(No Model.)

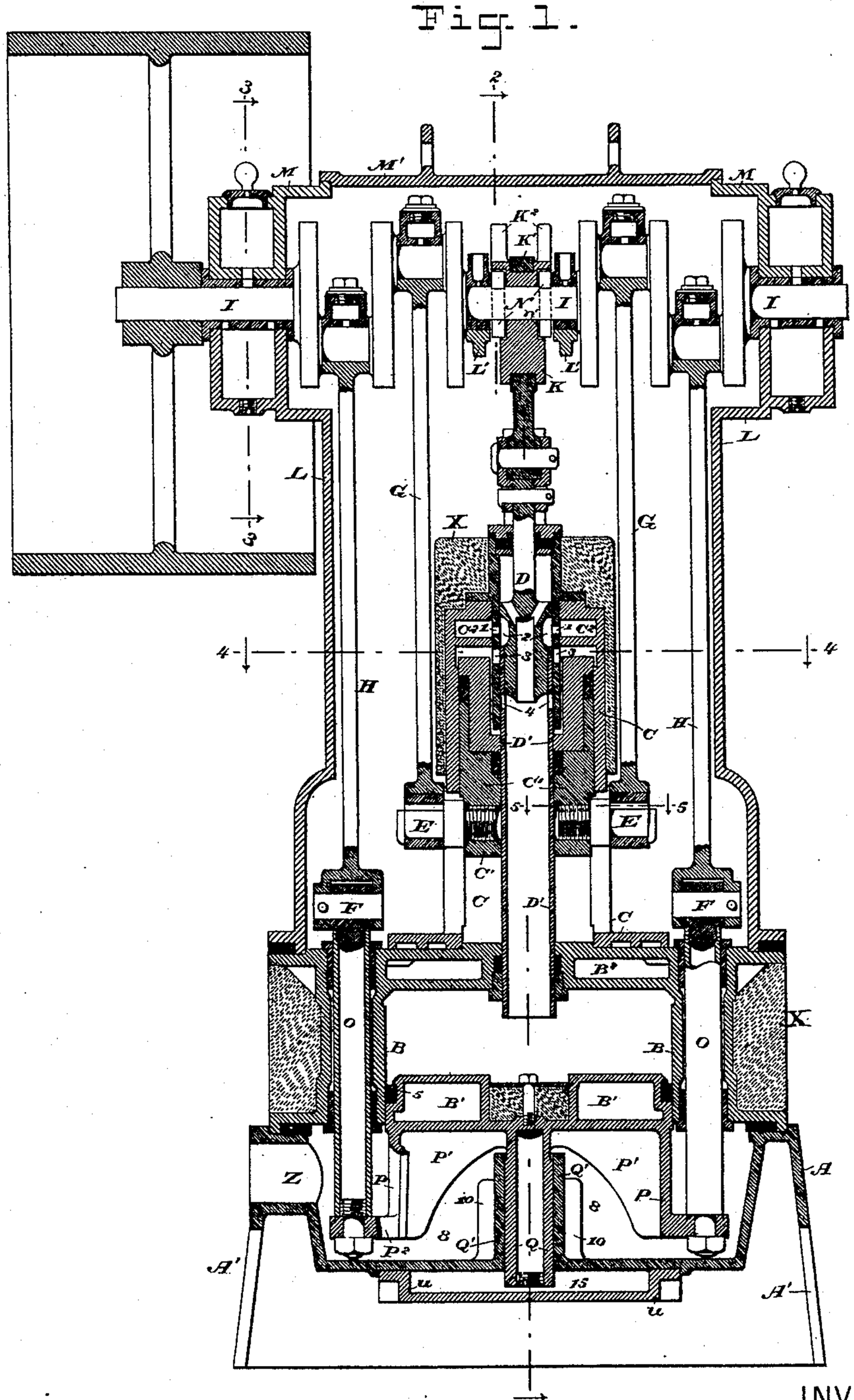
4 Sheets—Sheet 1.

R. CREUZBAUR.

STEAM ENGINE.

No. 358,843. Patented Mar. 8, 1887.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

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Fig. 2.

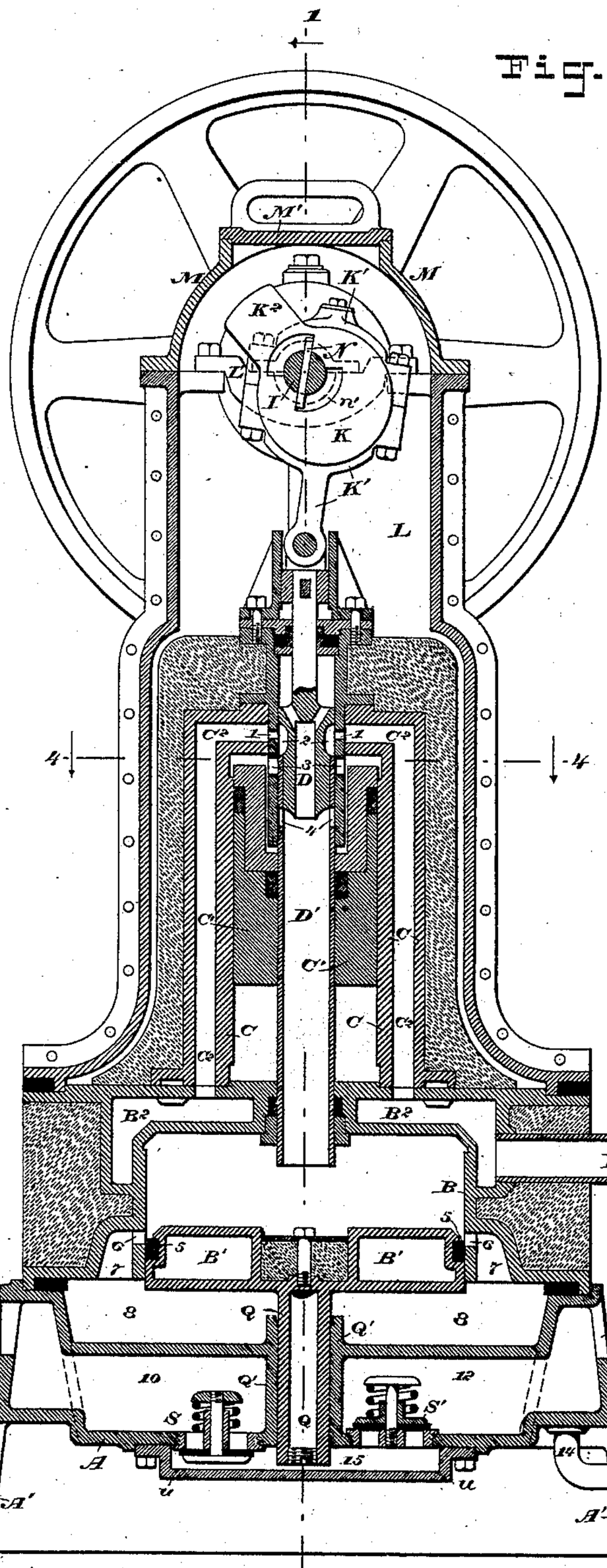
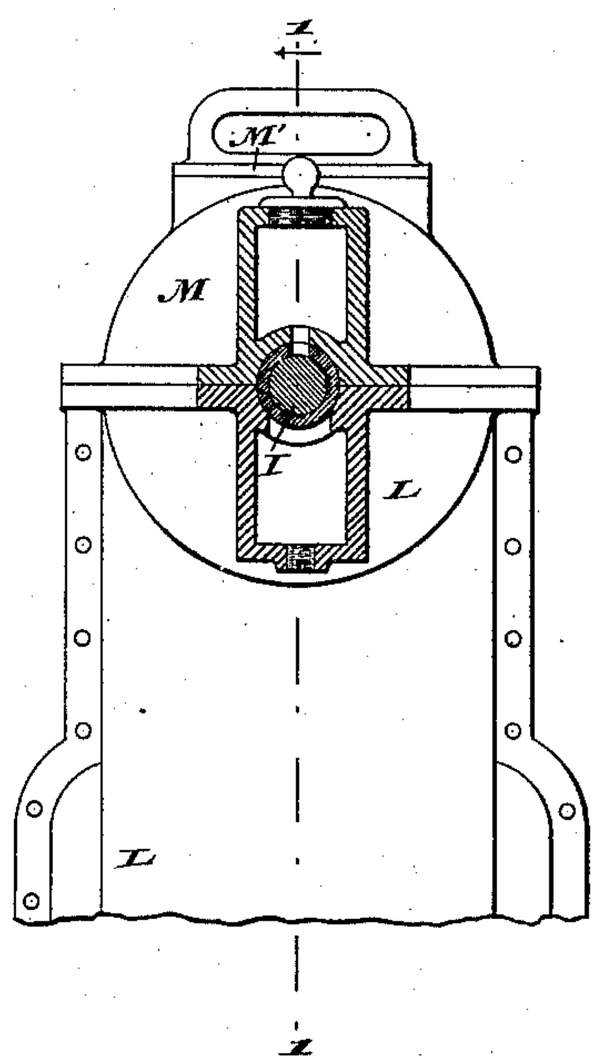


Fig. 3.



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4 Sheets—Sheet 3.

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STEAM ENGINE.

No. 358,843. Patented Mar. 8, 1887.

Fig. 4.

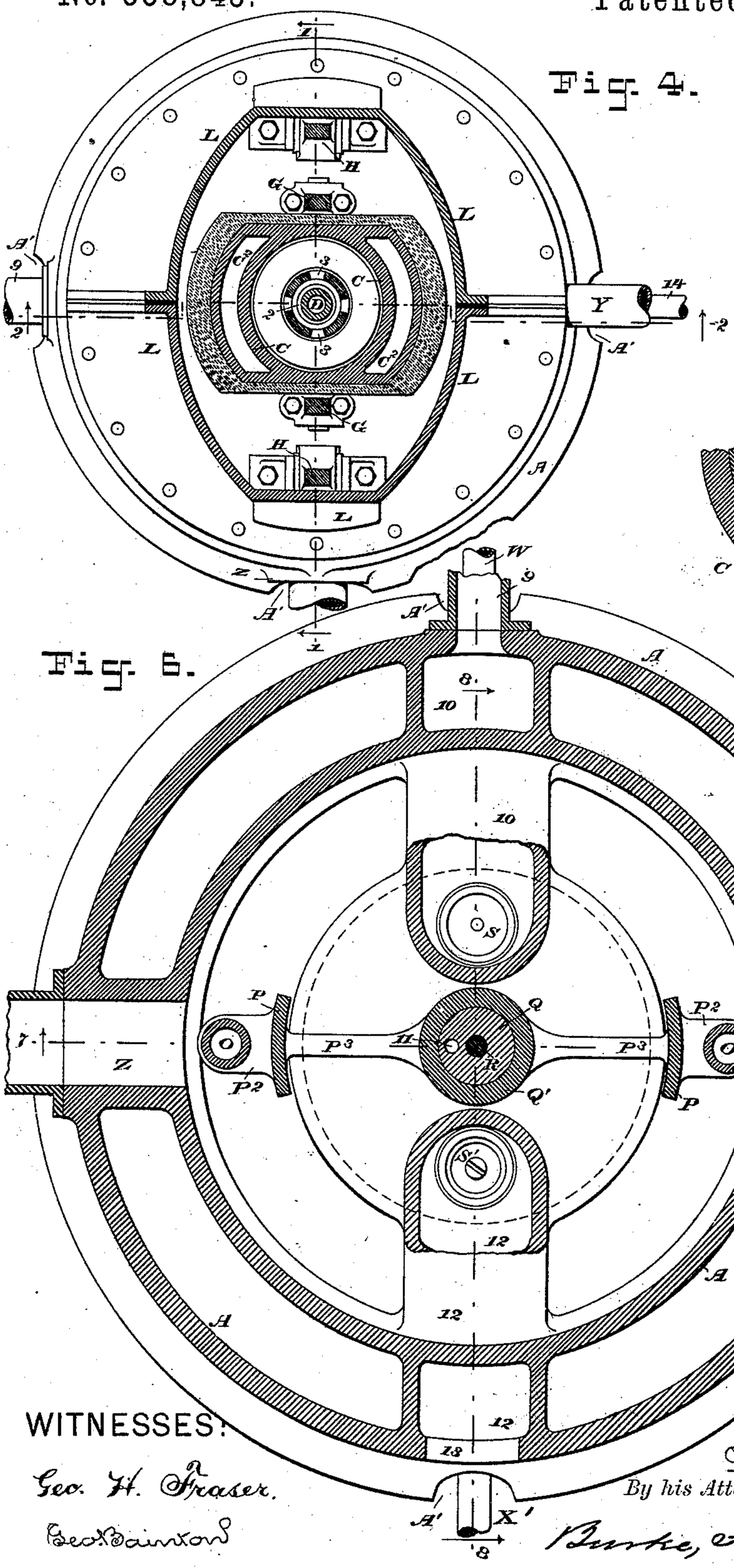

Fig. 5.

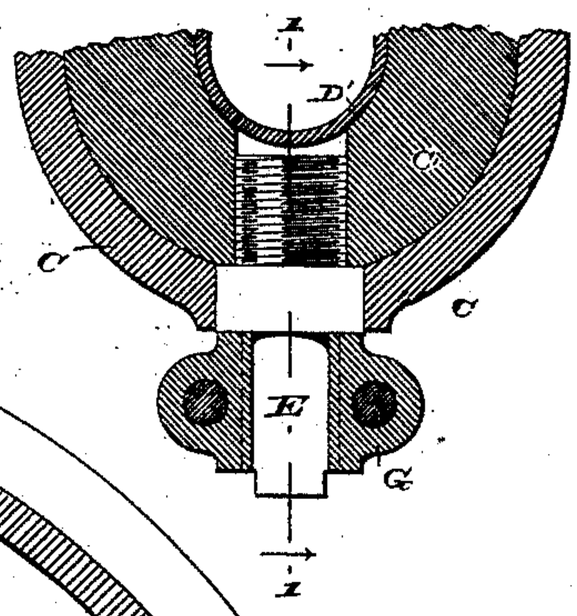

Fig. 6.

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STEAM ENGINE.

No. 358,843. Patented Mar. 8, 1887.

Fig. 7.

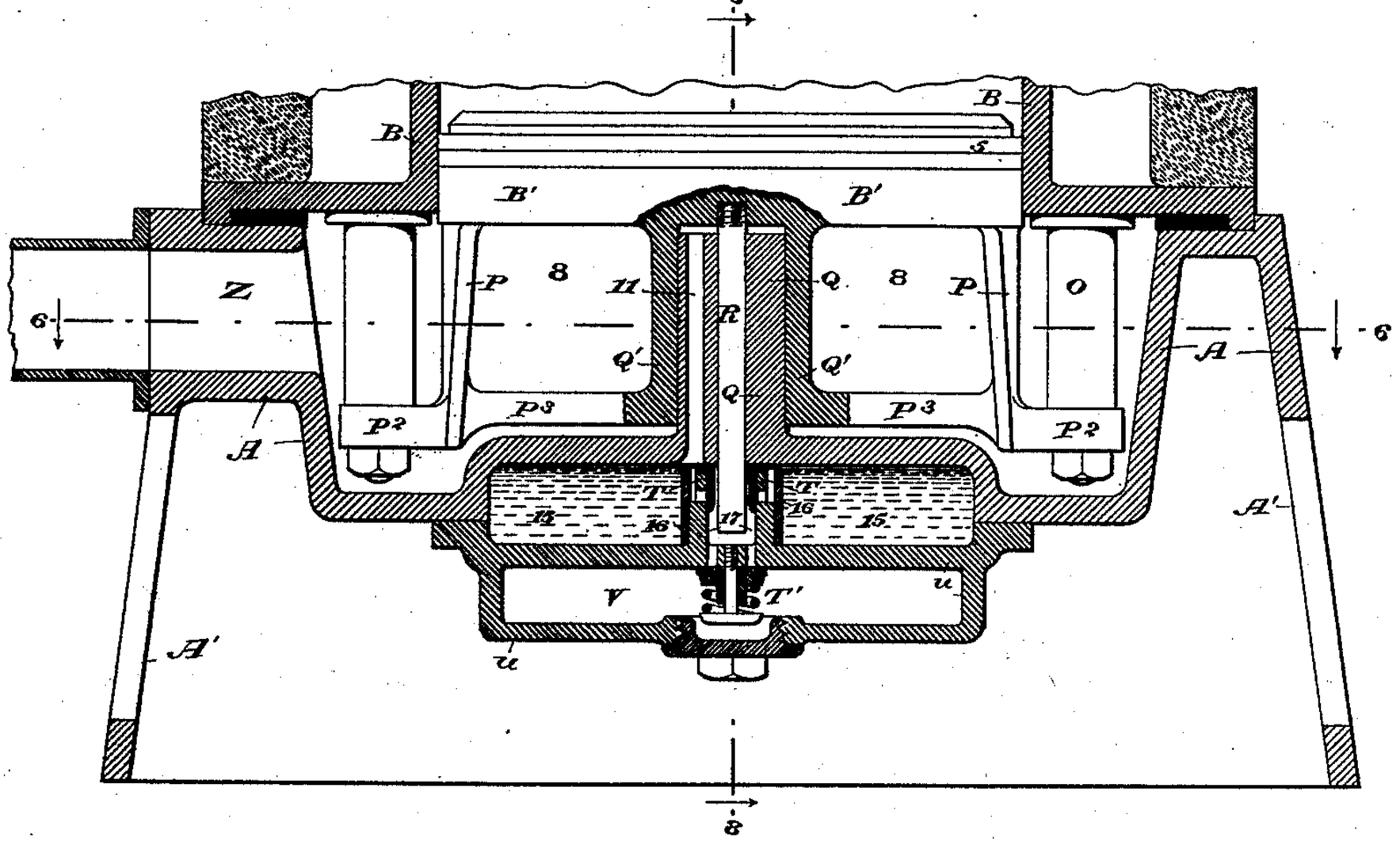
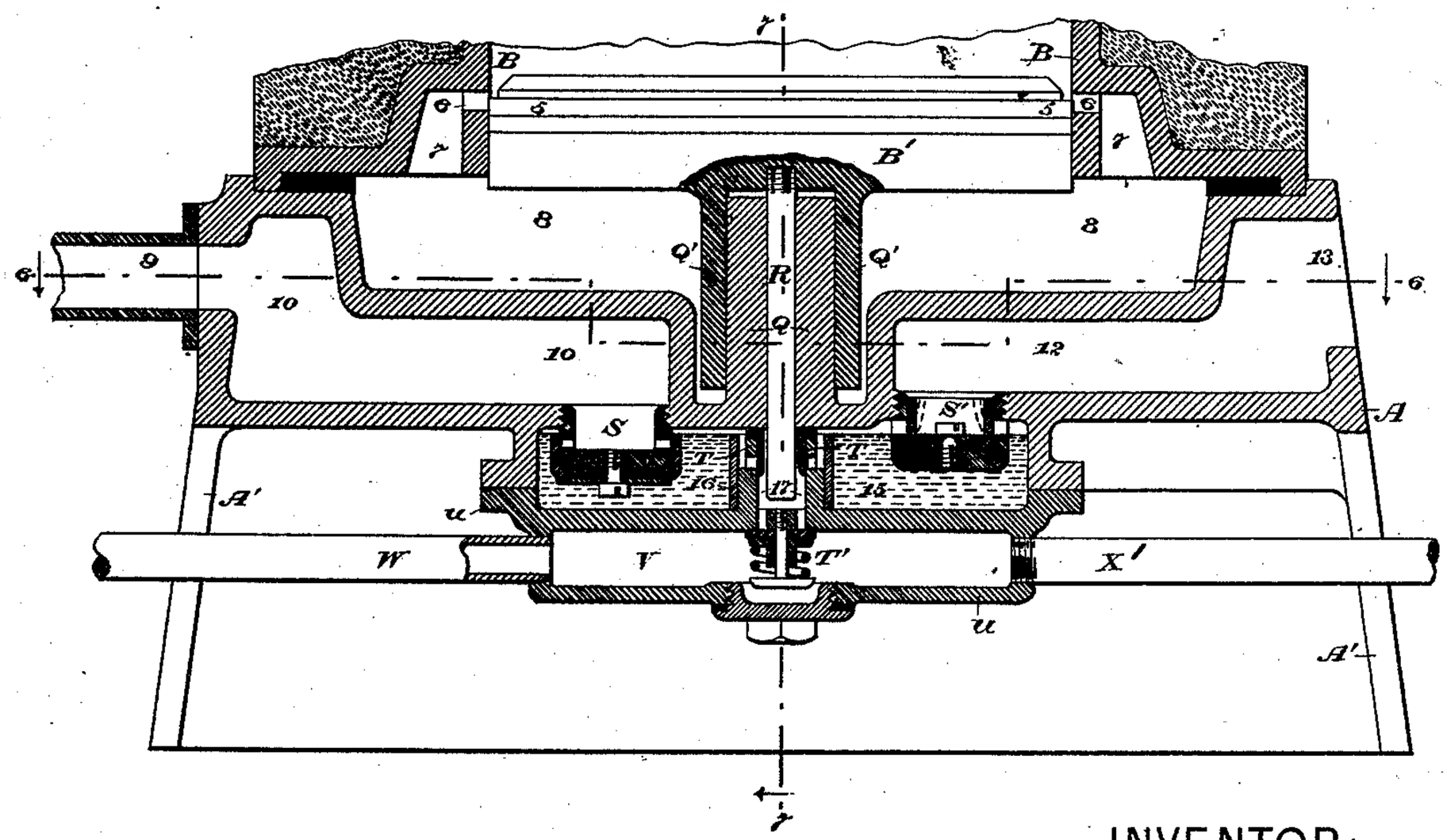


Fig. 8.



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UNITED STATES PATENT OFFICE.

ROBERT CREUZBAUR, OF BROOKLYN, NEW YORK.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 358,843, dated March 8, 1887.

Application filed March 2, 1886. Serial No. 193,721. (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 particularly to condensing single-acting compound engines, in general construction corresponding to the engine described in my pending application, filed February 24, 1886, Serial No. 193,001.

The objects of my present improvement are, first, to locate the air-pump in the base of the engine, through which the exhaust-steam from the low-pressure cylinder passes, the moving part of the air-pump—that is, either its piston or pump barrel—being rigidly attached to the low-pressure piston, and the non-moving part—in this case the pump-barrel—being rigidly attached to the base of the engine; second, to so construct the air-pump piston that it will serve as the pump-barrel for the boiler-feed pump, the feed-pump plunger working within the hollow piston of the air-pump; third, to locate and chamber the valves of the air and boiler feed pumps so that they will be accessible from openings in the base of the engine; fourth, to provide a cheaply-constructed casing for the high-pressure cylinder and connecting-rods, and for supporting the crank-shaft by constructing said casing of cast-iron in two parts, as will be hereinafter described. I attain these objects in the manner hereinafter described and by the means illustrated in the accompanying drawings, wherein—

Figure 1 is a vertical mid-section of my improved engine, taken in a plane coincident with the axis of the crank-shaft, this plane being indicated by lines 1 1 in Figs. 2, 3, 4, and 5. Fig. 2 is a similar section taken at right angles to that of Fig. 1, the plane of the section being indicated by line 2 2 in Fig. 1. Fig. 3 is a sectional view of the upper part only of the engine, the plane of the section being indicated by line 3 3 in Fig. 1. In this view only the bearing of the crank-shaft is in section. Fig. 4 is a horizontal section taken in the plane indicated by lines 4 4 in Figs. 1 and 2. Fig. 5 is a detached sectional view on a larger scale than Fig. 1, illustrating the coupling of connecting-rod G to wrist-pin E. Line 5 in Fig. 1 indicates the plane of the section. Figs. 1 and 2 show the engine provided only with an air-pump in its base. In Figs. 6, 7, and 8 I have shown the combined air and feed pump. These latter views are drawn to a scale one-half larger than Figs. 1 and 2 for convenience of illustration. Fig. 6 is a horizontal sectional view or plan, the plane of the section being indicated by lines 6 6 in Figs. 7 and 8. Figs 7 and 8 are vertical axial sections taken, respectively, in the planes indicated by the lines 7 7 and 8 8 in Fig. 6. These lines are also marked, respectively, on Figs. 8 and 7.

Like reference letters and characters designate like parts in all the figures.

A is the base of the engine.

B is the low-pressure cylinder.

B′ is the low-pressure piston, and B^2 is the steam-jacket of cylinder B.

C is the high-pressure cylinder. C′ is its piston, and C^2 is its steam-jacket.

D is the steam-distribution valve, and D′ is its tubular extension.

Y is the steam-inlet, whereby steam enters, flows through the jackets B^2 and C^2, and finally enters the high-pressure cylinder through ports 1 and 3 and valve-recess 2. It is exhausted from the high-pressure cylinder through ports 4 into the tubular extension D′, and flows thence to the low-pressure cylinder.

I is the main crank-shaft, which is coupled by connecting-rods G to wrist-pins E on the high-pressure piston C′, and by connecting-rods H and wrist-pins F to slide-rods O, and these latter play through bushed chambers or apertures in the low-pressure cylinder, and are connected rigidly to feet P^2 on legs P, pendent from the low-pressure piston B′. These legs are braced and strengthened by ribs or angle-pieces P′.

X represents non-conducting material around the cylinders.

K is the valve-operating eccentric. K′ is its strap or yoke, and K^2 its counter-balance.

M is the crank-shaft cover, and M′ is a removable top plate, whereby access is had to the oil-cups.

So far the construction is substantially the same as that shown in my pending application, and is not herein claimed.

L is the main inclosing-casing, formed separately from the cylinder-walls. It serves in

lieu of two pillow-blocks in sustaining the bearings of the crank-shaft, as well as, in combination with the cap M, to protect the working parts and to confine the heat within the engine. By making each pillow-block piece separately in the usual way one such pillow-block half-casing may be removed, while the other remains to sustain the shaft and its appendages in place during construction or repair.

L′ are detachable bearings supporting the crank-shaft on each side of the eccentric K. In order to drive the loose eccentric from the shaft in backward and forward gear, I provide the shaft with a lug projecting radially from its surface and engaging a recess in the eccentric, which recess is wide enough to allow sufficient oscillation of the eccentric for forward and backward gear. The lug, being recessed in the eccentric, stands flush with the face of the latter, and does not interfere with the bearings L′. In practice I form the eccentric-driving lug or lugs by mortising the shaft (which is here enlarged in order to preserve its strength) diametrically, and fixing in said mortise a key, N, the ends of which project and engage the recesses *n′* in the face of the eccentric.

In Fig. 1 I have shown the eccentric recessed on both faces and the shaft provided with two keys N; but one will serve.

In order to shift or reverse the engine when such an eccentric is employed, this may be done by turning the shaft backward or forward, as the case may be, through the medium of the fly-wheel. This is the ordinary mode of giving the valve the proper lead or direction.

The weight of piston C′, with its wrist-pins E, is made to equal or about equal that of the piston B′, with its attachments, including the rods O and wrist-pins F. To reduce their weight, the rods O are constructed tubular, as shown.

Q is the air-pump plunger or piston, attached to and usually formed integral with the piston B′, and Q′ is the air-pump barrel, attached to and usually formed integral with the base A. The water of condensation and the uncondensable air and gases from the condenser (not shown) enter at inlet 9, Fig. 2, into passage 10, and when the pump-plunger Q rises this water and air is drawn through valve S into chamber 15. On the return-stroke of the plunger this water and air is forced from chamber 15 through valve S′ and into passage 12. The air and gases escape through outlet 13, and the water is taken off through pipe 14.

The operation of the engine is as follows: The boiler-steam enters at Y, passes up through jackets B^2 and C^2, enters through port 1 into valve-cavity 2, and thence passes into cylinder C at port 3, above piston C′. Piston C′ is forced downward, drawing piston B′ up through the medium of the connecting-rods and cranks. The boiler-steam having been cut off at the proper point by the upward movement of valve D, the steam expands in cylinder C until its piston has nearly reached its lower dead-point. Ports 4 in sleeve-extension D′ are now brought into coincidence with ports 3, and the steam from cylinder C exhausts into cylinder B through sleeve-extension D′. The movement now changes, piston B′ moving downward and piston C′ upward. When the pistons have traveled about three-fourths of their stroke, the slide-valve D by its downward movement will have closed ports 3, and the steam remaining incarcerated in cylinder C will act as a cushion for the remainder of the stroke. The steam in cylinder B continues to expand until piston B′ uncovers the lateral ports 6 in the wall of cylinder B, when the steam will exhaust through passages 7 into exhaust-chamber 8 in base A, whence it will escape through outlet Z to the condenser. I have not considered it necessary to show the condenser, as it may be of the usual pattern, connected on the one side with outlet Z and on the other with inlet 9 to the air-pump.

I usually arrange the condenser at a little higher level than the valves S S′, in order that the water of condensation may flow readily to them through passage 10.

A′ are openings in the base A to provide access to the cap *u*, which forms the chamber 15. This cap is secured by screws or bolts and is easily removable. This enables me to get at the valves for adjustment and repair.

Referring, now, to Figs. 6, 7, and 8, I will describe the construction where the air-pump is combined with a boiler-feed pump. In this construction the barrel Q′ of the air-pump is attached rigidly to the low-pressure piston B′, and the plunger Q to the base A. The inlet 9, passage 10, valves S S′, chamber 15, passage 12, and outlet 13 are arranged and operate similar to the same parts in Figs. 1 and 2. In this construction, however, the valves S and S′ are formed of cups of soft rubber or other like material, the upturned walls of which cover the valve-apertures in the walls of the cylindrical valve-seats. The valve S is arranged exteriorly to its seat and opens into chamber 15, and the valve S′ is arranged interiorly and opens to passage 12.

16 is a mantle or curb arranged in chamber 15, and rising high enough to keep the level of the water in 15 above the level of the ports of valve S; but valve S′ is arranged at a higher level, with its ports above the water-level.

17 is the boiler-feed-pump chamber. T is the inlet-valve of this pump, and T′ is the outlet-valve of same, which opens into a passage, V, below chamber 15.

R is the plunger of the boiler-feed pump, which is attached at its upper end to the piston B′, and plays through a bore in the plunger or piston Q.

11 is the inlet-passage in plunger Q, connecting chamber 15 with the chamber Q′ of the air-pump above the plunger Q.

X′ is the feed-water outlet to the boiler, and W is a pipe connecting with an air-chamber.

The operation is as follows: Air and con-

densation-water from the condenser enter at inlet 9, pass through passage 10, and, when the piston B′ rises, are drawn through valve S into chamber 15, and the air passes up through passage 11 into the air-pump chamber. The water rises in chamber 15 to the top of the curb 16 and overflows to the inlet-valve T of the boiler-feed pump. As the piston R of this pump rises the water is drawn into chamber 17 by inward displacement of the valve T, and when piston R makes its downstroke the water is forced out from chamber 17 through valve T′, and thence through a pipe, X′, to the boiler. The cap *u*, which is or may be formed integrally with the chamber V, is bolted or otherwise removably attached to a flange on the bottom plate of base A, as shown, and to its inner or upper face is attached the feed-water-pump chamber 17. The upper edge of this chamber clamps the flanged edge of the rubber valve T against the bottom plate of the chamber A, thus packing the joint between these parts.

In the construction shown in Fig. 7 the lower ends of the pendent legs P are braced and strengthened by bars P^3, extending from said legs to the air-pump chamber Q′.

The employment of curb 16 and the arrangement of the ports of valve S′ above its level prevent the trapping of air. The air confined in chamber 17 of the feed-pump at starting will work its way up alongside of plunger R into the upper part of the air-pump barrel, where the pressure is comparatively light. These valves and chambers of the pump may be variously constructed and arranged, observing always the imperative conditions that the air must not be trapped or incarcerated and little cushioned, as the greater or less degree of vacuum in the condenser will depend upon the smaller or greater amount of air cushioned in front of the air-pump and in the passage leading thereto. This is fully provided for in the construction shown in Fig. 2, where the plunger dips into the water in chamber 15, which is kept full by placing the water-outlet 14 at a higher level than the valves S S′. In order to prevent excessive oscillation of the water in the chamber 15, a sheet of wire-gauze may be placed across on a level with the top of curb 16. In Figs. 7 and 8 I have shown the water in chamber 15.

I claim as my invention—

1. A condensing-engine having single-acting cylinders, and having the moving part of the air-pump—that is, either the pump-plunger or pump-barrel—directly attached to and moving with one of the engine-pistons, without any casing or chamber intervening between said piston and the part of the pump attached thereto, substantially as set forth.

2. A condensing-engine having single-acting cylinders, and having the moving part of its air-pump and the plunger of its boiler-feed pump attached to one of the engine-pistons, the said plunger of the boiler-feed pump playing through the plunger of the air-pump, substantially as set forth.

3. The combination, with the air-pump of a condensing-engine, of the plunger of the boiler-feed pump, arranged to play in the plunger of the air-pump, substantially as described, whereby the latter plunger serves as the barrel for the feed-pump, as set forth.

4. A condensing compound single-acting engine having its air-pump located in the base of the engine and operated directly by the piston of the low-pressure cylinder, and a cap or bonnet secured removably to the base of the engine and accessible, and said cap forming a housing for the air-pump valves, as set forth.

5. A compound condensing-engine having its air-pump located in the low-pressure exhaust-steam chamber and operated directly by the low-pressure piston without intervening partition, substantially as set forth.

6. A compound condensing-engine having its air-pump and boiler-feed pump located in the low-pressure exhaust-steam chamber and both pumps driven directly by the low-pressure piston, the pumps being combined and compounded substantially as herein set forth.

7. The combination, in an upright compound engine, of two pillow-blocks formed separately from each other and from the cylinders of the engine, and extended to form a casing which houses the working parts of the engine, in combination with a cap therefor, 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.