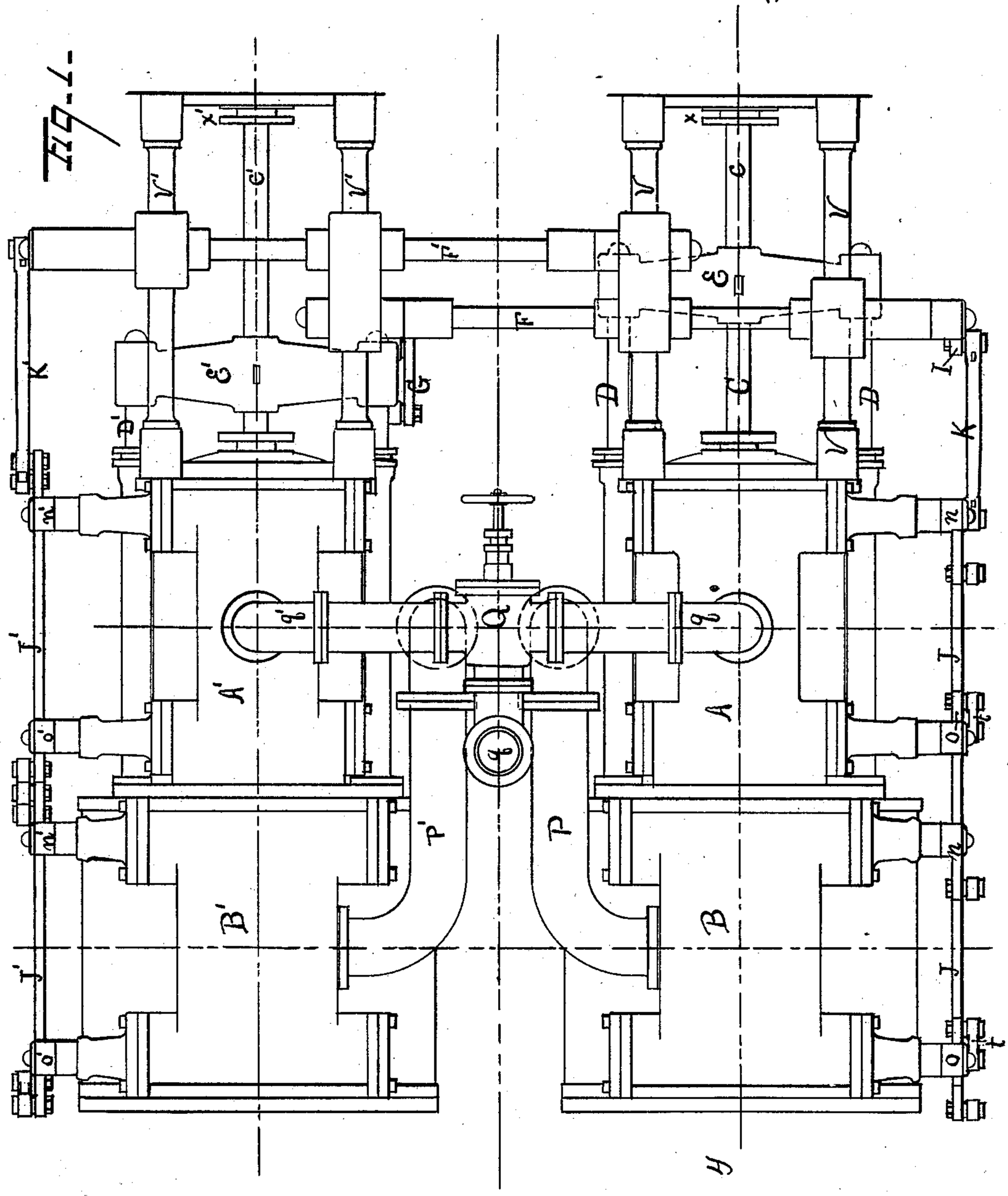
(No Model.) 4 Sheets—Sheet 1.

H. F. GASKILL.

DUPLEX ENGINE.

No. 364,640. Patented June 14, 1887.



WITNESSES.

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(No Model.)

4 Sheets—Sheet 2.

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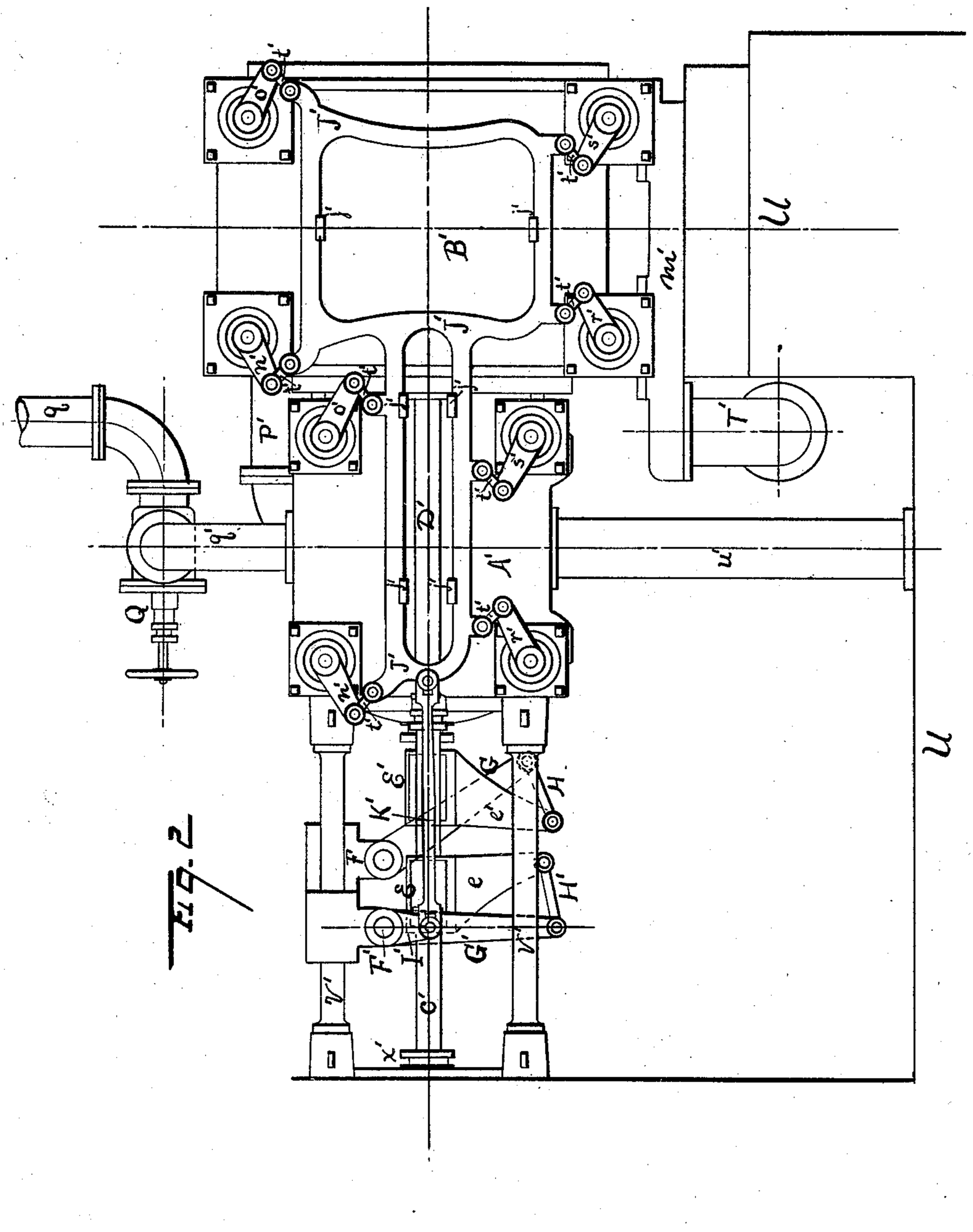

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(No Model.)

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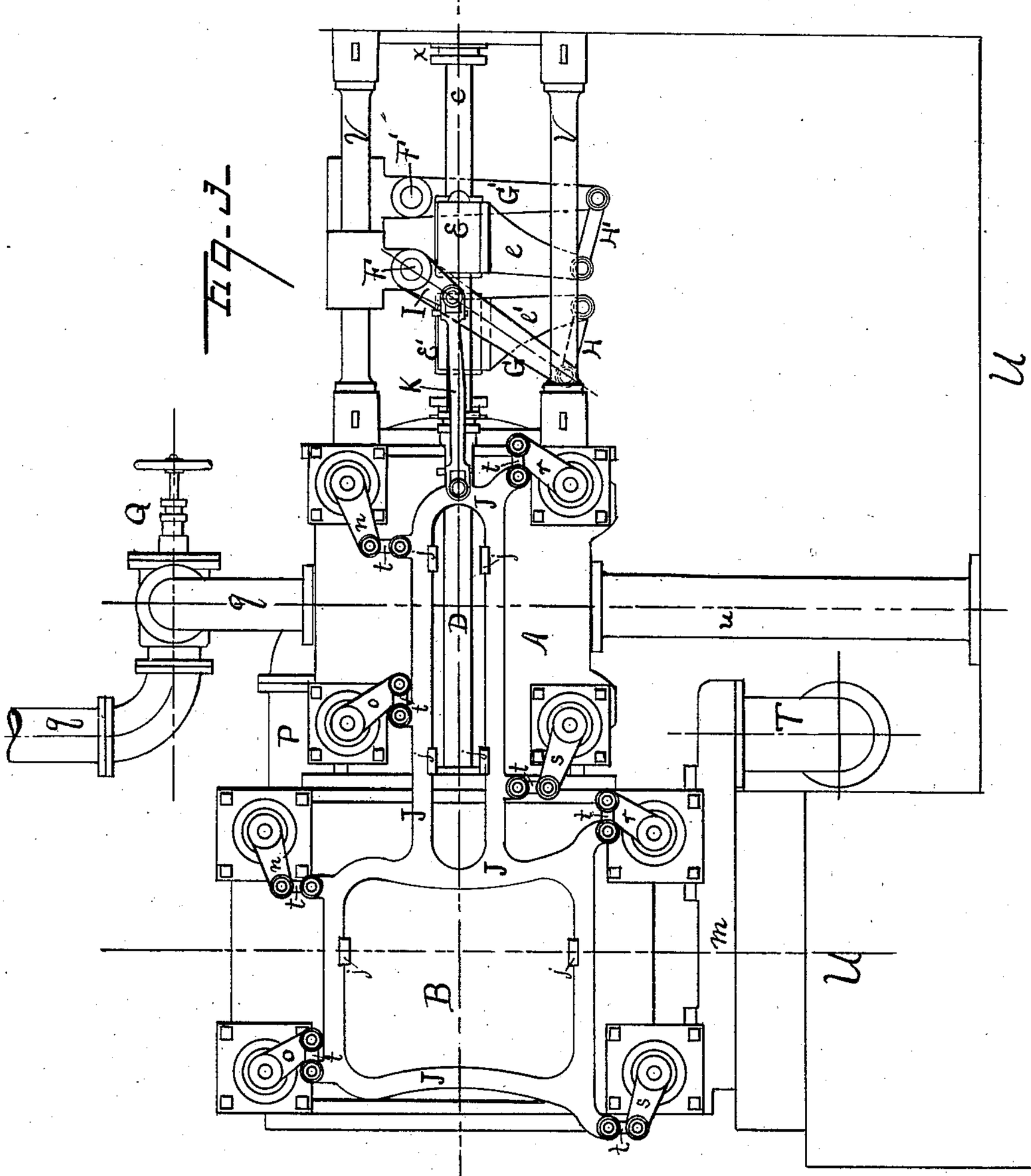

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H. F. GASKILL.

DUPLEX ENGINE.

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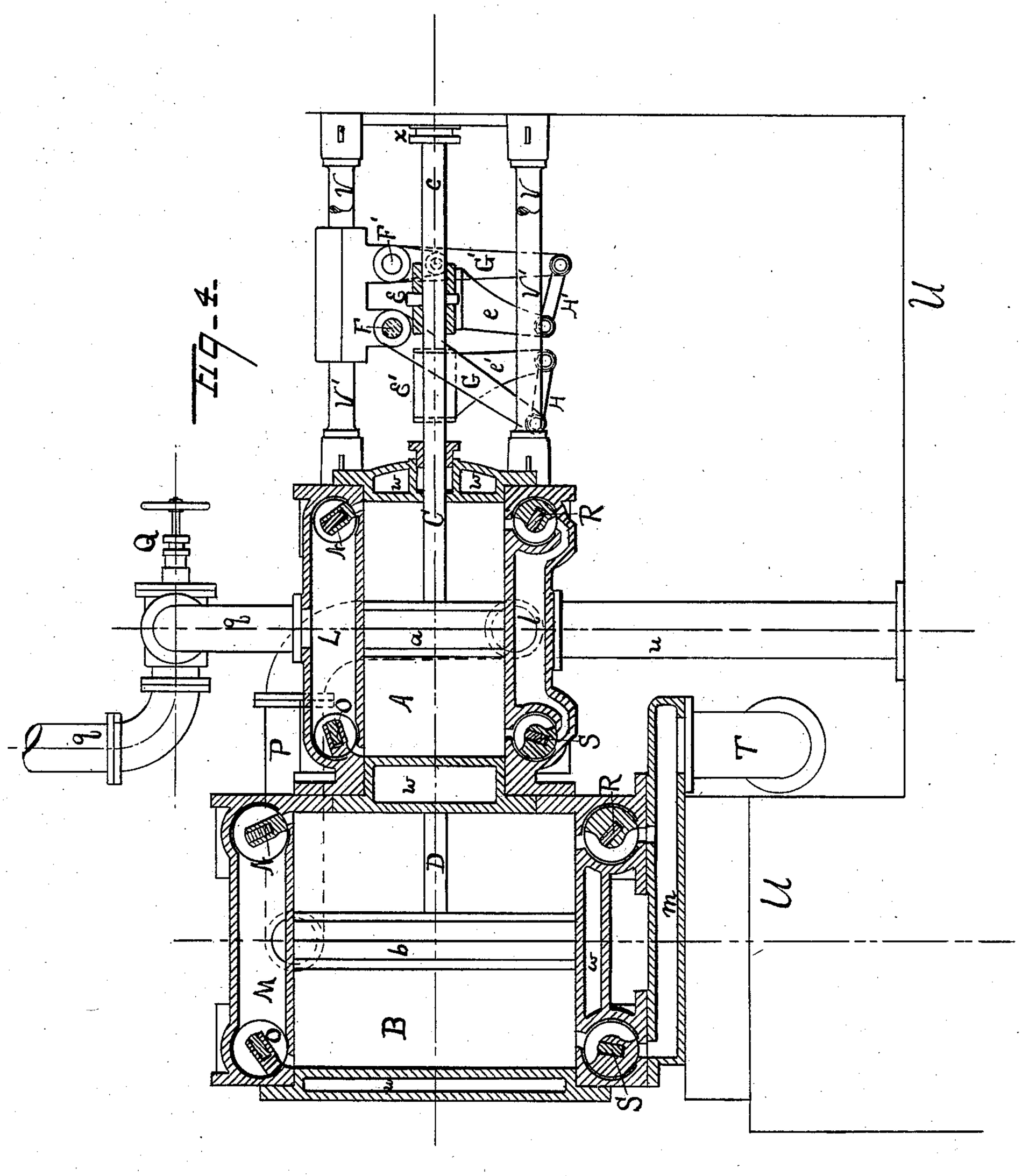
FIG. 4.



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UNITED STATES PATENT OFFICE.

HARVEY F. GASKILL, OF LOCKPORT, NEW YORK.

DUPLEX ENGINE.

SPECIFICATION forming part of Letters Patent No. 364,640, dated June 14, 1887.

Application filed March 24, 1887. Serial No. 232,320. (No model.)

To all whom it may concern:

Be it known that I, HARVEY F. GASKILL, of Lockport, New York, have invented certain new and useful Improvements in Duplex Engines, of which the following is a specification.

The principal objects of my invention are to arrange the valves of a duplex engine so as to avoid the waste of steam due to long and crooked ports and to operate the valves in a simple and effective manner.

Other objects of the invention will be apparent from the subjoined description.

To these ends the invention consists in certain devices or combinations detailed in the claims at the end hereof.

In the accompanying drawings I have shown the steam end of a duplex compound pumping-engine containing my invention.

The principal parts entering into the construction of the apparatus represented in the drawings are as follows: Two engines composing the duplex machine, their cylinders, their pistons and piston-rods, an arm or cross-head on each piston-rod, a rock-shaft to each engine, an arm on each rock-shaft, a link connecting said rock-shaft arm to the arm or cross-head on the piston-rod of its respective engine, a second arm on each rock-shaft, a reciprocating frame to each engine, a link connecting said second arm with the reciprocating frame of the opposite engine, a separate admission and a separate exhaust valve for each end of each cylinder, an arm on each valve by which it is operated, a link connecting each of said valve-arms with the reciprocating frame of its respective engine, and numerous constructional details which go to make up the complete operative machine.

In the drawings, Figure 1 is a top view of the apparatus above referred to—namely, the steam end of a duplex compound pumping-engine—which contains my invention. Fig. 2 is a side elevation of the left-hand engine. Fig. 3 is a side elevation of the right-hand engine. Fig. 4 is a sectional elevation of the right-hand engine, the section being taken through line 4 4 of Fig. 1.

Like letters of reference in the several figures refer to like parts, the parts of the right-hand engine being denoted by unaccented letters and the similar parts of the left-hand engine by accented letters.

A is the high-pressure cylinder. B is the low-pressure cylinder. C is the piston-rod of the high-pressure cylinder, a continuation of which, *c*, constitutes the pump-rod. D D are the piston-rods of the low-pressure cylinder, one on each side of the high-pressure cylinder. E is a cross-head joining the piston-rods D D and C. *e* is an arm on the cross-head or the piston-rod. F is a rock-shaft mounted in suitable bearings in the frame. G is an arm on the rock-shaft in convenient proximity to *e'*. H is a link connecting arm G with arm *e'*, so that rock-shaft F is operated by the movement of piston-rods C' D' D'. I is a second arm on rock-shaft F. J is a frame supported by and capable of moving in guides *j j*. K is a link connecting arm I with frame J, so as to reciprocate the same. L is the steam or valve chest of the high-pressure cylinder; M, the similar part of the low-pressure cylinder. N N are the steam-valves which admit steam to the forward ends of the cylinders. *n n* are the arms on the valve-stems by which said valves are operated. O O are the steam-valves which admit steam to the back ends of the cylinders. *o o* are the arms on the valve-stems by which said valves are operated. R and S are the exhaust-valves. *r* and *s* are the arms by which said exhaust-valves are respectively operated. *t* are links which connect the arms *n*, *o*, *r*, and *s* with the frame J, so that the reciprocation of the latter oscillates the valves.

It will be observed that when the valves are closed, as in case of *r* and *s*, (see Fig. 4,) their respective links *t* are at their right-angular position with respect to the motion of frame J, so that the valves are substantially stationary for a large part of the stroke, and may be made to cover their ports during the entire stroke by having a suitable amount of lap. The right-hand engine being at mid-stroke, as is shown in Fig. 4, its valves, which are controlled and operated by the left-hand engine, are about at the limit of their travel and the valves of the left-hand engine, which are controlled and operated by the right-hand engine, are at the middle of their travel. Steam is admitted to the high-pressure cylinders from throttle-valve Q through the steam-pipes *q*. The steam is exhausted from the high-pressure cylinders into the receiving-pipes P, whence it is admitted to the low-pressure cylinders.

From these latter it is exhausted into the base-casting *m* and passes thence to the condenser. The ports of the exhaust-valves R and S are placed a short distance from the cylinder ends, as shown in Fig. 4, so that they are closed by the pistons when near the end of their travel, whereby a portion of steam is confined and compressed by the pistons and forms a cushion at the end of each stroke. By placing the exhaust-valves at the lower side of the cylinders the entrained water passes out readily.

Referring to Figs. 2 and 3, it will be seen that the valves of the two engines move in opposite directions in opening, owing to the different positions of their arms *m m' o o'* with respect to the frames J and J'. For example, arms *n* extend from their valve-stems backward and toward the frame, while arms *n'* extend forward. Similarly, *o* and *o* extend forward while *o'* and *o'* extend backward, and likewise with *r* and *r' s* and *s'*. This arrangement of the arms permits the frames J and J' to both move in the same direction relatively to the pistons which operate them, and obviates the necessity which would otherwise exist of having one of the arms I and I' extend upward and the other downward from its rock-shaft.

It is of course understood that I do not limit myself to a compound engine or to a duplex engine having more than one cylinder to each engine; neither do I limit myself to the precise form or arrangement of parts herein set forth, as many modifications may be made by the mechanic from his knowledge and skill to suit the various requirements of practice; but

What I do limit myself to and claim as my invention is—

1. The combination, in a duplex engine, of a separate admission-valve for each end of each cylinder, a separate exhaust-valve for each end of each cylinder, and mechanism connecting the valves of one engine with the piston of the other engine of the duplex system, substantially as set forth.

2. The combination, in a duplex engine, of a separate exhaust-valve for each end of each cylinder, an exhaust-port located near but not at each end of each cylinder, and the pistons moving in the cylinders and adapted to close the exhaust-ports before reaching the limit of their travel, whereby a portion of steam is confined and forms a cushion at the end of each stroke, substantially as set forth.

3. The combination, in a duplex engine, of the cylinders, the exhaust-valves, and a separate exhaust-port for each end of each cylinder located in the lower side thereof, substantially as set forth.

4. The combination, in a duplex engine, of a separate admission and exhaust valve for each end of each cylinder, a reciprocating frame for each cylinder, and mechanism connecting said frame with the piston of the opposite engine of the duplex system, substantially as set forth.

5. The combination, in a duplex engine, of a separate valve for each end of each cylinder, a reciprocating frame to each cylinder, and a rock-shaft operated by each of the engines of the duplex system and connected to the reciprocating frames of the opposite engine, substantially as set forth.

6. The combination, in a duplex engine, of the separate valves, the valve-operating arms, the reciprocating frames, the links connecting the frames with the valve-arms, the rock-shafts, the links connecting the frames with the rock-shafts, and the links connecting the rock-shafts with the piston-rods, whereby the valves of each engine are operated by the opposite engine of the duplex system, substantially as set forth.

7. The combination of two engines constituting the duplex system, their pistons and rods, two reciprocating frames moving in the same direction relatively to the pistons operating them, and mechanism connecting said frames to the valves, substantially as set forth.

8. The combination of two engines constituting the duplex system, their pistons and rods, two reciprocating frames moving in the same direction as the pistons operating them, and mechanism connecting said frames to the valves, substantially as set forth.

9. The combination of the two engines, their pistons and rods, the two reciprocating frames operated each by the opposite engine and moving in the same direction relatively to the pistons operating them, and the valve-arms extending in opposite directions toward the frames, substantially as set forth.

HARVEY F. GASKILL.

Attest:
F. P. LUCE,
PERRY STOWELL.