

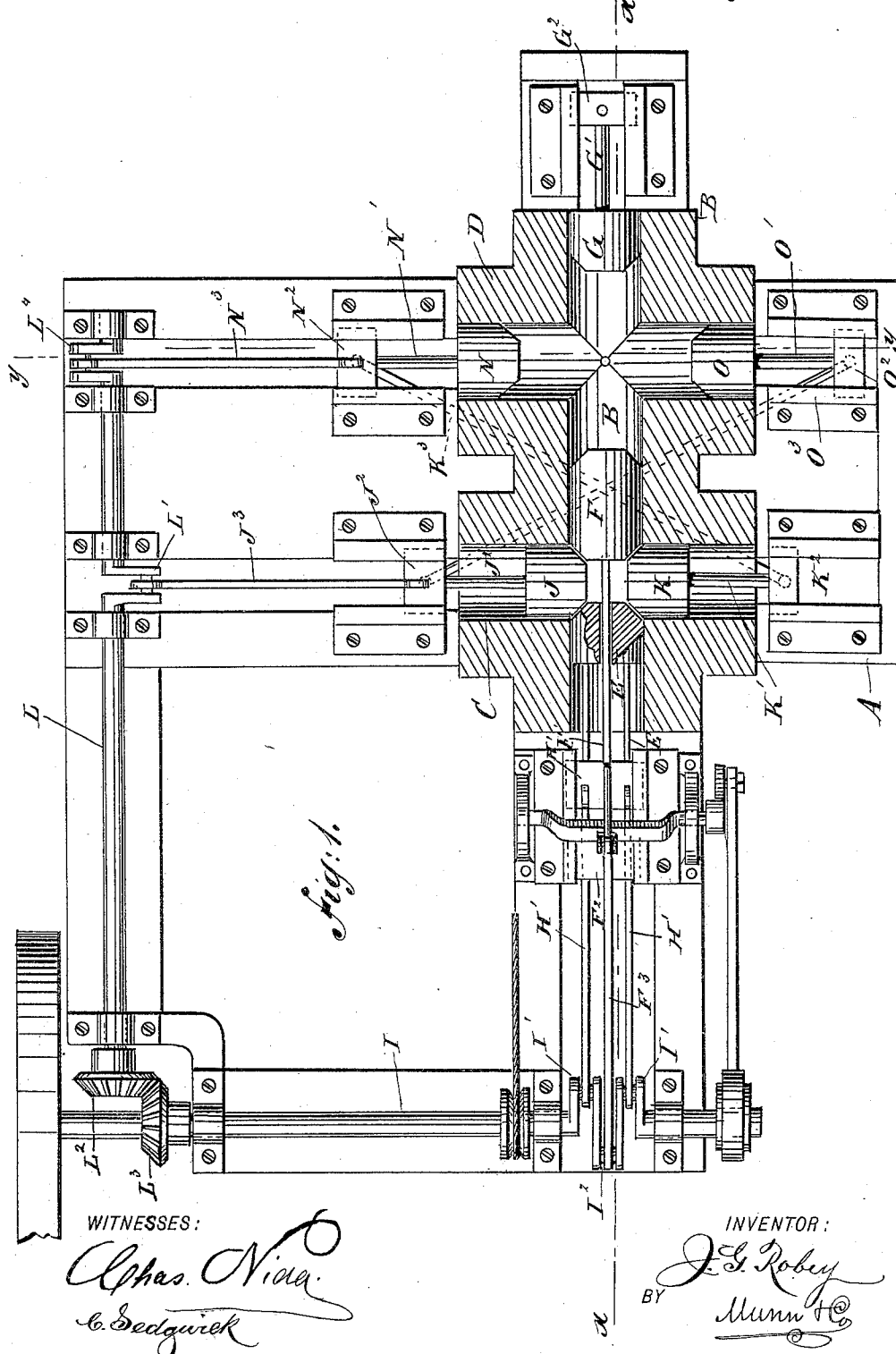
(No Model.)

3 Sheets—Sheet 1.

J. G. ROBEY.
STEAM ENGINE.

No. 431,996.

Patented July 8, 1890.



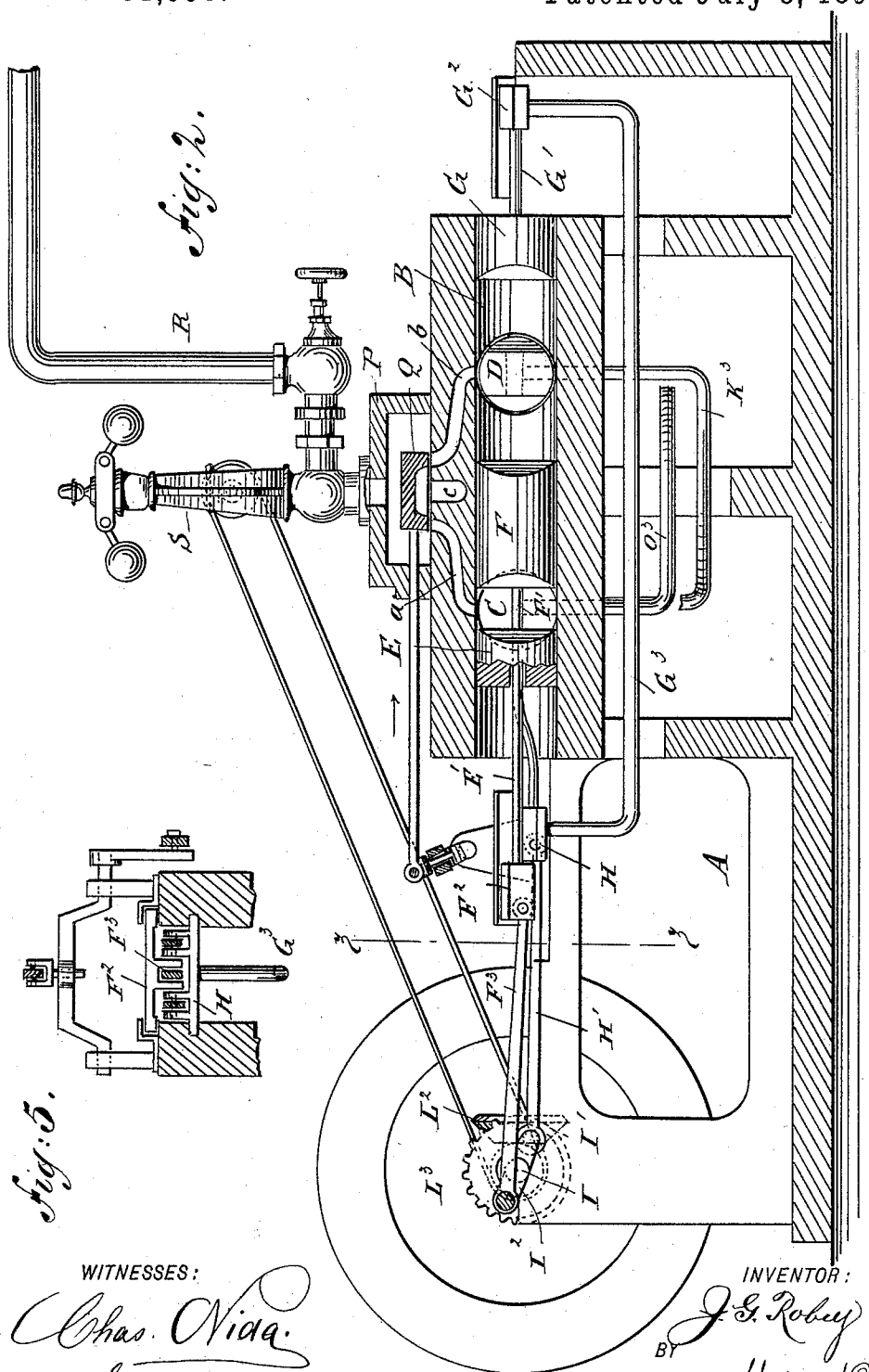
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3 Sheets—Sheet 3.

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Fig: 3.

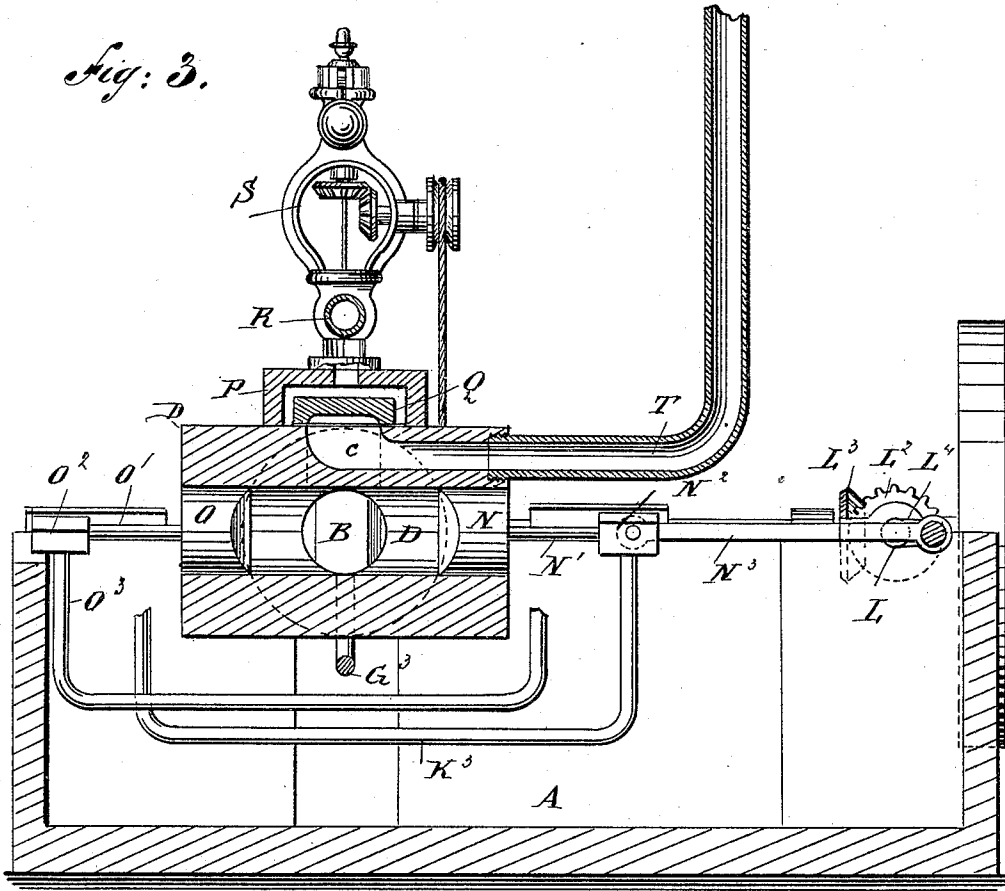
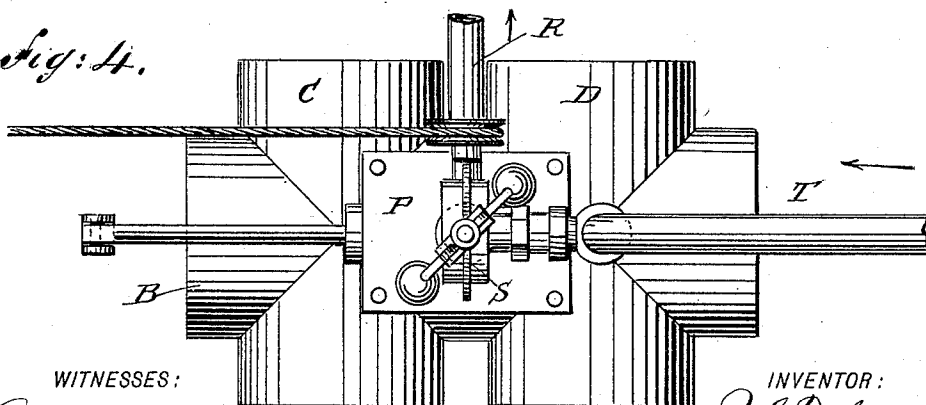


Fig: 4.



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INVENTOR:

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UNITED STATES PATENT OFFICE.

JAMES G. ROBEY, OF GREENVILLE, TEXAS.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 431,996, dated July 8, 1890.

Application filed April 2, 1890. Serial No. 346,300. (No model.)

To all whom it may concern:

Be it known that I, JAMES G. ROBEY, of Greenville, in the county of Hunt and State of Texas, have invented a new and Improved Steam-Engine, of which the following is a full, clear, and exact description.

The object of the invention is to provide a new and improved steam-engine in which the motive agent is utilized to the fullest advantage.

The invention consists of certain parts and details and combinations of the same, as will be hereinafter fully described, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional plan view of the improvement. Fig. 2 is a sectional side elevation of the same on the line *xx* of Fig. 1. Fig. 3 is a transverse section of the same on the line *yy* of Fig. 1. Fig. 4 is a plan view of the cylinders, steam-chest, and governor; and Fig. 5 is a transverse section of part of the improvement on the line *zz* of Fig. 2.

The improved steam-engine is provided with a suitably-constructed frame A, on which is mounted a longitudinally-extending cylinder B, intersected by two transverse cylinders C and D, standing at right angles to the said cylinder B. In the cylinder B are fitted to slide the pistons E, F, and G, of which the piston E travels in the inner end of the said cylinder up to the intersecting cylinder C, while the piston F travels in that part of the cylinder B lying between the intersecting cylinders C and D, and the piston G travels in the outer end of the cylinder up to the intersecting cylinder D.

The piston E is connected by one or more piston-rods E' with a cross-head H, fitted to slide in suitable guideways on the main frame A, and connected by one or more pitmen I' with crank-arms I', formed on the main driving-shaft I, extending transversely and mounted to turn in suitable bearings on the main frame A. The piston F is provided with a piston-rod F', which passes centrally through the piston E and connects with a cross-head F², fitted to slide in a suitable

guideway and pivotally connecting by a pitman F³ with a crank-arm I², held on the main driving-shaft I and standing in an opposite direction to the crank-arms I'.

The piston G is provided with an outwardly-extending piston-rod G', connected with a cross-head G², fitted to slide in suitable guideways on the main frame A and connected by a bent rod G³ with the cross-head H, so that the power of the piston G is transmitted to the cross-head H, which, by the means above described, transmits motion to the main driving-shaft I alternately with the motion derived from the piston E as the latter and the piston G slide simultaneously in the same direction, while the piston F operates simultaneously in an opposite direction to the said pistons G and E.

In the transverse cylinder C are fitted to slide the pistons J and K, adapted to travel simultaneously in opposite directions in unison with the pistons E and F. The piston J is provided with a piston-rod J', connected with a cross-head J², fitted to slide in suitable guideways on the main frame A and connected by a pitman J³ with a crank-arm L', formed on the auxiliary shaft L, extending longitudinally and mounted to turn in suitable bearings on the main frame A. The shaft L carries a bevel gear-wheel L² in mesh with a bevel gear-wheel L³, secured on the main driving-shaft I, so that the rotary motion of the said auxiliary shaft L is transmitted to the main shaft I. The piston K is provided with a piston-rod K', extending outward and connected with a cross-head K², fitted to slide in suitable guideways on the main frame A.

In the other transverse cylinder D are fitted to slide the pistons N and O, adapted to travel simultaneously in opposite directions and in conjunction with the pistons F and G. When the pistons N and O slide toward each other, a similar motion takes place with the pistons F and G, but at the same time the pistons J and K slide from each other in opposite directions, and the pistons F and E have the same movement. The piston N is provided with a piston-rod N', connected with a cross-head N², fitted to slide in suitable guideways and pivotally connected by a pitman N³ with a crank-arm L⁴, formed on the auxiliary shaft

L and standing in an opposite direction to the crank-arm L', previously mentioned.

The piston O is provided with a piston-rod O', extending outward and connected with a cross-head O², fitted to slide in suitable bearings and connected by a rigid rod O³ with the cross-head J² of the piston J. The cross-head K² previously mentioned is connected by a similar rod K³ with the cross-head N², as the pistons K and N slide simultaneously in the same direction and the pistons O and J slide in a similar manner.

On top of the cylinder B, and in the middle between the transverse cylinders C and D, is arranged a steam-chest P, in which is fitted to slide an ordinary slide-valve Q, operated by suitable means from the main driving-shaft I. The slide-valve Q operates over the steam-inlet ports *a* and *b* and the exhaust-port *c*. The port *a* leads from the steam-chest P to the center of the intersecting cylinders B and C, and in a similar manner the inlet-port *b* connects the said steam-chest P with the intersection of the cylinders B and D. Into the steam-chest P leads the usual steam-inlet pipe R, provided with a governor S, operated from the main driving-shaft I, and the port *c* is connected with the usual exhaust-pipe T, leading to the outside.

The operation is as follows: When the several pistons in the cylinders B, C, and D are in the position shown in Fig. 1, then the valve Q opens the port *a*, so that live steam from the steam-chest P passes through the said port *a* into the middle of the intersecting cylinders B and C, which exert an equal pressure against the four pistons E F J K, which now stand in their innermost position. The force of the steam moves the said pistons outward, and the pistons E and F, by their connections with the main driving-shaft I, impart a rotary motion to the latter, and the pistons J and K, by their connections with the auxiliary shaft L, rotate the latter, and this auxiliary shaft transmits its power to the main driving-shaft I by the means above described. During the outward movement of the pistons E F J K an inward movement of the pistons N O G and of the right-hand end of this piston F takes place, so that steam contained in the right-hand end of the cylinder B and the intersecting cylinder D is exhausted through the port *b* and the under side of the valve Q to exhaust-port *c*, from which the steam escapes to the outside by the exhaust-pipe T. When the pistons E F J K have reached their outermost position, the other pistons N G O have assumed an innermost position in conjunction with the right-hand end of the piston F. The valve Q is now reversed, so that the port *a* is connected with the exhaust-port *c*, and the port *b* is open to the steam-chest, so that live steam from the latter can pass to the intersection of the cylinders B and D to force the pistons F and G and N and O outward, whereby the pistons F and G impart rotary motion to the main driving-shaft I,

while the pistons N and O impart a similar motion to the auxiliary shaft L, connected with the said main driving-shaft I. During this outward movement of the pistons N, G, and O an inward movement of the pistons J E K takes place at the left-hand end of the piston F, so that the steam contained in the left-hand end of the cylinder B and the intersecting cylinder C exhausts through the port *a* into the port *c*, connected with the outside. It will thus be seen that while one set of pistons moves simultaneously outward the other set moves simultaneously inward, and while one set is being forced outward by the action of the live steam the other set exhausts, both sets being supplied by live steam from a single slide-valve Q, which regulates their exhaust. It will further be seen that the entire force contained in the motive agent is fully utilized, as it can spend its force simultaneously against four pistons driven in an opposite direction.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with a longitudinal cylinder and two parallel transverse cylinders intersecting the same, of a plurality of pistons working in the longitudinal cylinder and a pair of pistons working in each transverse cylinder, substantially as set forth.

2. The combination, with a longitudinal cylinder intersected by two parallel transverse cylinders and provided with a valve, the ports *a* *b* of which lead to the two points where the cylinders intersect, of a middle and end pistons in the longitudinal cylinder and a pair of pistons in each of the transverse cylinders, substantially as set forth.

3. In a steam-engine, the combination, with intersecting cylinders, of pistons operating therein, a single steam-chest held on the said cylinders and provided with inlet-ports leading to the intersection of the said cylinders, and also provided with an outlet-port, a valve operating in the said steam-chest over the said ports to control the inlet and outlet of the motive agent to and from the said intersecting cylinders, a main driving-shaft connected with the pistons in the longitudinally-extending cylinder, and an auxiliary shaft connected with the pistons in the transverse cylinders, substantially as shown and described.

4. In a steam-engine, the combination, with intersecting cylinders, of pistons operating therein, a single steam-chest held on the said cylinders and provided with inlet-ports leading to the intersection of the said cylinders, and also provided with an outlet-port, a valve operating in the said steam-chest over the said ports to control the inlet and outlet of the motive agent to and from the said intersecting cylinders, a main driving-shaft connected with the pistons in the longitudinally-extending cylinder, an auxiliary shaft connected with the pistons in the transverse cylinders, and means, substantially as described,

for connecting the said auxiliary shaft with the main driving-shaft, as set forth.

5 5. In a steam-engine, the combination, with a double-cruciform steam-cylinder, of a plurality of pistons working in the longitudinal member or section thereof and diagonally-connected pistons working in the transverse members or sections, substantially as set forth.

10 6. In a steam-engine, the combination, with a longitudinally-extending cylinder, of two transverse cylinders intersecting the said longitudinal cylinder at right angles, pistons

fitted to slide in the said cylinders and connected with a main and an auxiliary shaft, a 15 steam-chest held on the said cylinders and connected by inlet-ports with the intersection of the said cylinders, and a single slide-valve operating over the said ports and over an exhaust-port leading to the outside, substantially as shown and described. 20

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Witnesses:

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J. K. ROBEY.