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S. D. SHEPPERD.

GAS ENGINE.

No. 521,443. Patented June 12, 1894.

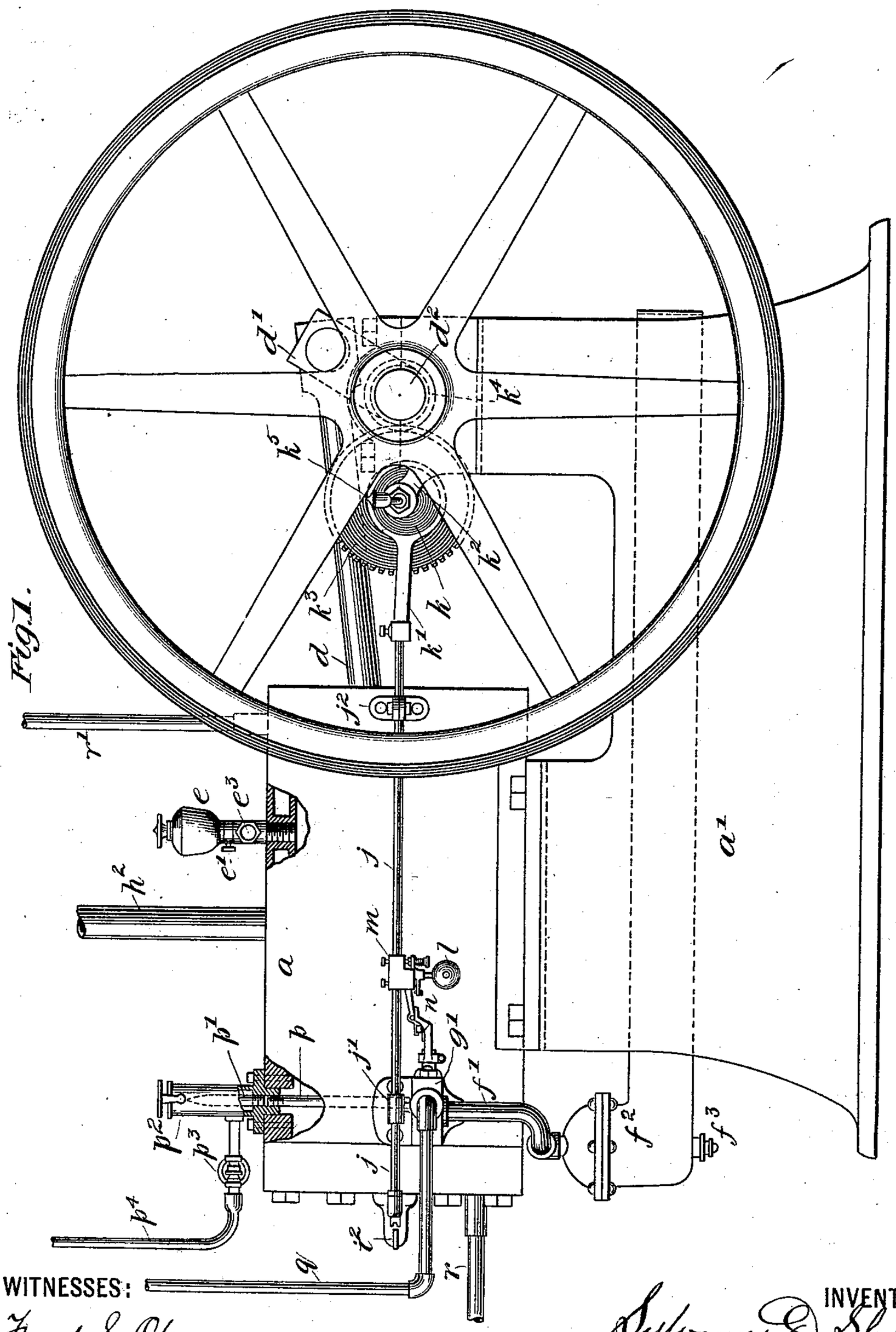

Fig. 1.

WITNESSES:

Frank S. Oberr

Alfred W. Van Zee

INVENTOR

Stephanus D. Shepperd

BY

Baldwin, Davidson & Wright

ATTORNEYS.

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

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S. D. SHEPPERD.

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Fig. 2.

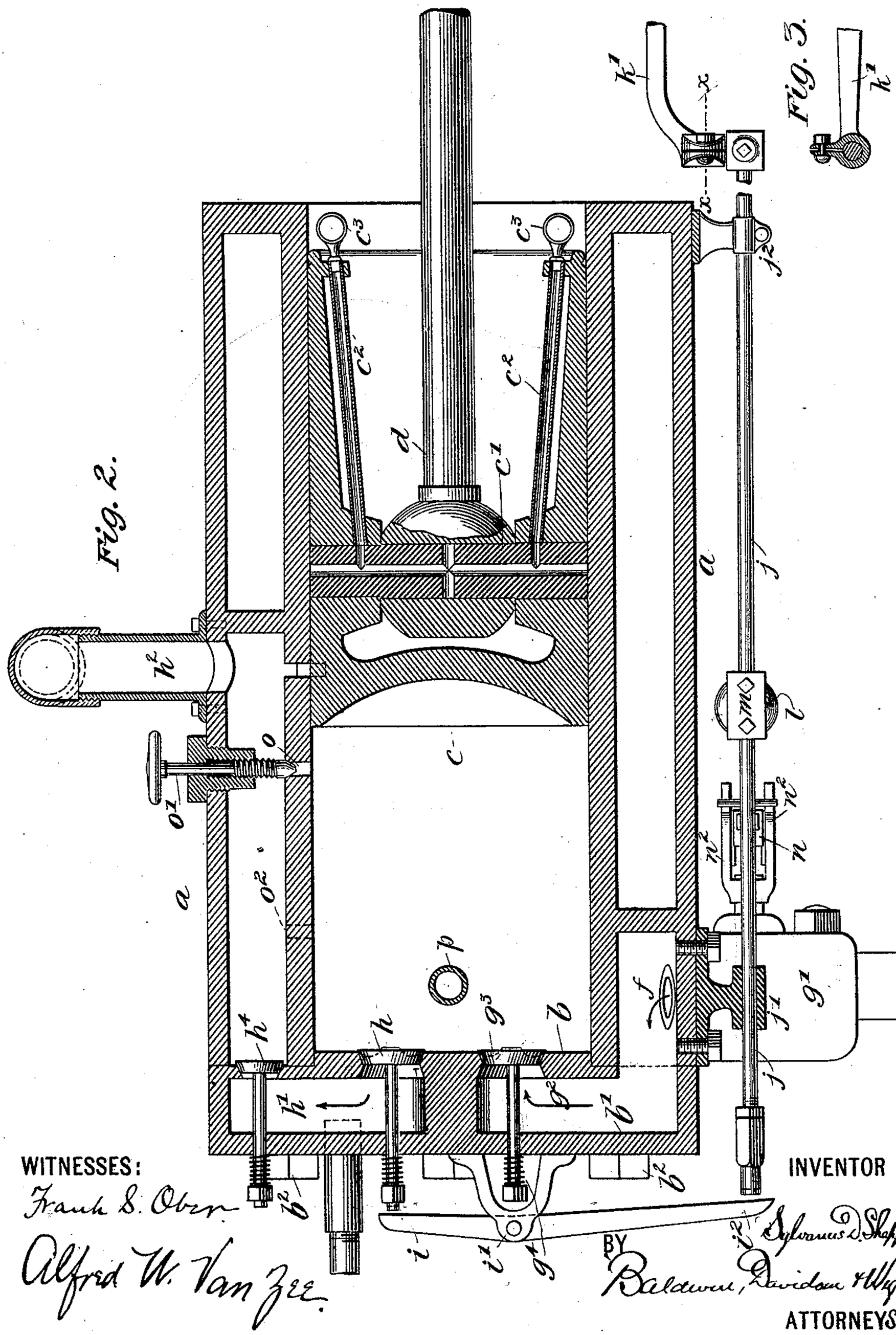

Fig. 3.

WITNESSES:

Frank S. Ober

Alfred W. Van Zee.

INVENTOR

Sylvanus D. Shepperd

BY

Baldwin, Davidson & Wright

ATTORNEYS

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

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S. D. SHEPPERD.

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Fig. 6.

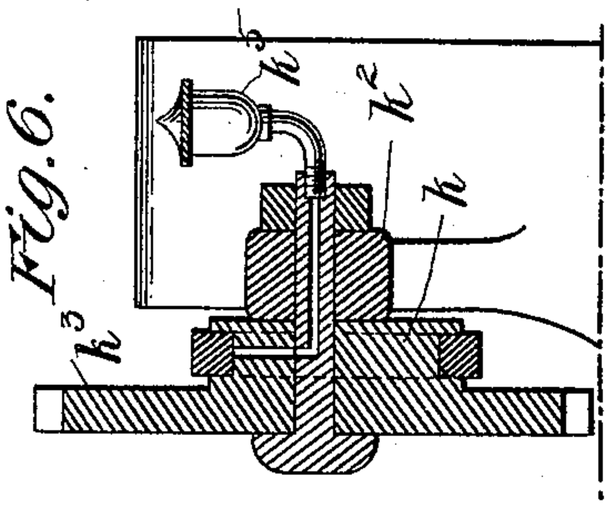


Fig. 7.

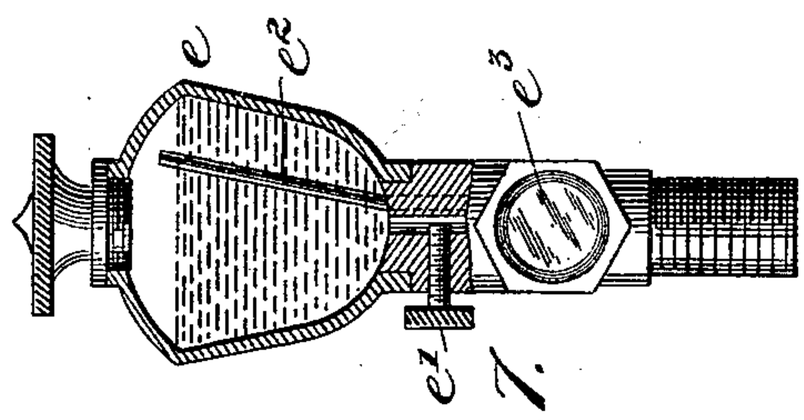


Fig. 4.

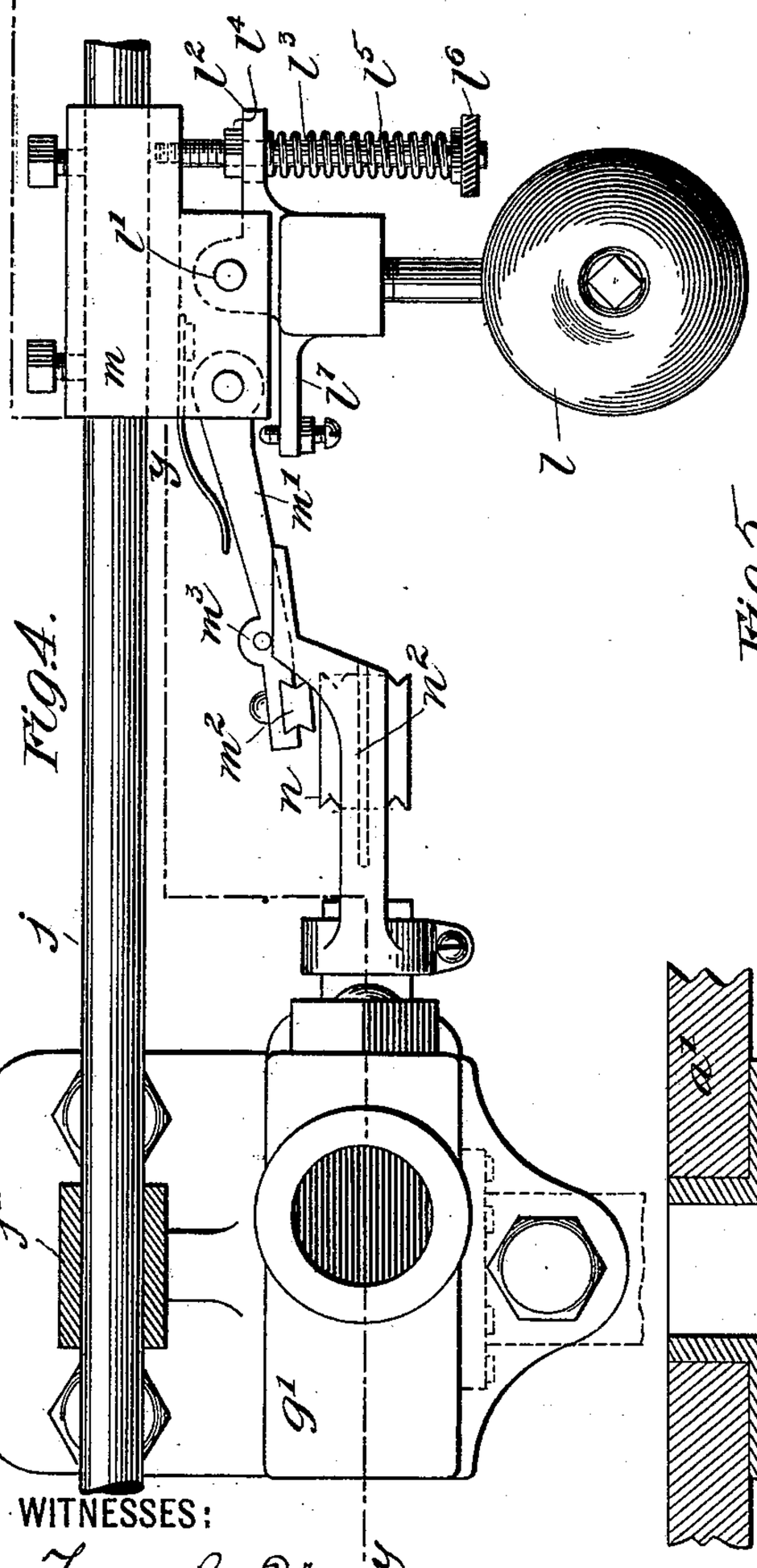
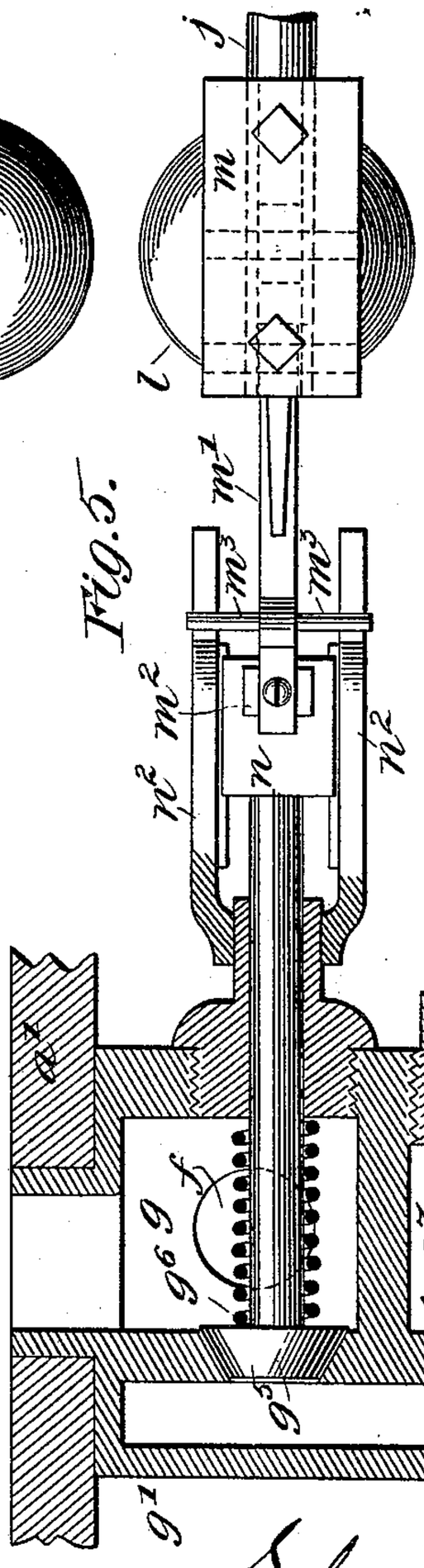


Fig. 5.



WITNESSES:

Frank S. Ober

Alfred W. Van Zee

INVENTOR

Sylvanus D. Shepperd

BY

Baldwin, Davidson & Wright

ATTORNEYS.

THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

SYLVANUS D. SHEPPERD, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE BACKUS WATER MOTOR COMPANY, OF SAME PLACE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 521,443, dated June 12, 1894.

Application filed October 26, 1893. Serial No. 489,213. (No model.)

To all whom it may concern:

Be it known that I, SYLVANUS D. SHEPPERD, a citizen of the United States, residing at Newark, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

This invention relates to that class of gas engines which act on the impulse principle, that is, by the explosion within the cylinder of the gaseous mixture at every alternate stroke of the piston, and on one side only of the piston, and it has for its object to improve and cheapen the mechanical construction, and to provide an improved automatic governor whereby no charge of the explosive mixture is allowed to enter the cylinder when the speed of the engine exceeds its normal rate.

The accompanying drawings clearly illustrate my improvements and to which I will now refer.

Figure 1 is a side elevation of a gas engine embodying my invention. Fig. 2 is a horizontal section of the cylinder and its accompanying parts on an enlarged scale. Fig. 3 is a section of the eccentric rod connection with the sliding valve governing rod, on the line *x x*. Fig. 4 is a side elevation, on an enlarged scale, of the valve governing mechanism. Fig. 5 is a section of the same on the irregular line *y y*. Fig. 6 is a sectional view of the eccentric and its bearing, and Fig. 7 is a sectional view of the cylinder oil cup.

The cylinder *a* and its water jacket are cast in one piece, open at both ends, the rear end being covered by the head *b*, which closes the cylinder proper, and the head *b'*, which constitutes the end of the water space. These parts *b* and *b'* are by preference cast in one piece, are secured to the cylinder by the bolts b^2 b^2, which enter bridge pieces formed between the cylinder and the water jacket, and are provided with inlet and outlet passages, and valves as hereinafter described. The cylinder is secured to the base *a'*. The piston *c* is of the ordinary trunk type used in this class of engines, being provided with a transversely arranged shaft or pin *c'* on which the piston rod *d* has its bearing and rocks. This shaft *c'* passes entirely through the piston, its ends being shaped to conform to the outer surface of the piston, and to fit the cylinder. It has a central longitudinal bore communicating with transverse holes, two of which are in line with the pipe connections c^2 c^2, the ends of which extend beyond the outer end of the piston, and are provided with oil cups c^3 c^3 thereby providing means for the access of oil to all parts of the shaft *c'*. To insure the cylinder being thoroughly oiled, an oil cup *e* is located at the forward end of it, the passage from the cup to the interior of the cylinder being through a wall, in the water space. This cup may be of the form shown at Fig. 7, in which *e'* is a regulating valve, e^2 a pipe extending up into the space above the oil, and e^3 a feed sight. The outer end of the piston rod *d* is connected to the crank *d'* whose shaft d^2 is journaled in bearings on the base *a'*, and is provided with the usual fly wheel and pulleys.

Between the parts *b b'* of the cylinder head, passages are formed for the inlet of the gas and air, and the outlet of the products of combustion from the cylinder, said passages being arranged to align with passages formed by walls in the water space. The air passage *f* opens into the chamber *g* of the gas valve case *g'* which communicates with the interior of the cylinder by the passage g^2 through an opening closed by the valve g^3 normally seated by the spring g^4. The air passage *f* communicates with the outside air through the pipe *f'*, in which is located the check valve f^2 of ordinary construction, said check valve being provided with adjusting means f^3 to regulate the amount of air allowed to pass into the engine.

A spring actuated valve *h* normally closes the opening between the cylinder and the exhaust passage *h'*, and this valve is opened during the alternate inward motions of the piston, by means of the lever *i* pivoted at *i'* to a projection from the head *b'*. The outer end i^2 of this lever extends beyond the side of the cylinder and is acted upon by the end of the sliding rod *j* fitted in bearings *j'* and j^2 secured to the cylinder, said rod receiving a reciprocating motion, from the eccentric *k* through the medium of the eccentric rod *k'*. This eccentric is journaled on a stud k^2 pro-

jecting from the frame and is connected to or forms a part of the gear k^3, which receives motion from a pinion k^4, secured to the crank shaft of the engine and one half as large as the gear k^3. To supply oil to the eccentric, both at its outer surface and at its bearing on the stud k^2, said stud has a central hole from its outer end, to which is attached the oil cup k^5, to a point within said bearing, a lateral passage at this point being in line with a passage in the eccentric to its outer bearing, as shown at Fig. 6.

The gas valve case g' is connected to the side of the cylinder and contains a valve g^5 in the chamber g normally kept closed by the spring g^6 and a valve g^7 adapted to be set and locked in position to determine the amount of gas that is allowed to enter the engine at each operation. The valve g^5 is operated automatically, that is, it is opened at each alternate stroke of the engine when the speed of the engine is normal, but is left closed when this speed is exceeded, and again opened when an explosive impulse is required to bring the engine up to and maintain it at its normal speed. The means devised by me to accomplish this acts somewhat on the principle of a pendulum, the same consisting of a weight l suspended at l' from the block m secured by set screws to the sliding rod j, the upper part of the arm or rod of the pendulous weight having an arm l^2, which embraces a screw-threaded rod l^3, having a nut l^4 above the arm to limit the movement of the weight in one direction, and a spring l^5 and adjusting nut l^6 to offer an adjustable resistance to the movement of the weight in the other direction. Another arm l^7 on the opposite side to that of the arm l^2 is provided with an adjustable screw or point, arranged to act against the under side of the bar or lever m', which is pivoted to the block m, and preferably held down by means of a spring. This lever has at its end a hooked piece m^2, which is arranged to catch over the head n secured to the stem of the valve g^5, when the lever m' is down and during the outward stroke of the piston; and to be released from this head n by the pins m^3, which projecting from the sides of the lever m', acts on the inclined surfaces n' of the frame n^2 in which the head n is fitted to slide. These parts of the apparatus are so adjusted that upon an increase of speed above the normal, the swing of the weight l is such, in the direction for it to hold up the lever m', that it holds up this lever sufficiently long to allow the hook m^2 to pass beyond and miss the edge of the head n, during the outward stroke, so that at such times the valve g^5 is not opened and no gas enters the engine. The frame n^2 is adjustably clamped to the valve case so that the inclined surfaces n' may be set in relation to the travel of the pins m^3 to cut off the gas at any desired point.

The exhaust passage h' opens into the exhaust pipe h^2, and an opening h^3 is formed into this passage through the cylinder a, at a point that is just cleared by the piston, when in its extreme outward position, the object of which is to allow most of the products of combustion to escape and thus relieve the piston from back pressure when it commences its return stroke, and before the valve h becomes fully open. A check valve h^4 may be a desirable feature in the passage h' fitted in the head $b\,b'$ to prevent the discharged gases being drawn back in the cylinder.

Engines of this character require to be worked by hand a short time in starting them, and to reduce this labor as much as possible, an opening o from the cylinder to the exhaust passage is provided, which is normally closed by the screw valve o', said valve being withdrawn to allow the air that is in the cylinder to escape and that would otherwise have to be compressed. When the engine is ready to operate this valve is closed. This valve as shown in Fig. 2 is more forward on the cylinder than is desirable, it will perform its functions better if set back farther as at the part marked o^2.

The improvement in the method of igniting the explosive mixture in the cylinder consists in communicating the exploding force to the center of the volume of the gases contained in the cylinder, and this is accomplished by extending into the gas space a pipe p, which is a continuation of the closed end pipe p' located in the furnace p^2, and which is maintained in a sufficiently heated condition to set fire to or explode the compressed gases therein, by means of the Bunsen burner p^3 supplied with gas by the pipe p^4, and constantly kept burning in the manner usual with this class of gas exploding device.

The pipe q supplies gas to the gas valve case g'. The pipes r and r' are the water supply and discharge to and from the water jacket.

By the arrangement of the detachable heads b and b' and the fitting of the cylinder inlet and outlet valves therein, as shown, the construction of the engine is much simplified and the parts readily reached for repair or adjustment.

The operation is as follows: The first outward movement of the piston draws, by suction, gas through the valve g^5 and passage g^2 and air through the passage f into the cylinder, said air and gas commingling as they pass to the valve g^3. This gaseous explosive mixture is by the return stroke of the piston compressed, and at the time of its greatest compression, the portion in the pipe p' is ignited, the explosion due thereto passes down the pipe p and ignites or explodes the volume of gas at the center, thereby insuring a much more perfect combustion than occurs in engines where the ignition takes place at one side of the gas chamber. This explosion causes the piston to move outwardly on its second stroke and so constitutes the source of power of the engine, the products of com-

bustion being discharged by the inward movement of the piston of this second stroke. A fresh charge of gases enters during the first half of the next stroke, and so on at each alternate revolution of the engine.

I claim as my invention—

1. In a gas engine, the combination of a cylinder, a jacket, walls cast between the jacket and the cylinder to form inlet and outlet passages, and a double head having a water space and cast with passages separated from the water space, said double head being adapted to close the end of the cylinder, and to form the end of the water jacket, the passages in said double head being arranged to align with the passages of the cylinder.

2. In a gas engine, the combination of a cylinder and water jacket, cast with walls between them to form inlet and outlet passages, a double head adapted to close the end of the cylinder and to form the end of the water jacket, provided with passages to align with the passages of the cylinder, said passages in the double head opening into valve seats in the cylinder head, and valves fitted to the valve-seats.

3. In a gas engine, the combination of a cylinder and water jacket, cast with walls between them to form a gas inlet passage at one side and an exhaust passage at the other side, a double head adapted to close the end of the cylinder and to form the end of the water jacket and provided with passages arranged to align with the inlet and outlet passages of the cylinder and opening through the head of the cylinder, and an air inlet passage communicating with the gas inlet passage.

4. In a gas engine, the combination of a cylinder and water jacket, cast with walls between them to form a gas inlet passage at one side and an exhaust passage at the other side, a double head adapted to close the end of the cylinder and to form the end of the water jacket and provided with passages arranged to align with the inlet and outlet passages of the cylinder and opening through the head of the cylinder, an air inlet passage communicating with the gas inlet passage, spring actuated valves fitted to close the inlet and exhaust openings in the cylinder, and a check valve in the exhaust passage of the head.

5. In a gas engine, the combination of a cylinder and water jacket, cast with walls between them to form a gas inlet passage at one side and an exhaust passage at the other side, a double head adapted to close the end of the cylinder and to form the end of the water jacket, provided with passages arranged to align with the inlet and outlet passages of the cylinder and opening through the head of the cylinder, an air inlet passage communicating with the gas inlet passage, spring actuated valves fitted to close the inlet and exhaust openings in the cylinder, a piston rod and a crank shaft, an eccentric actuated thereby, a sliding rod, and a lever, communicating motion from the sliding rod to the exhaust valve.

6. In a gas engine, the combination of a cylinder and water jacket, cast with walls between them to form a gas inlet passage at one side and an exhaust passage at the other side, a double head adapted to close the end of the cylinder and to form the end of the water jacket and provided with passages arranged to align with the inlet and outlet passages of the cylinder and opening through the head of the cylinder, an air inlet passage communicating with the gas inlet passage, spring actuated valves fitted to close the inlet and exhaust openings in the cylinder, a piston in the cylinder, and a valve for temporarily making communication between the cylinder and the exhaust passage.

7. In a gas engine, the combination of a cylinder and water jacket, cast with walls between them to form a gas inlet passage at one side and an exhaust passage at the other side, a double head adapted to close the end of the cylinder and to form the end of the water jacket and provided with passages arranged to align with the inlet and outlet passages of the cylinder and opening through the head of the cylinder, a vertical air inlet passage communicating with the gas inlet passage near its opening into the cylinder, spring actuated valves fitted to close the inlet and exhaust openings in the cylinder, a piston in the cylinder and an opening through the cylinder into the exhaust passage, near the outward limit of movement of the piston.

8. In a gas engine, the combination of a cylinder, a piston working therein, gas and air passages for the admission of an explosive mixture to the cylinder, an open-ended pipe extending from the center of the combustion chamber to the outside of the cylinder where it is closed, and a furnace outside the cylinder for continuously heating the closed end of the pipe while the engine is in operation.

9. In a gas engine, the combination with the explosion chamber, of a pipe extending from the center of the combustion chamber to the outside thereof, and open at the center of the combustion chamber, and means outside the cylinder for heating the closed end of said pipe.

10. The combination of a gas admission valve, a sliding rod, an exhaust valve connected with and operated thereby, a weight carried by said sliding rod, devices connected with the rod for operating the gas admission valve, means for making the valve actuating devices inoperative when the weight moves relatively to the rod beyond its normal stroke, a stop for limiting the movement of the weight in one direction, and an adjustable spring arranged to offer an adjustable resistance to its movement in the other direction.

11. In a valve controlling device for gas engines, the combination, of a gas valve normally held closed, a sliding rod, a weight carried thereby, a hooked lever or arm carried

by the sliding rod, a head on the stem of the valve with which the hooked arm engages, an inclined guide for disengaging the hooked arm from the valve stem head, an arm from the weight for preventing the hooked arm engaging the valve stem head, another arm projecting from the pendulous weight embracing a rod, and nut stop on this rod above the arm and a spring and nut on this rod below the arm.

12. In a gas engine, the combination of a working cylinder, its piston, a gas admission valve, means for operating it, a main exhaust opening at the outer end of the cylinder, a supplemental exhaust valve in the rear end of the cylinder behind the piston, means for opening the supplemental exhaust valve at each alternate stroke of the piston, and an automatic governor for controlling the gas admission valve.

13. The combination of the working cylinder, the piston reciprocating therein, the main exhaust opening, the supplemental exhaust opening in the cylinder in rear of the piston, a valve for controlling said opening, a sliding rod operatively connected with said supplemental exhaust valve to open it at each alternate reciprocation only of the piston, a gas admission valve, a weight carried by the sliding rod and movable relatively thereto and operatively connected with the gas admission valve, and devices operated by said weight to cause the operating devices of the gas admission valve to miss opening said valve when the speed of the engine is excessive.

In testimony whereof I have hereunto subscribed my name.

SYLVANUS D. SHEPPERD.

Witnesses:
ROBERT B. CISSEL,
FREDK. C. FRAENTZEL.