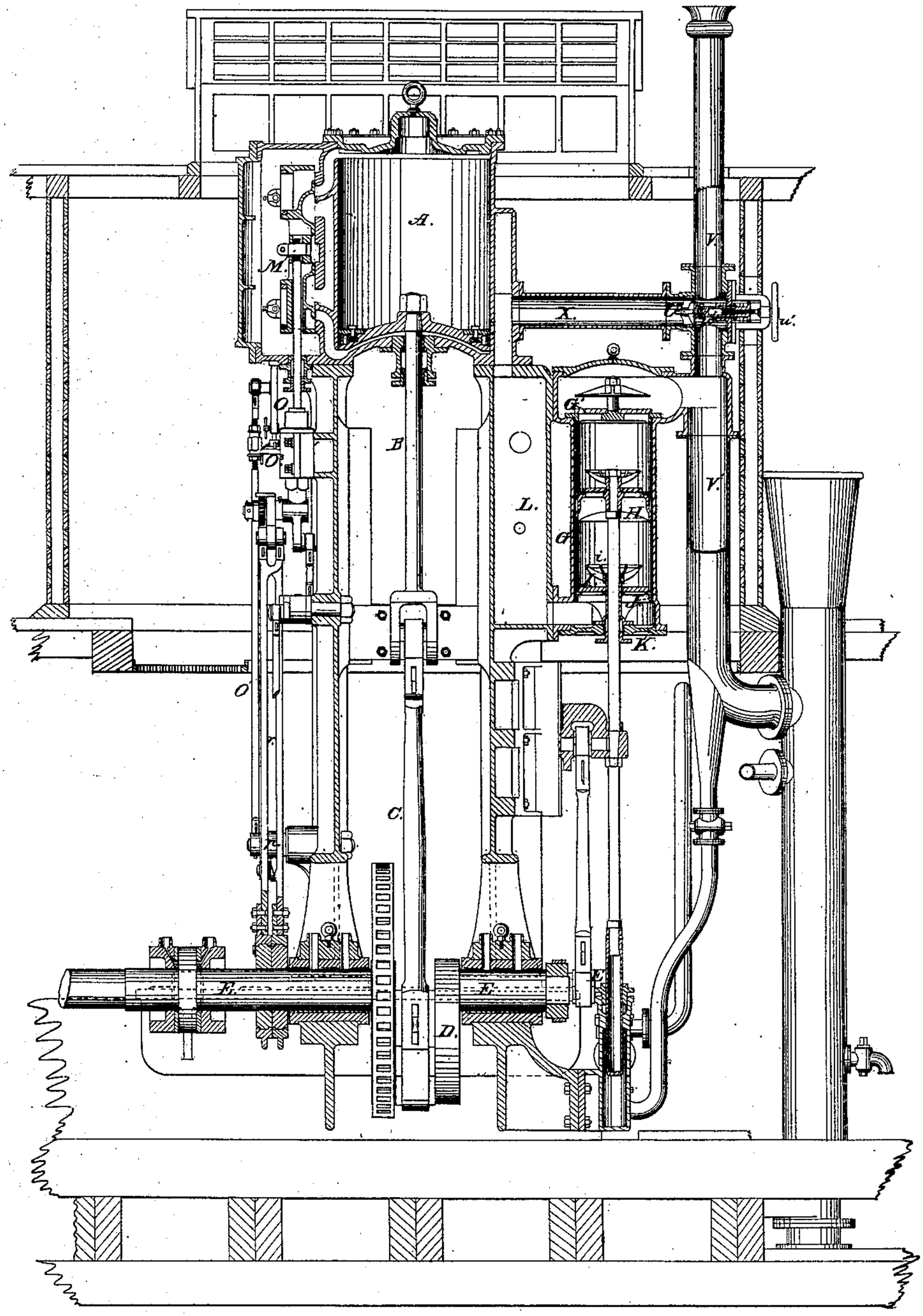
Sheet 1 - 3 Sheets.

G. H. Reynolds,

Reciprocating Steam Engine,

№ 69,839. Patented Oct. 15, 1867.

Fig: 1.



Witnesses:

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J. L. Kellogg

Inventor:

Geo. H. Reynolds

by J. D. Slaton, Attorney

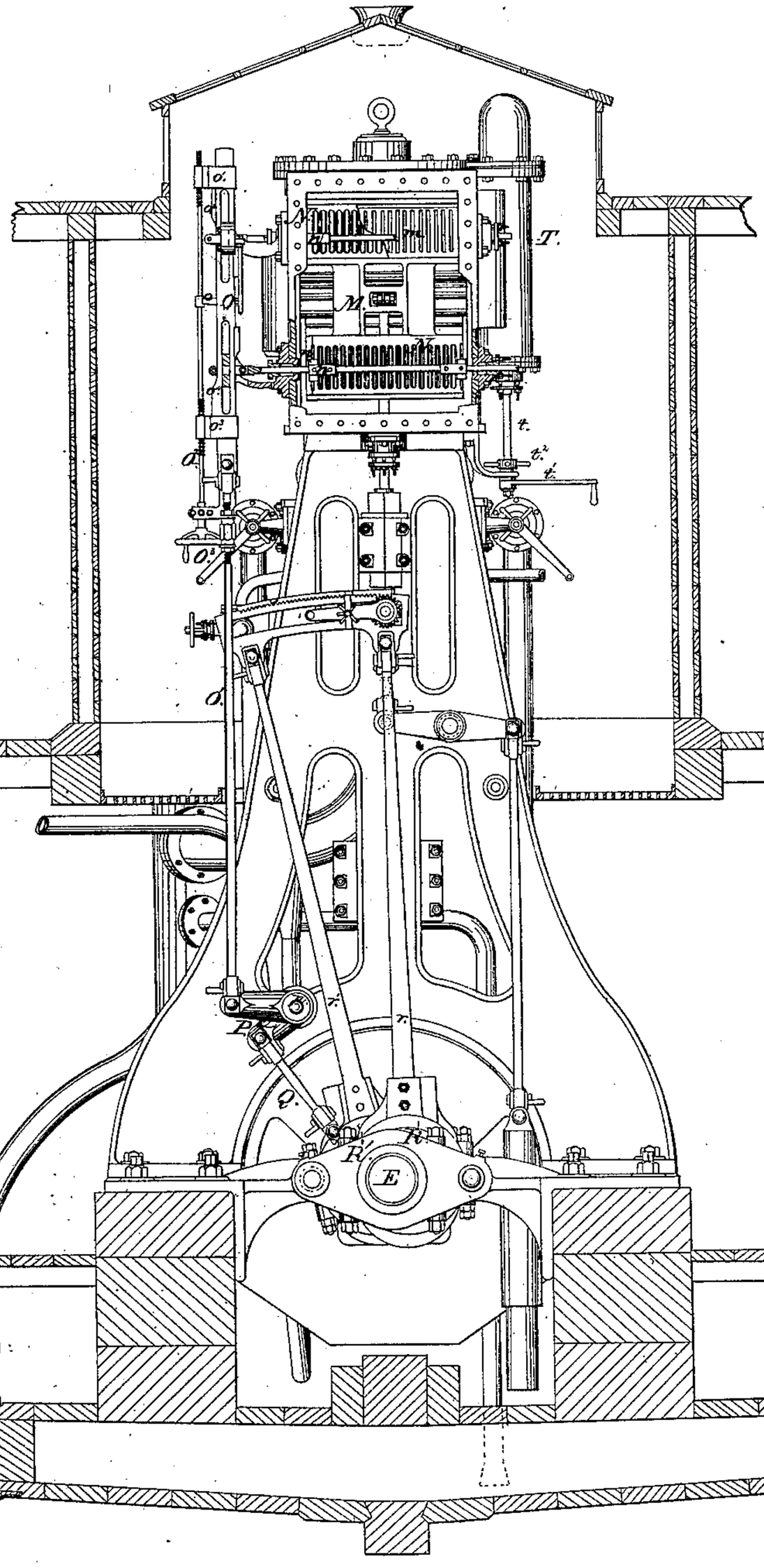
Sheet 2 - 3 Sheets.

G. H. Reynolds,

Reciprocating Steam Engine,

No. 69,839. Patented Oct 15, 1867.

Fig: 2.



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Sheet 3- 3 Sheets.

G. H. Reynolds,

Reciprocating Steam Engine,

No. 69,839. Patented Oct. 15 1867.

Fig: 4.

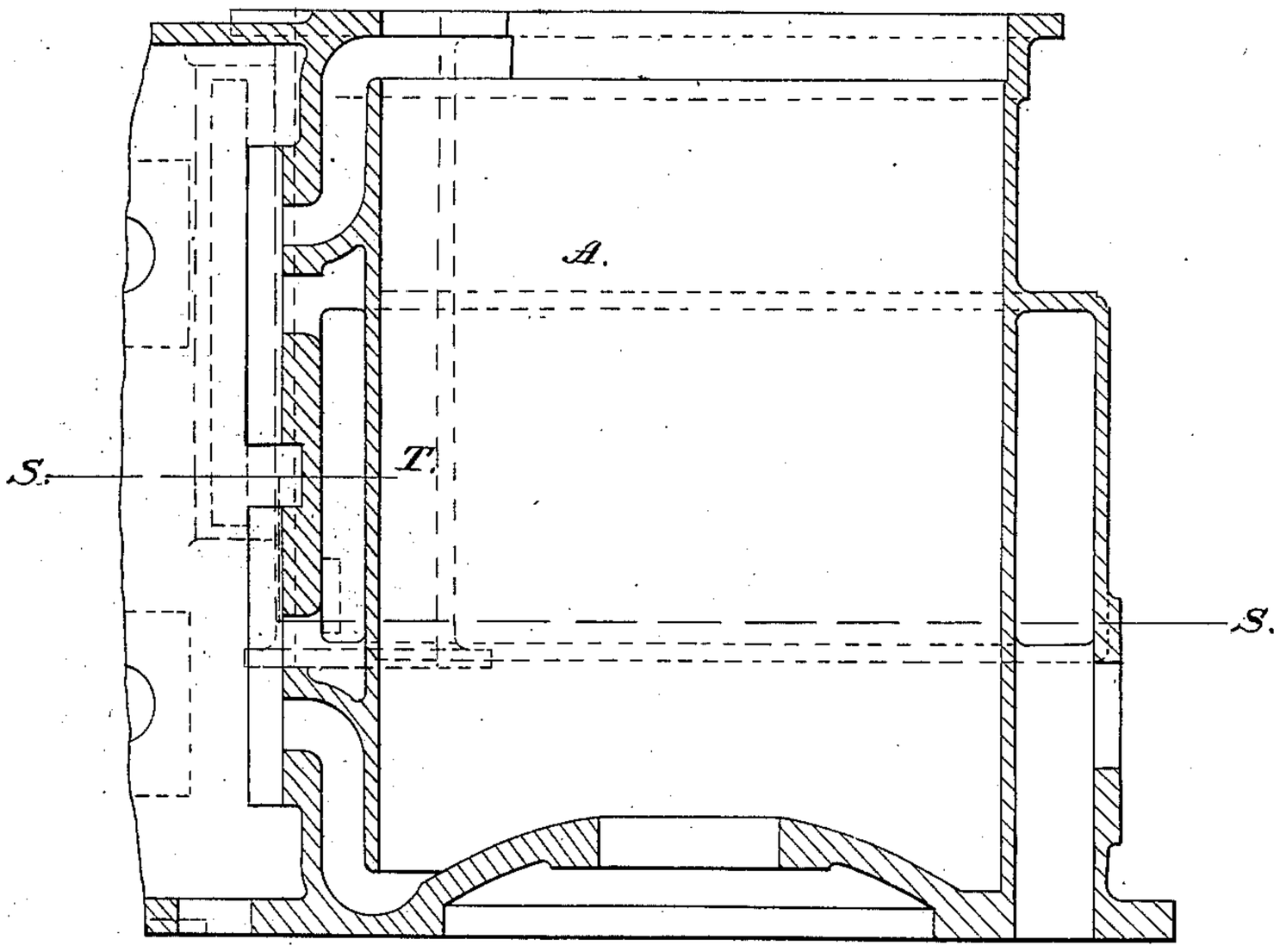
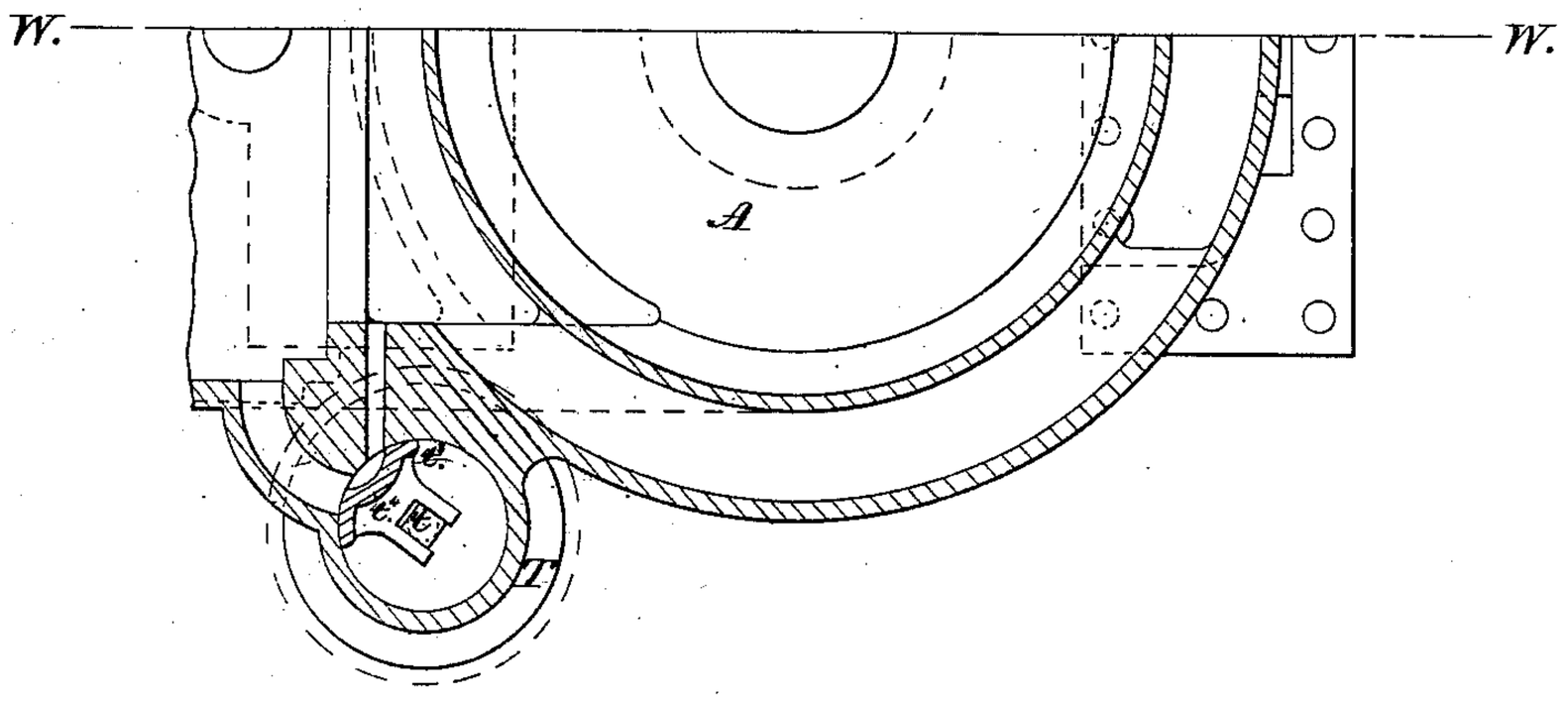


Fig: 5.



Witnesses:

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Inventor:

Geo H Reynolds

United States Patent Office.

GEORGE H. REYNOLDS, OF MYSTIC BRIDGE, CONNECTICUT.

Letters Patent No. 69,839, *dated October* 15, 1867.

IMPROVEMENT IN STEAM ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, GEORGE H. REYNOLDS, of Mystic Bridge, in the county of New London, and State of Connecticut, have invented certain new and useful Improvements in Steam Engines; and I do hereby declare that the following is a full and exact description thereof.

I will first proceed to describe what I consider the best means of carrying out my invention, and afterward designate what I believe to be new therein. The accompanying drawings form a part of this specification.

Figure 1 is a central vertical section through the engine as arranged for driving a propeller.

Figure 2 is an end view of the same, with certain parts of the mechanism removed to show the parts beyond.

Figures 4 and 5 represent some of the parts of my engine detached from the rest.

Figure 4 is a section on the line *w w* in fig. 5.

Figure 5 is a section on the line *s s* in fig. 4, showing the relation of the equilibrium and throttle-valves to each other and to the steam and exhaust-ports.

The figures represent the novel parts, with so much of the other parts as is necessary to indicate their relation thereto. The figures are in fact a tolerably complete drawing of the engine and of the adjacent parts of the vessel, but only the parts more directly connected with the invention will be particularly described.

Similar letters of reference indicate like parts in all the figures.

A is the cylinder, B the piston-rod, C the connecting-rod, D the crank, and E the shaft. My engine is a condensing engine. G is the air-pump, and H is the bucket therein. It is operated by means of a small crank mounted on a continuation of the shaft E, as represented. I is the foot-valve, of thick vulcanized rubber. It is guarded above by the grating *i*, and is supported below by the seat J, which fits within the lower portion of the barrel G of the air-pump, and extends downward, as indicated, by webs, and connects to the bonnet K. The lowering of this bonnet by removing the ordinary screw-bolts, not represented, allows the lowering of the foot-valve I and an access to all these parts for adjustment or repairs. M is the main slide-valve of the engine. Its back is grated over the two steam-ports, as indicated by *m*. The gratings are covered by gridiron valves, indicated by *n*, and these valves are operated by means of rods *n*, through the medium of a sliding bar, O, which is operated by means of the connection Q from a lever, P, which turns on the rock-shaft *p* and is impelled by the connection Q. This rod Q is jointed to the eccentric strap, which operates the main valve, there being two eccentrics and a link motion, as will be readily understood in operating the main valve M. The connection Q extends out from the eccentric R at an angle with the main eccentric rod *r*, and as a consequence it follows that the rocking of the rock-shaft *p* is performed at a different time from the motion of the main valve M; it is performed a little later, and this fact allows me, by properly proportioning and adjusting the mechanism which operates the gridiron valve N, to cut off the admission of the steam at periods something later than a half stroke. If the connection Q were not at an angle with the eccentric rod *r*, I could cut off the steam from the commencement up to half stroke. By setting it later I can vary over the same range, but at a later period in the stroke, that is, I can cut off at periods from one-eighth to five-eighths, or from one-quarter up to three-quarters, etc. It will be understood that the sliding rods *n*, which operate the gridiron valves N, do not traverse with the main slide, while the gridiron valves do so traverse. It follows that there is liberty for the one to move relatively to the other lengthwise of the cylinder. This is provided for by the two dogs n' on each of the rods, which extend inward and press against the ends of each gridiron. This arrangement allows each gridiron to traverse without being affected by the rods, excepting that when either of the rods *n* is moved it communicates a corresponding motion to the corresponding gridiron, moving it laterally in one direction or the other. The mechanism for adjusting the point of cut-off I do not propose to claim in this patent, but I will very briefly describe it. The right and left-hand screw O^2, operated by the hand-wheel O^3, is held by collars each side of the support *o*, so that it is compelled to traverse vertically to this support, which is carried on the sliding bar O, the left-hand screw-thread raising the block o^1, to which is attached the wedge-piece o^2. The right-hand screw operates in the opposite direction, moving the block o^3, to which is connected the wedge-piece o^4. At each stroke of the piston the sliding rod O and its connections traverse up and down at a period a little later than the traversing of the main slide. The wedge-pieces o^2 and o^4 are fixed on the sliding bar O, and each in proper time opens the corresponding gridiron valve N. The wedge-pieces o^2 and o^4, which are

adjustable, as described, each closes its valves by the returning motion of the sliding bar O at a period which varies according as the right and left-hand screw O^2 is turned in one direction or the other. L is my condenser. I attach much importance to the fact that this important member and the air-pump before described are located at a high level, so that while the water is discharged from the condenser into the air-pump with the ordinary facility the water is discharged from the air-pump without accumulating so as to form a load upon the latter. When the air-pump is placed low in deep sea-going vessels there is a long column of water leading from the delivery valve, the weight of which forms a considerable resistance to the motion of the air-pump, but the inertia of which is of much greater consequence, particularly when the engine traverses very rapidly. Propeller engines are required to operate rapidly, and under some circumstances in a heavy sea are liable to temporarily increase the rapidity of their stroke some tenfold. The very rapid action of the air-pump under such circumstances strikes the inner mass of water between the air-pump and the side of the vessel, which stands in the delivery-pipe in the air-chamber, and causes most serious concussions. My arrangement reduces this quantity of water to an insignificant amount. The delivery pipe drops downward from the delivery valve G′, and the vent pipe leading upward therefrom allows the atmosphere to circulate in the delivery pipe, by the elastic action of which all concussions are softened. There is no load of water to be started and stopped at each movement of the air-pump, excepting that which is delivered by the air-pump itself at each stroke, and the very insignificant quantity allowed to stand around and upon the delivery valve G′ to keep it wet. U is a valve operated by a stem, *u*, and a hand-wheel, *u′*, which closes a connection between the vapor pipe V and the exhaust-passage X. So long as this valve is closed, as represented, the engine works as a low-pressure engine, but when, in consequence of any accident, it becomes necessary to work the engine high-pressure, in other words, non-condensingly, it is necessary simply to open this valve and shut off the supply of injection water. The engine thus far works high-pressure, the exhaust steam flowing through the pipe X and up the vapor pipe V. Any water which comes over with the steam or which is condensed in the cylinder or its connections flows down into the condenser until that is full, and then flows out through the valves of the air-pump, or more directly through the pipe X into the discharge pipe V′. In stopping the engine it is desirable to leave the piston at or near a half stroke, and it is important to provide a means of equalizing the pressure by opening a connection directly or indirectly between the two ends of the cylinder. It has long been common, as in my engine, to provide a valve for this purpose, so that by simply turning the stem the communication between one end and the other of the main cylinder will be opened or closed. My arrangement, however, differs from any before known in the fact that this mechanism is connected with the main throttle-valve, so that the opening of the throttle-valve to admit steam to operate the engine closes the communication between the two ends of the cylinder, and the closing of the throttle-valve opens this communication. In the engines heretofore constructed these necessary movements required two operations, and they were liable to be ill-timed. The mode which I prefer for connecting these parts is, to make the two valves in one piece and mount them on a single shaft enclosed in the same casing, or they may be made separately and connected by links or otherwise, if desired. The casing which encloses my two valves is indicated by T, and the stem which operates both by *t*. They are both operated by the handle t^1, and the whole is held in either position by means of the hand-nut t^2. My two valves may be constructed in any approved manner, but I prefer the form known as the rolling valve for the throttle, and the same form of valve with a hollow D throat for the equilibrium valve before referred to. The lap of these valves is so proportioned that in shutting off steam the throttle-valve will be quite closed a little before the equilibrium valve commences to open. In letting on steam to start again the equilibrium valve will be closed a little before the throttle commences to open. R′ is the backing eccentric, and *r′* the backing eccentric rod.

Some of the advantages due to certain features of my invention may be separately enumerated as follows: First, by reason of the fact that my equilibrium valve t^3 and throttle-valve t^4 are connected together, so as always to be opened and shut at the proper times relatively to each other, I am able to reduce the labor of attending the engine, and to diminish the risk of regulating the proper adjustment of these parts. Second, by reason of the fact that I place the air-pump and condenser in the elevated position represented, I am able to operate them with all the efficiency due to the ordinary arrangement, and at the same time to relieve the air-pump from the weight and inertia of any considerable quantity of water beyond the delivery valve. Third, by reason of the fact that my valve U is arranged, as represented, to open and close the communication between the exhaust-passage X and the vent pipe V, I am able to transform the engine at will from a condensing to a non-condensing engine with very little labor or difficulty. Fourth, by reason of the fact that my foot-valve I is mounted on the seat, which is connected to the bonnet J, and capable of being raised and lowered together, as specified, I am able to obtain ready access to all the parts with less expense and labor than in an ordinary engine. Fifth, by reason of the fact that my valves N are provided with corresponding duplicate openings, matching their seats as specified, and are operated by a movement which is later in each stroke than that of the main slide, I am able to cut off the admission of steam to the cylinder with a very slight sliding movement, without disturbing any of the main parts of the engine, and to vary the period of the cut-off between later periods in each stroke than would otherwise be practicable. Sixth, by reason of the fact that my link Q, which operates the rock-shaft *p* and gives motion to the sliding rod O, is connected to the forward eccentric R, at an angle with the eccentric rod *r*, as represented, I am able to obtain the required late movement of the valves without an additional eccentric.

Having now fully described my invention, and the best means of constructing and operating the same, what I claim as new therein, and desire to secure by Letters Patent, is as follows:

1. I claim connecting the equilibrium valve t^3 and throttle-valve t^4, so that both shall be operated together, substantially in the manner and for the purpose herein set forth.

2. I claim the within-described arrangement of the condenser L, air-pump G, and discharge pipes V′ relatively to the cylinder A.

3. I claim the relief valve U, arranged as represented, and adapted to transform the engine from a complete condensing to a complete non-condensing engine, and the reverse, substantially in the manner and for the purpose herein specified.

4. I claim arranging the foot-valve I on the seat, which is connected with the bonnet J and adapted to be raised and lowered therewith, substantially as and for the purpose herein specified.

5. I claim operating the gridiron valves N on the back of the main slide M, moving across by a movement later than the movement of the main slide, substantially as and for the purposes herein specified.

6. I claim the link Q, arranged to act obliquely to the eccentric rode by the same eccentric so as to operate the gridiron valves N, or their equivalents, by means of one of the main eccentrics R, substantially as and for the purpose herein specified

In testimony whereof I hereunto set my hand in the presence of two subscribing witnesses.

GEO. H. REYNOLDS.

Witnesses:

D. L. FREEBORN,

FRANK A. HADICKE.