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A. D. LINN.

MULTI-CYLINDER ENGINE.

No. 365,081. Patented June 21, 1887.

Fig. 4.

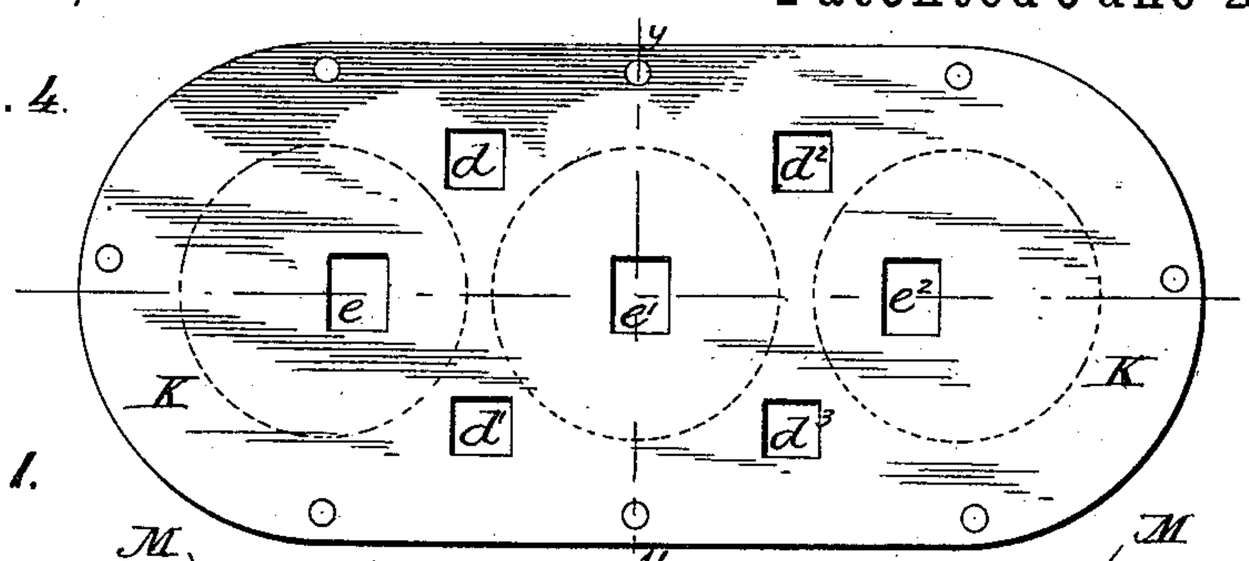
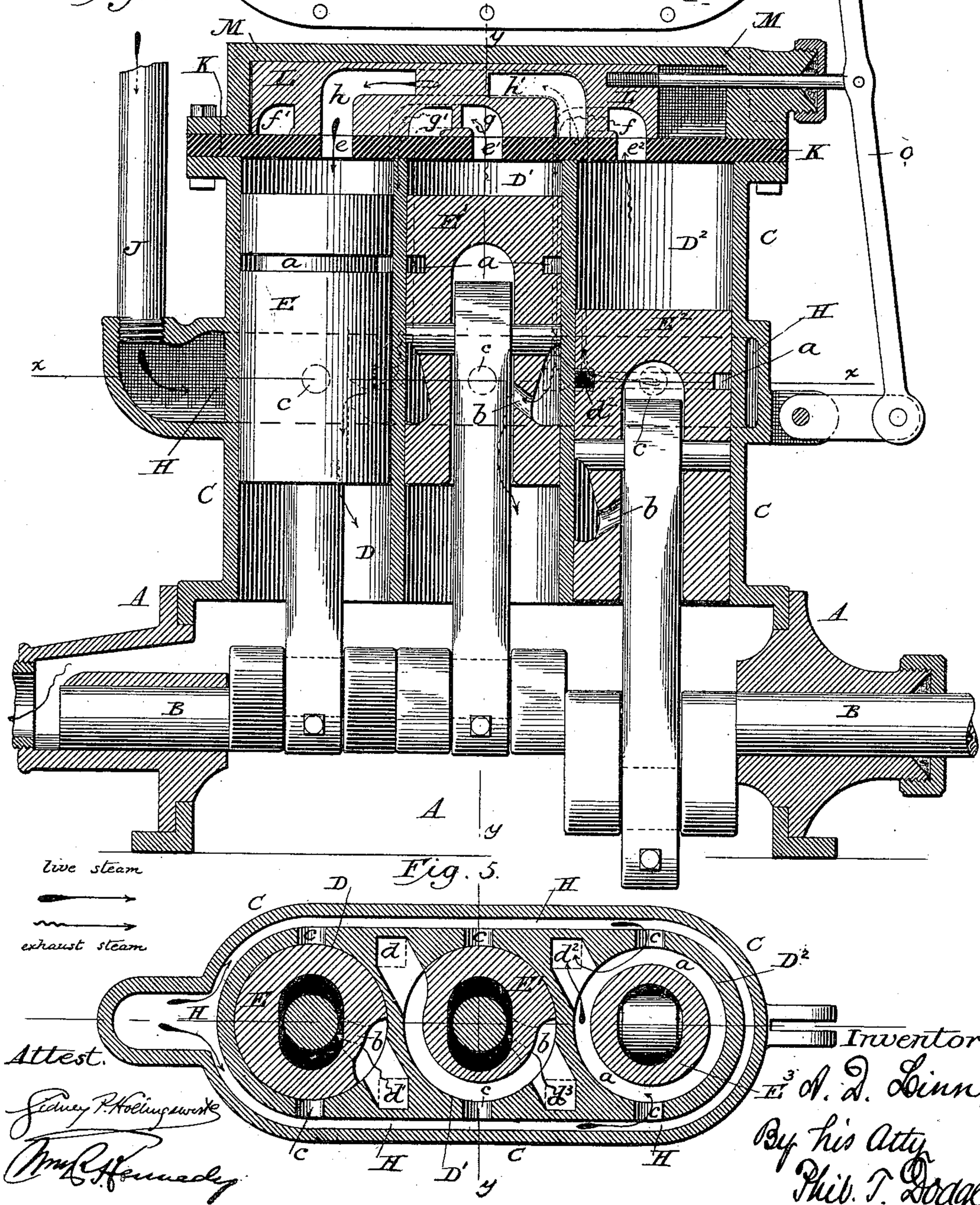


Fig. 1.



Attest.

Sidney P. Hollingsworth

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By his Atty

Phil. T. Dodge.

(No Model.)

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MULTI-CYLINDER ENGINE.

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Fig. 8.

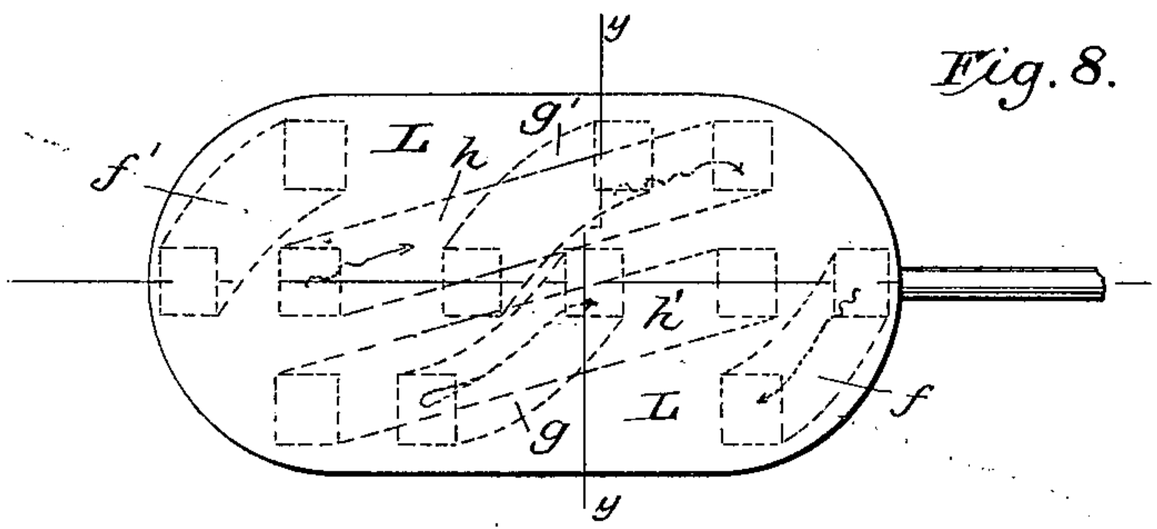
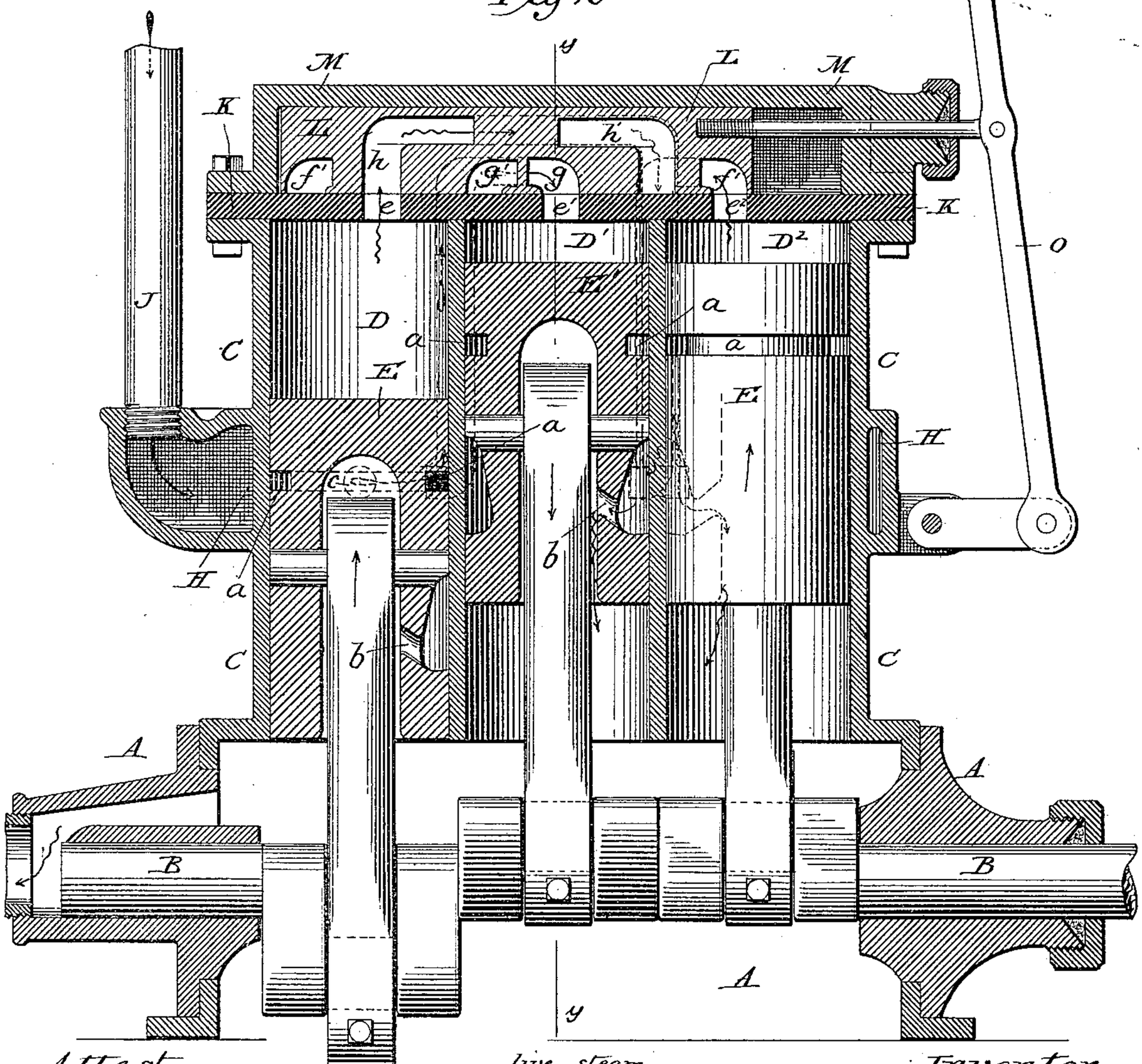


Fig 2



Attest

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live steam →

exhaust steam ⇝

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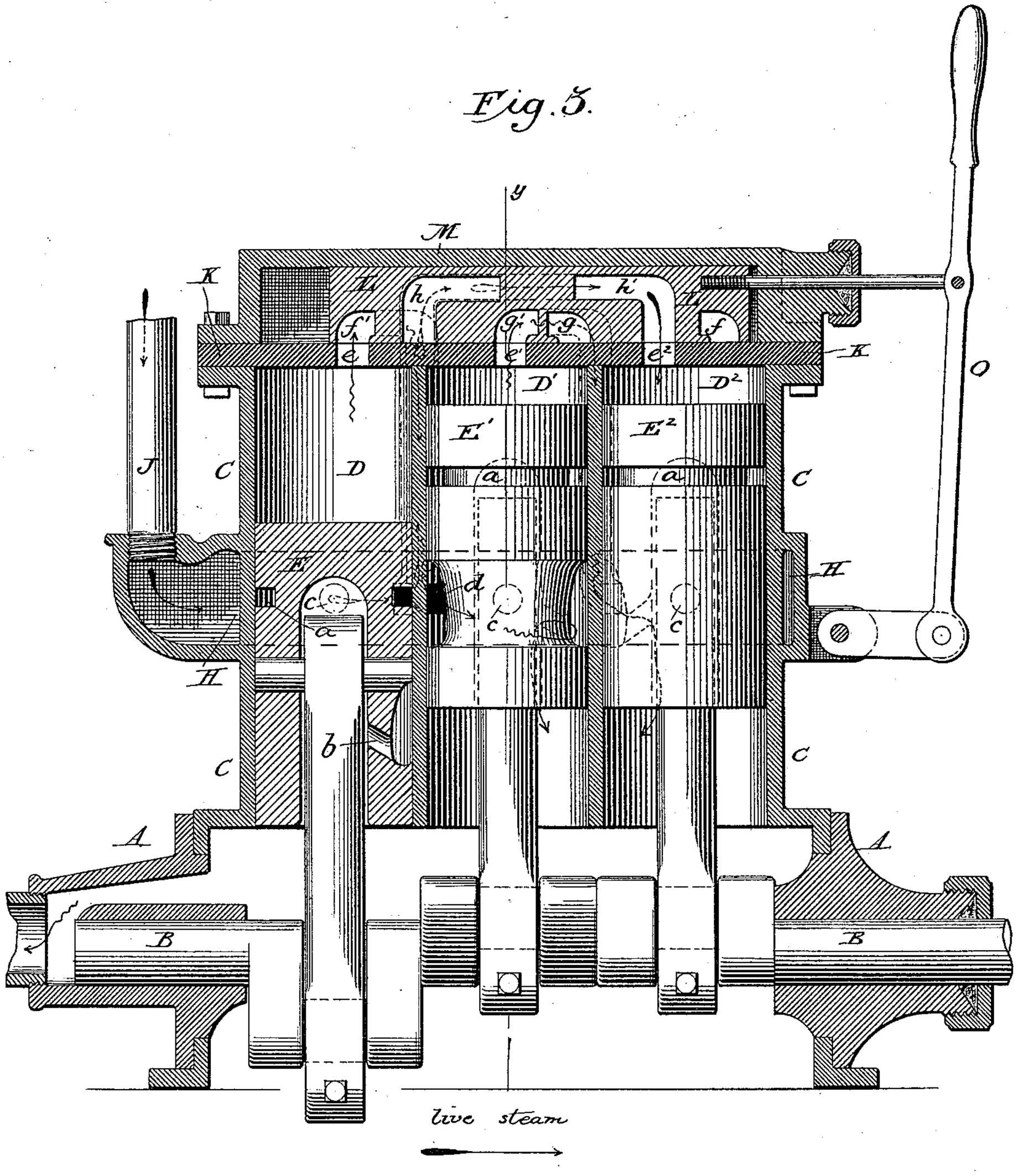
A. D. LINN.

MULTI-CYLINDER ENGINE.

No. 365,081. Patented June 21, 1887.

Fig. 5.



live steam

exhaust steam

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(No Model.) 5 Sheets—Sheet 4.

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MULTI-CYLINDER ENGINE.

No. 365,081. Patented June 21, 1887.

Fig. 6

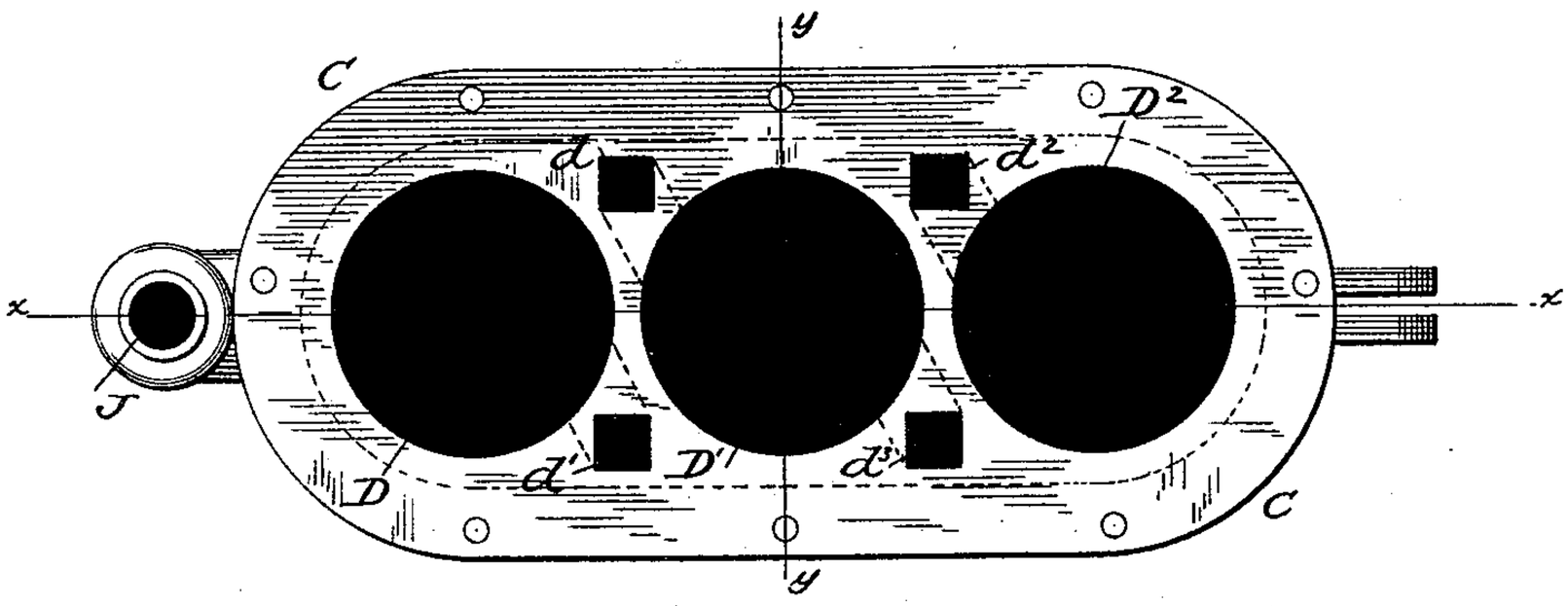
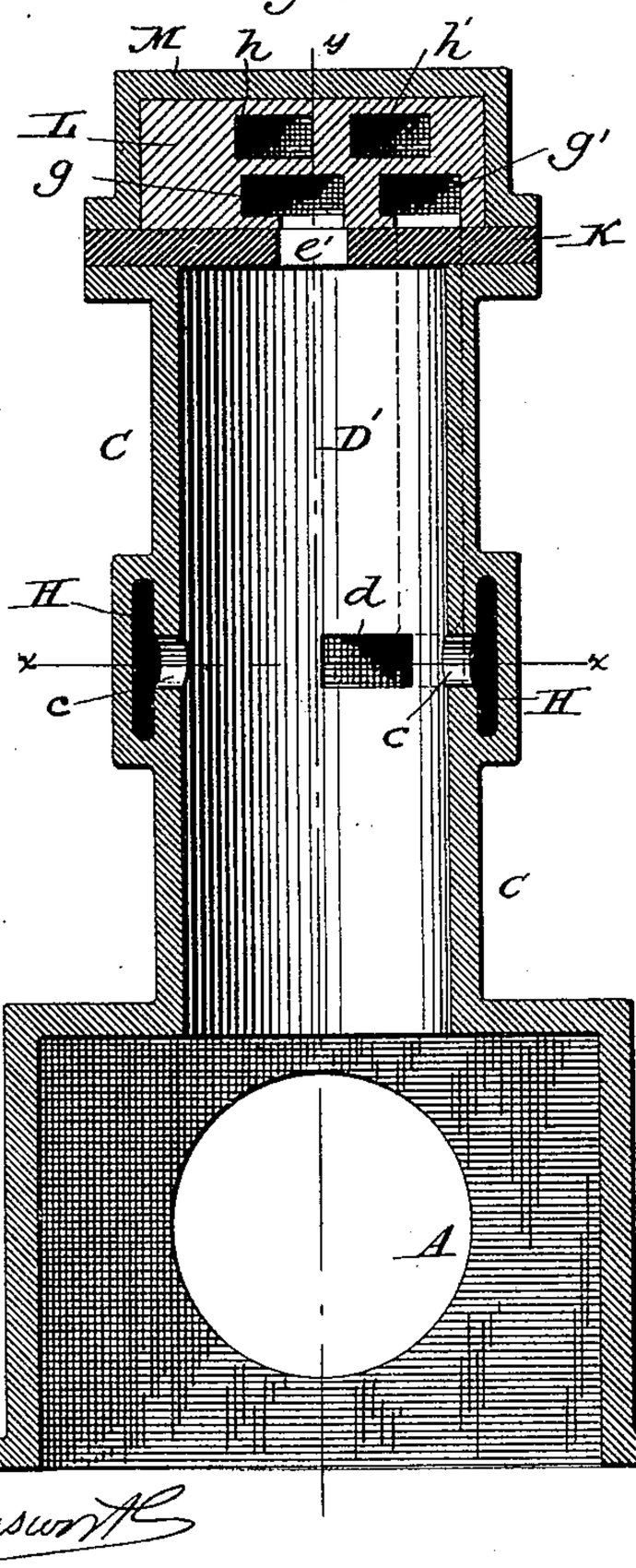


Fig. 7.



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(No Model.) 5 Sheets—Sheet 5.

A. D. LINN.

MULTI-CYLINDER ENGINE.

No. 365,081. Patented June 21, 1887.

Fig. 9.

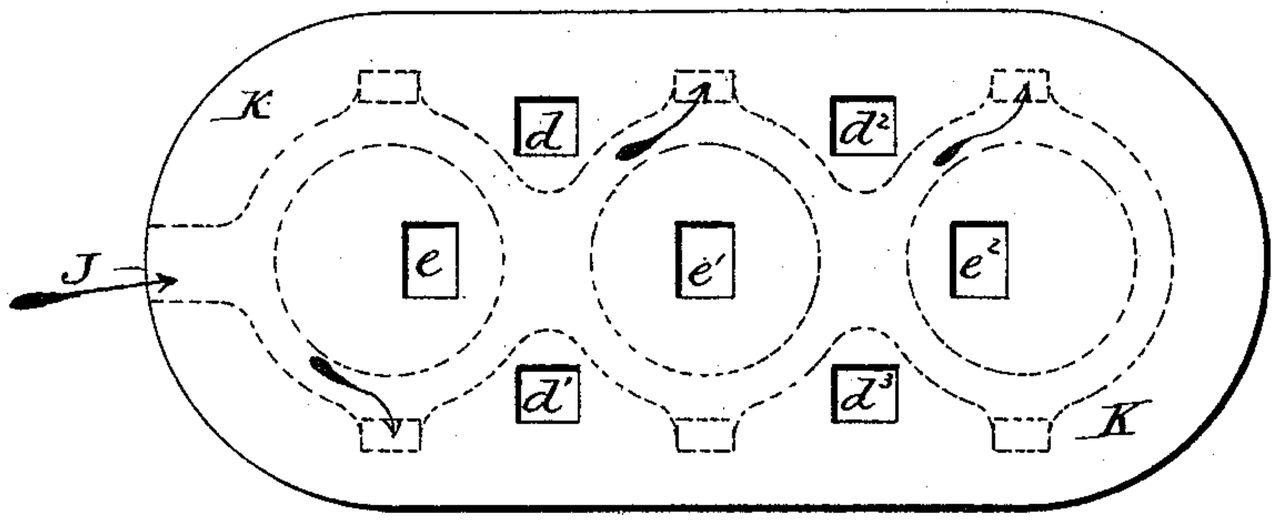


Fig. 10

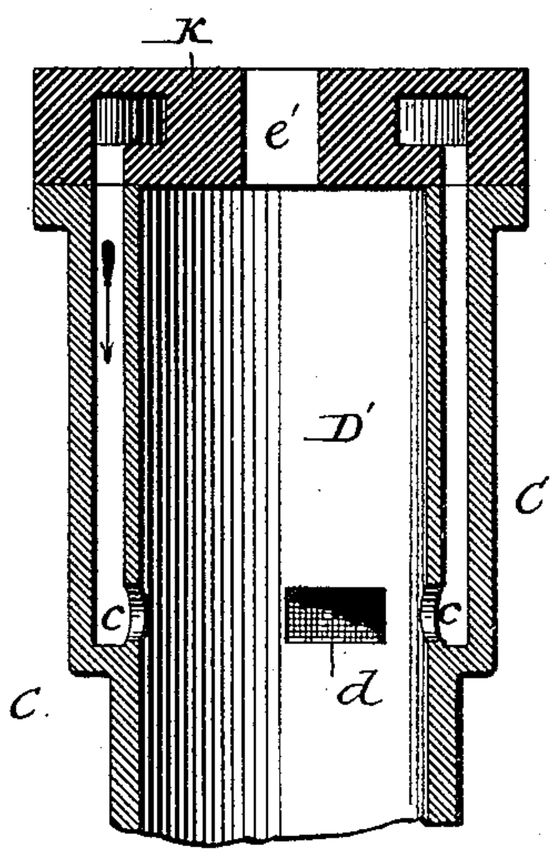
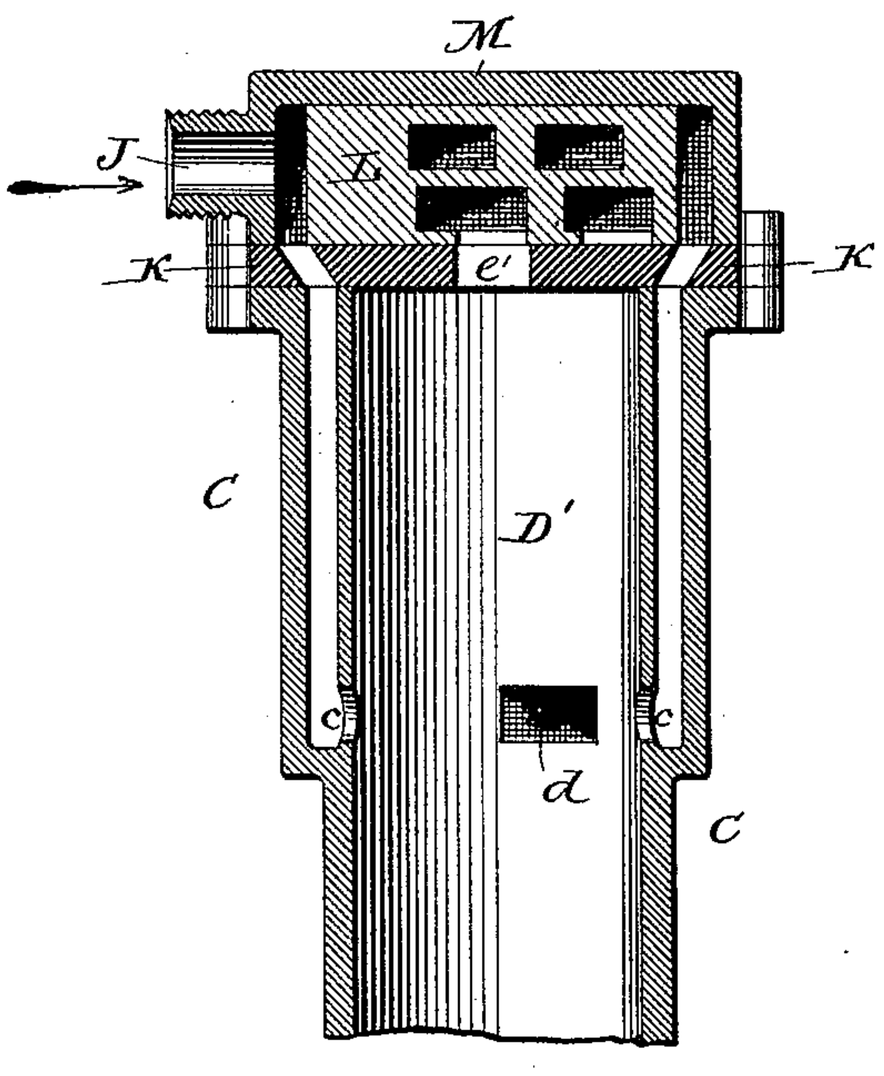


Fig. 11.



Attest.

Sidney P. Hollingsworth

Wm L. Hennedy.

Inventor.

A. D. Linn

By his Atty.

Phil. T. Dodge

UNITED STATES PATENT OFFICE.

ALLEN D. LINN, OF RACINE, WISCONSIN, ASSIGNOR TO THE RACINE HARDWARE MANUFACTURING COMPANY, OF SAME PLACE, AND THOMAS KANE, OF CHICAGO, ILLINOIS.

MULTI-CYLINDER ENGINE.

SPECIFICATION forming part of Letters Patent No. 365,081, dated June 21, 1887.

Application filed March 17, 1886. Serial No. 195,570. (No model.)

To all whom it may concern:

Be it known that I, ALLEN D. LINN, of Racine, in the county of Racine and State of Wisconsin, have invented certain Improvements in Multi-Cylinder Engines, of which the following is a specification.

My invention relates to that class of engines in which a series of cylinders are provided with pistons connected to a common shaft, and in which the several pistons serve as valves to regulate the delivery of steam to and from the cylinders of the other pistons.

The aim of my invention is to provide an engine of extreme simplicity and durability, the motion of which may be instantly reversd at will; and to this end it consists in a peculiar construction and arrangement of fixed ports, of pistons with ports therein, and a valve for effecting the reversal.

In the accompanying drawings, Figure 1 represents a vertical axial section through three cylinders in the plane of the crank-shaft, the engine being adjusted to turn in a forward direction. Fig. 2 is a similar view of the engine with the pistons at different points in their movement. Fig. 3 is a similar section with the valve adjusted to cause the rotation of the engine in the opposite direction. Fig. 4 is a top plan view of the plate which covers the trunk or body of the engine, showing the several ports therein. Fig. 5 is a horizontal section on the line *x x* of Fig. 1, showing the manner in which the induction and eduction ports of the piston communicate with the stationary ports in the body. Fig. 6 is a top plan view of the body, with the upper parts removed to expose the upper ends of the cylinders and the stationary ports. Fig. 7 is a transverse vertical section on the line *y y* of Figs. 1, 5, and 6. Fig. 8 is a top plan view of the reversing-valve, the shape and position of the several ports opening through its under side being indicated in dotted lines. Fig. 9 is a top plan view, and Fig. 10 a vertical cross-section, showing a modified form of the live-steam ports. Fig. 11 is a vertical cross-section showing said ports in still another form.

Referring to the drawings, A represents a hollow base-frame provided with bearings which support the ends of a horizontal shaft, B, having three cranks at an angle of one hundred and twenty degrees from each other. On this base-frame is mounted an upright trunk or body, C, cast complete in one piece, with three vertical cylindrical openings, D D′ D², commonly denominated "cylinders," extending therethrough from top to bottom, their lower ends opening directly into the base-chamber.

In the respective cylinders are mounted three vertically-reciprocating pistons, E E′ E², connected by pitmen in the ordinary manner with the respective cranks of the shaft B. Each of these pistons fits closely within the cylinder and is provided near the upper end with a peripheral groove, *a*, through which it delivers live steam to actuate another piston, and also with a peripheral recess or port, *b*, through which it delivers exhaust-steam from another cylinder, as will be hereinafter more fully explained. The three cylinders are duplicates or substantially duplicates of each other. Their exhaust-ports are made of the form represented in the several figures and each of a considerable height.

The trunk or body C is formed with an encircling chamber, H, into which live steam is delivered through the pipe J or other conductor. This live-steam chamber H communicates, as shown in Figs. 5, 7, and elsewhere, with each cylinder by ports *c*, extending through the walls of the cylinder. It is preferred to provide each cylinder, as shown, with two of these ports on opposite sides, in order that the pressure of the inflowing steam may be equalized on the two sides of the piston, in order to reduce the friction and to prevent excessive wear on one side; but it is to be understood that a single port may be used in each cylinder.

The ports *c* do not admit the steam for actuating the pistons in the cylinders which they enter; but, as hereinafter described, they deliver the steam indirectly to other cylinders. For this reason these ports *c* are located midway of the height of the cylinders and in such position that they are always below the upper ends of the pistons.

In the trunk or body there are formed four

vertical ports or passages, $d\ d'\ d^2\ d^3$, extending from the top downward to the level of the inlet-ports c, and opening into the respective cylinders, as plainly shown in Fig. 5.

The upper ends of the cylinders are closed by an overlying plate, K, as shown in Fig. 4. Through this plate there extend openings in line with the ports $d\ d'\ d^2\ d^3$, and also ports $e\ e'\ e^2$, opening into the upper ends of the respective cylinders. Overlying this plate there is an adjustable stationary valve, L, (shown in Figs. 8 and 9,) containing three ports, $f\ g\ h$, used when the engine runs in a forward direction, and also three ports, $f'\ g'\ h'$, used when the engine is running in a reverse direction. Each of these ports enters the under face of the valve at one point, and after passing therethrough emerges at another point, as shown in the drawings. Each port is separate and distinct from the other, having no direct communication therewith. Overlying the reverse-valve there is a hollow plate, M, flanged and bolted firmly in place. A hand-lever, O, pivoted to one end of the frame is connected by a stem with the valve L, for the purpose of moving the latter endwise, in order to reverse the engine.

The operation of the engine is as follows: When it is to run in a forward direction, the valve L is placed in the position shown in Figs. 1 and 2. The live steam entering the pipe J passes through the chamber H to the exterior of the cylinders, seeking their inlet-ports c, in order to enter the cylinder when the ports are opened. In Fig. 1 the right-hand piston E^2 is shown at the lower end of its stroke and ready to commence the upward stroke, while the other pistons are near their upper positions. In this position of the parts the annular groove a of the right-hand piston, E^2, forms a communication between the ports c of the right-hand cylinder and the port d^2, the live steam entering said port c and passing through the groove in the piston E^2 into the port d^2, and thence upward through the latter into the port h' of the valve L, and through this port and the opening e into the upper end of the left-hand cylinder, D, where it acts to depress the piston E. At this time the middle piston, E', in the cylinder D' is rising, and the exhaust-steam escapes through the opening e' at its top, and thence through the port g in the valve-plate to the port d', whence it descends to the exhaust-port b of the left-hand piston, E, through which it escapes into the base-chamber. At the same instant the exhaust-steam is flowing from the right-hand cylinder, D^2, through the opening e^2 at its top into the port f, thence down the port d^3 to the exhaust-port b of the middle piston, E', whence it escapes to the base-chamber. It will be seen that at this stage of the action the right-hand piston is admitting live steam to the left-hand cylinder, the left-hand piston exhausting steam from the middle cylinder, and the middle piston exhausting steam from the right-hand cylinder. As the rotation continues, the parts assume the position shown in Fig. 2, the left-hand piston being at its lowest point and about to rise, the middle piston in the course of its descent, and the right-hand piston in the course of its ascent. At this stage the live steam entering the port c of the left-hand cylinder passes through its annular groove a to ports d', and thence through ports g and opening e' into the top of the middle cylinder. The exhaust-steam from the left-hand cylinder passes through the opening e and port h to port d^2, whence it is exhausted through the port b of the right-hand piston. The steam escapes from the right-hand cylinder through the top opening, e^2, and port f to port d^3 to the exhaust-port b of the middle piston. When the motion of the engine is to be reversed, the valve is moved to the right, assuming the position shown in Fig. 3, bringing the ports $f'\ g'\ h'$ into action. The course of the live and exhaust steam is plainly indicated by the arrows on the drawings.

Instead of extending the live-steam passage around the middle of the cylinders, as heretofore described, the steam-inlet ports may be extended upward in the wall of the cylinders to the upper end, and there connected with a common port formed in the top plate, as shown in Figs. 9 and 10; or the top plate or cap may be enlarged to form a steam-chamber, from which the ports may be extended downward directly to the sides of the cylinder, as in Fig. 11.

The plans last described are but modifications of those shown in the leading figures, there being in each case a common port admitting live steam to opposite sides of the several cylinders, that it may enter the annular grooves in the pistons and be directed thence to other cylinders, as before described.

It will of course be understood that when the engine is to run constantly in one direction, the movable reversing-valve may be omitted—that is to say, a single set of ports are formed in a stationary plate or in the cylinder.

Having thus described my invention, what I claim is—

1. In a multi-cylinder engine, the combination of the cylinders, all communicating through side ports with a common steam-supply passage, secondary ports opening through the walls of the respective cylinders and communicating each with another cylinder through the head, and a series of pistons, each provided with a peripheral groove for the admission of live steam and with an exhaust-port for delivering steam from the secondary ports through the end of the cylinder, substantially as described and shown.

2. In a high-pressure engine, the three cylinders of equal diameter, each having through its side a live-steam port and a secondary port leading to the top of another cylinder, both in position to be constantly covered by the piston, in combination with the pistons, each provided with a peripheral groove or port to direct the live steam entering the side of its own cylinder through the secondary port to another cylinder, and each provided also with

a peripheral exhaust-port discharging through the lower end of its own cylinder the steam from another cylinder, substantially as described and shown.

3. In a steam-engine, three cylinders, each closed at one end and open at the other, and exhaust-ports leading from the top of one cylinder through the middle or lower portion of another, in combination with the pistons provided with peripherally-opening exhaust-ports arranged to register with the exhaust-ports of the cylinder and to deliver the exhaust-steam from the top of each cylinder through the open end of another.

4. In a steam-engine, the three parallel cylinders, each provided with steam-ports *c* through the side, in position to be constantly covered by the piston, and with the ports *d*, *d'*, d^2, and d^3, in combination with the three pistons, each provided with a live-steam port, *a*, in its circumference and with an independent exhaust-port.

5. In a multi-cylinder engine, a series of cylinders open at one end and closed at the other, pistons mounted in the respective cylinders, each provided with an exhaust-port opening through its periphery and extending therethrough toward the open end of the cylinder, and an exhaust-port extending from another cylinder in position to communicate with the port of the piston, as described, whereby the exhaust-steam from one cylinder is delivered through the piston of another cylinder, and thence from the open end of said second cylinder.

6. In a steam-engine in which the piston of one cylinder serves as a valve to control the flow of steam to another cylinder, the combination of said piston with a cylinder having steam-admission ports *c* on opposite sides, as described, whereby side pressure and wear upon the piston are prevented.

In testimony whereof I hereunto set my hand this 9th day of March, 1886, in the presence of two attesting witnesses.

ALLEN D. LINN.

Witnesses:
E. G. DURANT,
F. H. KELLER.