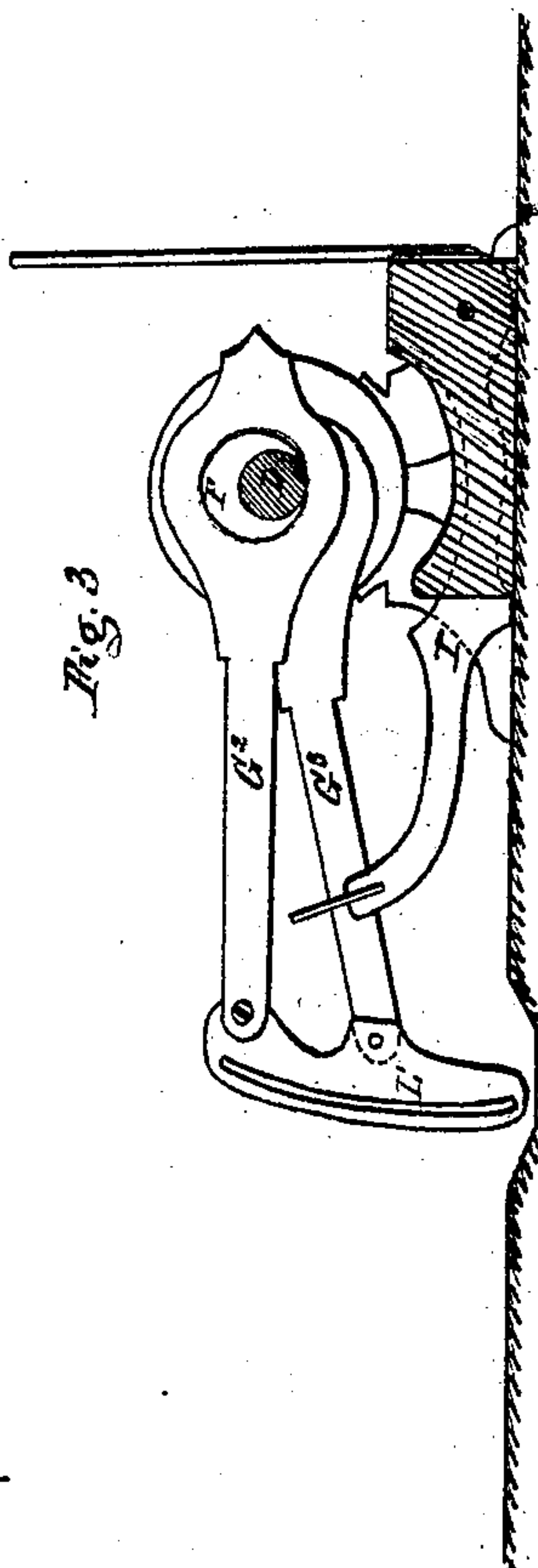
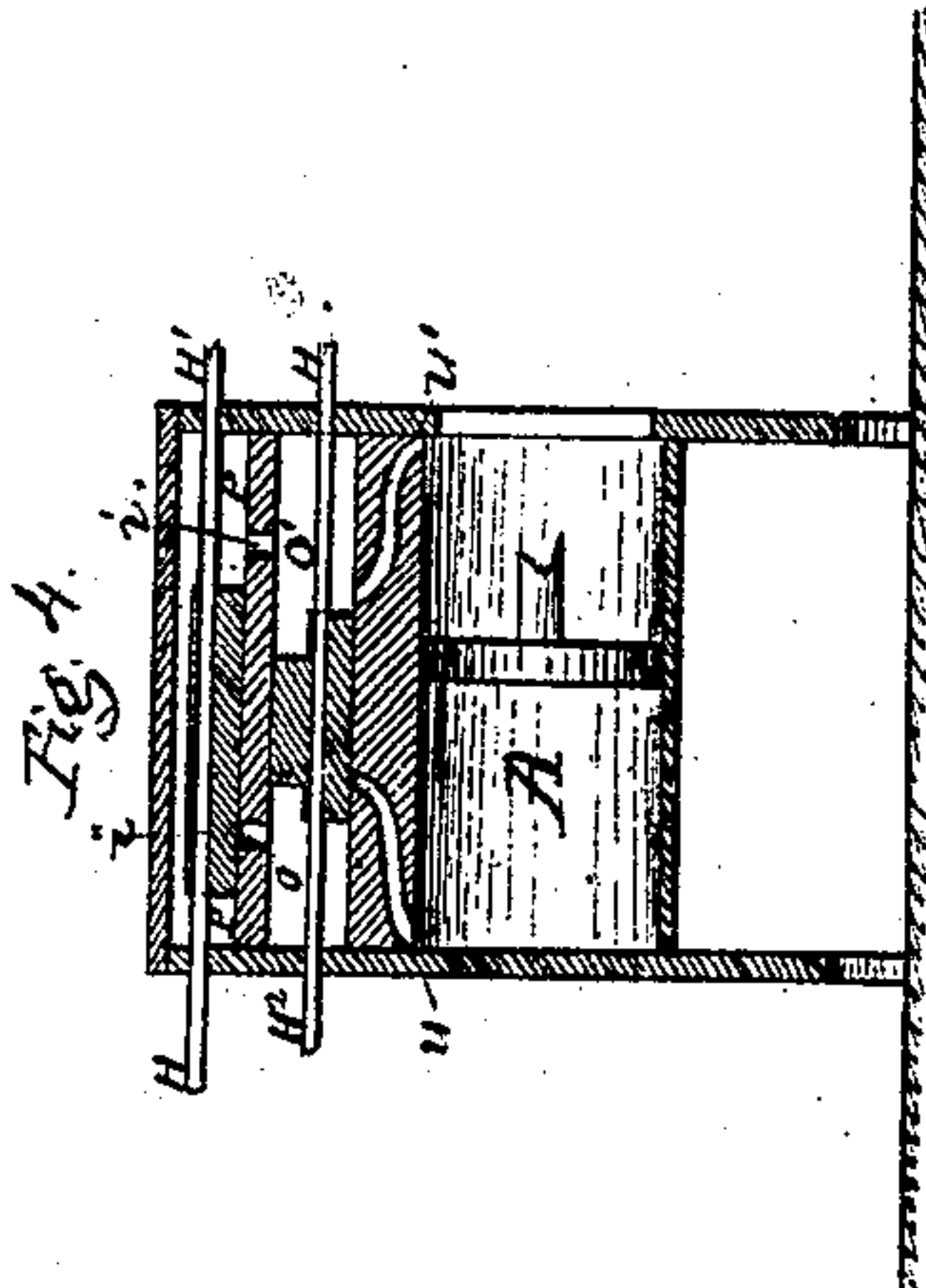


2. Streets. Sheet 1.

No. 93383.

Patented Aug. 3. 1869.



Attest
Th. Clausen
A. Ruppert.

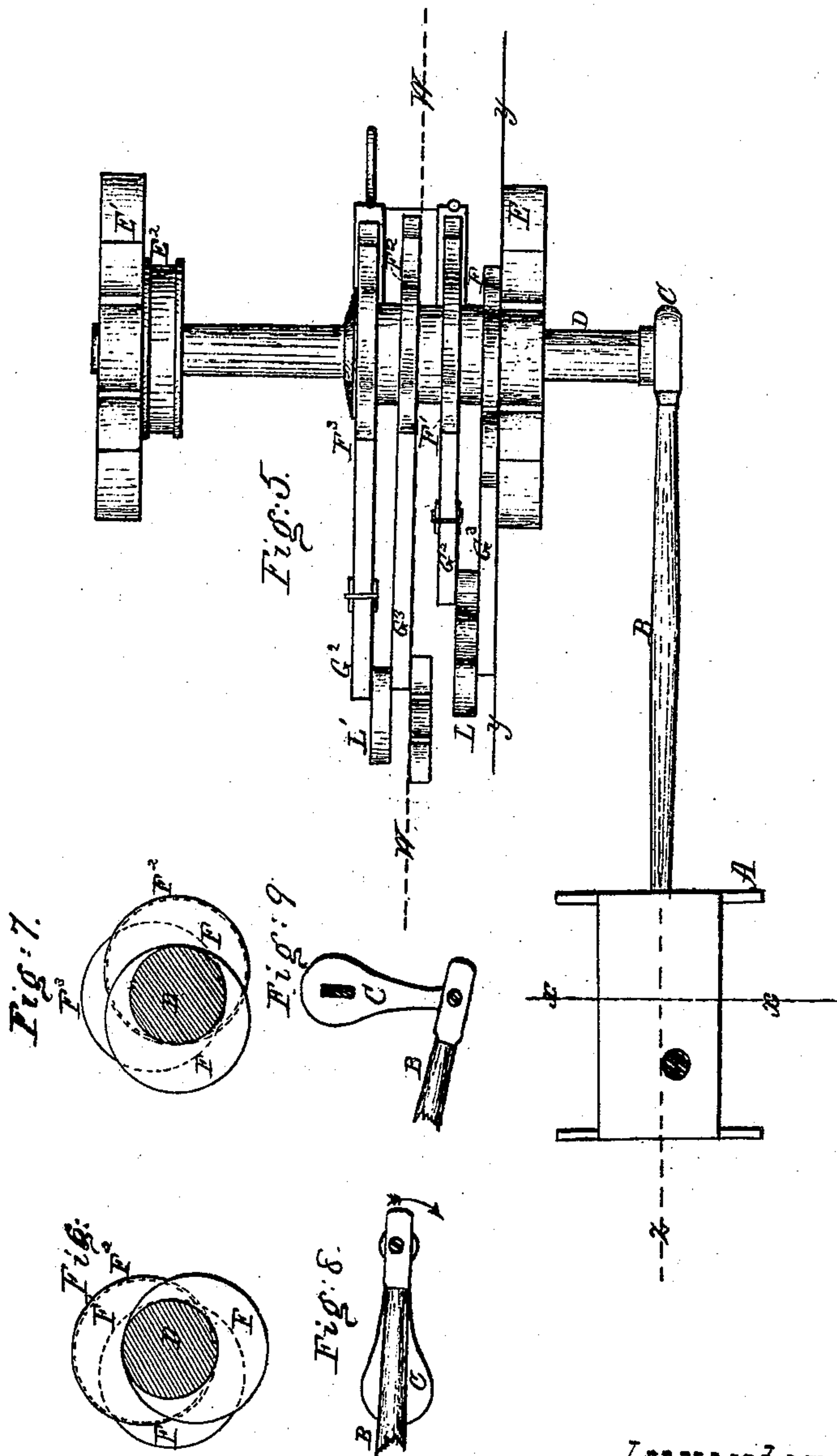
Inventor
J. D. Willoughby

J. D. Willoughby, 2. Sheets, Sheet 2.

Steam Engine.

No. 93383.

Patented Aug. 3. 1869.



Witnesses.
C. F. Clausen.
a. Ruppert.

Inventor.
J. D. Willoughby

United States Patent Office.

JAMES D. WILLOUGHBY, OF SHIPPENSBURG, PENNSYLVANIA.

Letters Patent No. 93,383, dated August 3, 1869.

IMPROVEMENT IN STEAM-ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, JAMES D. WILLOUGHBY, of Shippensburg, in the county of Cumberland, and State of Pennsylvania, have invented a new and useful Improvement in Steam-Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the annexed drawings, and to the letters of reference marked thereon.

This invention relates to steam-engines; and

It consists in the construction, combination, and arrangement of its parts, as will be more fully described hereinafter.

Figure 1 is a side elevation;

Figure 2 is a transverse vertical section on line *x x* of fig. 5;

Figure 3 is a longitudinal vertical section on line *W W*, fig. 5;

Figure 4 is a vertical longitudinal section on line *z z*, fig. 5;

Figure 5 is a plan view;

Figure 6 is a transverse vertical section on line *y y* of fig. 5;

Figure 7 is a transverse vertical section on line *W W* of fig. 5;

Figure 8 shows the position the crank and shaft are in, when the eccentrics are in the position shown in fig. 6; and

Figure 9 shows the position the crank and shaft are in, when the eccentrics are in the position shown in fig. 7.

A is the steam-cylinder; B, the piston-rod; *c*, the crank; and D, the shaft, all made as such parts are usually made.

E E are bearings, that hold the shaft in its proper position.

F F¹ F² F³ are the eccentrics, that are on the shaft D. Their position is shown in figs. 6 and 7.

Fig. 6 shows the position of the eccentrics when the engine is on its dead-centre, as shown by the position of the crank in fig. 8.

Fig. 7 is the position the eccentrics are in when the engine is at half stroke, as is shown by the position of the crank in fig. 9.

The eccentric F² is shown, in dotted lines, behind F¹, in figs. 6 and 7. It is placed on the shaft D, at a right angle to the crank *c*.

The eccentric F³ is placed on the same shaft, one-fourth of a revolution behind F².

G and G¹ are rods, extending from the eccentrics F and F¹ to the link L, and are pivoted to each end of the link, in the usual manner.

This link has a slot in it, longitudinally. Into this slot, one end of the rod H is entered, the other end being attached to the valve H².

G² and G³ are rods, of equal length, that extend from the eccentrics F² and F³ to the link L¹. One rod

is pivoted to the upper end of the link, and the other to the middle of the link, as seen in fig. 3.

The link has a longitudinal slot in it, into which one end of the rod H¹ is put. The other end of the rod is attached to the valve H³.

T T¹ are levers, or devices to raise and hold the links in any desired position, to operate on the valves.

H² is an induction and eduction steam-valve.

Over the back of this valve is placed a partition-plate, P P, which divides the steam-chamber into two parts.

The valve H² is like other valves on its face or under side, but has packing around it, so as to fit upward against the plate P P, and on each side against the steam-chamber, so as to prevent the steam from passing from one end of it to the other. This packing may be secured either to the valve or to the steam-chamber, and, if desired to relieve the valve from pressure, may be put on at two points, as seen in the drawings at S.

The plate P P has two ports in it, *i i*, for the admission of steam to the chambers *o* and *o'*, or to each end of the valve H², the packing on that valve having made two chambers below the plate P P.

H³ is a valve, that lies on plate P P, and is of sufficient length to extend from the middle of one part to the middle of the other.

By this arrangement, when the valve closes one port half way it will have half opened the other, and when the valve has completed its stroke in either direction, it will have to travel just as far back to close the port last opened as it did travel forward since it opened that port, thus occupying a half stroke, or the time of a half stroke of the engine, and insuring thereby uniformity in time in cutting off steam, either on the forward or backward stroke of the engine.

K K are elevations around the ports *i i*, and other points, for the valve to rest steam-tight upon, and allow steam elsewhere to get under the valve, to avoid downward pressure.

R is a pipe, for the admission of steam into the chamber M, where the cut-off valve H³ operates.

The mode of connecting the piston-rod with the piston-head, or oscillating the rod in the cylinder-head, as well as the device for holding the links in any desired position, and the mode of connecting the valves with the links, may all be varied to suit circumstances, and the most approved known forms can be substituted. Cams or cranks, under certain circumstances, may be used instead of eccentrics to operate the valves, and the valve H² may be made in whatever form is most convenient for receiving the packing.

The Operation.

Steam is admitted, through the pipe R, to the steam-chamber M, around the valve H³. As the

valves now stand in figs. 1 and 4, the steam would pass down, through the port *i'*, into the steam-chamber *o'*, and, through the port *u'*, into the cylinder A. As the cut-off link *L*¹ is now held, the cut-off valve *H*³ would not close the port *i'* much before the end of the stroke of the engine, for the reason that the eccentrics *F*² and *F*³, which move the link, are so placed on the shaft *D* that they cause the lower end of the link, which is now controlling the valve, to be so late in reaching the cutting-off point that the stroke of the engine is nearly completed before that point is reached. If the link had been so held as to cause the middle of it to control the valve, then the steam would have been cut off at half stroke; or, if held so as to cause the upper end to control the valve, then the steam would have been cut off at the commencement of the stroke of the engine.

Any variation in the point of contact between the link and valve, will produce a corresponding difference in the time of cutting off.

The eccentrics are so arranged on the shaft that the return motion cuts off as did the forward motion.

The lower end of the link *L*¹ might be dispensed with in engines which did not require a greater range of cutting off than is found between the two pivoted points of the link; and if that limited range were required nearer the middle or last part of the stroke of the engine, the eccentrics might both be placed further back on the shaft, to accomplish the object desired.

It is obvious that the eccentrics may be made larger or smaller, and may be varied in size relatively to each other; they may be put a little closer together, or further apart; the pivoted points may be varied; the projecting end of the link may be put upward; and various other modifications might be made, which are regarded as the same thing to accomplish the same purpose, which is to cut off steam with as wide a range as may be desired, and to close and open the ports when the valve is making its most rapid motion, and, if possible, at the same point of stroke in the forward and backward motion of the engine.

By this arrangement, there will, alternately, be more pressure of steam on one end of the valve than on the other, which pressure will urge the valve in the direction it should travel during the last half of each stroke of the engine. This device becomes an auxiliary engine, to move the valve without the loss of steam.

If two valves, with no communication between, were used, one for each part, instead of the one valve *H*², and if the cut-off valve *H*³, either as one valve, or in two parts, were made to open and close the ports, as desired, the same results would be reached as by packing the valve *H*², except the aid rendered by the steam in the chamber to move the valve.

The link *L* is the same as that now in general use for moving valves, and will answer well in this case, as by it the steam can be reversed.

In locomotives, and some other engines, the link-motion is used as a means of cutting off steam, which can only be done by shortening the stroke of the valve; and, when the stroke is much shortened, the ports are never fully opened, and any shortening of the stroke

causes the ports to be opened and closed more slowly, and is followed by a corresponding throttling of the induction and eduction-steam.

By using the cut-off valve *H*³, the valve *H*² can be made with reference only to receiving and discharging steam, and be free from the defects incident to cutting off steam by that valve.

It will be seen, that whenever the cut-off valve *H*³ closes one port it opens the other. This arrangement is necessary, for the reason that this mode of cutting off steam requires the valve to travel the same distance each way over the ports, no matter at what point of the stroke of the engine the cutting off may take place. By so doing, the opening and closing of the port is always done when the valve is moving most rapidly, and not, as in many other cases, when the valve is at or near its slowest motion.

The fact that the valve *H*³, or cut-off valve, always opens a port into the lower steam-chamber, at the same time that it closes one, would be a defect, if there had not been devised some mode of preventing the in-flowing steam from reaching the cylinder-port, which the valve *H*² or cylinder-valve has not yet closed, and from which it is desired to cut off the steam.

This end has been accomplished, by making the valve *H*² steam-tight in the chamber, as has been specified, so that the steam, which is admitted by the cut-off valve into the chamber *o*, cannot get to *o'*, neither can the steam get from the chamber *o'* to the chamber *o*.

The port leading directly from chamber *o* or *o'* to the cylinder, is always closed by the cylinder-valve *H*², at the time the steam commences to enter the chamber, and remains closed until the proper time arrives to admit steam to the cylinder, which admission is caused by the cylinder-valve moving from over the port.

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

1. The construction of the induction and eduction-valve *H*³, with packing upon its surfaces, which serves to prevent the passage of steam from one of its ends to the other, substantially as shown and described.

2. The construction of the cut-off valve *H*³, substantially as and for the purpose described.

3. The combination and arrangement of the valves *H*² *H*³, and induction-ports *i* *i'*, substantially as shown and described.

4. The construction of the link *L*¹, substantially as shown and described.

5. The combination of the link *L*¹, eccentric rods *G*² and *G*³, and eccentrics *F*² and *F*³, substantially as shown and described.

6. The combination of the link *L*¹, valve-rod *H*¹, valve *H*², which it moves, substantially as shown and described.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

J. D. WILLOUGHBY.

Witnesses:

A. RUPPERT,

C. F. CLAUSEN.