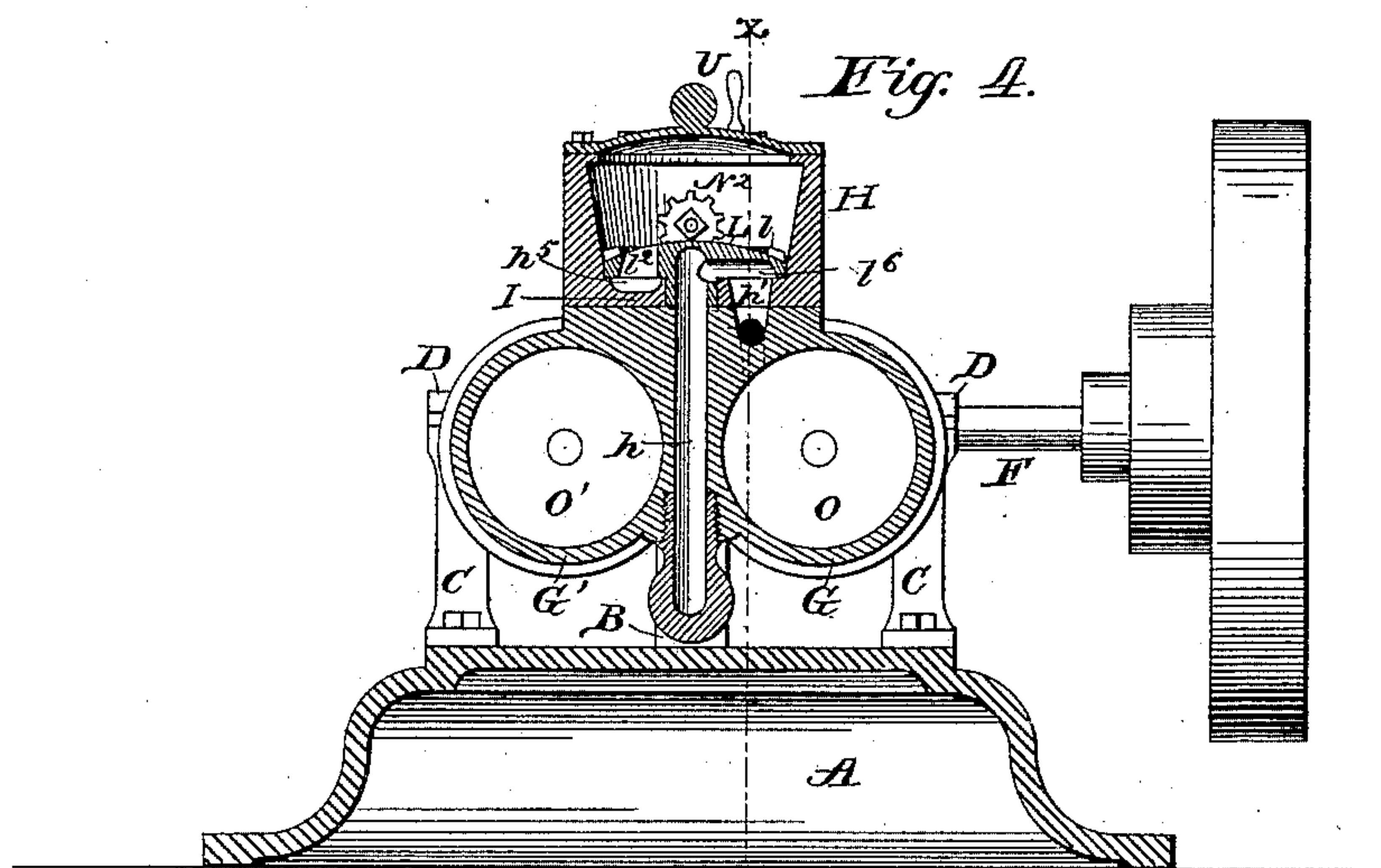
No. 339,074.

Patented Mar. 30, 1886.

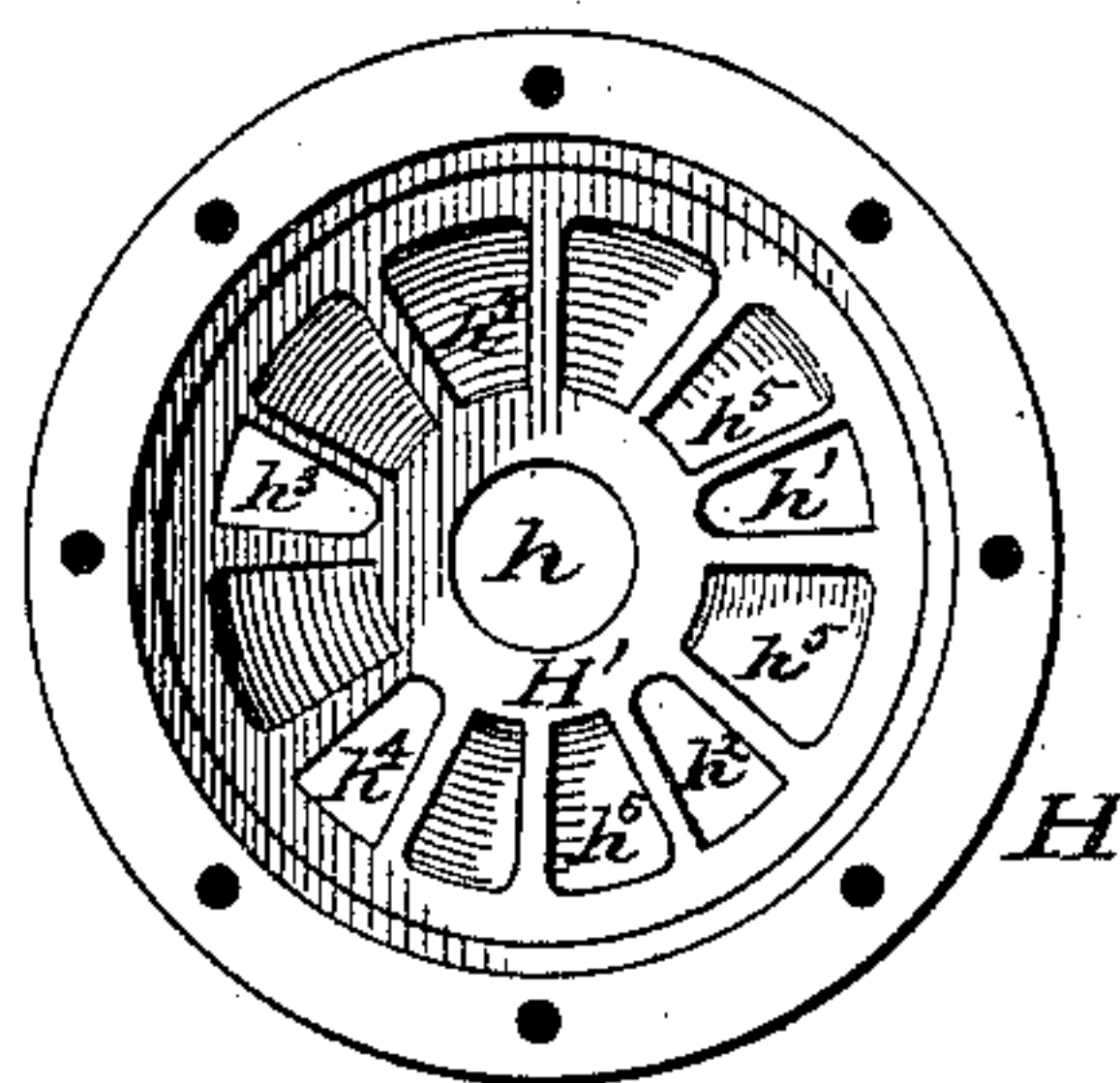
*Fig. 3.*



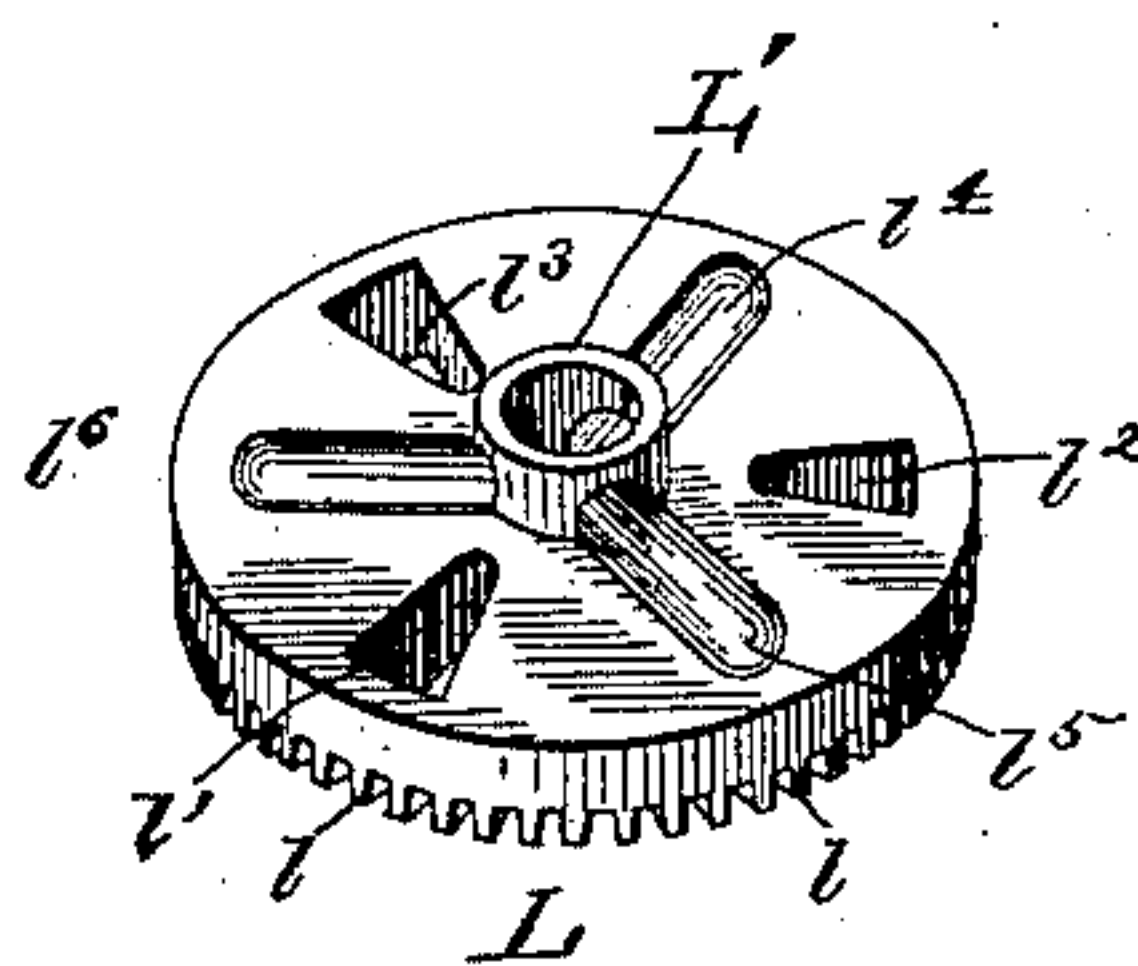
*Fig. 4.*



*Fig. 5.*



*Fig. 6.*



Witnesses

*Percy C. Bowen.*  
*J. W. Ganner*

Inventor

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By his Attorneys

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# UNITED STATES PATENT OFFICE.

OSCAR F. RODEHAVER, OF ZANESVILLE, ASSIGNOR OF ONE-HALF TO EDWARD ELLIS, OF ELLIS, AND THOMAS W. LEWIS, OF ZANESVILLE, OHIO.

## STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 339,074, dated March 30, 1886.

Application filed December 7, 1885. Serial No. 184,946. (No model.)

*To all whom it may concern:*

Be it known that I, OSCAR F. RODEHAVER, a citizen of the United States, residing at Zanesville, in the county of Muskingum and State of Ohio, have invented a new and useful Improvement in Steam-Engines, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to an improvement in steam-engines; and it consists in the peculiar construction and combination of devices that will be more fully set forth hereinafter, and particularly pointed out in the claims.

In the drawings Figure 1 is a side elevation of a steam-engine embodying my invention. Fig. 2 is a top plan view of the same. Fig. 3 is a vertical longitudinal sectional view taken on the line  $x x$  of Fig. 2. Fig. 4 is a vertical transverse sectional view taken on the line  $y y$  of Fig. 2. Fig. 5 is a detailed plan view of the valve-seat. Fig. 6 is a detailed view of the valve. Fig. 7 is a detailed sectional view of the reversing-sleeve.

A represents the base or support of the engine, on the upper side of which is bolted a longitudinal bridge, B. Standards C are on the front end of the base, and are provided at their outer upper ends with boxes D. The bridge has a box, E, at its front end in line with the boxes D, and in the said boxes D and E is journaled a driving-shaft, F, which has cranks  $f$  and  $f'$ , that extend from the shaft at right angles to each other. To the rear end of the bridge are secured the steam-cylinders G and G', and midway between the said cylinders, on their upper sides, is located a steam-chest, H, which is circular or cylindrical in shape, as shown.

The bottom of the steam-chest is formed into a circular valve-seat, H'. An exhaust-port,  $h$ , extends from the center of the valve-seat down between the steam-cylinders and communicates with an exhaust-pipe, I.

$h'$  and  $h^2$  represent ports that extend from the valve-seat to the front and rear ends, respectively, of the cylinder G, and  $h^3$  and  $h^4$  represent ports that extend from the valve-seat to the front and rear ends, respectively, of the cylinder G'. These ports are arranged radially from the exhaust-port, and the spaces

between the said ports are cupped or recessed, as at  $h^5$ , forming steam-chambers to cushion the valve L, which is rotary and bears on the face of the valve-seat. This valve has crown-teeth  $l$  on its upper side, and is provided with openings  $l'$ ,  $l^2$ , and  $l^3$  that are arranged at equal distances from each other and pass over the ports  $h'$ ,  $h^2$ ,  $h^3$ , and  $h^4$  as the valve rotates. A central stud,  $L'$ , depends from the lower side of the valve and enters a countersunk opening made in the valve-seat.

Formed with or secured to the shaft F, near the center of the said shaft, is a miter gear-wheel,  $f^2$ .

M represents a shaft that is journaled near its lower end in a standard,  $b$ , that projects from the bridge, and has its upper end journaled in a stuffing-box,  $m$ , secured in the front side of the steam-chest. This shaft M is formed in two sections,  $M'$   $M^2$ , the meeting ends of which are connected by a hollow sleeve, N. This sleeve has a straight longitudinal slot,  $n$ , in its lower end, and an oblique slot,  $n'$ , in its upper end. The section  $M'$  of the shaft has a stud,  $m'$ , that works in the slot  $n$ , and the section  $M^2$  has a stud,  $m^2$ , that works in the slot  $n'$ .

To the lower end of the shaft M is keyed a miter gear-wheel,  $N'$ , that meshes with the wheel  $f^2$ , and to the upper end of the said shaft within the steam-chest is secured a spur-pinion,  $N^2$ , that meshes with the toothed valve.

Pistons O and O' work in the cylinders G and G', respectively, and have piston-rods P and P' and pitmen R R' that connect them with the cranks of the driving-shaft in the usual way.

An arm,  $b'$ , extends transversely from the lower side of the bridge near its front end, and to the outer ends of this arm are attached the front ends of guide-rods S, which are arranged parallel with and below the piston-rods, and have their rear ends secured in the front cylinder-heads. The cross-heads T, that connect the piston-rods and the pitmen, have depending extensions T', that are bored to receive the guide-rods and reciprocate thereon.

U represents a hand-lever, which is fulcrumed at its lower end to the bridge near the



inner end of the latter, and is connected to the sleeve N.

An inlet-pipe, V, communicates with the steam-chest and is provided with a valve, v, to control the amount of steam fed to the engine.

The operation of my invention is as follows: We will assume that the engine is at its initial position when the opening  $l'$  of the valve registers with the port  $h^2$ . When steam is admitted to the steam-chest, it finds its way through the opening  $l'$  and port  $h^2$  into the cylinder G behind the piston O, forcing the latter out and partly rotating the crank-shaft, which latter is provided with the usual fly-wheel and driving-pulley. The motion of the crank-shaft is imparted to the valve through the shaft M and the gear-wheels previously described herein. Midway between the openings in the valve, on the underside thereof, are radial channels  $l^4$ ,  $l^5$ , and  $l^6$ . As the cranks on the driving-shaft are at an angle of forty-five degrees to each other, the outstroke of the piston O is followed, when the said piston is at the center of the cylinder G, by the piston O' in the cylinder G'. As the valve rotates the port  $h^2$  is closed and the port  $h^4$  uncovered by opening  $l^2$ , to admit steam behind the piston O' in cylinder G', and at the same time the channel  $l^5$  registers with port  $h^2$ . The opening  $l'$  then uncovers the port  $h'$  to admit steam in front of the piston O, to impart the backstroke thereto, the steam in the rear end of cylinder G being driven through the port  $h^2$  and the channel  $l^6$  into the exhaust-port. The opening  $l^3$  next uncovers the port  $h^3$ , and the channel  $l^4$  registers with the port  $h^4$  simultaneously, to admit steam to the front end of cylinder G' and exhaust it from the rear end thereof on the backstroke of the piston O, and so on, the valve making but one revolution to every three revolutions of the crank-shaft. The valve is thus permitted to run slowly and with very little friction.

In order to reverse the engine, the hand-lever U is moved toward the steam-chest, which causes the stud  $m^2$  of the shaft-section M<sup>2</sup> to travel in the oblique slot  $n'$  of the sleeve and impart the sufficient retrograde movement to the valve.

The ports leading to the cylinders are provided with valves W, which may be operated from the outside and caused to cut off the said ports. By this means, when one engine will furnish sufficient power, the other may be cut off by turning the valves and disconnecting its pitman from the crank-shaft.

An engine thus constructed is exceedingly compact, strong, and simple, and effects an economy in structure and a great reduction in friction, thus cheapening the cost of manufacture and correspondingly adding to its power and efficiency.

Having thus described my invention, I claim—

1. In a steam-engine, the combination of the bridge, the cylinders secured thereto, the transverse arm, and the guide-rods for the cross-heads secured to the said arm and to the cylinder-heads, substantially as described.

2. The combination, with the steam cylinder or cylinders having the exhaust-port, of the steam-chest, the rotary valve therein having the openings  $l'$ ,  $l^2$ , and  $l^3$ , and the channels on its under side communicating with the exhaust-port, the shaft geared with the valve and having a geared connection with the driving-shaft, said gear-connection allowing the latter shaft to revolve three times to every one revolution of the rotary valve, as set forth.

3. In a steam-engine having two cylinders and a common exhaust-port for both cylinders, the combination of the rotating valve having the openings  $l'$ ,  $l^2$ ,  $l^3$ , the central depending stud having the central bore or cavity, and the radial channels on the under side of the valve intermediate between the openings therein and communicating with the depending stud, and the valve-seat having the countersunk opening to receive the stud, substantially as described.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in presence of two witnesses.

OSCAR F. RODEHAVER.

Witnesses:

THOMAS W. LEWIS,  
EDWARD ELLIS.