

(No Model.)

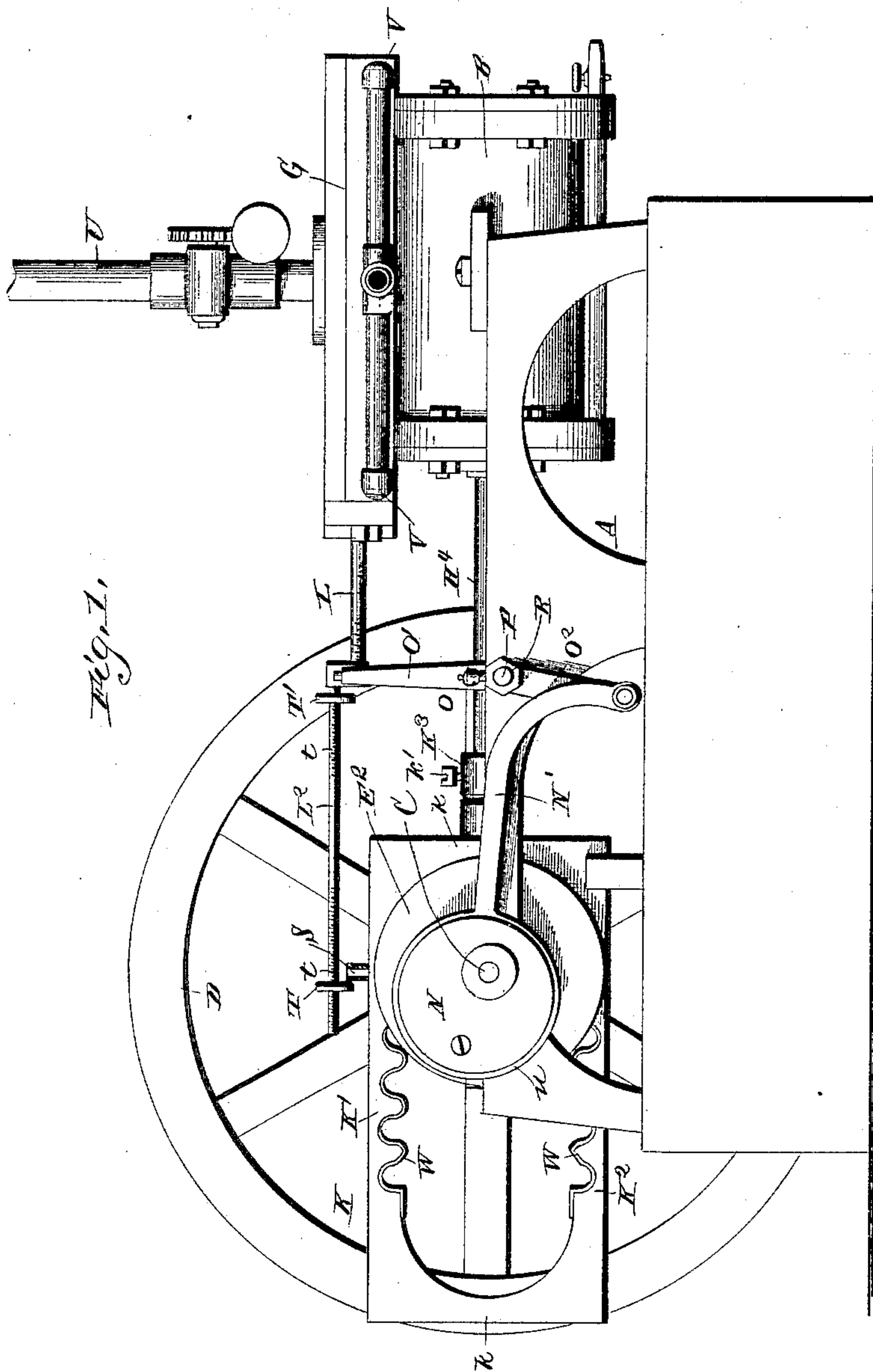
3 Sheets—Sheet 1.

F. WINN.

DIRECT ACTING STEAM ENGINE.

No. 394,047.

Patented Dec. 4, 1888.



Witnesses.

C. H. Taylor,  
C. E. Doyle.

Inventor,

Frank Weir.

by C. A. Howells,  
Attorneys.

(No Model.)

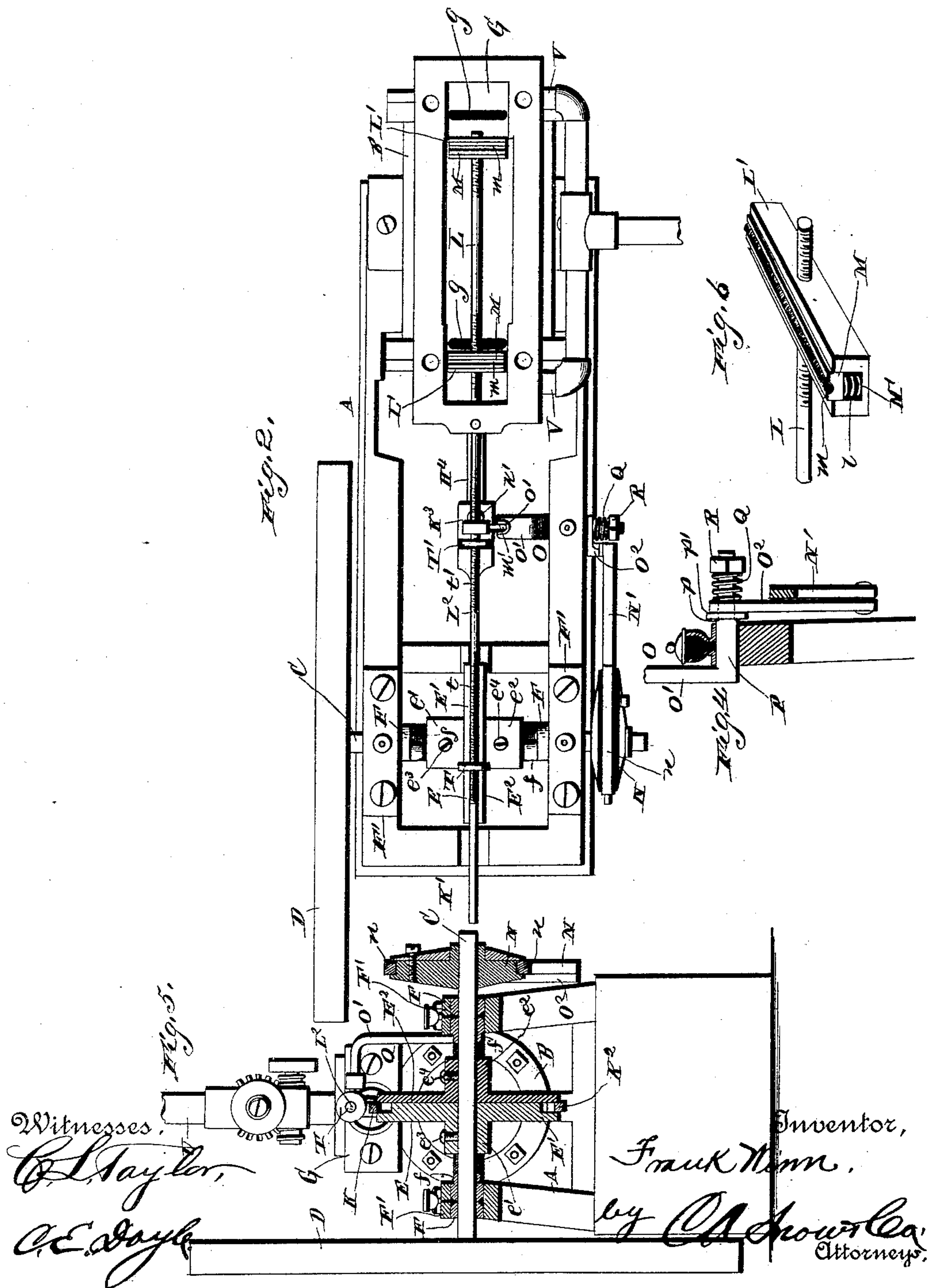
3 Sheets—Sheet 2.

F. WINN.

DIRECT ACTING STEAM ENGINE.

No. 394,047.

Patented Dec. 4, 1888.



(No Model.)

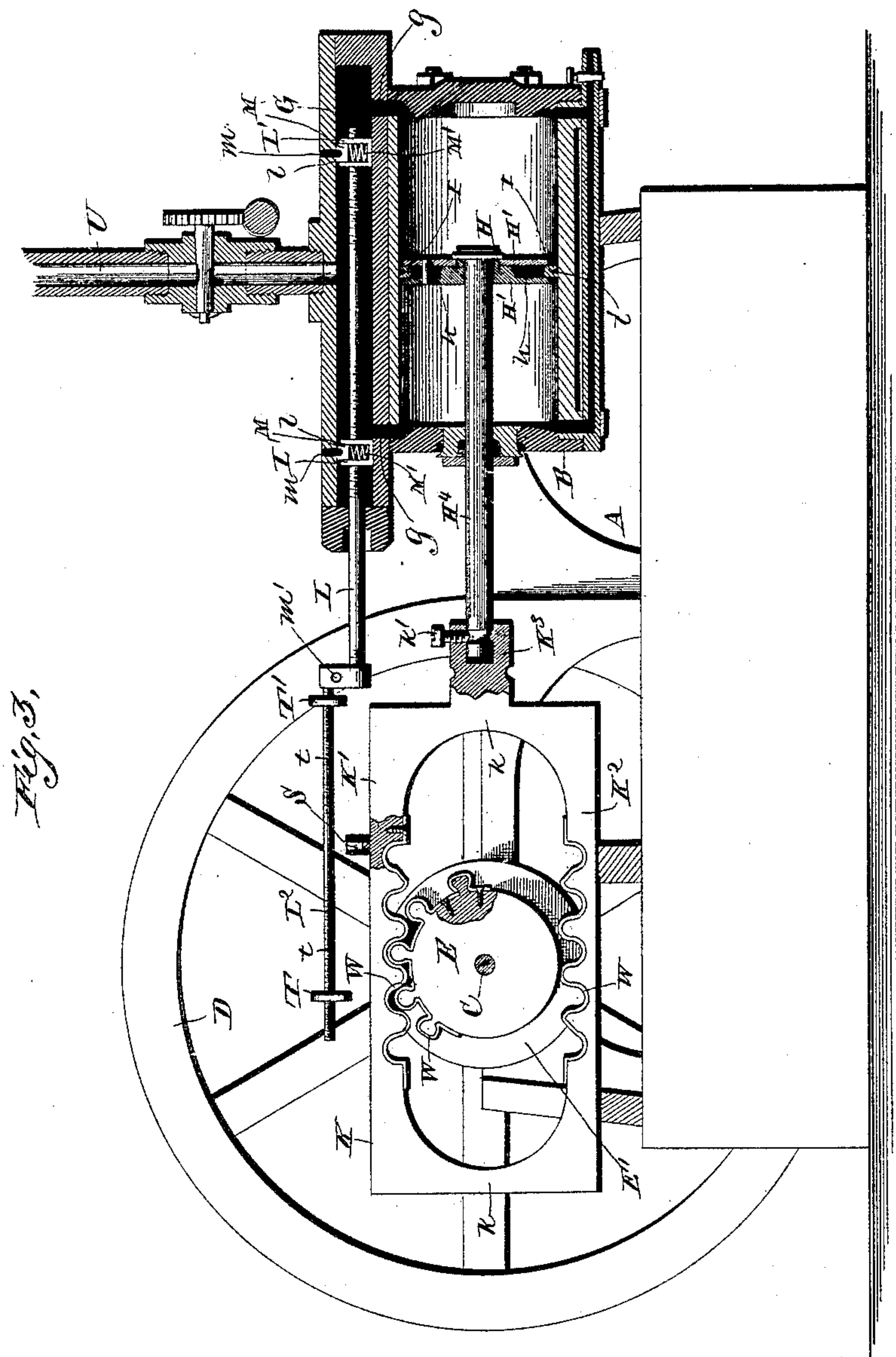
3 Sheets—Sheet 3.

F. WINN.

DIRECT ACTING STEAM ENGINE.

No. 394,047.

Patented Dec. 4, 1888.



Witnesses,

*C. D. Taylor,*  
*C. E. Dayle.*

Inventor,

*Frank Winn,*

*by C. A. Shaw & Co.*  
Attorneys.



# UNITED STATES PATENT OFFICE.

FRANK WINN, OF DALLAS, TEXAS.

## DIRECT-ACTING STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 394,047, dated December 4, 1888.

Application filed September 30, 1887. Serial No. 251,138. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK WINN, a citizen of the United States, residing at Dallas, in the county of Dallas and State of Texas, have invented new and useful Improvements in Direct-Acting Steam-Engines, of which the following is a specification.

My invention relates to improvements in direct-acting steam-engines; and it consists in a certain novel construction and arrangement of parts, fully set forth hereinafter, and specifically pointed out in the claims.

In the drawings hereto annexed, Figure 1 is a side view of the engine. Fig. 2 is a top plan view of the same with the top of the steam-chest removed. Fig. 3 is a central longitudinal section of the same. Fig. 4 is a detail view, partly in section, of the lever for operating the valve-stem. Fig. 5 is a transverse sectional view taken longitudinally of the main shaft. Fig. 6 is a detail view of one of the valves.

Referring by letter to the drawings, A designates the bed or frame of the engine; B, the cylinder at one end thereof; C, the main shaft of the engine journaled at the opposite end of the bed from the cylinder, and D the driving-wheel on the main shaft.

E designates a gear-wheel secured on the main shaft near the center thereof, having a series of cogs or teeth thereon extending a short distance around the periphery of the wheel. This gear-wheel is in effect a segmental gear-wheel, and the teeth thereon are round, with the exception of those at the ends of the series, which are slightly flattened or elliptical in shape.

E' represents a disk, which is secured rigidly on one side of the cog-wheel, and it extends slightly beyond the outer ends of the cogs on the said wheel, so as to protect them. The said disk is preferably formed integral with the cog-wheel, and it is provided on the outer side with a collar, e', surrounding the main shaft and secured rigidly thereto by means of the set-screw e<sup>3</sup>.

E<sup>2</sup> designates a disk similar to the disk E', which is placed on the opposite side of the cog-wheel and protects or covers the cog-teeth on that side, and the disk E<sup>2</sup> is provided on the outer side with a collar, e<sup>2</sup>, to embrace the main shaft, and the same is held in place by

the set-screw e<sup>4</sup>. It will be seen that a groove is formed between the disks E' and E<sup>2</sup>, and in the said groove is arranged a series of cog-teeth.

F F designate sleeves which embrace the shaft C and bear in sockets or semicircular recesses in the sides of the frame of the engine, and F' F' represent caps or blocks provided on the under sides with similar semicircular recesses, which are adapted to be bolted over the said sleeve, and thus bind it in the recesses in the frame. The inner ends of the said sleeves are provided with squared bosses ff, adapted to be engaged by a wrench, and the interior of the sleeves is grooved and the grooves filled with Babbitt-metal bushing.

On the upper side of the cylinder is the steam-chest G, and g g are the passages or ports for the steam, which lead from the chest into the cylinder on opposite sides of the piston-head H.

V V are the exhaust-pipes, which lead from the sides of the steam-chest near the ends, to convey away the steam which has been used. The piston-head H comprises the two parallel circular disks H' H', arranged a short distance apart and secured to the piston-rod H<sup>4</sup>.

h represents the space between the disks.

I represents the packing-ring formed in two semicircular sections, which are adapted to fit in the space h, and the outer side of the said ring is provided with a small groove, i, which is designed to be filled with packing in the ordinary manner.

K designates a sliding rack-frame, which is rectangular in shape and comprises the upper and lower bars, K' K<sup>2</sup>, respectively, and the end bars, k k. The inner sides of the upper and lower bars are provided with cogs or teeth, which are circular or rounded in shape, with the exception of the end teeth, which are slightly flattened on the outer sides to register with the flattened or elliptical teeth on the gear-wheel. The upper and lower bars of the rack-frame operate in the groove between the disks E' E<sup>2</sup>, and the teeth on the said bars engage with the teeth on the cog-wheel. The inner end of the rack-frame is provided with a sleeve, K<sup>3</sup>, which is secured rigidly on the end of the piston-rod by means of the set-screw k'.

L designates the valve-stem, passing



through a packing-box in the end of the steam-chest, and  $L'L'$  are the valves screwed on the said stem. The stem is threaded for a short distance on each side of the valves to allow of an adjustment of the valves toward and from each other.

$ll$  represent grooves on the upper sides of the valves, and in the said grooves are arranged the packing-bars  $M M$ , having small longitudinal grooves  $m$  therein to receive packing. Small spiral springs  $M' M'$  are arranged under the ends of the packing-bars to press them against the top of the steam-chest and render the escape of steam impossible. These valves, as will be understood, are adapted to close the passages  $g g$ , which lead from the steam-chest to the cylinder. The end of the valve-stem outside of the chest is provided on the side with a laterally-extending pin,  $m'$ , for a purpose to be hereinafter explained.

$N$  designates an eccentric secured on the main shaft, to the movable sleeve  $n$  of which is secured the end of the eccentric-rod  $N'$ , which extends forwardly and is curved downwardly at the front end.

$O$  designates the lever for operating the valve-stem, and it comprises two independent arms—the upper arm,  $O'$ , and the lower arm,  $O^2$ .

$P$  designates a shaft, which is journaled in the side of the frame of the engine, to the inner end of which is rigidly secured the upper arm,  $O'$ , and the upper end of the said arm is provided with a longitudinal slot,  $o'$ , to receive the pin  $m'$ . It will be seen that as the upper end of the arm  $O'$  is oscillated the valve-stem will be reciprocated by means of the pin  $m'$ , sliding in the slot  $o'$ . A shoulder,  $p$ , is formed on the shaft  $P$  near the outer end, and a friction-washer,  $p'$ , is arranged against the said shoulder. The lower arm of the divided lever  $O$  is journaled on the outer end of the shaft  $P$  on the outer side of the said friction-washer, the lower end of the said arm being connected to the front end of the eccentric-rod  $N'$ .

$Q$  represents a coiled tension-spring arranged around the shaft  $P$  on the outer side of the upper end of the lower arm,  $O^2$ , and the nut  $R$  is screwed on the end of the shaft on the outer side of the said spring. The spring is very strong, and it will be seen that when the nut  $R$  is screwed tightly against the outer end of the spring the inner end thereof will press with considerable force against the upper end of the arm  $O^2$ . Consequently, if the lower end of the arm  $O^2$  is oscillated, the friction between the upper end thereof and the shaft  $P$  will cause the latter to turn, and as the upper arm,  $O'$ , is attached to the said shaft it also will be oscillated.

Thus it will be readily seen that although the lever is broken or divided, and the arms thereof may, if desired, be moved in opposite directions or independently of each other, the frictional contact between the said arms, caused

by the tension-spring, is sufficient to cause one of the arms to be moved when the other is moved, provided there is nothing to interfere with its motion. Therefore, as the upper end of the arm  $O'$  is connected to the valve-stem, and the lower arm,  $O^2$ , is connected to the eccentric on the main shaft, the valves will be operated to cut off and admit the steam in the same manner as if the lever were rigid and formed in one piece. The upper bar of the rack  $K$  is provided with a vertical finger,  $S$ . The valve-stem is extended rearwardly over the rack and threaded, as seen at  $t t$ , and  $T T'$  are interiorly-tapped stops which are screwed on the said threaded portions in the path of the finger  $S$ ; and it will be seen that the said stops may be adjusted at will on the extension  $L^2$  of the valve-stem.

The operation of the engine is as follows: The steam is admitted through the pipe  $U$  on the upper side of the steam-chest, and the force of the said steam as it enters the chest does not come upon the valve in such a way as to render the operation thereof more difficult at one point than at another; but the pressure is divided, acting in both directions equally, and therefore not affecting the operation of the valves in the least. The steam passes into the cylinder on one side of the piston, and as the latter moves (say from left to right) the rack bar or frame is similarly operated. Therefore the teeth on the upper bar of the said frame engage with the teeth of the cog-wheel and turn the latter. The movement of the said wheel operates the main shaft, and consequently the eccentric, and therefore the valves are moved through the agency of the divided lever (which is now acting as a rigid lever) and the valve-stem. Just before the piston-head arrives at the end of the stroke (and before the valves could be operated by the lever above described) the finger on the rack-bar strikes the stop on the inner end of the extension to the valve-stem and cuts the steam off instantly and admits it on the other side of the piston, thereby forming a cushion of steam, against which the piston presses. It will be understood that the piston is almost at the end of the stroke before the steam is reversed, and therefore the motion of the same is not interfered with, but it is immediately started in the reverse direction, due to the force of the steam. This action is repeated at the opposite end of the cylinder. It will now be readily seen that without the automatic cut-off, consisting of the finger on the rack-bar acting against the stops on the valve-stem, the engine would operate as the lever would actuate the valve-stem and cut-off and admit the steam in the ordinary manner; but the action of the said lever cut-off is too slow at the end of the stroke, and if it only were used there would be a hammer, caused by the end teeth of the sliding frame striking against the gear-wheel. This hammer or knock is entirely avoided by the use of the instantaneous cut-off above described,



for the reason that just before the piston reaches the end of the stroke steam is admitted on the opposite sides thereof, and a cushion is formed, which entirely deadens the shock and causes the piston to turn from one motion to the other quickly.

The finger S on the rack-bar is preferably covered with rubber, or any similar padding, to deaden the noise caused by striking against the stops at each end of the stroke.

The object in forming the end teeth of the rack with a beveled portion and flattening the end teeth of the cog-wheel is to enable the engagement of the said teeth to be close and perfect as the rack-frame turns to make the return motion. As the piston moves from left to right, the upper rack-bar of the sliding frame is in engagement with the gear-wheel, and when it reaches the end of the stroke the lower rack-bar engages the said teeth to continue the motion of the gear-wheel, and it is at the point where the upper bar releases and the lower bar engages the gear-teeth that there is the greatest danger of a jar or hammer; but by forming the end teeth as herein described all such danger is avoided and the rack changes from one motion to the other without the slightest jar, causing the cog-wheel to have a steady rotation.

The object in forming the lever O in two independent portions connected by a tension-spring will now be evident. The eccentric controls the operation of the valve, moving it in the ordinary manner; but at the same time, when the piston has almost reached the end of the stroke, the valves are operated by the action of the finger S upon the stem. When the finger strikes the stop on the stem, the upper arm of the lever is necessarily moved independently of the lower arm, and hence the reason for making the said arms independently movable.

As a protection to the teeth of the gear-wheel, and also of the rack-bar, a shell or covering, W, is secured on the wearing-faces thereof, conforming exactly to the shape of the teeth. When this shell becomes worn, it may be removed, as it is only secured on by screwing or other simple means, and a new shell substituted. This construction is shown in the drawings.

It will be understood from the description of the valves in the steam-chest that it is not necessary to form grooves in the packing-bars and fill the same with packing, as the pressure of the bars against the side of the chest will be sufficient to prevent the escape of steam.

This engine may be arranged to operate as an upright as well as a horizontal engine, as will be readily understood.

Having thus described my invention, I claim—

1. The combination, with the piston-rod carrying the piston, and the valve-stem carrying the valves to operate in the steam-chest, of the shaft C, the gear-wheel E on the said shaft,

provided with a series of rounded teeth, the end teeth of the said series being slightly flattened or elliptical in form, the eccentric secured to the shaft, the lever O, connected at the lower end to the said eccentric and at the upper end to the valve-stem, and the rack-frame K, secured to the piston-rod and having the upper and lower toothed bars, K' K<sup>2</sup>, alternately engaging the said gear-wheel and provided with flattened or elliptical teeth at their ends to register with the flattened or elliptical teeth on the gear-wheel, all constructed and arranged substantially as and for the purpose specified.

2. The combination, with the piston-rod carrying the piston, and the valve-stem carrying the valves, of the shaft C, operated by the piston-rod, the eccentric on the shaft, the lever O, comprising the arms O' O<sup>2</sup>, pivoted together and capable of independent movement, and connected, respectively, to the eccentric and the valve-stem, and the spring to hold the said arms in frictional contact, substantially as and for the purpose specified.

3. The combination, with the valve-stem and piston-rod, of the shaft C, the eccentric on the shaft having the rod N' attached thereto, the shaft P, having the shoulder p thereon, the arm O', attached thereto and connected at the upper end to the valve-stem, arm O<sup>2</sup>, journaled on the shaft P, the nut to screw on the outer end of the shaft P, and the spring Q, coiled around the shaft and bearing at opposite ends against the arm O<sup>2</sup> and the nut, substantially as and for the purpose specified.

4. The combination, with the piston-rod and the valve-stem having the stops T T' thereon, of the shaft C, having the gear-wheel E and the eccentric N thereon, the shaft P, parallel with the main shaft and having the shoulder p thereon, the arm O', attached thereto and connected at the upper end to the valve-stem, the arm O<sup>2</sup>, journaled on the shaft P and bearing against the shoulder p, the thumb-nut on the outer end of the shaft, the tension-spring Q on the shaft and bearing at the ends against the arm O<sup>2</sup> and the nut, the rack-frame K, secured to the end of the piston-rod and having the toothed bars K' K<sup>2</sup> to alternately engage the gear-wheel E, and the finger S on the said frame to engage the stops T T' alternately at the opposite ends of the stroke to cut off the steam instantaneously, all constructed and arranged substantially as and for the purpose specified.

5. The combination, with the piston-rod and the threaded valve-stem L<sup>2</sup>, adapted to be operated in the usual manner, the adjustable stops T T', mounted on the threaded portion of the said valve-stem, the shaft C, having the gear-wheel E thereon, provided with a segmental series of teeth, of the rack-frame K, attached to the end of the piston-rod and having the upper and lower toothed bars, K' K<sup>2</sup>, to alternately engage the teeth of the gear-wheel, and the finger S on the upper side of the frame adapted to alternately strike the



stops T T' near the ends of the stroke and cause an instantaneous reversal of the steam to form a cushion between the end of the cylinder and the piston, substantially as and for the purpose hereinbefore specified.

6. The combination, with the piston-rod and the valve-stem adapted to be operated in the usual manner, the adjustable stops T T' on the said valve-stem, the shaft C, having the segmental gear-wheel E and the eccentric N thereon, the divided lever O, comprising the independent arms O' O<sup>2</sup>, pivoted together, and the tension-spring to bind the said arms together for simultaneous operation, the lower arm being connected to the eccentric and the upper arm to the valve-stem, of the rack-frame K, connected to the piston-rod and having the rack-bars K' K<sup>2</sup> to alternately engage the segmental gear-wheel, and the finger S, carried by the frame K and adapted to engage the stops T T' on the valve-stem at opposite ends of the stroke to cause an instantaneous cut-off, substantially as and for the purpose specified.

7. The combination, with the valve-stem having the adjustable stops T T' thereon, and the piston-rod carrying a finger, S, to alter-

nately engage the said stops, of the shaft C, operated by the piston-rod and having the eccentric thereon, and the lever O, connected at the lower end to the said eccentric and at the upper end to the valve-stem, substantially as and for the purpose specified.

8. The combination, with the cylinder and the steam-chest, of the piston, the valve-stem operating in the steam-chest, the valve on the said stem having the groove in the upper side, the bar M, fitting in the said groove and having a groove, *m*, therein to receive packing, and the springs M' under the bar M, to normally press it against the side of the steam-chest, the rack K on the piston-rod, having the stud S, and the stops T T' on the valve-stem, acted upon by the said stud, substantially as and for the purpose specified.

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

FRANK WINN.

Witnesses:

E. G. SIGGERS,  
MYRTLE STALNAKER.