(No Model.) 2 Sheets—Sheet 1.

R. CREUZBAUR.

STEAM ENGINE.

No. 358,846. Patented Mar. 8, 1887.

Fig. 2.

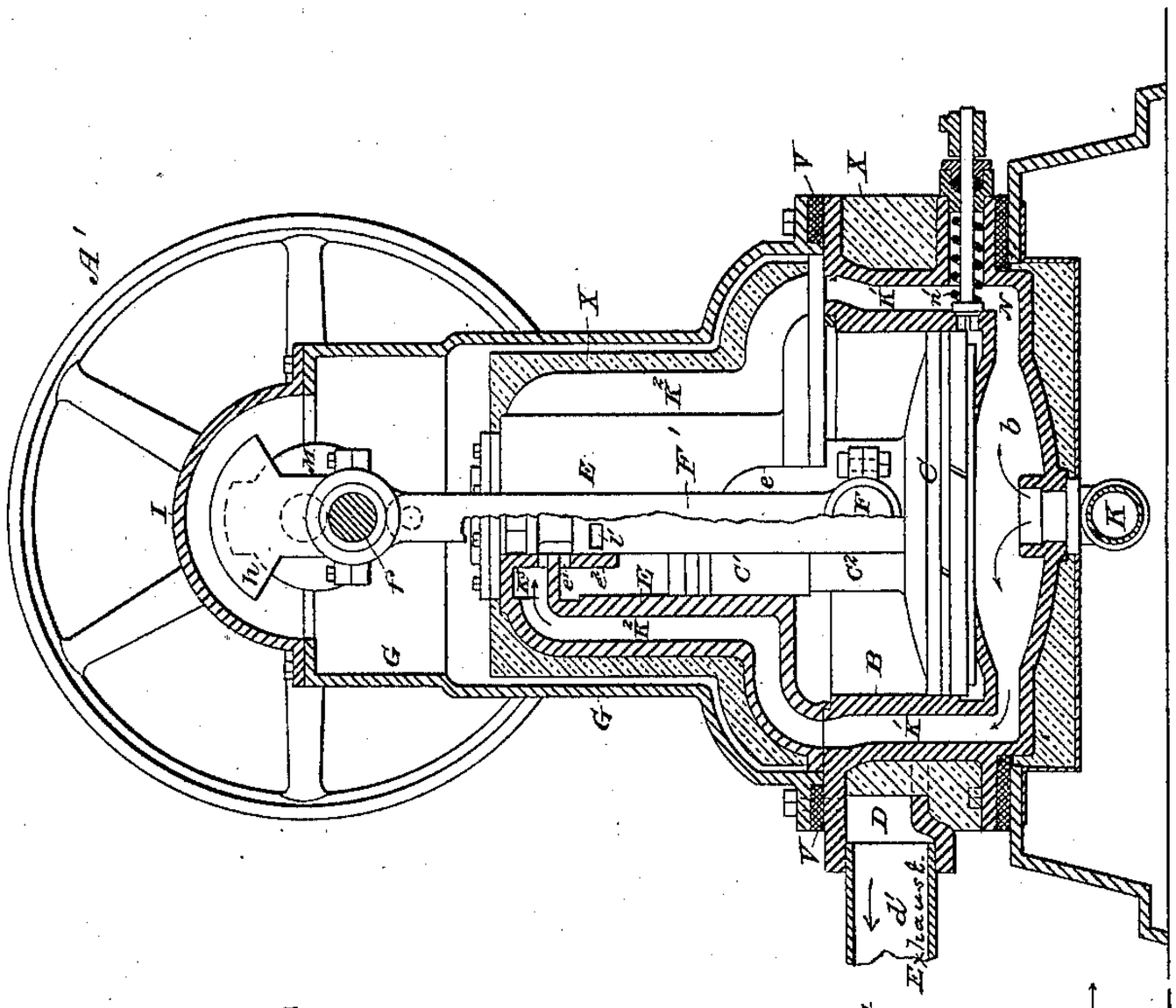
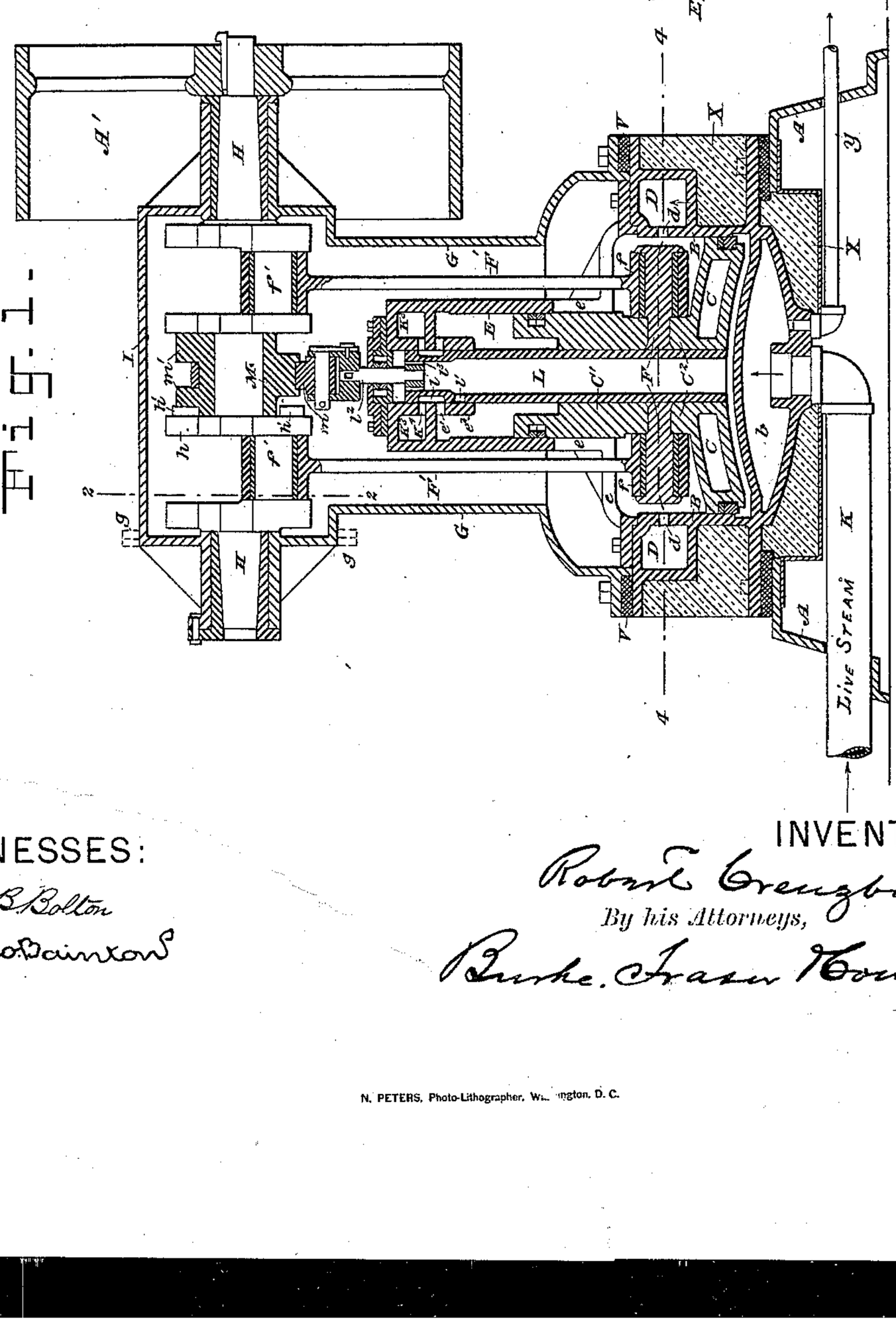


Fig. 1.



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By his Attorneys,

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

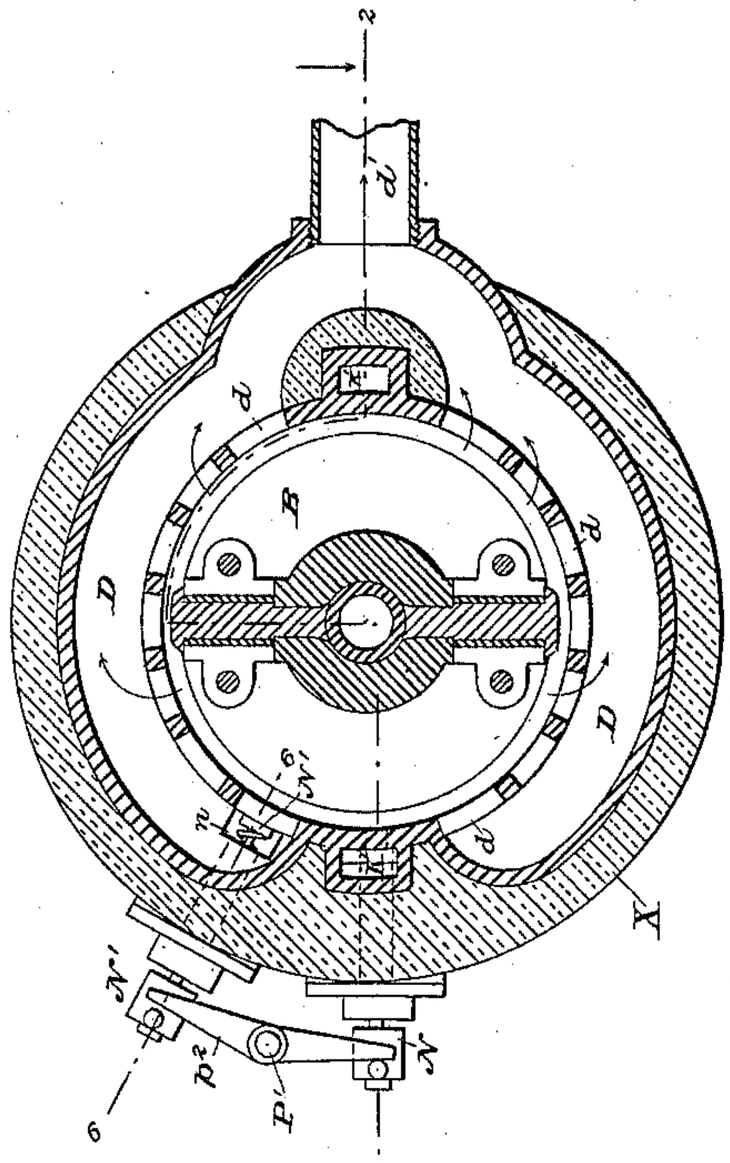


Fig. 5.

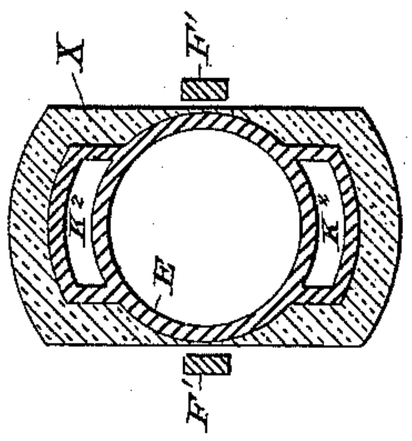


Fig. 6.

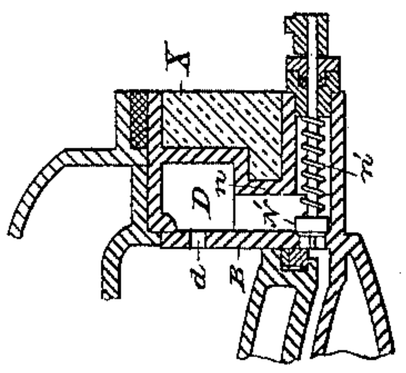
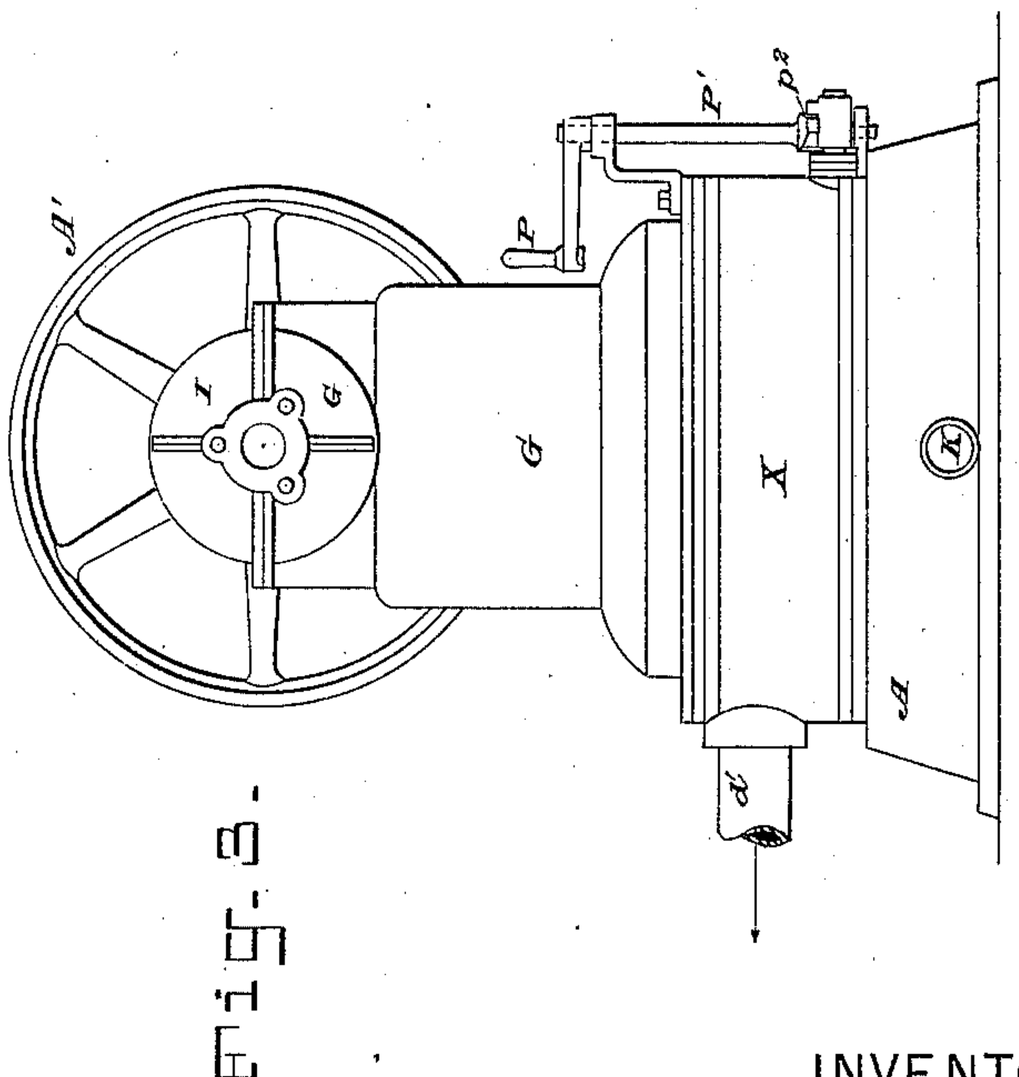


Fig. 7.



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UNITED STATES PATENT OFFICE.

ROBERT CREUZBAUR, OF BROOKLYN, NEW YORK.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 358,846, dated March 8, 1887.

Application filed July 13, 1885. Renewed July 27, 1886. Serial No. 209,205. (No model.)

To all whom it may concern:

Be it known that I, ROBERT CREUZBAUR, a citizen of the United States, and a resident of Brooklyn, Kings county, New York, have invented certain Improvements in Steam-Engines, of which the following is a specification.

My invention relates to compound steam-engines with single-acting cylinders placed end to end; and the objects of my invention are, first, to arrange the cylinders with their non-working ends opposed, to connect the pistons of different displacement rigidly together, and to so admit the steam to the cylinders as to impart alternate working strokes or movements to the pistons, whereby rotative force is exerted on the crank-shaft during the entire revolution; second, to provide for the steam distribution through a centrally-arranged valve without an exhaust-passage through the same, except for the steam which is exhausted from the high-pressure into the low-pressure cylinder, thus isolating the live steam from the exhaust-steam, which passes into the condenser or atmosphere through ports in the sides of the low-pressure cylinder; third, to provide both cylinders with steam-jackets furnished with live steam with a pressure-relief valve opening into said jacket from the low-pressure cylinder, said valve also serving as a starting, re-enforcing, and reversing valve, as will be explained; fourth, to provide, in combination with a special hand-operated live-steam valve, an exhaust-valve, which serves to reverse as well as start the engine.

In the drawings, which serve to illustrate my invention, Figure 1 is a vertical mid-section of the engine, taken in the plane of the axis of the main shaft. Fig. 2 is a section taken at right angles to the main shaft, the right and left halves of the figure being taken in the sectional planes indicated by the lines 2 2 in Figs. 1 and 4. Fig. 3 is a side elevation of the engine from the same point of view as Fig. 2, but on a smaller scale. Fig. 4 is a horizontal section on line 4 4 in Fig. 1. Fig. 5 is a horizontal section of the high-pressure cylinder, showing the steam-jacket and non-conducting covering. Fig. 6 is a sectional view showing the exhaust chamber and valve.

A is the bed-plate.

B is the low-pressure cylinder, flanged and bolted to the bed-plate, with a packing of heat-intercepting material interposed between.

G is the outer casing, flanged and bolted to the cylinder B, with a packing of non-conducting or heat-intercepting material, V, interposed between.

H is the main shaft mounted in bearings in the casing G, and I is a cap flanged and bolted to the casing G.

A′ is the fly-wheel or pulley on shaft H.

E is the high-pressure cylinder, which is flanged and accurately fitted to the top of cylinder B and bolted firmly down upon the same.

C is the piston of the low-pressure engine, which is usually made hollow in order to lighten it and intercept the radiation of heat, and C′ is the piston of the high-pressure engine. These pistons are rigidly connected together, and are usually made integral. Both are properly provided with packing in the usual way. The neck C^2, which connects the pistons, is provided with wrist-pins F F, to which are coupled the lower ends, *f f*, of the connecting-rods F′ F′, the upper ends of which are coupled to the crank-pins *f′ f′* on shaft H. Slots or openings *e e* are formed in the lower part of cylinder E, to make room for the play of the connecting-rod eyes *f f*.

The live steam, or boiler-steam; enters a jacket, *b*, formed on the lower end of cylinder B, through a pipe, K, passes upward through two jacket-like passages, K′, at the sides of cylinder B, and passes thence into the divided jacket K^2 of the cylinder E, which, like the jacket of cylinder B, is formed integral with the cylinder. From the jacket K^2 the steam passes into the steam-chest K^3, formed in the upper part of the cylinder E. Thus the live steam flows through the connected steam-jackets the entire length of the two cylinders from the inlet to the steam-chest.

L is a tubular valve, which plays in a seat formed centrally in the upper part of the cylinder E, and through a bore in the pistons C C′, opening below under the piston C into the lower end of cylinder B. In the valve-seat is a port, K^4, which opens from chest K^3 into an annular cavity, *l*, in the exterior face of the wall of valve L, and in the prolongation e^2 of said valve-seat is a port, *e′*, which opens from the cavity *l* into the upper end of cylinder E. The exhaust-port *l′* in the valve is brought into

coincidence with port e', and the steam from cylinder E exhausts through valve L into cylinder B.

D is an annular exhaust-chamber, formed integrally with cylinder B and at its upper part. This chamber communicates with cylinder B through ports $d\ d$ in the wall of said cylinder, and with the condenser or the atmosphere through an exhaust-outlet, d'. The ports d are uncovered by the piston C when the latter reaches the end of its upstroke.

To the upper end of valve L is attached a stem, l^2, which passes out through a stuffing-box on the top of the steam-chest, and this stem is coupled to the yoke or strap m of a valve-operating eccentric, M, loosely mounted on the main shaft H. The eccentric is counterbalanced by knobs or weights $m'\ m'$, and is driven by one or the other of two studs, h', on the counter-balance h of one of the crank-arms. In order to balance valve L, the upper end of same is provided with an opening, l^3.

Fig. 1 shows the pistons at the end of their downstroke. This view, for the sake of clearness, also shows the valve L at the end of its downstroke, although this is not precisely the position it will occupy in practice when the pistons stand as shown. Live steam passes from the chest K^3 through port K^4, through the cavity l of the valve, and enters cylinder E through port e'. When the valve rises, it closes port K^4 and brings the port l' in the valve into coincidence with port e'. The steam from cylinder E exhausts through these ports, and the hollow of the valve L into cylinder B below piston C. When the pistons reach the end of their upstroke, being driven upward by the exhaust from cylinder E, the piston C passes above and uncovers ports $d\ d$, and the steam exhausts from cylinder B into D, and passes thence to the condenser or to the atmosphere.

It will be observed that when the steam from cylinder E flows into cylinder B through the tubular valve L, it impinges on the roof or upper plate of the live-steam chamber b, and its heat is thus maintained, instead of being radiated by contact with the cold metal.

To start, re-enforce, or reverse the engine, I employ two valves adapted to be opened and closed alternately and controlling the admission of live steam under piston C, and the exhaust of said steam, after it has done its work, into the exhaust-chamber D. The inlet-valve N is clearly shown in Fig. 2. It comprises a valve on the end of a stem which projects out through a stuffing-box in the lower part of cylinder B. This valve controls a post in the cylinder B, which connects said cylinder with the live-steam passage K'. The valve is normally held up to its seat by a spring, n'. The outlet or exhaust valve N' (see Fig. 6) is constructed in precisely the same way; but it controls a port which opens from the cylinder B into a pocket or passage, n, and thence into the exhaust-passage D. In order to operate these valves by hand, I mount on a vertical axis, P', a rock-lever, p^2, the ends of which take behind lugs on the outer ends of the respective valve-stems. The lever is operated by a crank or arm, P. (Seen in Fig. 3.) The valve N' must have a stronger spring, n', than the valve N, in order to resist the pressure of the live steam in the cylinder. The pocket or passage n is employed to connect the port at the lower end of the cylinder with the chamber D, which is at the upper end. The sectional view Fig. 6 illustrates the construction clearly.

The ports controlled by valves N and N' are made full large enough to control the lower piston at a low speed in overcoming extraordinary resistances—as a heavy grade, for example. In reversing the engine, when the piston C is about midway of its down or exhaust stroke, live steam is admitted at the valve N, which reverses the movement of the piston and brings the eccentric M into contact with the reversing driving-stud h' in the usual way, whereby it imparts the proper reverse action to the valve.

The back-pressure under piston C, after its exhaust-ports d are closed, serves to cushion the pistons and neutralize the momentum of the pistons and their attachments on the downward stroke.

It is evident that the valve may be arranged to cut off the steam automatically at any point in its stroke, and that the engine may be reversed by a traverse eccentric and weights acting by centrifugal force, as usual with other steam-engines.

X represents non-conducting or heat-intercepting material arranged around the cylinders.

A drainage-pipe, y, to drain chamber b, is shown in Fig. 1.

When a condenser is employed, the casing G I should be air-tight, in which case the whole may be cast in one piece, an end cap being provided at the left for the insertion of the shaft H. I have indicated this slight modification by dotting in the flanges g that would be required in this case.

In my pending applications, Serial No. 193,001, filed February 24, 1886, and Serial No. 207,309, filed July 7, 1886, I show constructions somewhat similar to those shown and claimed herein. I wish it understood that I do not herein claim what is shown and claimed in said applications.

Having thus described my invention, I claim—

1. Two single-acting engines, with their cylinders placed end to end and provided with connecting steam-jackets and having pistons of different displacement, and the said connected jackets arranged to receive steam at one end and to yield it to the engine at the other end, whereby the live steam flows the length of the two cylinders through the jackets, substantially as set forth.

2. A compound engine composed of two single-acting engines, wherein the cylinders of

said engines are placed with their non-working ends opposed, the pistons rigidly connected together, and the valve which controls the admission of live steam to the high pressure engine, and the exhaust-steam from the high-pressure engine to the low-pressure engine is in the form of a tube, substantially as described, arranged to play longitudinally through both pistons, substantially as set forth.

3. The combination, in an engine composed of two single-acting engines, of the two cylinders arranged end to end, as described, the two pistons connected rigidly together, as described, the tubular valve arranged centrally within the cylinders and playing through the pistons, as described, whereby the steam from the high-pressure engine is exhausted into the cylinder of the low-pressure engine, and the cylinder of the low-pressure engine provided with exhaust-ports controlled by its piston, substantially as set forth, whereby all the exhaust-steam from said cylinder passes out at said ports.

4. An engine composed of two single-acting engines, the cylinders of said engines being placed end to end, the pistons connected together, and the steam-distribution valve placed centrally in said engines, said engine being provided with two auxiliary hand-operated valves, substantially as described, one for controlling the admission of live steam to the cylinder of the low-pressure engine behind its piston and the other for controlling the exhaust of said steam therefrom, substantially as set forth.

5. The combination, with the cranked main shaft, of the cylinders B and E, secured together endwise and provided with live-steam and exhaust-steam ports and passages, substantially as described, the pistons C and C′, connected rigidly together and arranged in said cylinders, the connecting-rods whereby the pistons are coupled to the crank-shaft, the centrally-arranged tubular valve L, mounted to play through the pistons, as set forth, and mechanism, substantially as described, for actuating said valve, all substantially as set forth.

6. An engine composed of two single-acting engines, wherein the cylinders of said engines are placed with their non-working ends opposed, the pistons connected rigidly together, the steam-distribution valve, of tubular form, arranged to play through said pistons, and a live-steam chamber, *b*, is placed at the working end of the low-pressure cylinder and opposite the end of the tubular valve, whereby the steam from the high-pressure cylinder on entering the low-pressure cylinder may impinge upon the surface of chamber *b*, substantially as set forth.

7. The combination of the two cylinders arranged end to end with their non-working ends opposed, the two pistons connected rigidly together by a neck, C, the said neck provided with wrist-pins F F, the cranked main shaft, the connecting-rods coupled at one end to the crank-pins in the shaft and at the other end to the wrist-pins F F, and a steam-distribution valve, all arranged to operate substantially as set forth.

8. A compound engine composed of two single-acting engines with pistons of different displacement, having a centrally-arranged tubular valve, with its valve-casing and ports located in an extension of the high-pressure cylinder, whereby live-steam is delivered to the high-pressure cylinder and the exhaust-steam is delivered from the high-pressure to the low-pressure cylinder, and the low-pressure cylinder provided with exhaust-ports controlled by its piston, substantially as set forth.

9. Two single-acting engines with their cylinders placed end to end and their pistons rigidly connected, and said pistons coupled by connecting-rods to a crank-shaft rotatively mounted or journaled in a casing which incloses the said shaft, the connecting-rods, and one of the cylinders, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

ROBERT CREUZBAUR.

Witnesses:
HENRY CONNETT,
ARTHUR C. FRASER.