(No Model.) 5 Sheets—Sheet 1.

H. W. TUTTLE.

COMPRESSION GAS ENGINE.

No. 510,213. Patented Dec. 5, 1893.

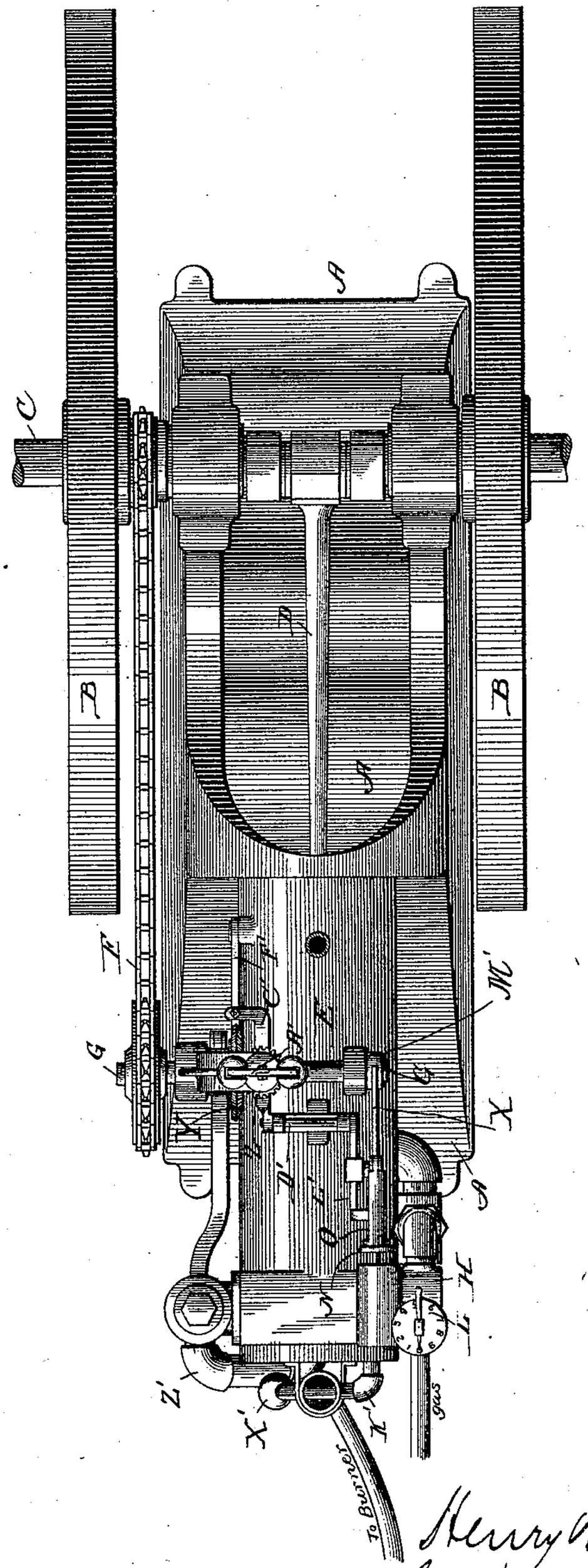

Fig. 1.

Witnesses:

Wm. M. Rheem.

J. Laurence Gerry

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Henry W. Tuttle

by Frank T. Brown

Attorney

THE NATIONAL LITHOGRAPHING COMPANY,
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(No Model.) 5 Sheets—Sheet 2.

H. W. TUTTLE.

COMPRESSION GAS ENGINE.

No. 510,213. Patented Dec. 5, 1893.

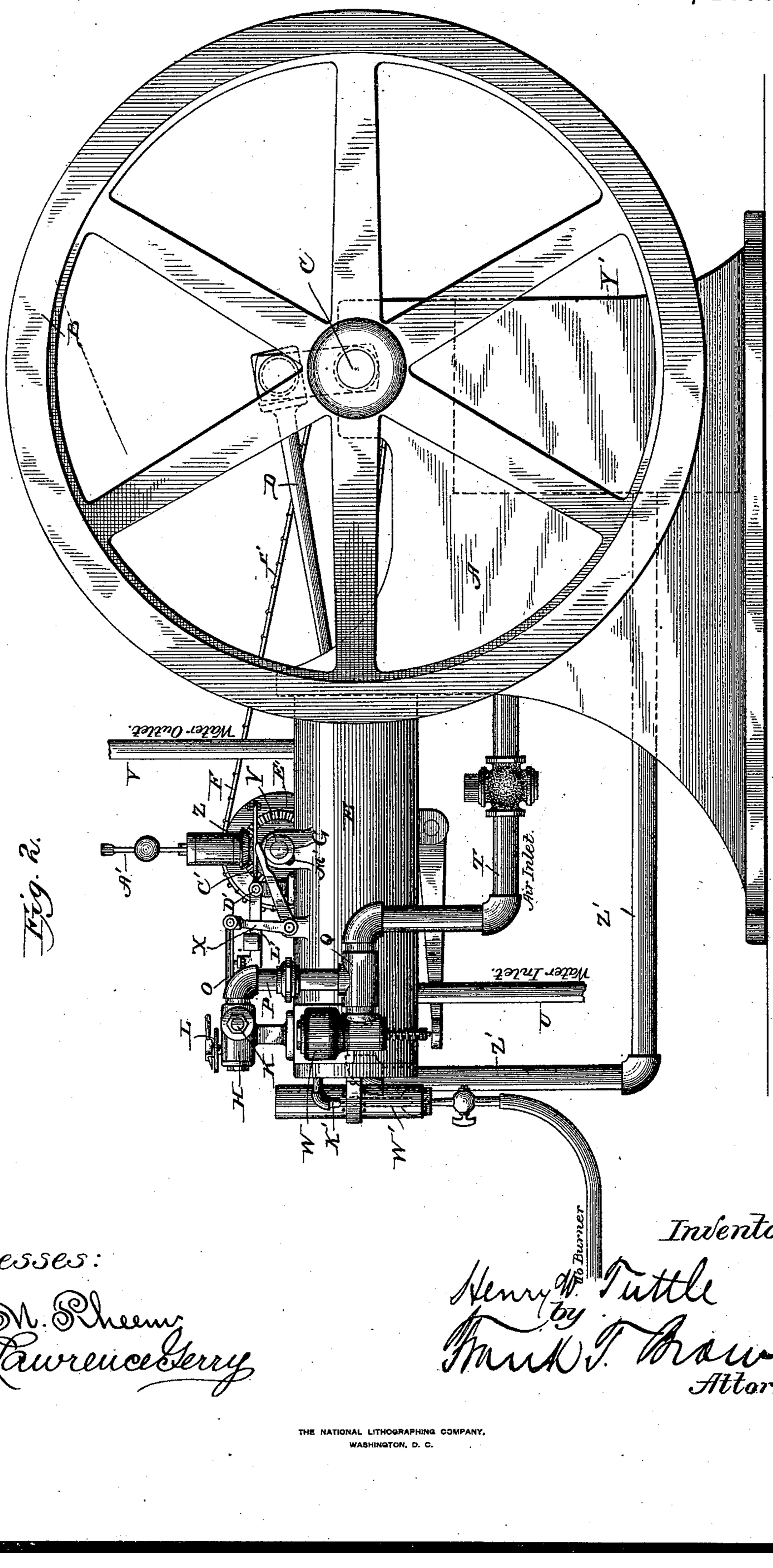

Fig. 2.

Witnesses:

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(No Model.) 5 Sheets—Sheet 3.

H. W. TUTTLE.

COMPRESSION GAS ENGINE.

No. 510,213. Patented Dec. 5, 1893.

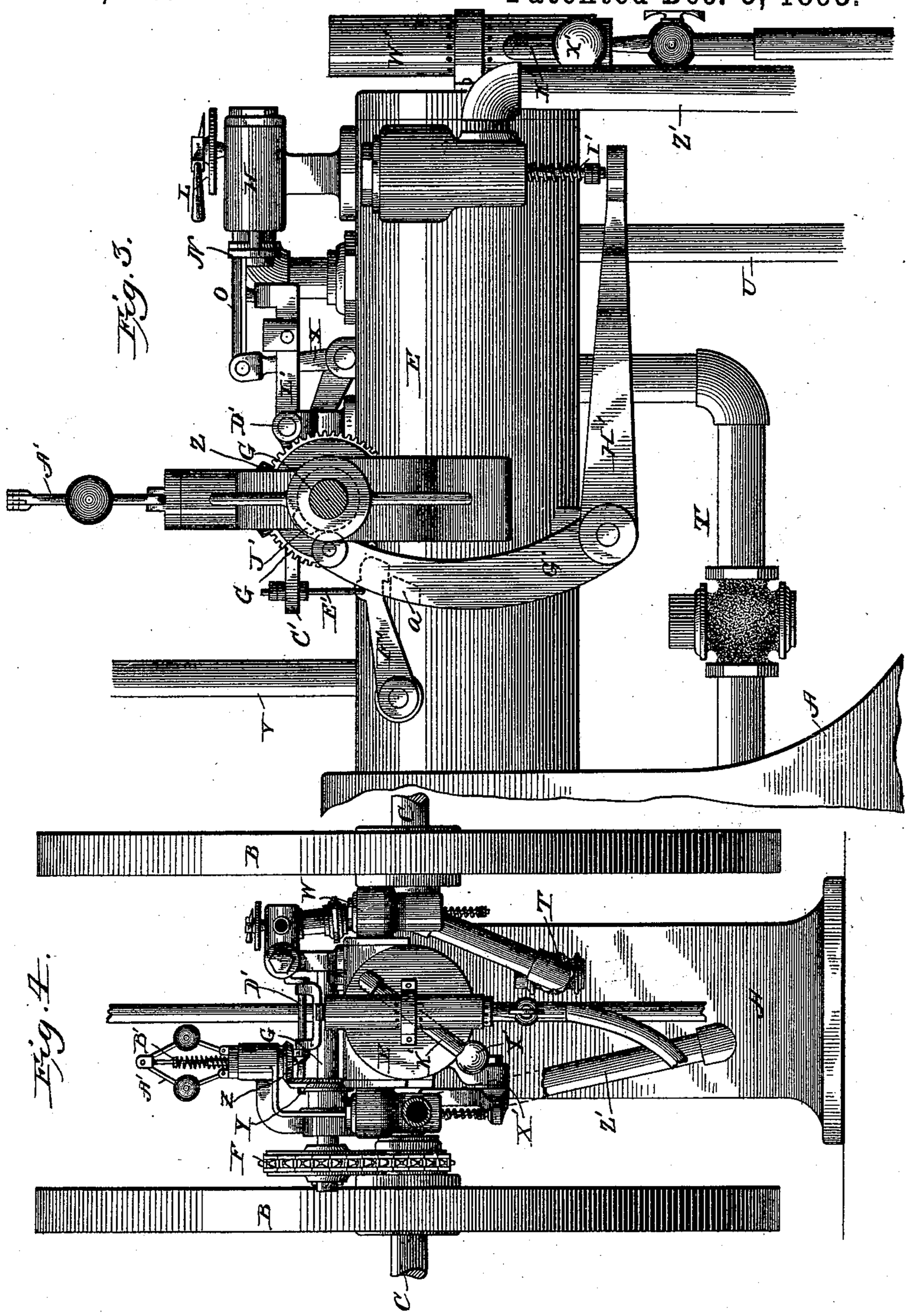

Fig. 3.

Fig. 4.

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(No Model.)

5 Sheets—Sheet 4.

H. W. TUTTLE.

COMPRESSION GAS ENGINE.

No. 510,213. Patented Dec. 5, 1893

Fig. 5.

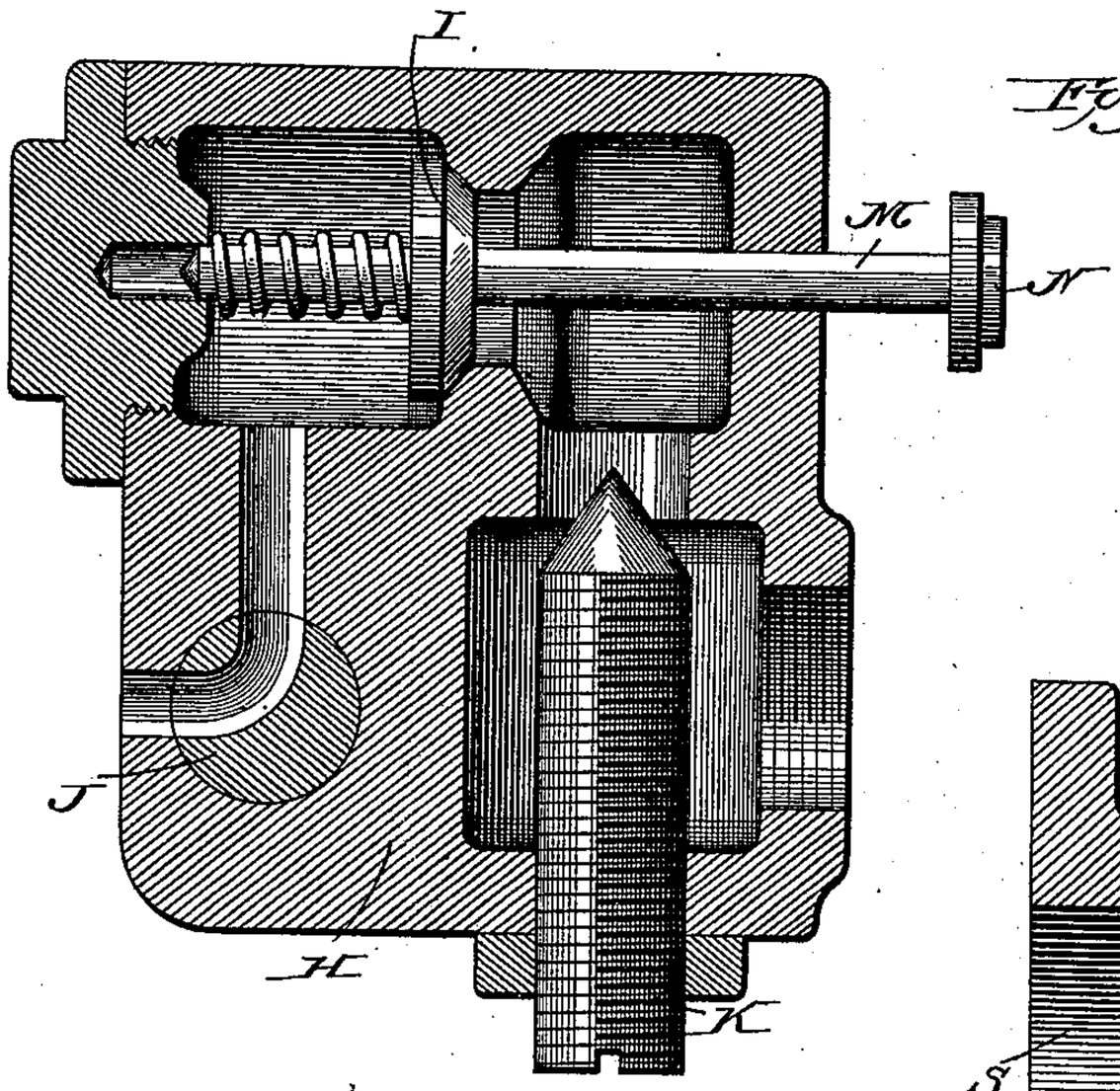


Fig. 6.

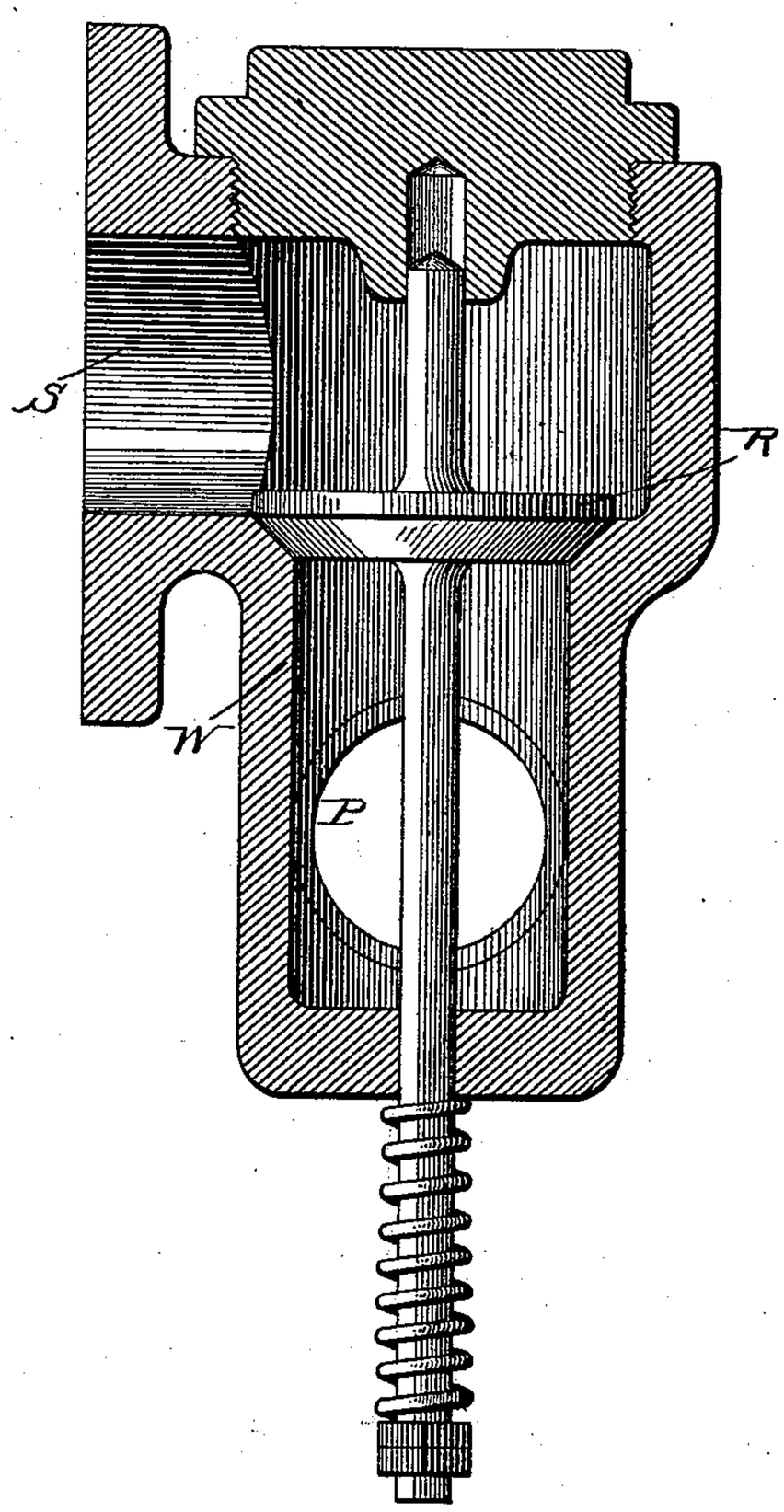
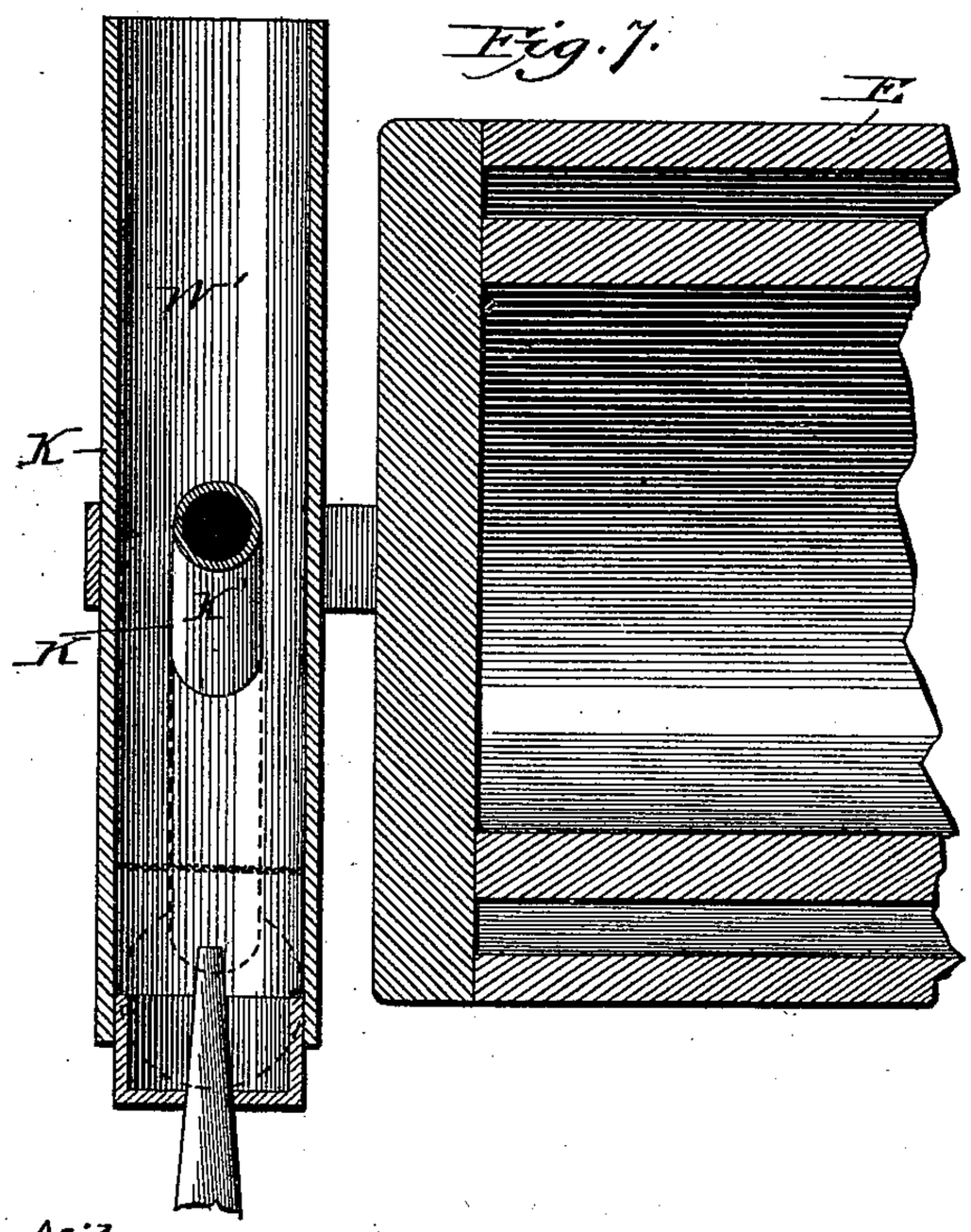


Fig. 7.



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(No Model.) 5 Sheets—Sheet 5.

H. W. TUTTLE.

COMPRESSION GAS ENGINE.

No. 510,213. Patented Dec. 5, 1893.

Fig. 8.

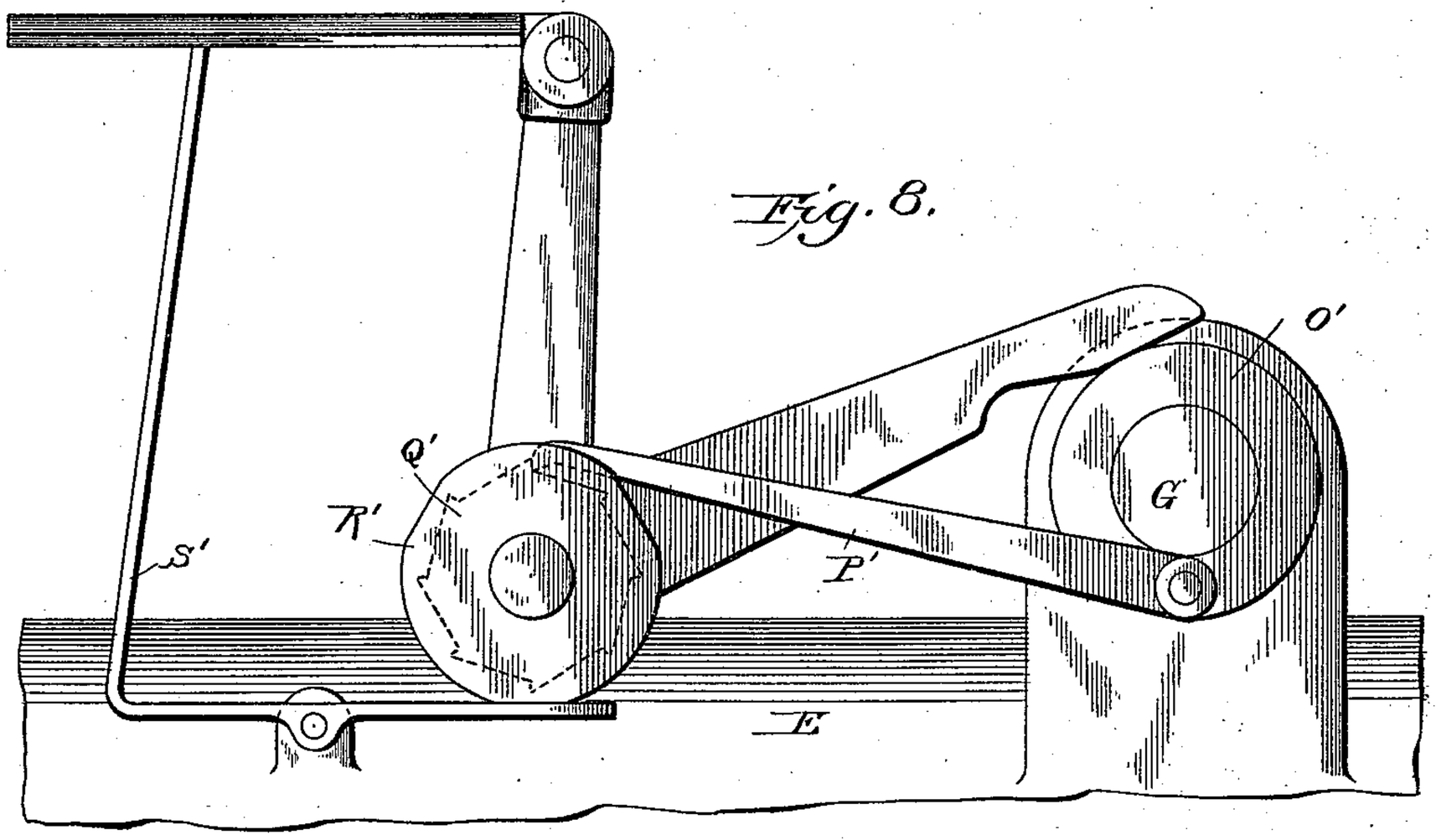


Fig. 9.

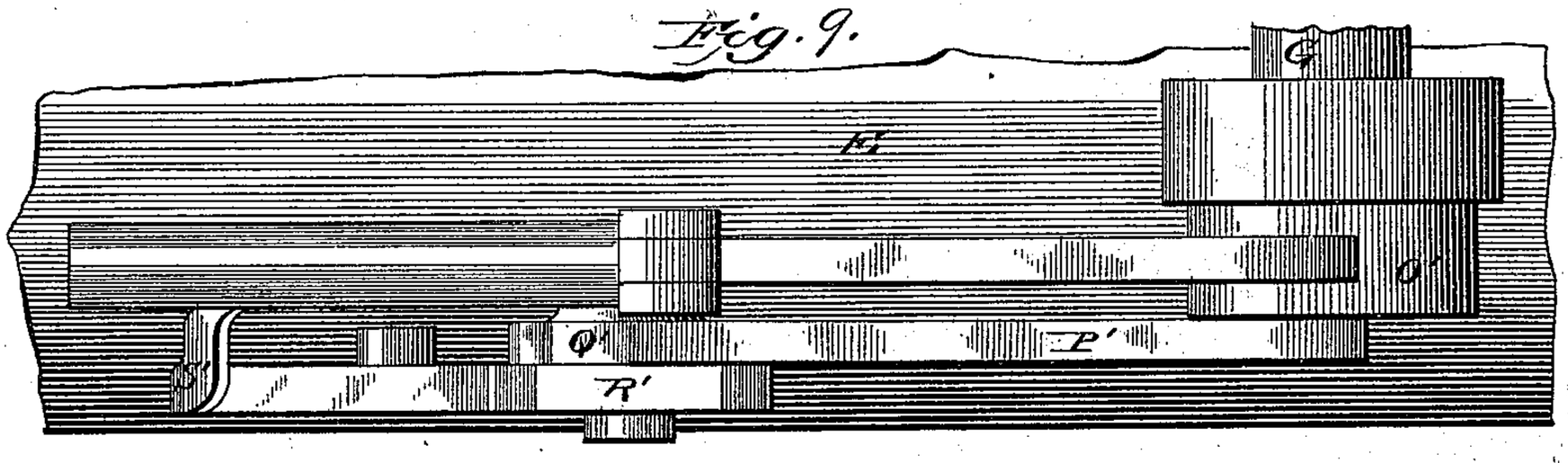
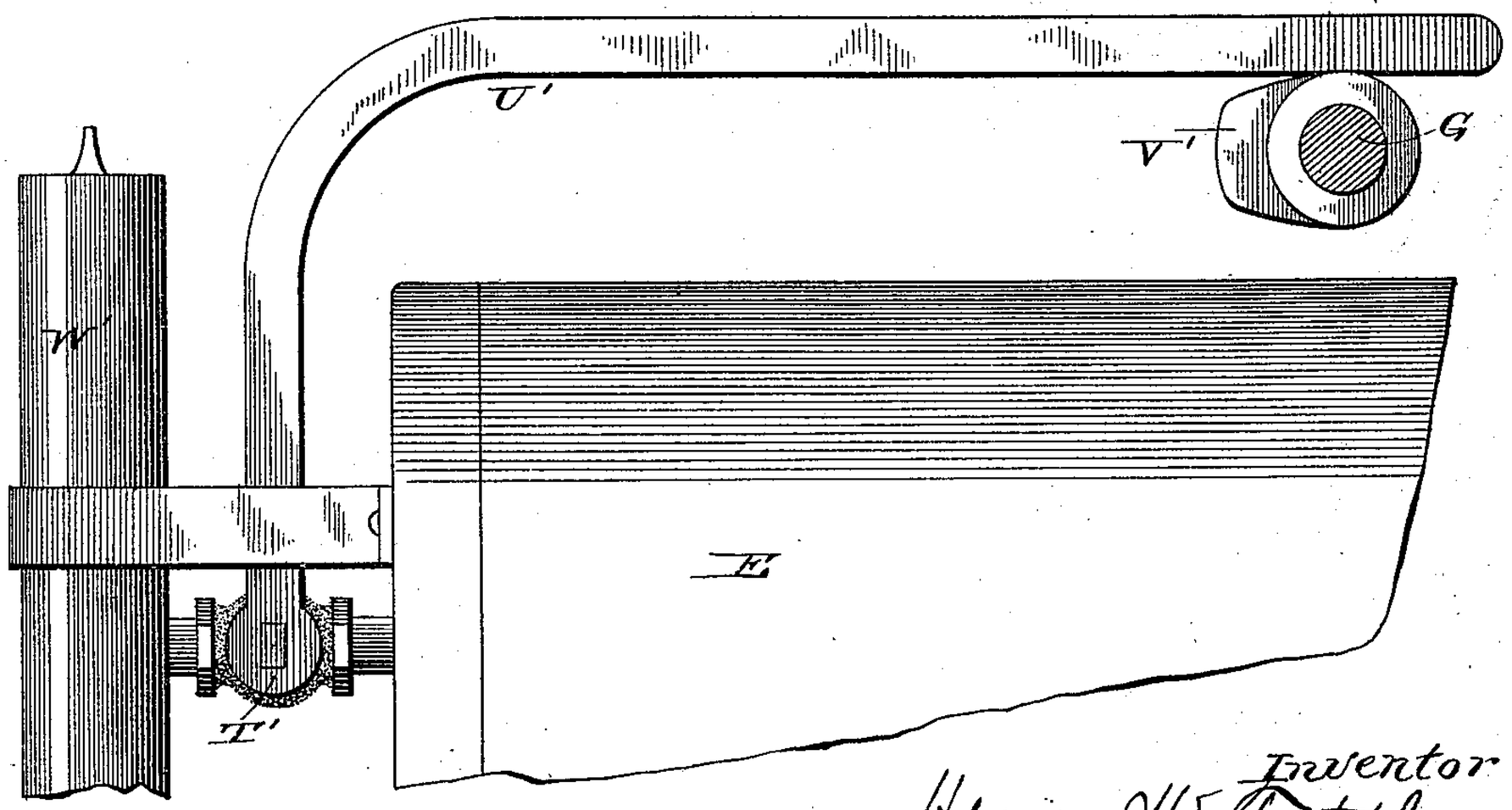


Fig. 10.



Witnesses:

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UNITED STATES PATENT OFFICE.

HENRY WALTER TUTTLE, OF CHICAGO, ILLINOIS.

COMPRESSION GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 510,213, dated December 5, 1893.

Application filed August 25, 1892. Serial No. 444,033. (No model.)

To all whom it may concern:

Be it known that I, HENRY WALTER TUTTLE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Compression Gas-Engines, of which the following is a specification.

My invention relates to a compression gas engine, and it consists in the construction, substantially as shown in the accompanying drawings, set forth in the succeeding description, and more particularly pointed out in the claims.

Like letters refer to the same parts in the several figures of the drawings in which—

Figure 1 is a plan view of the machine. Fig. 2 is an elevation of the left side of the machine. Fig. 3 is a longitudinal vertical section taken on a line between the cylinder and the sprocket chain, so as to show a side elevation of the mechanism for operating the exhaust valve, and other details. Fig. 4 is a front end view of the machine. Fig. 5 is a sectional view in detail of the gas inlet valve. Fig. 6 is a sectional view in detail of the exhaust valve. Fig. 7 is a vertical section of the burner and of the forward end of the cylinder. Fig. 8 is a detail view in side elevation of a modified form of the device for tripping the arm which operates the gas inlet valve. Fig. 9 is a plan view of the same; and, Fig. 10 is a detail view in side elevation of the gas burner, the end of the cylinder and mechanism for operating the intermediate valve for controlling the passage between the burner and the cylinder.

In the drawings, A designates the frame of the machine, which may be of any suitable design and construction and of proper material.

B designates the fly wheels.

C designates the main shaft which is driven by the engine, and communicates the power of the same to any desired mechanism.

D designates the pitman which forms the connection between the piston and the main shaft, and communicates the motion of the former to such shaft by means of a crank upon the shaft, or in any other suitable manner.

E designates the cylinder which may be of any suitable construction and material, and of a size in proportion to the work to be done by the engine.

F designates the sprocket chain which connects the sprocket wheels upon the main shaft and upon a short shaft G which latter is mounted in brackets upon the cylinder. The main shaft and the short shaft are preferably connected by this sprocket chain; but as may readily be seen, they may be connected by any other suitable form of gearing.

H designates the valve casing mounted in any suitable manner, but preferably by a bracket above the forward end of the cylinder, and containing various chambers and valve seats. The valve J is preferably arranged in such casing and is a hand-operated throttle valve, which admits gas to the chamber behind the automatic gas valve I. This former valve has its stem extending through the valve casing and connected to the handle L which latter may be provided with a pointer, and work over a graduated plate. The supply of gas from the gas main or reservoir is admitted by this throttle valve. It is usually found that when the engine is first started the valve should be opened only partially and the graduated plate is arranged to indicate a predetermined extent to which the valve should be opened.

The automatic gas valve I is a spring-closed valve provided with a stem M, which projects rearwardly through the valve casing and has upon its end the head N against which the push arm or rod O is forced at regular intervals to automatically open such valve and admit gas to pass through the same and into the adjoining chamber in which is located the set screw valve K and from which the gas passes by means of a pipe P into the mixing chamber Q, and through the spring-seated check valve R and aperture S into the cylinder.

The screw valve K may be regulated to control the flow of gas into the engine and is set, at any convenient point, at will, according to the pressure of the gas supply.

An air inlet pipe T conveys air to the mixing chamber Q and consequently the air and gas together pass into the cylinder. A suitable cock should be provided to open or cut off the supply of air.

The cylinder is preferably kept cool, as is

usual, by being provided with an outer jacket, and having water passing into the chamber formed by such jacket and the exterior surface of the cylinder, from an inlet pipe U and out through a pipe V; but in the present construction I have provided a construction which enables me to materially reduce the quantity of water to be used by sucking in air and discharging the same in a continuous current while the flow of gas is temporarily cut off. The mechanism for accomplishing this function will be hereinafter described.

The valve casing in which is seated the spring valve R, I designate by the letter W. The gas inlet valve as before suggested is periodically opened by the push rod or arm O striking the head of such valve. This push rod is connected with a bell-crank lever X which is pivoted in brackets upon the cylinder and the other end of which rests upon the short shaft G, and is given its movement by a cam or other device secured thereon, or connected therewith. This is the mechanism which I have found advantageous in practice, and which I prefer as at present advised, but it is obvious that other forms of mechanism will readily suggest themselves to those skilled in the art as equivalents for the mechanism which I have described for this purpose.

One feature of my invention relates to a governor or automatic control for tripping this pusher arm or rod and dislodging it from its pushing position so that at such times it will not push or operate the gas inlet valve. The object of controlling the flow of the gas automatically is to govern the speed of the engine, and keep the cylinder cool. In Figs. 1, 2, 3 and 4 of the drawings I have shown the form of construction for this purpose which I am now using, and which I prefer, and I will, therefore, first describe that construction.

Connected to the short shaft G is a bevel gear Y and journaled in a bracket is another bevel Z which engages the first named gear and thereby has the movement of the short shaft imparted to it. Mounted upon the hub of this gear Z is a well known form of governor A′ consisting of four arms with a weight between the jointure of each pair and having their lower ends pivoted to and carried by the hub of the gear, and their upper ends jointed to a rod B′ which extends downwardly through such hub and terminates just over an angle arm C′ which latter is connected at one end to a rock shaft D′ journaled in brackets on top of the cylinder, and has depending from its other end a rod E′ which latter enters an eye formed in a pivoted hook F′ and normally holds the latter out of engagement with a lug *a* formed on the inside of the upper arm G′ of a bell-crank lever whose lower arm H′ is placed immediately under the stem I′ of a spring seated exhaust valve which is constructed and arranged in a similar manner to the valve shown in Fig. 6 of the drawings, which latter has heretofore been described as arranged upon the other side of the cylinder. The short shaft G before mentioned has also formed upon it a cam J′ shown best in dotted lines in Fig. 3 which periodically strikes the upper arm G′ of the bell crank lever and thereby imparts upward movement to the lower arm H′ of such bell-crank lever and causes it to strike the stem I′ of the exhaust valve and open the same, and permits the cylinder to exhaust. But when the engine is running too rapidly, the centrifugal motion given the weights of the governor causes them to separate and consequently force downwardly the rod B′ and exert a pressure upon the angle arm C′ which in turn forces downwardly the rod E′ and the hook F′ so that the latter catches upon the lug *a* and holds back the arm G′ of the bell crank lever out of the path of the cam J′ on the short shaft and consequently the other arm H′ of the bell crank lever holds open the exhaust valve until the speed is slackened and the cylinder is cooled; when the governor lifts the rod B′ and thereby releases the angle arm which is then automatically lifted because it is secured to the rock shaft D′ upon the other end of which is secured a weighted arm L′. On the same rock shaft D′ at its opposite end is secured a cam M′. Resting upon such shaft in the path of the cam is one arm of an elbow lever X which at its angle is pivoted to a bracket on the cylinder and has its other arm connected to the push rod O, which latter as has been before mentioned is thereby caused to move backward and forward and periodically open the inlet gas valve. The weighted arm L′ is arranged just underneath the push rod, and when the engine travels too rapidly the governor, as has been before explained, forces downward the rod B′ against the angle arm C′ and causes the same to turn the rock shaft D′ in its bearing and lift the weighted arm L′ which latter in turn lifts the end of the push rod O above the head N of the gas valve and, consequently as long as such push rod remains thus lifted, its movement will not open said gas valve and the speed of the engine must necessarily slacken until it reversely affects the governor and the rod B′ is lifted out of operative contact with the angle arm of the rock shaft.

By the above explanation it will be seen that the governor regulates the inflow of gas, through the push rod, rock shaft and weighted tripping lever, and at the same time holds the exhaust valve open so as to afford free egress for gases in the cylinder. The weight is adjustable upon the tripping arm, and hence it may be set at any convenient point and, consequently, may be used to regulate the point at which such push rod is tripped. It is obvious that many different mechanisms may be used to trip this push rod, and that these various forms will readily suggest themselves to those skilled in the art, and it would ex-

tend the limits of this specification too greatly to mention all the modifications which might be made.

I have in Figs. 8 and 9 illustrated a mechanism, also for lifting the push rod above the head of the gas valve, for a different purpose. By reference to these figures it will be seen that the short shaft G may be provided with a crank wheel O′ to which may be connected a long pawl P′, which in turn is caused to operate a ratchet Q′ to which latter is secured a cam disk R′. A bent lever S′ has its one end in contact with the cam disk and its other arm arranged under the push rod, and, consequently, the movement of the cam disk will effect the turning of the angle lever and the lifting of the push rod. Inasmuch as this second tripping device is not operated from the governor, as was the one first mentioned, but directly from the short shaft, it follows that periodically the push rod is by this bent lever lifted above the head of the gas valve and consequently such valve at that stroke remains closed, but as the piston is still caused to move by the inertia of the fly wheels, its suction draws air alone into the cylinder, which tends to cool the same, and therefore reduce the quantity of water necessary for such cooling purpose. Of course this mechanism may be timed to thus lift the push rod as the exigencies of the situation might demand, but ordinarily I prefer to so time it that the push rod will be caused to slide above the head of the gas valve every third stroke. As before suggested when the supply of gas is thus cut off, and the piston sucks in air to the cylinder, a current through the cylinder is established, because such air is forced out through the exhaust valve, the latter being opened by the cam J′ striking the upper arm G′ of the bell crank.

In all the figures of the drawings in which the cylinder and burner are shown, the burner is connected directly to the cylinder without any intermediate valve, and this is best shown in Fig. 7, but the usual and preferred arrangement is that shown in Fig. 10 in which there is a valve T′ arranged in the pipe between the burner and the cylinder which valve may have secured to its stem a curved arm U′ the free end of which rests on the short shaft G in the path of a cam V′ secured to such shaft; and thus the valve is automatically operated from the driving power. Of course other arrangements might be arranged for the same purpose, and such will be obvious to those skilled in the art without their being set forth in this specification.

The burner in most respects is of the usual construction and need not be described in all its details, but there is added thereto a construction which is advantageous in practice and which constitutes one feature of the present invention. The pipe which connects the burner with the cylinder has usually a depending branch but it is found in practice that the heat to which this pipe is subjected forms a scale upon its inner surface which becomes detached and drops into the lower portion of such pipe, and obstructs the flow into the cylinder. In the present invention the pipe enters the cylinder and then passes downwardly and at an inclination through the burner proper so that the scale which is formed is not in the path of the flow of the gas but drops below such path and may be received in any suitable receptacle and preferably in a bulb secured to the lower end of such pipe, as is shown in Fig. 4 of the drawings. The pipe I designate by the letter K′ and the bulb by the letter X′. The bulb furthermore serves as a compression chamber in the pipe so that additional pure gas may enter the same. This inclination of the pipe and bulb is best shown in Figs. 1, 2, 3, 4 and 7, Fig. 10 for clearness showing the old style of horizontal pipe connection.

Of course other variations of the several parts shown in the drawings and heretofore described might be made by those skilled in the art without departing from the spirit of my invention, and I do not desire to be limited to the exact construction shown and described.

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

1. In a gas engine the combination of a cylinder, a normally closed gas valve having a stem projecting outwardly in the path of a push rod, a push rod, a driving shaft, and mechanism between the push rod and driving shaft for operating the latter intermittently, a pivoted tripping lever arranged to dislodge the push rod from its operative position, a rock shaft connected at one end to the tripping lever, and having at its other end an arm projecting in the path of a sliding stem of a governor, and a governor geared to the driving shaft of the engine, and serving to project its stem against a projecting arm on the rock shaft, whereby when the speed of the engine becomes too great the rock shaft will be caused by the governor to throw up the tripping lever and dislodge the push rod, and thereby prevent the same from opening the gas valve, whereby the motor fluid is temporarily cut off; substantially as and for the purpose set forth.

2. In a gas engine, the combination of a cylinder, a normally closed gas valve having a projecting stem, a push rod adjacent to the projecting stem of such valve and in position to actuate the same; an elbow lever having one arm connected to the push rod another arm resting on a driving shaft in the path of a cam thereon, a driving shaft provided with such cam, and with gearing for actuating the governor, the governor provided with a sliding stem, a rock shaft having at one of its extremities an arm projecting into the path of the sliding stem on the governor, and at its other extremity a tripping arm arranged adjacent to the push rod, and adapted to dis-

lodge the same from its operative position; substantially as and for the purpose set forth.

3. In a gas engine, the combination of a cylinder, a normally closed gas valve, a push rod for opening such valve and mechanism connecting such rod with the driving power of the engine, a tripping lever arranged to dislodge the push rod from its operative position, a rock shaft having its one end secured to the tripping lever and its other end to an arm, a normally closed exhaust valve, a bell crank for opening the same, and locking devices for the bell crank connected to the arm of the rock shaft, a governor having a sliding rod in position to strike the arm of the rock shaft, and thus control both the tripping lever and the locking mechanism; and gearing connecting such governor with the driving power of the engine; substantially as and for the purpose set forth.

4. In a gas engine the combination of a cylinder, an air pipe communicating therewith, and a gas pipe also communicating with the cylinder through a joint connection with the air pipe; a normally closed gas valve in advance of the connection of the two pipes, a push rod for opening the gas valve, and mechanism for periodically operating the same connected with the driving power of the engine, a lifting device arranged in operative relation to the push rod, and connections between the same and the driving power of the engine whereby said lifting device is actuated less frequently than the push rod, and, consequently, periodically air alone is sucked into the cylinder to cool the same; substantially as shown and described.

5. In a gas engine the combination of a cylinder, an air pipe and a gas pipe joining a common pipe before entering the cylinder, a normally closed gas valve, a push rod for opening such gas valve, a shaft having a cam and connections for operating the push rod, a lifting device for dislodging the push rod from its operative position and mechanism also arranged upon the short shaft and connected to the lifting device and so timed as to actuate the latter less frequently than the push rod is actuated, whereby air and gas are periodically admitted to the cylinder together, and less frequently air alone is admitted to such cylinder; substantially as shown and described.

6. In a gas engine the combination of a cylinder, air and gas pipes joining before entering such cylinder, a normally closed gas valve, a push rod opening such valve, a bell crank lever connecting such push rod with a cam upon a short shaft, a pivoted lever in position to dislodge the push rod from its operative position with relation to the valve stem; an eccentric also on the short shaft; a pawl connected to such eccentric, and a ratchet and cam actuated by such pawl, and arranged and timed in relation to the lifting lever and push rod so that the lifting lever will be operated less frequently than the push rod; substantially as and for the purpose set forth.

7. In a gas engine, the combination of a burner, a heating pipe passing through the chimney surrounding the burner and into the cylinder, a valve in such pipe, and mechanism connecting such valve with the driving power of the engine; substantially as and for the purpose set forth.

8. In a gas engine the combination of a cylinder, a pipe extending downwardly from such cylinder and at an inclination through a chimney surrounding an exterior gas burner, and terminating in a receptacle; substantially as and for the purpose set forth.

9. In a gas engine, the combination of a cylinder, an exterior burner, a pipe communicating with the cylinder, and passing downwardly into the chimney surrounding the burner and through the same, whereby any scale forming within such pipe will pass downwardly beyond the burner, and thus not obstruct the flow of gas into the cylinder; substantially as and for the purpose set forth.

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

HENRY WALTER TUTTLE.

Witnesses:
FRANK T. BROWN,
J. LAWRENCE GERRY.