(No Model.) 3 Sheets—Sheet 1.

P. MALTBY.

REVERSING VALVE FOR STEAM ENGINES.

No. 452,455. Patented May 19, 1891.

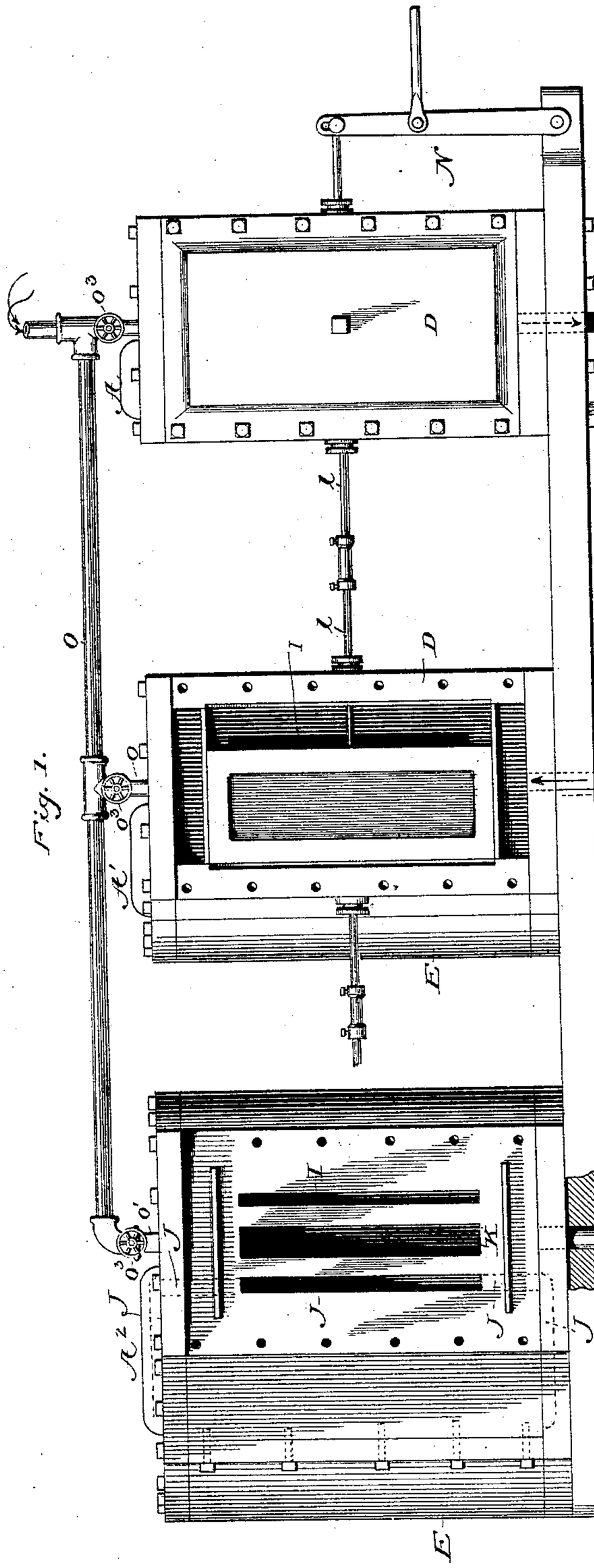

Fig. 1.

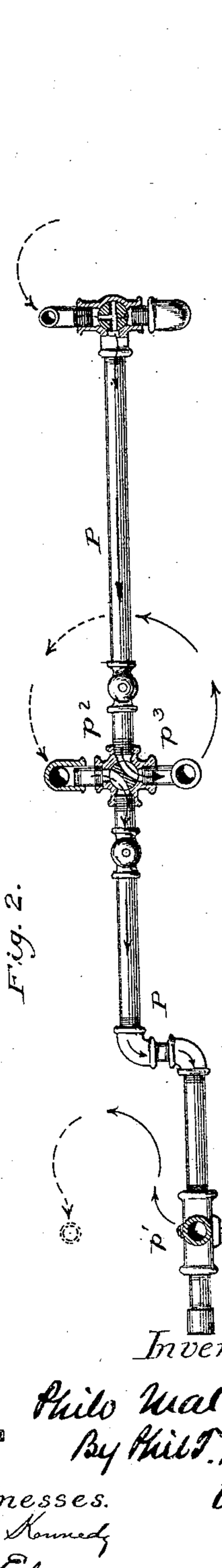

Fig. 2.

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F. S. Elmore

(No Model.) 3 Sheets—Sheet 2.

P. MALTBY.

REVERSING VALVE FOR STEAM ENGINES.

No. 452,455. Patented May 19, 1891.

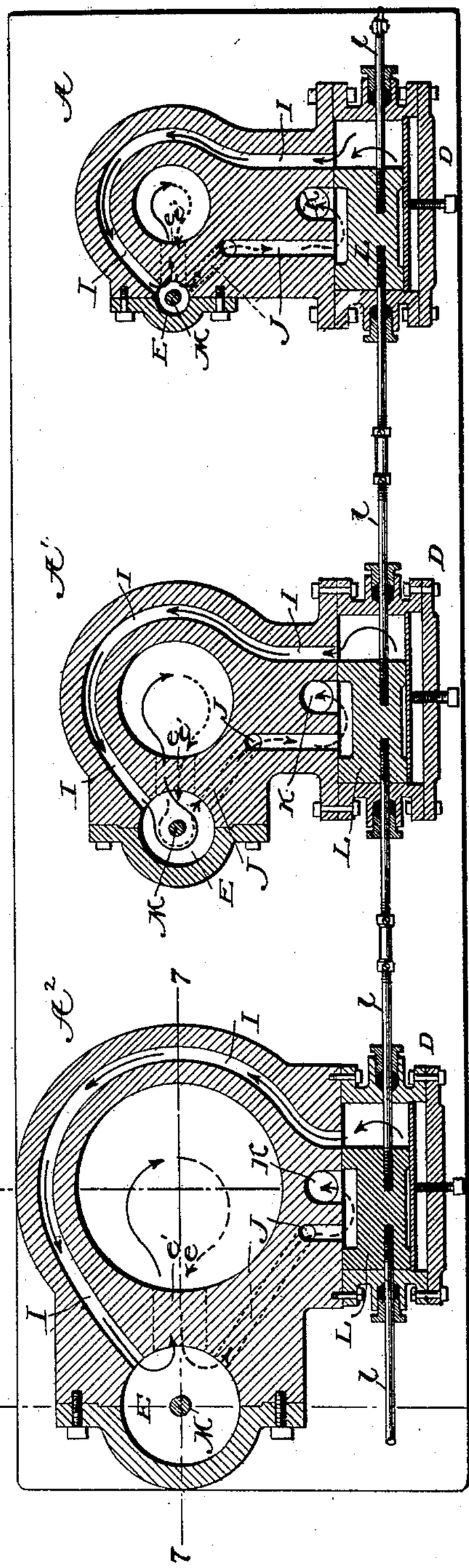

Fig. 3. on line 5-5

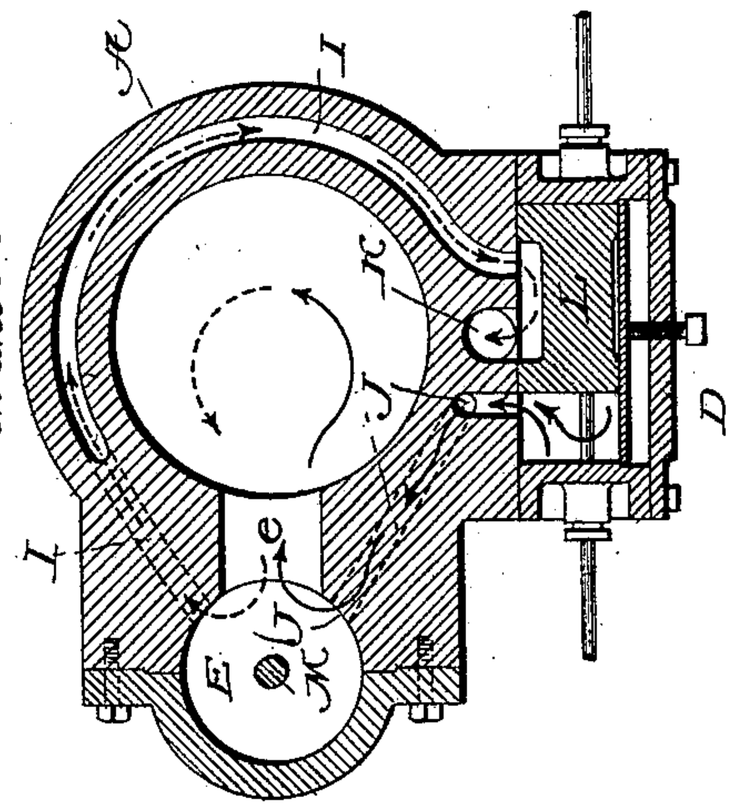

Fig. 5. on line 5-5

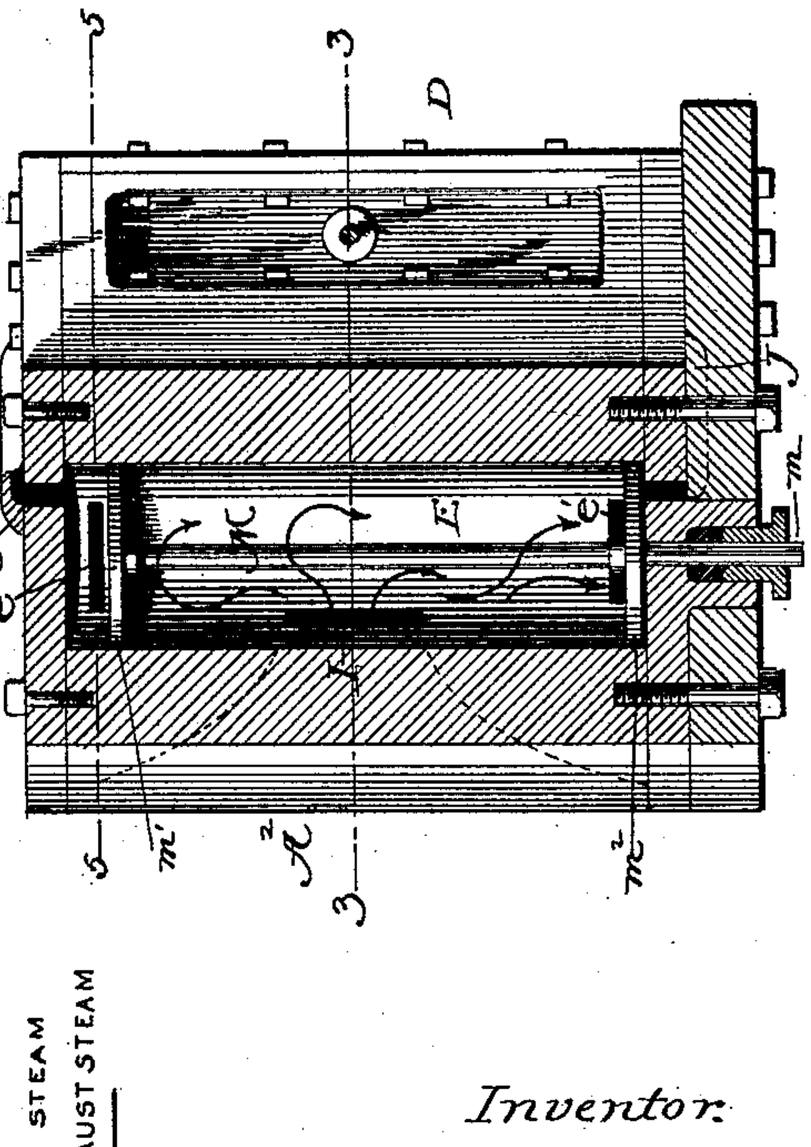

Fig. 4 on line 4-4

— LEGEND —
LIVE STEAM
EXHAUST STEAM

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(No Model.) 3 Sheets—Sheet 3.

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REVERSING VALVE FOR STEAM ENGINES.

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Fig. 6.

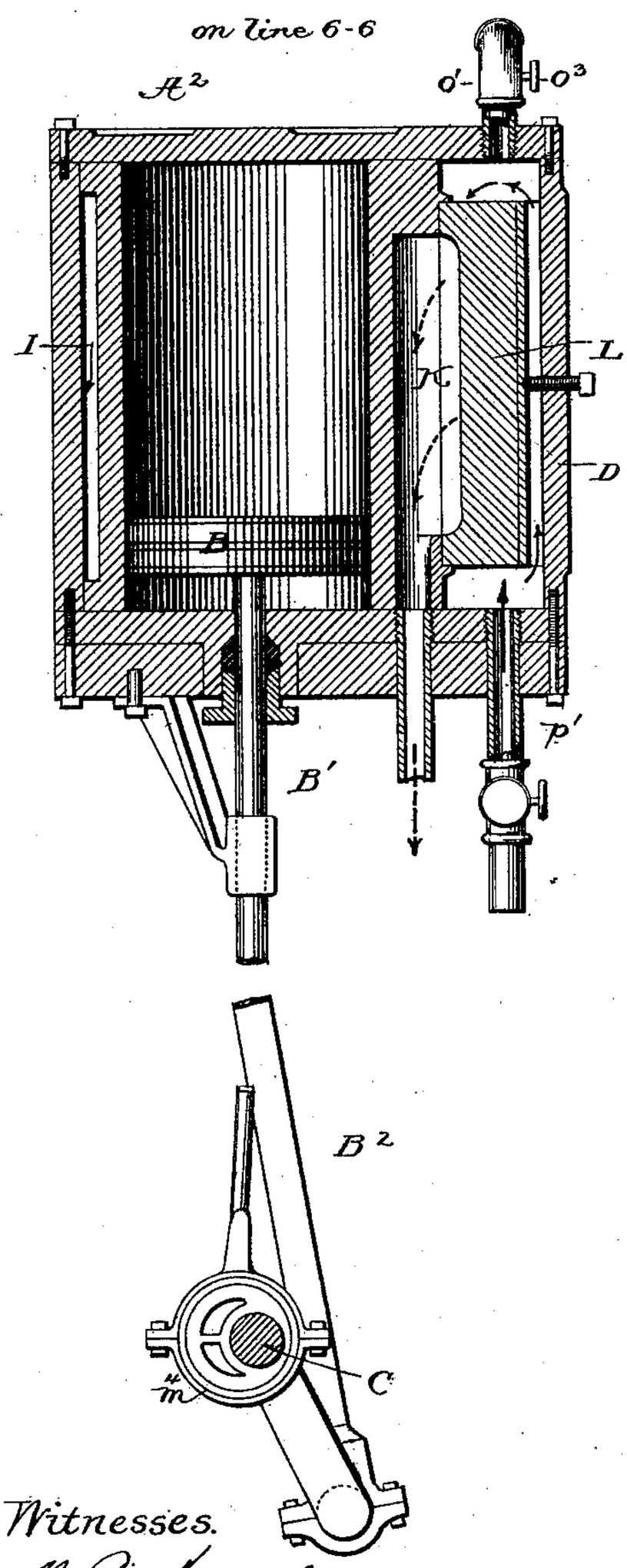
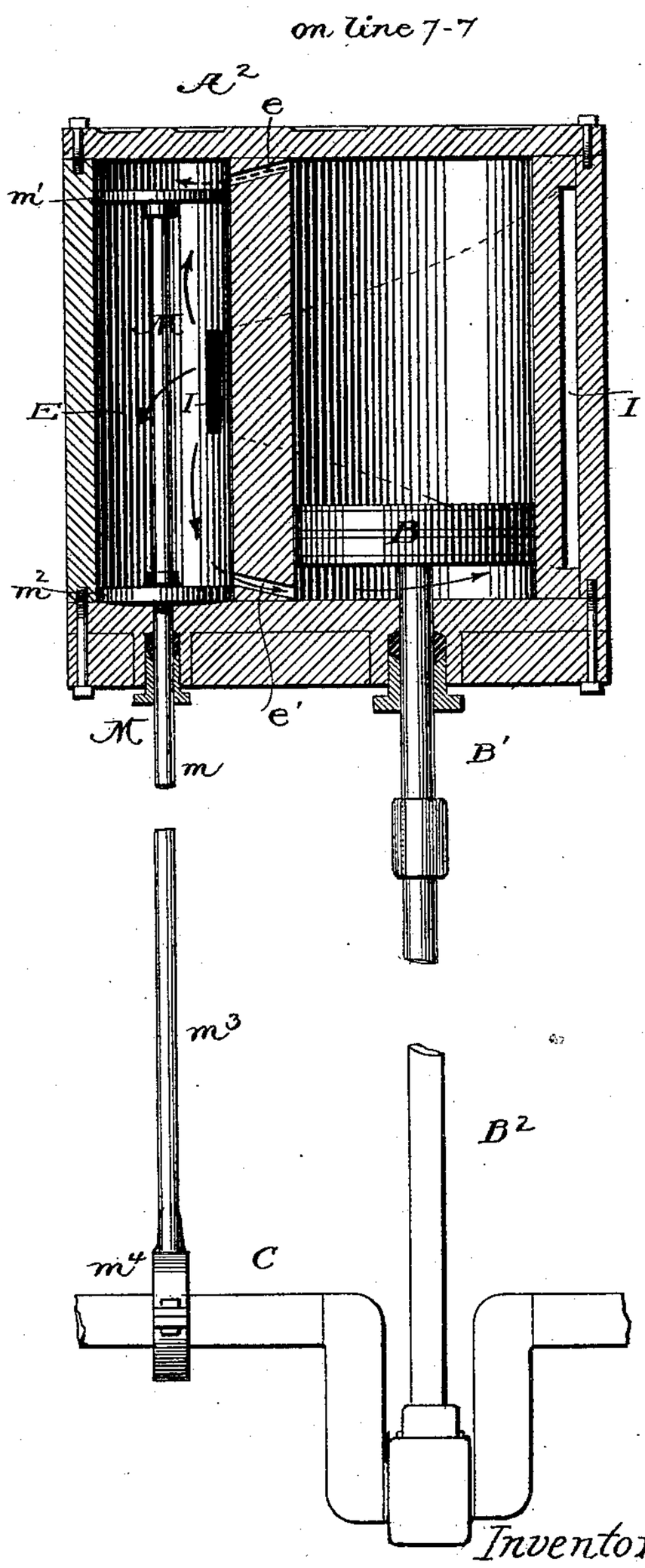


Fig. 7.



Witnesses.
W. R. Kennedy.
Fabius Stanly Elmore

Inventor.
Philo Maltby
By Phil. T. Dodge Atty

UNITED STATES PATENT OFFICE.

PHILO MALTBY, OF CLEVELAND, OHIO.

REVERSING-VALVE FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 452,455, dated May 19, 1891.

Application filed November 22, 1890. Serial No. 372,368. (No model.)

To all whom it may concern:

Be it known that I, PHILO MALTBY, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain Improvements in Reversing-Valves for Steam-Engines, of which the following is a specification.

My invention relates more particularly to that class of reciprocating compound engines in which the cylinders are arranged side by side.

The aim of the invention is to secure the reversibility of the engine at will by simple valve mechanism and without the employment of the ordinary link-motion or its equivalent.

My engine is provided, as are all compound engines, with ports for delivering the exhaust-steam from the one cylinder to the receiving-chest of the next larger cylinder. Each cylinder is provided with a reciprocating piston-valve for delivering the steam from the chest into and out of the opposite ends of the cylinder on opposite sides of the piston in substantially the ordinary manner. In order to effect the reversal of the engine, I change the course of the steam from the chest to the piston-valve, so that it will reach the valve either between the pistons or outside of the same, according as the engine is to revolve in one direction or the other. This change in the course of the steam passing to the piston-valve is effected by extending two ports from the steam-chest to points outside of the pistons and a third port from the chest to a point between the pistons and then providing in the chest a reversing-valve by which either the end port or the middle port may be opened at will and the other port connected with the exhaust. This reversing-valve, which is preferably of the ordinary D type, stands normally at rest. In practice I connect the reversing-valves of the front cylinders with a single operating device, by which they may be moved simultaneously. By thus throwing the three valves at one operation I am enabled to effect the instantaneous reversal of the engine without changing the position of the main valves. It may consequently be driven directly and positively from a single eccentric or other simple driving mechanism, such as is commonly used in non-reversing engines.

In the accompanying drawings, Figure 1 is a side elevation showing the three cylinders of a compound engine constructed on my plan, portions of the valve-chest being removed to expose other parts to view. Fig. 2 is a diagram illustrating the arrangement of the ports leading the exhaust-steam from one cylinder to another. Fig. 3 is a horizontal section on the line 3 3 of Fig. 1, showing both the reversing and the main or cut-off valves. Fig. 4 is a vertical section on the line 4 4 of Fig. 3, through the piston-valve of one of the cylinders. Fig. 5 is a horizontal section on the line 5 5 of Fig. 4, showing on a larger scale the valve mechanism and ports. Fig. 6 is a vertical section through a cylinder and reversing-valve on the line 6 6 of Fig. 3. Fig. 7 is a vertical section through the main or steam-controlling valve on the line 7 7, Fig. 3.

Referring to the drawings, A, A′, and A^2 represent three engine-cylinders of different diameters arranged vertically side by side, and each containing, as usual, a reciprocating piston B, connected by piston-rod B′ and pitman B^2 to a crank-shaft C, common to the series.

As the cylinders and valves are constructed in duplicate, I will first consider the construction and operation of the ports and valves of one cylinder and thereafter describe the manner in which the valves and cylinders are connected to operate in series. Each cylinder is provided on one side with a steam-receiving chest D, and near the same with a valve-chest E of cylindrical form, extending the entire length of the cylinder.

From one side of the steam-chest D a port I leads in a curved path to the middle of the valve-chest. From the other side of the steam-chest a port J is extended in a forked or divided course into the outer ends of the valve-chest. The two ports I and J open through a flat face in the steam-chest on opposite sides of an exhaust-port K, and are both controlled by a sliding reversing-valve L, resembling an ordinary D-valve. When this valve is moved to the left, as shown in Figs. 1 and 3, it opens port I, allowing live steam to pass through said port directly to the middle portion of the valve-chamber, and at the same time it connects the exhaust-port K with the port J, thus allowing the exhaust-

steam to pass from the two ends of the valve-chamber to the exhaust. This will be understood on reference to Figs. 1 and 3, in which the unbroken arrows indicate the course of the live steam and the broken arrows the course of the exhaust-steam. When, however, the reversing-valve L is shifted to the right, as shown in Fig. 5, it opens the mouth of the steam-port J within the valve-chest and at the same time connects the port I with the exhaust-port, so that the live steam will pass from the steam-chest to the outer ends of the valve-chest through the branches of port I, while exhaust-steam will pass from the central portion of the valve-chamber through port J and under valve L to the exhaust-port K.

It will be observed that the reversing-valve and ports, as above described, determine the course of the live steam to the valve-chamber, causing it to enter the same at the middle or at the outer ends, as demanded.

From the valve-chest near its ends two ports *e* and *e'* lead directly into opposite ends of the cylinder, as plainly shown in Figs. 3, 4, 5, and 7. The course of the steam from the valve-chest into and out of the cylinder is controlled by the piston-valve M, consisting of the stem *m* and the two pistons *m'* and m^2, fixed thereon and closely fitting the chamber near opposite ends, so that as the rod is reciprocated the pistons are carried alternately above and below the cylinder-ports *e e'*. When the reversing-valve L is adjusted to the left, as shown in Fig. 3, the live steam passes from the steam-chest through the port I into the ends of the valve-chest E between the pistons *m' m²*, so that as these pistons are moved to and fro, uncovering the ports *e* and *e'* alternately, the live steam is permitted to pass into the ends of the cylinder. The exhaust-steam escaping through the cylinder-port, which is for the time being between the pistons *m'* and m^2, passes into the valve-chamber between the pistons and thence outward through the port J, under the reversing-valve L, to the exhaust-port K, and the engine will continue to run in one direction. When the reversing-valve is adjusted to the left, as shown in Fig. 5, the live steam passes from the steam-chest through port J and fills the space between the valve-pistons *m'* and m^2, whence it is delivered through the ports *e e'* into opposite ends of the cylinder alternately. The exhaust-steam escapes through the cylinder-port which is for the time being outside of the piston, and thence through port J and valve L to the exhaust-port K. Thus it will be seen that when the engine is running in one direction it receives steam from the outer sides of the valve-pistons and exhausts between them, and that when running in the opposite direction it receives steam from between the valve-pistons and exhausts outside of them.

The valve-pistons *m'* and m^2 serve not only to control the cylinder-ports *e* and *e'*, but also, as shown in Fig. 4, to shut off direct communication between the ports I J and the cylinder-ports alternately, so that the passage of live steam to both ends of the cylinder at one time is prevented.

Having now described the operation of one cylinder and its valves, I will describe the manner in which the several cylinders and valves are connected.

Referring to Figs. 1, 2, and 3, it will be observed that the three cylinders are arranged with their reversing-valves L in line, and that the three valves are connected by rods *l* with a single operating device N, so that the three valves may be moved and the entire engine reversed by a single action. The operating device N may be of any suitable character to be operated either by steam-power or by hand. The main valves M may be operated each by a pitman m^3, mounted on an eccentric m^4 on the main shaft, or by any equivalent means commonly known in the art for operating reciprocating valves. It is to be particularly noted that each of the steam-controlling valves may have a simple and permanent connection with its operating device in the same manner as the valves of an ordinary non-reversing engine, the use of a link or other reversing mechanism to vary the position of the valve being wholly unnecessary, the reversal of the engine being effected by changing the course of the steam to the main valves and without changing the position of the valves themselves.

The exhaust-steam from one cylinder is delivered to the steam-chest of the next, as practiced in all compound engines. The arrangement of pipes or conductors to this end may be modified at will; but I recommend the arrangement represented in Figs. 1 and 2, in which O represents a live-steam pipe leading from the boiler directly into the chest of the high-pressure cylinder A. This pipe is provided with branches *o* and *o'*, leading into the chest of the remaining cylinders, so that if required either or all of the cylinders may be worked at high pressure. Suitable three-way valves o^3 are located in these branches in order to shut off the passage of live steam to the cylinder A' or A^2, while the exhaust-steam is delivered from the port K of the high-pressure cylinder through pipe P, having branches *p* and *p'*, leading into the chests of the cylinders A' and A^2.

A valve p^2 is provided for directing all the exhaust-steam from the first cylinder through the branch *p* into the cylinder A when the engine is operating in the ordinary manner. When, however, the second cylinder is to be worked at high pressure, this valve may be turned so as to close the branch *p* and direct the exhaust-steam forward through the pipe to the third cylinder. A second valve p^3 is located adjacent to the third cylinder, so that it may be adjusted to direct the exhaust-steam from the second cylinder into the chest of the

third, or adjusted so as to close the branch p' when the third cylinder is worked at high pressure.

The cylinders A and A will each be provided, as shown in Fig. 2, with a direct connection to the exhaust-pipe.

Under the ordinary operation of the engine the course of the steam is as follows: Entering the first cylinder through pipe O, it is exhausted through pipe P, and passes thence through branch p into the chest of the second and larger cylinder, whence it is exhausted through the continuation of pipe P and through its branch p' into the chest of the third cylinder.

In order to prevent excessive friction of the reversing-valves and to hold them to their seats, I mount against the back of each valve a stationary covering-plate R, filling the entire top of the steam-chamber and adjustable by means of a set-screw r or equivalent device for holding it down to its place. This plate, against which the valves slide, excludes the steam from the upper surface of the latter, so that the valve moves with ease, like those of the ordinary balanced pipe.

While I prefer to use the piston-valve herein described, it will of course be understood that I may use a suitably-constructed slide-valve or its equivalent in the valve-chamber, in connection with the ports and reversing-valve, as herein described.

Having thus described my invention, what I claim is—

1. In a compound engine, a series of communicating cylinders, each provided with a valve for controlling the delivery of steam thereto and therefrom, as usual, and also provided each with a steam-receiving chest, a reversing-valve therein, and ports through which said valve reverses the course of the steam to the main valve, and devices connecting the series of reversing-valves and adapted to move them simultaneously.

2. The series of communicating steam-cylinders provided with steam-controlling valves M and reversing-valves L, with ports leading therefrom, as described, said reversing-valves being arranged in line and directly connected in series, that they may be moved in unison, whereby the motion of the engine may be reversed by shifting the reversing-valves and without changing the position of the main valves or other operating devices.

3. In a reversible steam-engine, the working-cylinder and its piston, in combination with the steam-receiving chest D, the valve-chest E, the port I, leading from one side of chest D to the middle of chest E, the forked port J, leading from the other side of chest D to the ends of chest E, an intermediate exhaust-port K, also leading from chest D, the reversing-valve L, to connect the ports I and J alternately with the exhaust-port, the ports e e', leading from the chest E into the ends of the cylinder, and the steam-controlling valve M in chest E, whereby the course of the steam and the motion of the engine may be reversed by shifting-valve L.

4. In a compound engine, two or more communicating cylinders provided with reversing-valves for changing the course of the steam to the main valve, said reversing-valves arranged in line and directly and rigidly together, substantially as described.

In testimony whereof I hereunto set my hand, this 17th day of November, 1890, in the presence of two attesting witnesses.

PHILO MALTBY.

Witnesses:
W. R. KENNEDY,
FABIUS STANLY ELMORE.