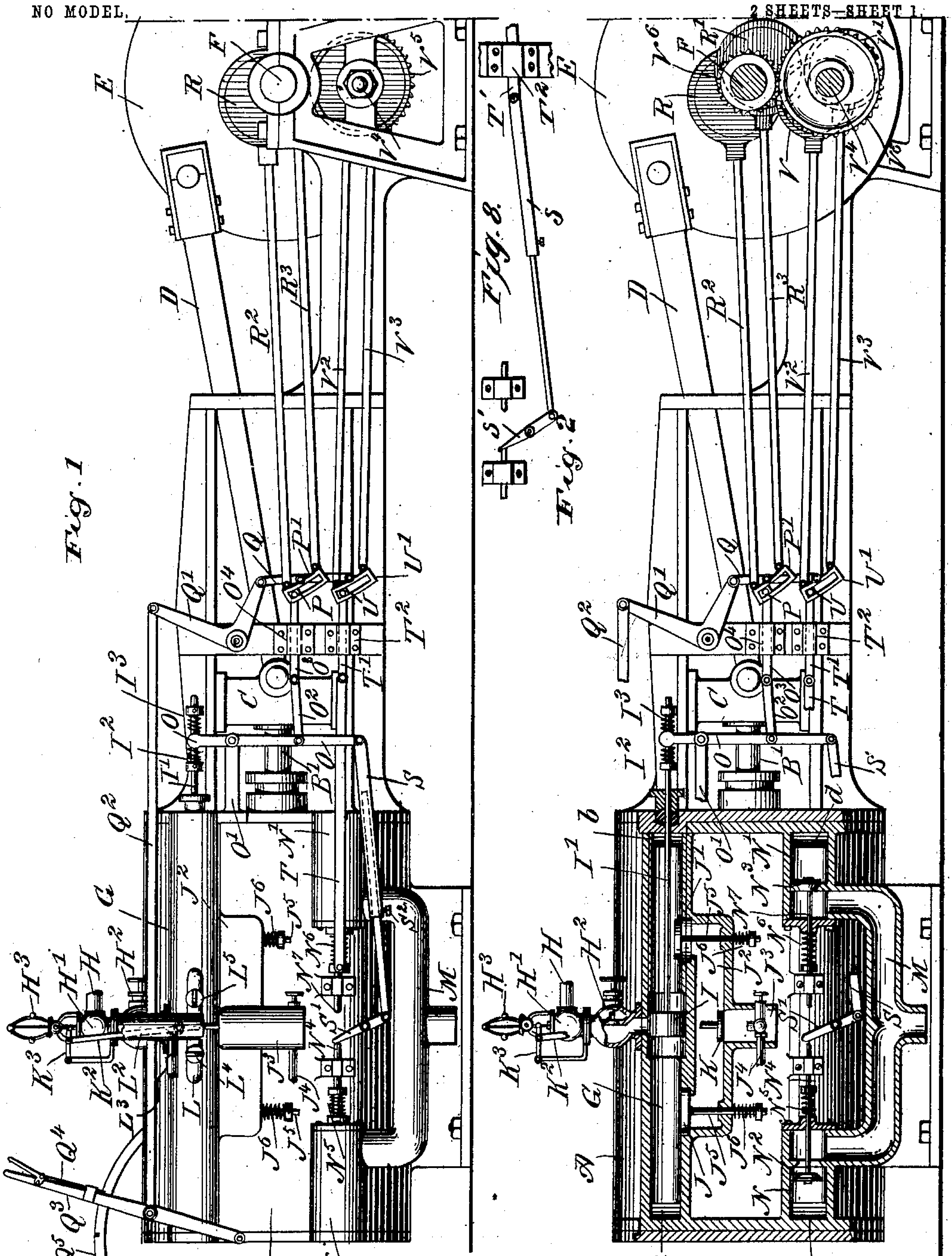
No. 753,647. PATENTED MAR. 1, 1904.

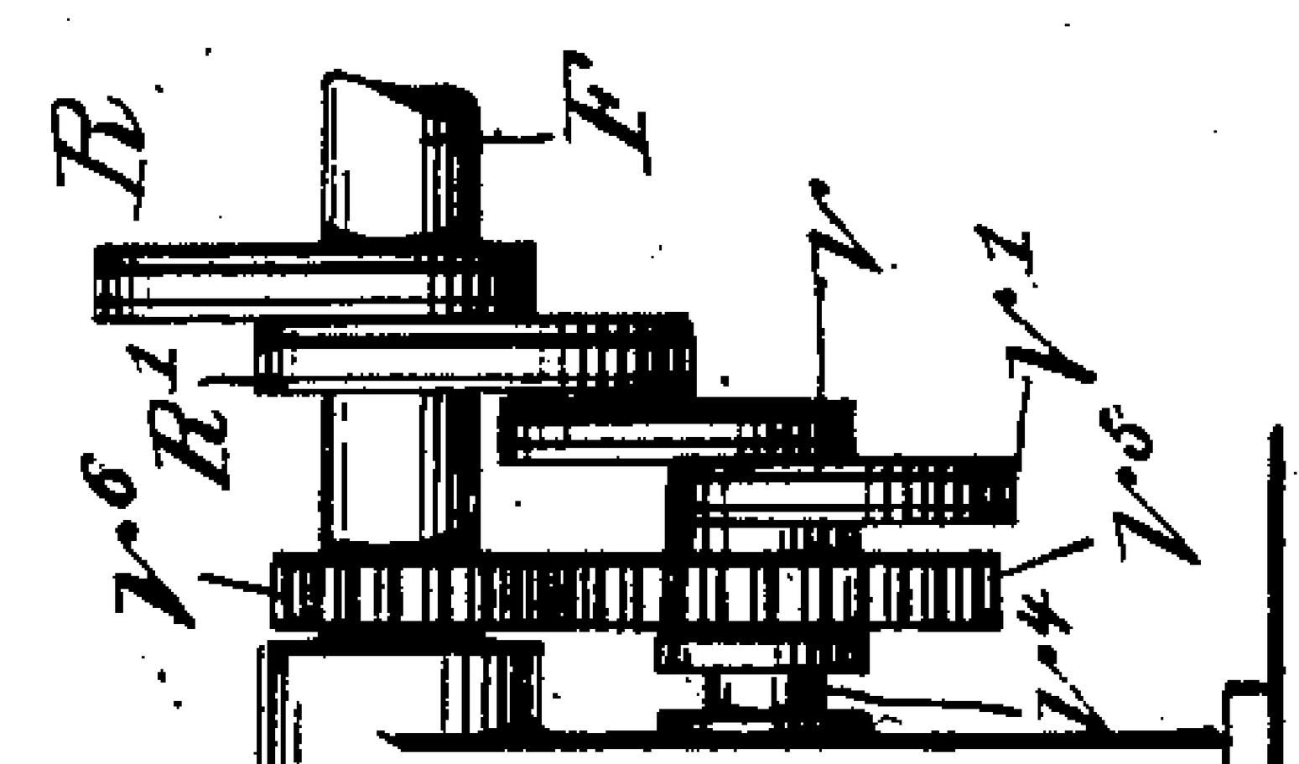
O. B. THORSON.

STEAM OR GAS ENGINE.

APPLICATION FILED JAN. 26, 1903.

NO MODEL. 2 SHEETS—SHEET 1.





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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 6

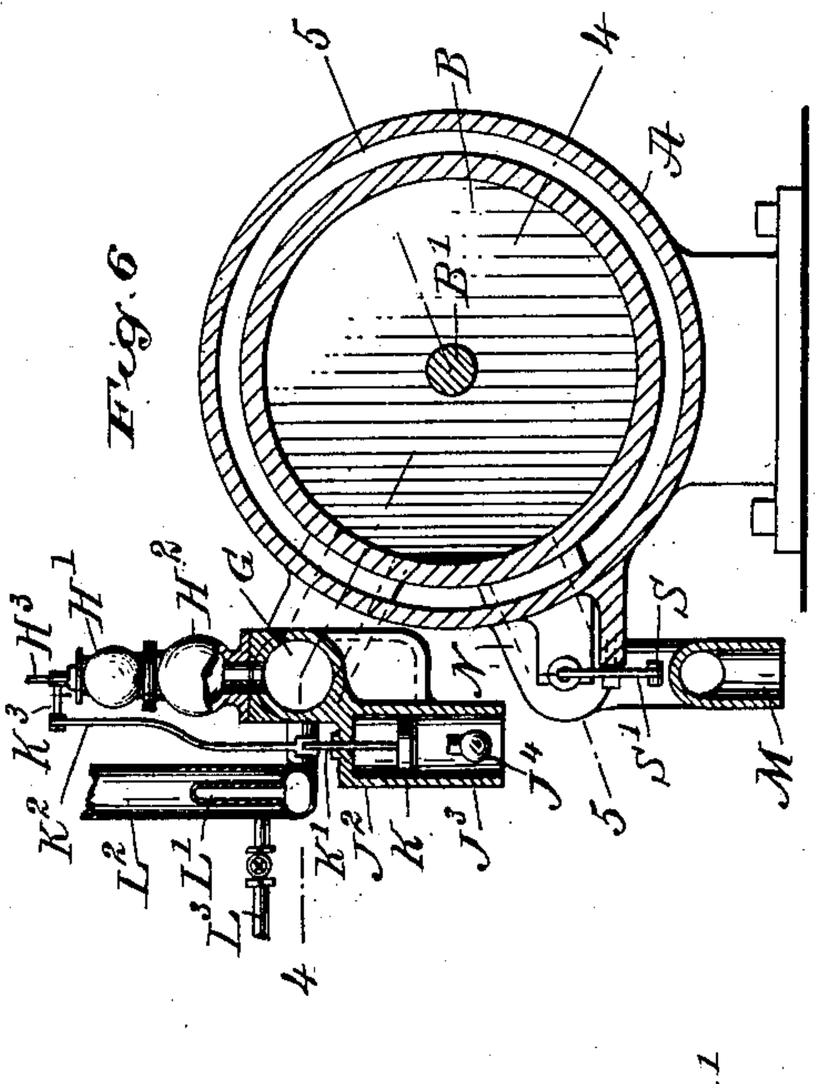


Fig. 7

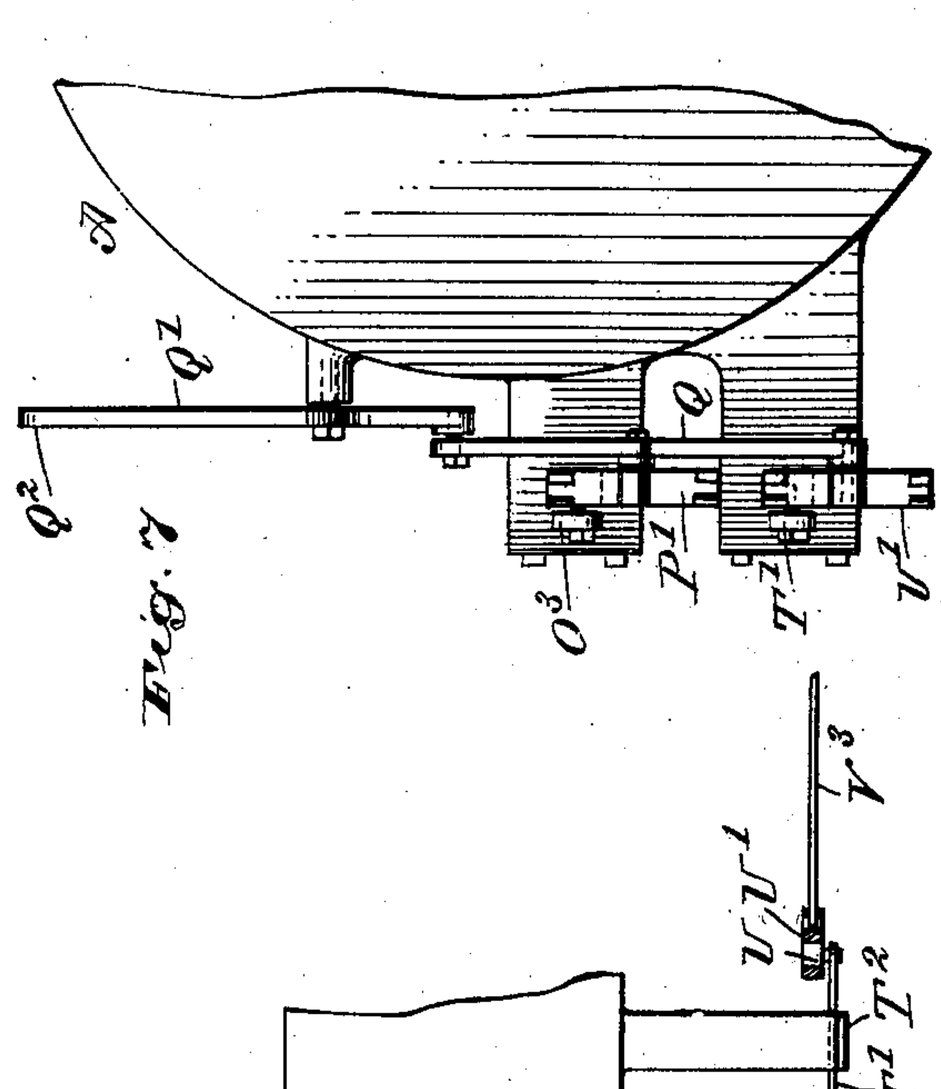


Fig. 4

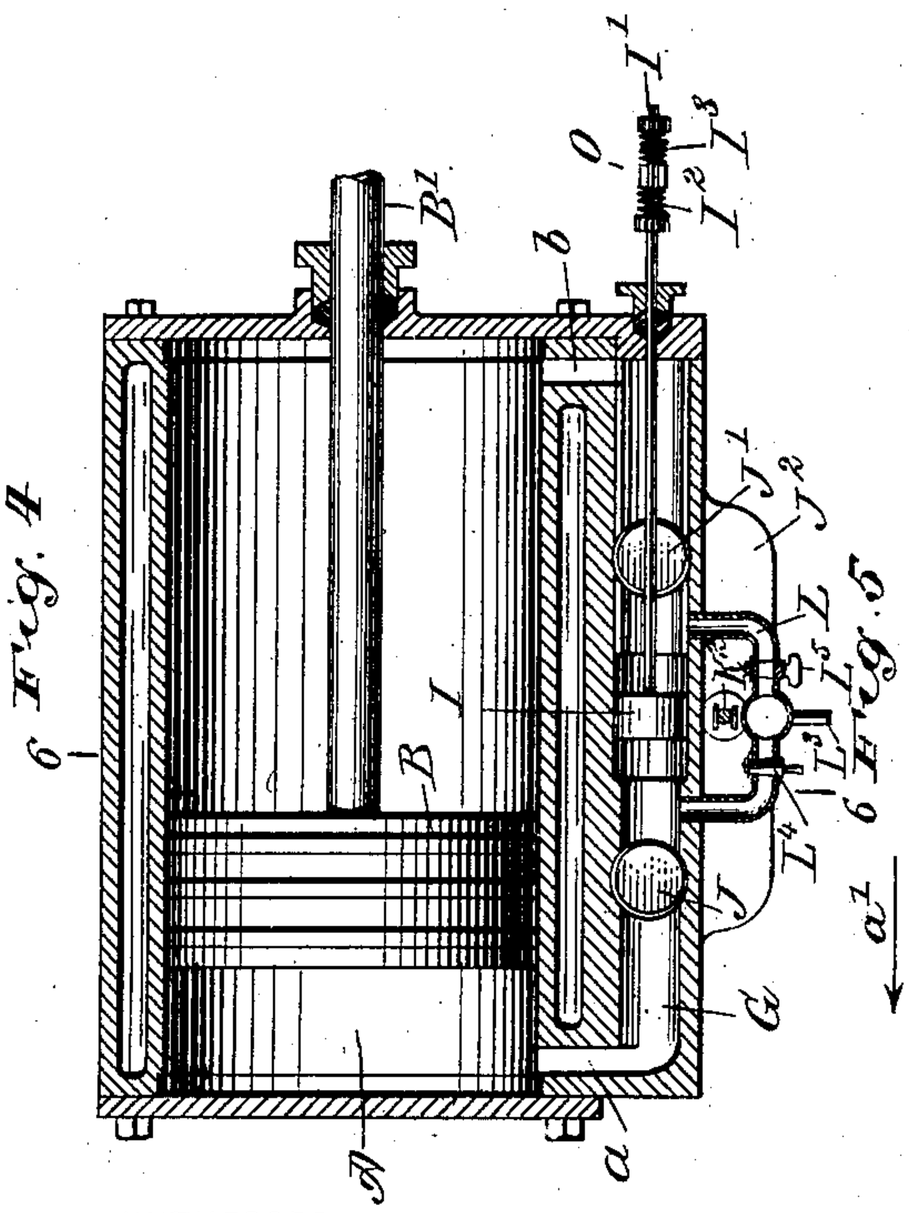
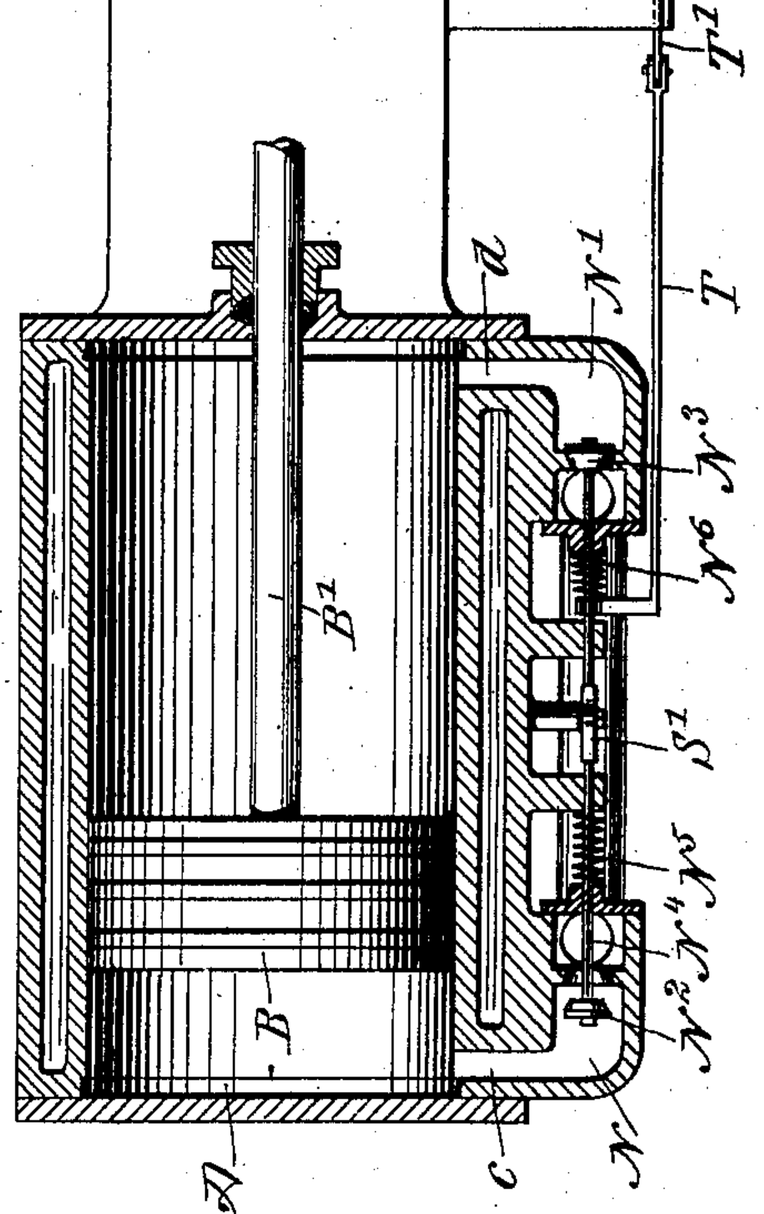


Fig. 5



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No. 753,647. Patented March 1, 1904.

UNITED STATES PATENT OFFICE.

OLIOUS B. THORSON, OF NEAR THOR, IOWA.

STEAM OR GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 753,647, dated March 1, 1904.

Application filed January 26, 1903. Serial No. 140,553. (No model.)

To all whom it may concern:

Be it known that I, OLIOUS B. THORSON, a citizen of the United States, residing near Thor, in the county of Humboldt and State of Iowa, have invented a new and Improved Steam or Gas Engine, of which the following is a full, clear, and exact description.

The invention relates to engines which can be readily changed from a steam-engine to an explosive-engine, or vice versa.

The object of the invention is to provide a new and improved engine arranged to permit the use of either steam or an explosive mixture as the motive agent or steam at one end of the cylinder and an explosive mixture at the other end, at the same time allowing the engineer to reverse the engine whenever it is desired to do so.

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

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a side elevation of the improvement. Fig. 2 is a sectional side elevation of the same. Fig. 3 is an end elevation of the eccentrics. Fig. 4 is a sectional plan view of the improvement on the line 4 4 of Fig. 6. Fig. 5 is a similar view of the same on the line 5 5 of Fig. 6. Fig. 6 is a cross-section of the same on the line 6 6 of Fig. 4. Fig. 7 is an enlarged end view of the reversing link-gear, and Fig. 8 is a detail view showing the parts adjusted for operating the exhaust-valves when but one motive agent is employed.

In the cylinder A is mounted a reciprocating piston B, connected by its piston-rod B′ with a cross-head C, connected by a pitman D with a crank-disk E, secured on the main driving-shaft F of the engine. The ends of the cylinder A are connected by ports *a* and *b* with a motive-agent-admission chest G, connected at its middle by a pipe H with a boiler or other suitable steam-supply, the said pipe H containing a governor-valve H′ and a hand-valve H^2 under the control of the operator. In the chest G is mounted to slide a piston-valve I, adapted to close the entrance end of the pipe H or to connect the latter with the chest G at either side of the piston-valve, so as to direct the steam either alternately to the ports *a* and *b* or to one of the said ports, as hereinafter more fully explained.

Spring-pressed self-closing admission-valves J and J′ control the connection between an explosive-mixture chamber J^2 and the chest G on opposite sides of the piston-valve I, as plainly indicated in Fig. 2, so that the explosive mixture may pass alternately into the chest G on opposite sides of the piston-valve I or only into one side of said chest, as hereinafter more fully explained.

The chamber J^2 is provided with an air-inlet pipe J^3, into which extends a gas-supply pipe J^4 for supplying gas to the pipe J^3 to form, with the air, an explosive mixture passing into the chamber J^2, and from the latter by way of the valves J and J′ or either of the said valves into the chest G to finally pass into the corresponding end of the cylinder A by way of the ports *a* and *b*. A valve K controls the inlet of the pipe J^3 to the chamber J^2 to regulate the amount of explosive mixture passing into the chamber J^2, and this valve K has its stem K′ connected by a link K^2 with a lever K^3, engaging the stem of a governor H^3, controlling the governor-valve H′, previously mentioned. Thus the admission of the steam and that of the explosive mixture is controlled from the single governor H^3.

The chest G has its ends connected with each other by a by-pass L, (see Fig. 4,) opening into a heated igniting-tube L′, so as to ignite the explosive mixture in either end of the chest G and the corresponding end of the cylinder, as hereinafter more fully explained, the said tube L′ extending in a pipe L^2 in which burns a flame to heat the tube L′, the gas for the flame being supplied by a pipe L^3. (See Figs. 4 and 6.) Valves L^4 and L^5 are arranged in the by-pass on opposite sides of the igniting-tube L′, so that either end of the by-pass can be closed in case the engine is arranged for using steam on one side of the cylinder and an explosive mixture at the other side of the cylinder. As shown in Fig. 4, the valve L^4

is closed while the valve L^5 is open, so that the gaseous mixture in the right-hand side of the chest G can pass to the igniting-tube L′ to be ignited and to cause ignition of the charge in the right-hand end of the cylinder A. In the case mentioned steam is used as the motive agent in the left-hand end of the said cylinder. The ends of the cylinder A are also connected by ports *c* and *d* with exhaust-chambers N and N′, containing valves N^2 and N^3 for connecting the chambers N and N′ with a common exhaust-pipe M for carrying off the exhaust-steam and exhaust-gases.

The valve-stem I′ of the piston-valve I carries at its outer end springs I^2 and I^3, engaging opposite sides of a lever O, fulcrumed on a bracket O′, attached to the inner cylinder-head, as shown in Fig. 1, and the said lever O is pivotally connected by a link O^2 with a bar O^3, mounted to slide in a suitable bearing O^4, attached to the engine-frame. The bar O^3 is connected with the block P of a link P′, fulcrumed on a rod Q, hung on a bell-crank lever Q′, connected by a link Q^2 with a reversing-lever Q^3, carrying a suitable locking-lever Q^4, engaging a notched segment Q^5, as indicated in Fig. 1. The link P′ is connected at opposite sides of its fulcrum with the eccentric-rods R^2 and R^3 of eccentrics R and R′, held on the main shaft F, so that when the engine is in motion the rotary motion of the shaft F causes the eccentrics R and R′ to impart a rocking motion to the link P′, so that its block P gives a sliding motion to the bar O^3, which by the link O^2 rocks the lever O to move the stem I′ and with it the valve I forward and backward to control the admission of steam into the chest G from the pipe H, as previously mentioned. The lower end of the lever O is connected by a link S with a lever S′, fulcrumed on the cylinder and adapted to engage the stem N^4 of the valve N^2 to move the valve N off its seat at the time the engine works with steam-pressure at the left-hand end and not with an explosive mixture. The stem N^4 of the valve N^2 is pressed on by a spring N^5 to normally hold the valve N^2 in a closed position, and a similar spring N^6 presses on the stem N^7 of the valve N^3 to normally hold the latter closed. The stem N^7, just mentioned, is connected by a link T with a bar T′ similar to the bar O^3 and likewise mounted to slide longitudinally in a bearing T^2, and this bar T′ is connected with the block U of a link U′, fulcrumed on the bar Q previously mentioned. The link U′ is connected on opposite sides of its fulcrum with the eccentric-rods V^2 and V^3 of eccentrics V and V′, secured on a shaft V^4, connected by a gear-wheel V^5 with a pinion V^6, fastened on the main shaft F, so that when the latter makes two revolutions the shaft V^4 is caused to make one revolution, owing to the size of the pinion V^6 and gear-wheel V^5. Now from the foregoing it will be seen that the valve N^2 is opened once at every revolution of the shaft F to exhaust the left-hand end of the cylinder of exhaust-steam, while the valve N^3 is opened but once during two revolutions of the shaft F, so that the right-hand end of the cylinder remains closed to the exhaust M during the suction and compression period and is only connected to the exhaust pipe M by way of the valve N^3 at the end of the explosion period.

The stems J^5 of the valves J and J′ are pressed on by springs J^6 to normally hold the valves J and J′ in a closed position; but the valves open against the tension of their springs during the suction period, as hereinafter more fully explained.

The operation is as follows: When the several parts are in the position illustrated in the drawings, then the engine is arranged for using steam at the left-hand end of the cylinder A and for using an explosive mixture as the motive agent at the right-hand end of the cylinder. The piston B is now on the return stroke in the direction of the arrow *a*′, caused by the ignited mixture of gas and air in the right-hand end of the cylinder, the exhaust-steam in the left-hand end of the cylinder A now passing through the port *c*, exhaust-chamber N, and open valve N^2 into the exhaust-pipe M, while the piston-valve I is in a closed position—that is, closing the inlet of the steam-supply pipe H to the chest G. The valve N^2 is held open by the action of the lever S′; but as soon as the piston B has reached the end of its outward stroke then the action of the eccentrics R and R′ on the link P′ causes a swinging of the lever O, so that the position of the valve I is changed—that is, moved to the right—to allow steam to pass through the pipe H into the left-hand end of the chest G, so that the steam can pass through the port *a* into the left-hand end of the cylinder A to move the piston B on the inward stroke in the inverse direction of the arrow *a*′. The swinging motion of the lever O just mentioned causes the lever S′ to swing out of engagement with the stem N^4 to allow the spring N^5 to move the valve N^2 to its seat, so that the left-hand end of the cylinder is closed to the exhaust during the inward stroke of the piston B. Now while the piston B moves forward the other valve N^3 is moved into an open position by the action of the eccentrics V and V′, link Q′, bar T′, and link T, so that the exhaust-gases can pass out of the right-hand end of the cylinder into the exhaust-pipe M. When the piston B moves on its second outward stroke in the direction of the arrow *a*′, then the suction period takes place in the right-hand end of the cylinder A—that is, the explosive mixture is drawn from the chamber J^2 by way of the valve J′ and into the right-hand end of the chest G through the port *b* into the right-hand end of the cylinder A—and on the next inward stroke of the piston B in the inverse direction of the arrow *a*′

the mixture in the right-hand end of the cylinder A is compressed and finally ignited, when the piston has reached the end of its inward stroke, so that the piston is now forced outward by the explosion, and when the piston reaches the end of its outward stroke the valve N^3 opens to allow the exhaust-gases to escape from the cylinder, as before mentioned.

It is understood that steam is admitted to the left-hand end of the cylinder A for every inward stroke of the piston B, while the piston is forced outward by the force of the explosion every second stroke of the piston.

The link S is made in telescoping sections adapted to be fastened together by a set-screw S^2, as plainly shown in Fig. 1. By this arrangement the link S can be lengthened to bring the lever S′ in a central position relative to the stems N^4 and N^7 to actuate the stems alternately to open the valves N^2 and N^3 alternately when the steam is used as motive agent in both ends of the cylinder A. The link T is then not used and is disconnected from the stem N^7. When an explosive mixture is to be used as motive agent in both ends of the cylinder A, then the link T is disconnected from the slide-bar T′, the set-screw S^2 is loosened, and the link S disconnected from the lever O and connected with the said slide-bar T′, after which the lever S′ is set into a central position relative to the valve-stems N^4 N^7, and then the set-screw S^2 is screwed up to fasten the telescoping sections of the link S together. Both valves N^2 and N^3 are now opened at the proper time.

When it is desired to use the engine as a steam-engine only, the hand-lever Q^3 is moved in such a position that the lever O imparts a sliding motion to the valve I to connect the inlet-pipe H alternately with the right and left hand ends of the chest G to alternately admit steam to both ends of the cylinder A. It is understood that in this case the valves J and and J′ do not open, as the pressure of the steam in both ends of the chest G holds the said valves in a closed position.

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

1. An engine, comprising a cylinder, a piston reciprocating therein, a motive-agent chest connected with the ends of the cylinder, a steam-supply connected with the chest, a valve in the chest for controlling the admission of steam to either end thereof, said valve also serving to divide the chest into two compartments, an explosive-mixture supply connected with the chest at opposite sides of the valve, and valves for controlling the admission of the explosive mixture to said chest, as set forth.

2. An engine comprising a cylinder, a piston reciprocating therein, a motive-agent-admission chest connected with the ends of the cylinder, a steam-supply connected with the chest, a piston-valve in the chest, controlling the admission of the steam from the said steam-supply, an explosive-mixture supply connected with the chest, at opposite sides of the said piston-valve, and self-closing admission-valves controlling the inlet of the explosive mixture to the chest from the said explosive-mixture supply, as set forth.

3. An engine comprising a cylinder, a piston reciprocating therein, a motive-agent-admission chest connected with the ends of the cylinder, a steam-supply connected with the chest, a piston-valve in the chest, controlling the admission of the steam from the said steam-supply, an explosive-mixture supply connected with the chest, at opposite sides of the said piston-valve, self-closing admission-valves controlling the inlet of the explosive mixture to the chest from the said explosive-mixture supply, and positively-actuated exhaust-valves for the said cylinder, as set forth.

4. An engine comprising a cylinder, a piston reciprocating therein, a main shaft connected with and driven from the said piston, a motive-agent-admission chest connected with the ends of the cylinder, a steam-supply connected with the chest, a piston-valve in the chest, controlling the admission of the steam by the said steam-supply, an explosive-mixture supply connected with the chest at opposite sides of the said piston-valve, self-closing admission-valves controlling the inlet of the explosive mixture to the chest from the said explosive-mixture supply, exhaust-valves for the said cylinder, means actuated from the said main shaft, for controlling the said piston-valve, and means actuated from the main shaft, for controlling the said exhaust-valves, as set forth.

5. An engine comprising a cylinder, a piston reciprocating therein, a main shaft connected with and driven from the said piston, a motive-agent-admission chest connected with the ends of the cylinder, a steam-supply connected with the chest, a piston-valve in the chest, controlling the admission of the steam by the said steam-supply, an explosive-mixture supply connected with the chest at opposite sides of the said piston-valve, self-closing admission-valves controlling the inlet of the explosive mixture to the chest from the said explosive-mixture supply, exhaust-valves for the said cylinder, and two link-gears driven from the main shaft, one controlling the said piston-valve and one of the exhaust-valves, while the other link-gear actuates the remaining exhaust-valve, as set forth.

6. An engine comprising a cylinder, a piston reciprocating therein, a main shaft connected with and driven from the said piston, a motive-agent-admission chest connected with the ends of the cylinder, a steam-supply connected with the chest, a piston-valve in the chest, controlling the admission of the steam by the said steam-supply, an explosive-mixture supply connected with the chest at opposite sides of the said piston-valve, self-closing admission-valves controlling the inlet of the explosive

mixture to the chest from the said explosive-mixture supply, exhaust-valves for the said cylinder, and reversing link-gears, driven at a different rate of speed from the said main shaft, the high-speed gear controlling the piston-valve and one of the exhaust-valves and the low-speed gear actuating the other exhaust-valve, as set forth.

7. An engine comprising a cylinder, a piston reciprocating therein, a motive-agent-admission chest connected with the ends of the cylinder, a steam-supply connected with the chest, a piston-valve in the chest, controlling the admission of the steam from the said steam-supply, an explosive-mixture supply connected with the chest, at opposite sides of the said piston-valve, self-closing admission-valves controlling the inlet of the explosive mixture to the chest from the said explosive-mixture supply, and an igniting device, connected with the said chest, at opposite sides of the piston-valve therein, as set forth.

8. An engine comprising a cylinder, a piston reciprocating therein, a motive-agent-admission chest connected with the ends of the cylinder, a steam-supply connected with the chest, a piston-valve in the chest, controlling the admission of the steam from the said steam-supply, an explosive-mixture supply connected with the chest, at opposite sides of the said piston-valve, self-closing admission-valves controlling the inlet of the explosive mixture to the chest from the said explosive-mixture supply, a valved by-pass connected with the chest at opposite sides of the said piston-valve, and an igniting device in the said by-pass, to allow the explosive mixture to reach the igniter from either side of the piston-valve, as set forth.

9. An engine comprising a cylinder, a piston reciprocating therein, a motive-agent-admission chest connected with the ends of the cylinder, a steam-supply connected with the chest, a piston-valve in the chest, controlling the admission of the steam from the said steam-supply, an explosive-mixture supply connected with the chest, at opposite sides of the said piston-valve, self-closing admission-valves controlling the inlet of the explosive mixture to the chest from the said explosive-mixture supply, and a governor for the steam-supply and the said explosive-mixture supply, as set forth.

10. An engine comprising a cylinder, a piston reciprocating therein, a main shaft connected with and driven from the said piston, a motive-agent-admission chest connected with the ends of the cylinder, a steam-supply connected with the chest, a piston-valve in the chest, controlling the admission of the steam from the said steam-supply, an explosive-mixture supply connected with the chest at opposite sides of the said piston-valve, self-closing admission-valves controlling the inlet of the explosive mixture to the chest from the said explosive-mixture supply, exhaust-valves for the said cylinder, reversing link-gears, driven at a different rate of speed from the said main shaft, the high-speed gear controlling the piston-valve and one of the exhaust-valves and the low-speed gear actuating the other exhaust-valve, and a lever, under the control of the operator, for shifting and setting the link-gears, as set forth.

11. An engine, comprising a cylinder, a piston therein, a motive-agent chest connected with the ends of the cylinder, a steam-supply connected with the chest, means for controlling the admission of steam to either end of the chest, said means also serving to divide the chest into compartments, and a valve-controlled explosive-mixture supply connected with the chest at each side of its center, as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

OLIOUS B. THORSON.

Witnesses:
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JNO. J. HANSON.