No. 626,155. Patented May 30, 1899.

E. J. FITHIAN.

GAS ENGINE AND MEANS FOR GOVERNING SAME.

(Application filed Oct. 4, 1898.)

(No Model.) 3 Sheets—Sheet 1.

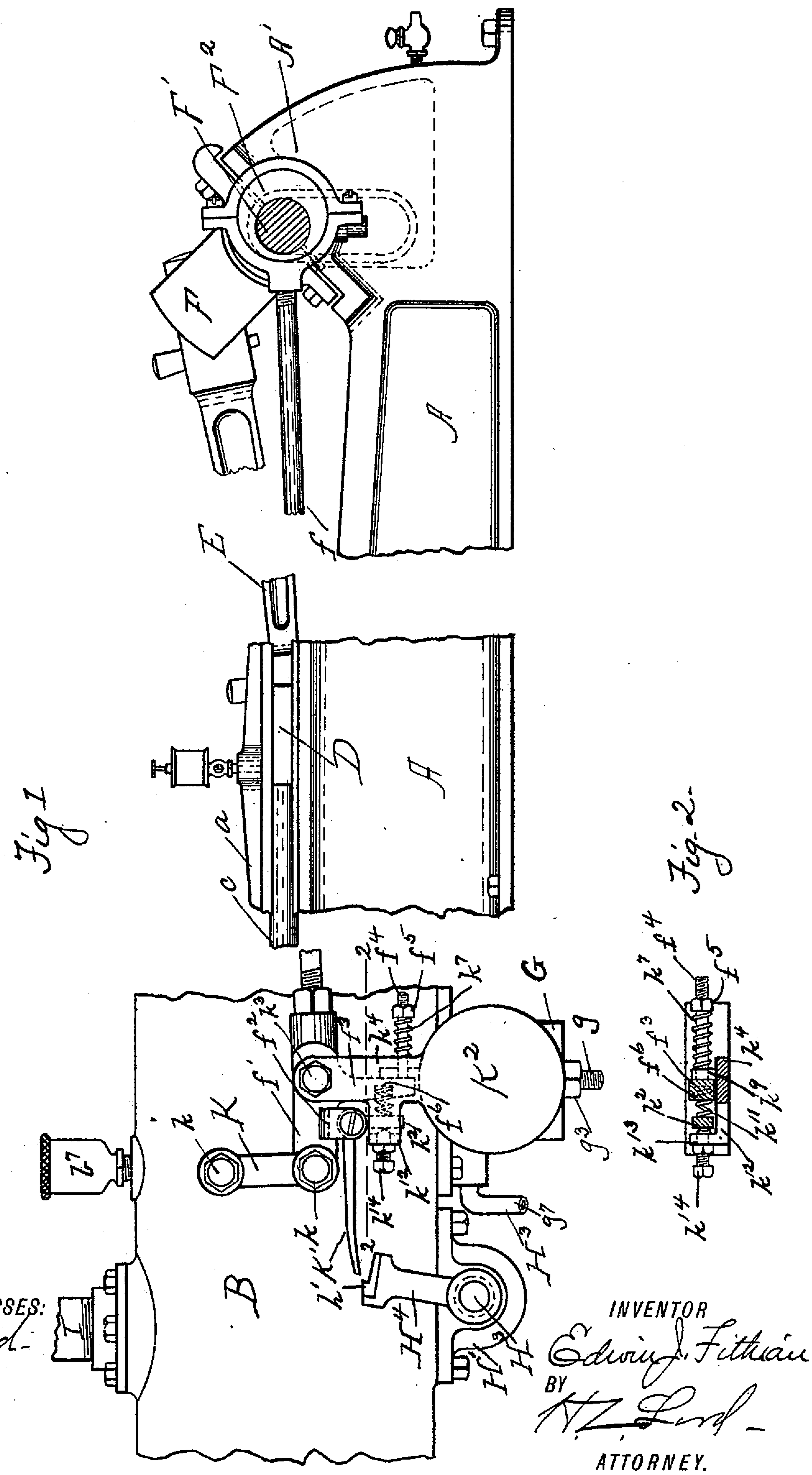

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Fig. 3.

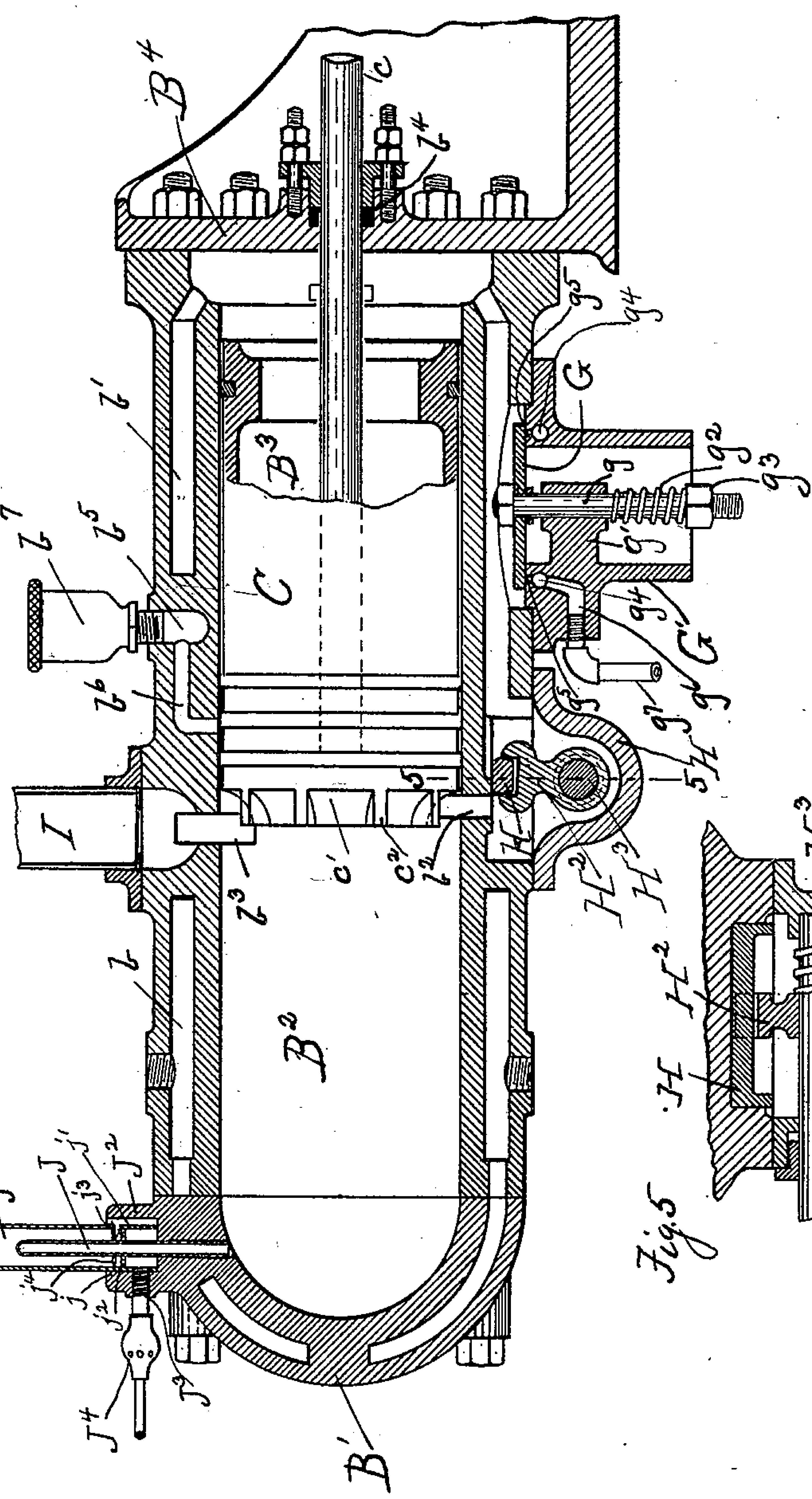


Fig. 4.

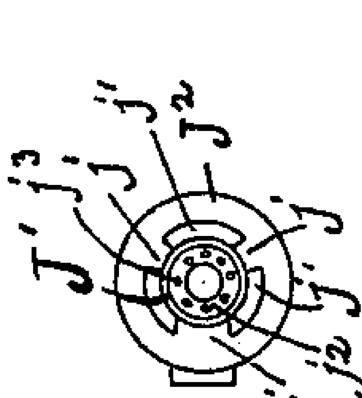
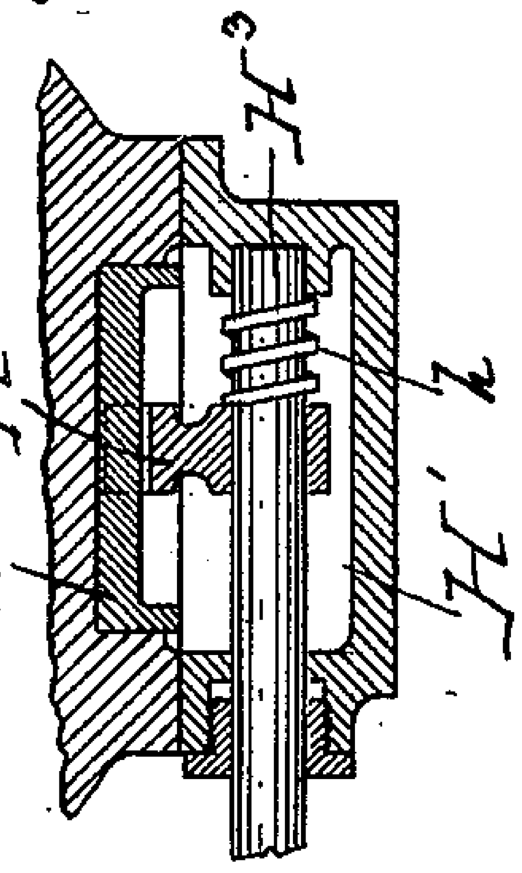


Fig. 5



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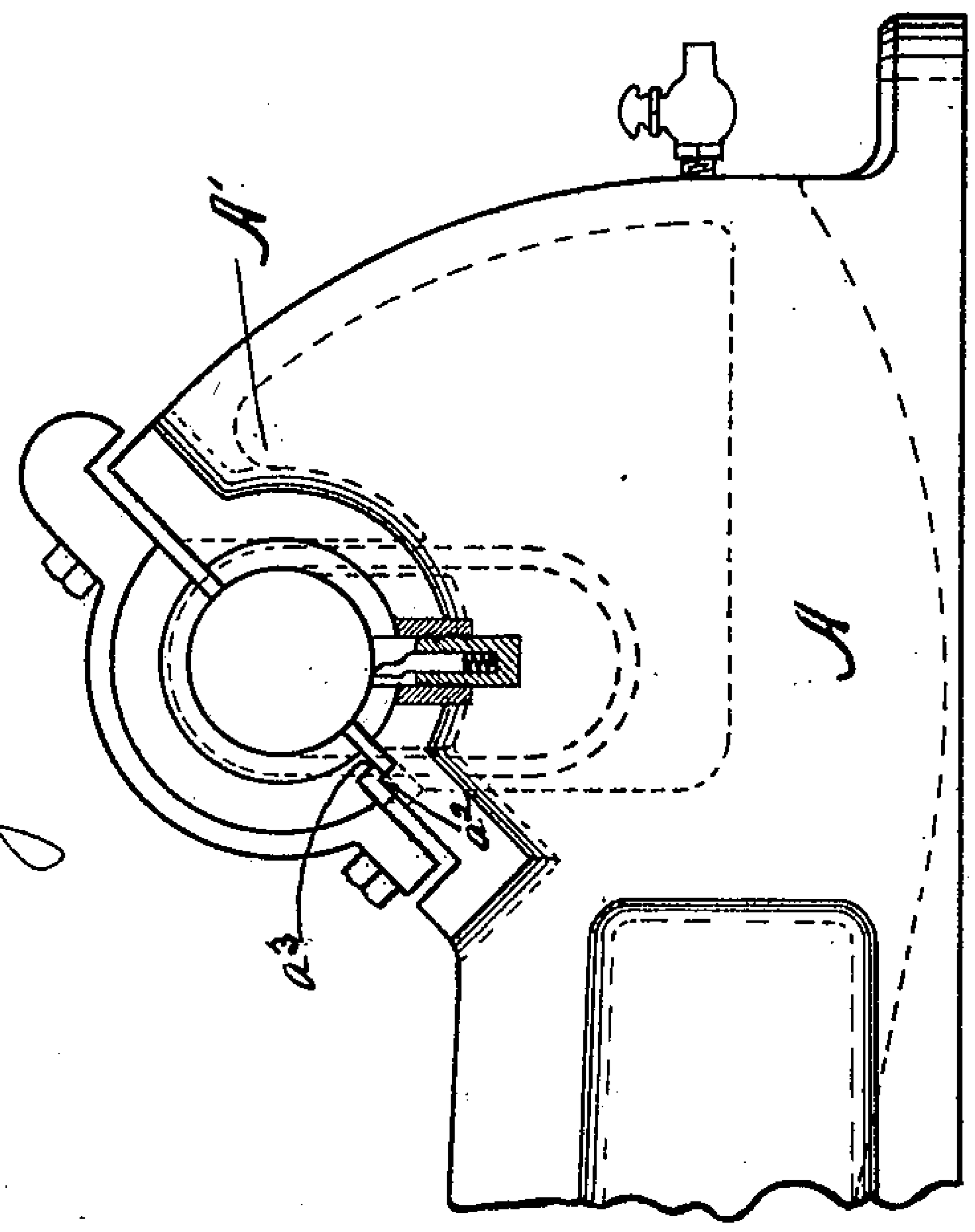

Fig. 7

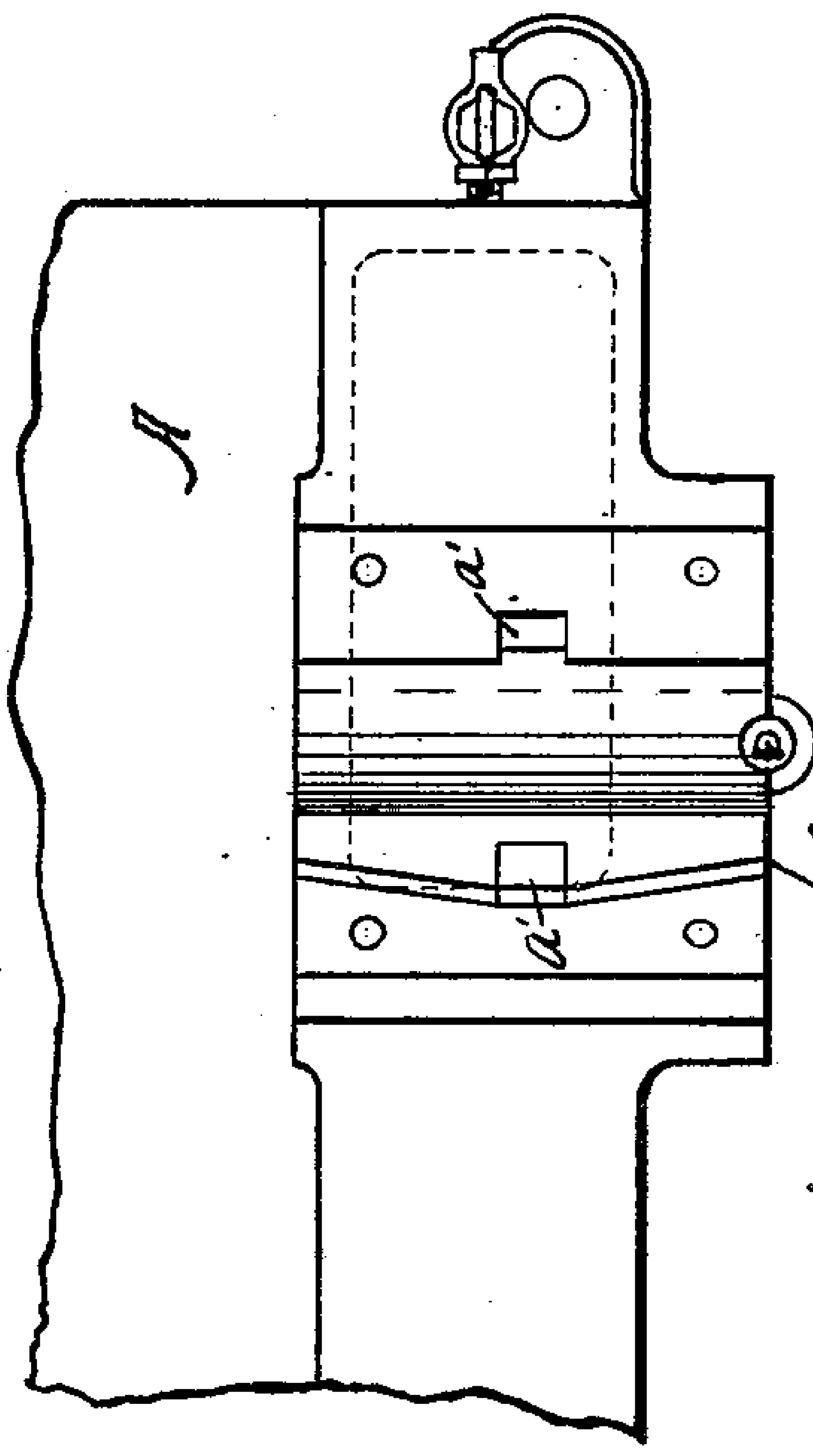

Fig. 8

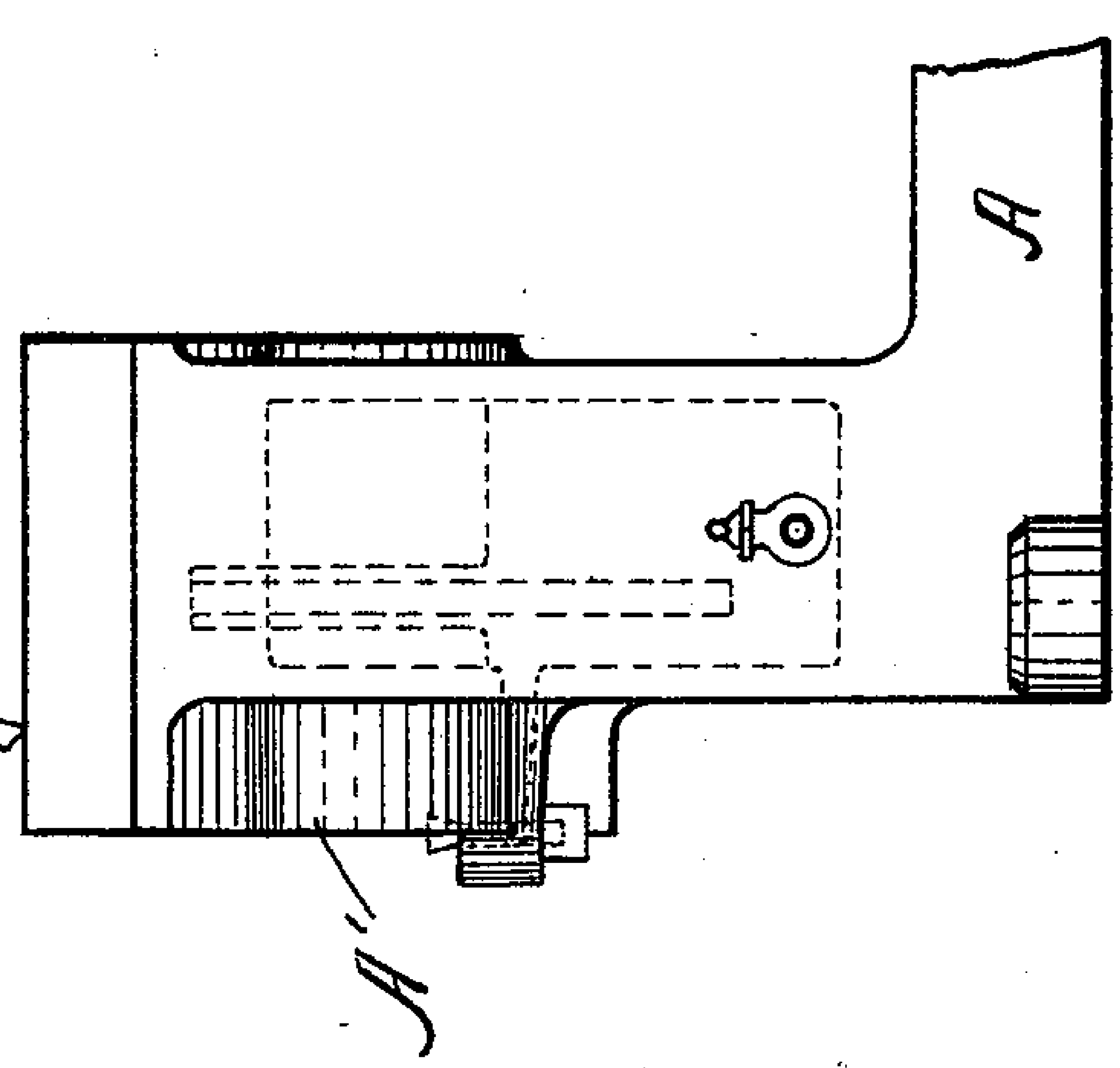

Fig. 6

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UNITED STATES PATENT OFFICE.

EDWIN J. FITHIAN, OF GROVE CITY, PENNSYLVANIA.

GAS-ENGINE AND MEANS FOR GOVERNING SAME.

SPECIFICATION forming part of Letters Patent No. 626,155, dated May 30, 1899.

Application filed October 4, 1898. Serial No. 692,621. (No model.)

To all whom it may concern:

Be it known that I, EDWIN J. FITHIAN, a citizen of the United States, residing at Grove City, in the county of Mercer and State of Pennsylvania, have invented certain new and useful Improvements in Gas-Engines and Means for Governing Same; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to gas-engines and incidental mechanisms; and it consists of certain improvements in the construction thereof, as will be hereinafter fully described, and pointed out in the claims.

The invention is illustrated in the accompanying drawings, as follows:

Figure 1 shows a side elevation of the engine; Fig. 2, a section of the governor mechanism on the line 2 2 in Fig. 1. Fig. 3 shows a section of the engine-cylinder; Fig. 4, a plan view of the igniting device; Fig. 5, a section of the governor-valve mechanism on the line 5 5 in Fig. 3; Fig. 6, an end view of the crank-shaft box; Fig. 7, a side elevation of the same; Fig. 8, a plan of the same with the cap removed.

A marks the bed of the engine; B, the cylinder; C, the piston; c, the piston-rod; D, the cross-head, which is carried in guides a; E, the connecting-rod; F, the crank, and F′ the crank-shaft. These may be of any desired construction, except as hereinafter specified.

The piston C divides the cylinder into two parts—the combustion-chamber B^2 and the compression-chamber B^3. The combustion-chamber end of the cylinder is closed by a semispherical head B′, and the compression end of the cylinder is closed by the head B^4, preferably part of the frame. In the head B^4 is the ordinary gland or stuffing-box b^4, through which the piston-rod passes. The combustion end of the cylinder is provided with a water-jacket b, which extends into and through the head B′. The compression-chamber B^3 communicates with an annular chamber b', located in the cylinder-wall, similar to the water-jacket b, but surrounding the compression-chamber. An opening is made into this chamber b', and a mixing-valve G is arranged in the opening.

The mixing-valve mechanism consists of the valve-casing G′, which is bolted to the cylinder-wall. The upper surface of this valve-casing is faced off, thus forming a valve seat or surface for the valve G. The valve G is provided with a stem g, which passes through a guide g' and is provided at its end with an adjustable nut g^3. A spring g^2 is coiled around the stem and is tensioned against the guide g' and the adjustable nut g^3, so as to force the valve G upon its seat. The valve-casing G′ has a centrally-located entrance, which is open to the atmosphere. An annular port g^4 is arranged in the valve-casing G′ beneath the valve G, and small ports g^5 extend from the annular port g^4 through the surface of the valve-casing under the valve. The annular port g^4 is connected by the passage g^6 with the gas-supply pipe g^7. With a movement of the piston toward the combustion end of the cylinder the compression-chamber B^3 b' is enlarged. This reduces the pressure of the mixture in the compression-chamber, and if this falls below air-pressure the force of the air tends to raise the valve G and allow the admission of a fresh supply of mixture. In effecting this operation, however, the air-pressure is opposed by the tension of the spring g^2, which may be adjusted as desired. This effect of adjusting the spring g^2 is to change the proportions of gas and air admitted by the valve G. Its operation in this respect is as follows: When a greater tension is put upon the spring g^2, the force of the air does not open the valve so widely, and the result of this is that the gas-ports g^5 being nearer the edge of the valve and nearly the capacity of the passage between the valve G and its seat a greater proportion of gas is admitted than is the case where the valve is opened more widely and the air allowed to pass in more freely.

As the piston C moves toward the compression end or front end of the cylinder the mixture in the chamber B^3 b' is compressed, and just as the piston C reaches its extreme forward position it uncovers the inlet-port b^2, which allows the admission of the mixture to the combustion-chamber B^2. This movement of the piston also uncovers the exhaust-port b^3, which is preferably located at a little distance in front of the extreme forward movement of the piston in order that the exhaust may have begun before the admission of fresh mixture. The port b^3 opens into the exhaust-pipe I. The end of the piston is beveled at c', and this beveled portion extends over the port b^2 when the piston is in its extreme forward position. The incoming mixture striking this beveled surface is deflected and, passing along the lower side of the combustion-chamber, striking the spherical end, is again deflected, the combined result of which is that the burned gases are driven out of the exhaust-port, leaving the combustion-chamber substantially filled with pure unexploded mixture. In order to prevent the passage of the mixture on its entrance circumferentially around the bevel-surface c' directly into the exhaust-port b^3, I have provided the series of projecting walls c^2. These extend out at substantially the same diameter as the piston over the beveled surface, and thus prevent an annular movement of the mixture at its entrance.

It will readily be seen that with the mechanism so far described a charge of mixture will be introduced into the combustion-chamber with each revolution of the engine. In order that the power of the engine may be governed, it is desirable to provide mechanism whereby only a sufficient number of charges may be introduced to effect the power desired. In order that the mixture may be prevented from entering the combustion-chamber except when the speed of the engine requires a fresh charge, I have provided the slide-valve H, which is arranged to operate upon the port b^2 and to close the same when it is moved to its backward position. This valve is contained in the valve-chest H', upon which it rides and by which it is kept to its seat. A rock-arm H^2 is mounted on a rock-shaft H^3 and is provided at its upper end with a throat, which engages the slide-valve H, so that the valve is moved as the shaft H^3 is rocked. A coil-spring h is arranged in the shaft H^3 and is tensioned to effect a rocking movement of the shaft and to hold the valve H normally in its forward or open position. The mechanism for actuating the rock-shaft H is hereinafter described.

The igniter is formed as follows: The igniting-tube J extends through the head B' into the combustion-chamber B^2 and is of the usual form. A lug J^2 is cast on or secured to the head and surrounds the tube J. This lug has a socket, into which the burner-tube J' is introduced. The socket is provided with the inwardly-projecting lugs j and the intervening annular cavities j'. The lugs j are arranged to contact and support the tube J'. The tube J' is provided with the burner-partition j^2, in which are the jet-orifices j^3. The supply-pipe J^3 is secured in the lug J^2 and extends into the burner-tube J'. It is provided with the usual mixer J^4. Below the surface of the lug J^2 and above the burner-partition j^2 is the slot or opening j^4, the purpose of which is to allow the passage of air to the burner. The novel feature of this device consists principally in locating these slots j^4 below the surface of the lug J^2 and providing passages to said slots in the socket. The advantage of placing these slots below the surface consists in making them free from the influence of strong currents of air, which have the effect when said slots are exposed of extinguishing the fire in the burner-tube, and consequently stopping the engine.

The mechanism for operating the valve H is as follows: An eccentric F^2 on the crank-shaft drives an eccentric-rod f, on which is secured an extension f'. A link K, pivoted on the cylinder at k, supports the cylinder end of the eccentric-rod by pivotal connection at k'. A throat f^2 extends downwardly from the extension f' and has pivoted in it the thrust-bar K', which is provided with a downwardly-extending L k^2. The forward end of the thrust-bar is slightly beveled and arranged to engage a shoulder h' on a rock-arm H^4, which rock-arm is mounted on the rock-shaft H^3. It will readily be seen that if the thrust-bar K' engages the shoulder h' and moves toward the rear or combustion end of the cylinder the valve H will be moved over the port b^2, and will thus prevent the entrance of mixture to the combustion-chamber. To accomplish this result at the desired time, the governor mechanism is provided as follows: A weight K^2 is suspended by an arm k^4 from a pivot k^3 on the extension f'. An arm f^3 extends downwardly from the extension f' and is provided at its lower end with a projecting stud f^4, on which is an adjustable nut f^5. A flange k^9 extends inwardly from the arm k^4 and contacts the arm f^3 in such a manner as to prevent the movement of the weight K^2 in a direction of the combustion-chamber from its normal position directly beneath the pivot k^3. This flange k^9 is provided with a slot which extends around the stud f^4, and a spring k^7 is tensioned between the flange k^9 and the nut f^5, so that while the weight can move in a forward direction from beneath the pivot such a movement is retarded by the spring k^7.

A projection k^{12} extends from the arm k^4 past the L k^2 of the thrust-bar and is provided with a flange k^{13}, which extends back of the L k^2. A set-screw k^{14} is screwed through the flange k^{13} into contact with the L k^2 of the thrust-bar. A spring k^{11} is arranged in a socket f^6 in the arm f^3 and is tensioned against the L k^2, so as to press the L into contact with the set-screw k^{14}. The operation of this device is as follows: When the engine is running under a load which requires the introduction of a charge of mixture with each revolution of the engine, the governor-weight K^2 is prevented from swinging forwardly on its pivot k^3 a sufficient distance to cause the movement of the bar K' by reason of the operation of the weight upon the L k^2 through the medium of the set-screw k^{14}, so that it will engage the shoulder h'. As long as the engine continues running at this speed the valve H remains open and the governor mechanism effects no operation of the valve; but should the load be so decreased as to cause the engine to run faster than the desired speed the weight K^2 will be retarded by its inertia when the eccentric-rod is moved toward the rear sufficiently to overcome the tension of the spring k^7, so that the weight will swing on its pivot k^3 to a position in front of said pivot. This swinging of the weight through the medium of the set-screw k^{14} presses the L k^2 forwardly, and thus carries the thrust-bar K′ downwardly a sufficient distance to engage the shoulder h'. With the further rearward movement of the eccentric-rod the thrust-bar K′ is carried backwardly into engagement with the shoulder h', so that the rock-shaft is moved with the movement of the eccentric-rod, so as to close the valve H. As the force of inertia incident to the initial movement of the weight K^2 is overcome by the spring k^7 and the weight moves back to its normal position the thrust-bar K′ is maintained in engagement with the shoulder h' by reason of the undercut on said shoulder and the tension of the spring h upon the rock-shaft which opposes the movement of said rock-shaft by reason of the thrust of the thrust-bar. This engagement of the shoulder is sufficient to overcome the tension of the spring k^{11}, so that the engagement remains until the rock-shaft has moved back to its normal position by reason of the return movement of the eccentric-rod. As the valve reaches its extreme forward position and is stopped the tension of the spring h ceases to act against the thrust-bar K′, so that with the slightly-forward movement of the eccentric-rod the thrust-bar is raised to its normal position by the tension of the spring k^{11}. It will be noted that this governor mechanism, with its valve, is only operated when it is desired to miss a charge and that while the engine is running under full load no operation takes place by reason of the said mechanism. The location of the thrust-bar is regulated so as to require a greater or less swing of the weight K^2 by means of the set-screw k^{14}, so that the speed of the engine can be regulated in this way, if desired. The tension-spring k^7 may also be adjusted by the nut f^5, so that the retarding effect of the spring may be made greater or less, and thus the swing of the weight K^2 regulated. In this way also the speed of the engine may be regulated as desired.

In order to lubricate the cylinder, I have provided the following device: A socket b^5 is made in the wall of the cylinder, from which a passage b^6 leads into the cylinder. The passage b^6 opens into the socket b^5 at a place considerably above the bottom of the socket. The purpose of this arrangement is to make a settling-chamber of the socket b^5, so that the oil entering the cylinder may be perfectly clear. By occasionally cleaning the socket this effect may be made constant. An ordinary drop-cup b^7 is preferably arranged in the socket b^5. This construction is particularly advantageous in an engine having the exhaust-port extending from the upper part of the cylinder in a position to be opened by the extreme forward movement of the piston, because with such an engine, in addition to the advantage of the settling-chamber formed by the socket b^5, the passage b^6 carries the oil into the cylinder at a point nearer the end of the piston than would be practical if the opening were made direct.

In order that the thrust of the engine may be more readily sustained by the bed of the engine and the crank-boxes, I have formed the lower part of the box in the engine-frame and have parted the box at an angle to the bed, so that the lower part of the box faces toward the cylinder. By this arrangement the thrust on the crank is sustained by that part of the box contained in the bed. In order to provide for the better lubrication of this box, I provide what is known as a "chain-oiler." This consists of a chain (shown in dotted lines in Figs. 6 and 7) which runs around the crank-shaft through openings a' in the box and into an oil-chamber below. I have found that a box thus inclined when provided with an oiling device similar in character to that herein described tends to wipe off and carry out through the parting of the boxes a large amount of the oil. To prevent this escape of oil, I have provided the following means: Along the lower surface of the box I have provided the shoulder a^2, which inclines toward the center or opening a'. The upper part of the box is preferably provided with a shoulder a^3 to conform to the shoulder a^2. It will readily be seen that as the oil is wiped off by the edge of the parts of the box and runs down between the parts of the box it will be caught by the shoulder a^2 and carried to the opening a' and thence to the reservoir, from which the oil is supplied.

What I claim as new is—

1. In a gas-engine, the combination with the combustion-chamber; and the piston; of means for admitting a full charge of explosive mixture to said combustion-chamber normally with each complete traverse of the piston; mechanism for cutting off at the entrance to the combustion-chamber the admission of the air and gas, when the power exceeds the load; and a governor for operating the cut-off mechanism to cut off the admission of mixture a sufficient number of strokes to adjust the engine to the load.

2. In a gas-engine, the combination with the combustion-chamber; and the piston; of means controlled by the piston for admitting a full charge of explosive mixture to said combustion-chamber normally with each complete traverse of said piston; mechanism for cutting off the admission of mixture when the power of the engine exceeds the load; and a

governor for actuating said cut-off mechanism to cut off the admission of mixture a sufficient number of strokes to adjust the engine to the load.

3. In a gas-engine, the combination with the combustion-chamber; and a piston; of a port leading to said chamber opened by said piston with each complete traverse thereof; means for closing said port; and a governor for actuating said means only when the power of the engine exceeds the load and then to close said port a sufficient number of strokes to adjust the engine to the load.

4. In a gas-engine, the combination with the combustion-chamber having the port, b^2, leading thereto; and the piston arranged to uncover the port, b^2, at the extreme end of its traverse; of the valve, H, arranged to cover said port; a rock-arm, H^2, engaging said valve; rock-shaft, H^3, carrying said rock-arm; a spring tensioned to effect a movemnt of said rock-arm to hold said valve normally off of the port, b^2; and means for actuating said valve when the power of the engine exceeds the load and then to close said port.

5. In a gas-engine, the combination with the cylinder one end of which forms the combustion-chamber, and the other the compression-chamber; and a piston separating said chambers; of means for admitting a full charge of explosive mixture from the compression-chamber to the combustion - chamber normally with each complete traverse of the piston; mechanism for cutting off the passage of mixture from the compression-chamber to the combustion-chamber when the power of the engine exceeds the load; and a governor for operating the cut-off mechanism to cut off the admission of mixture a sufficient number of the strokes to adjust the engine to the load.

6. In a gas-engine the combination with the cylinder comprising a combustion-chamber and a compression-chamber; of a passage connecting the chambers and opening into the combustion-chamber at a point uncovered by the piston with each complete traverse thereof; means for closing said passage; and a governor for operating said means only when the power of the engine exceeds the load and then to close said passage.

7. In a gas-engine the combination with the cylinder B, having the combustion-chamber, B^2, compression-chamber, B^3, passages between said chambers leading to the combustion-chamber through the port, b^2; and the piston; of the valve, H, arranged in the passage and over the port, b^2, said valve being arranged to remain normally off said port; and a governor connected to actuate said valve when the load of the engine requires the missing of a charge and then to close said port.

8. In a gas-engine, the combination with the combustion-chamber; and the piston; of a valve mechanism normally opened with each complete traverse of the piston; and a governor arranged to actuate said valve mechanism only when the load requires a charge to be missed and then close said valve mechanism.

9. In a gas-engine, the combination with the combustion-chamber; and a piston; of means for admitting an explosive mixture to said chamber opened by said piston normally with each complete traverse thereof; a governor-valve arranged to leave said means for the admission of mixture normally open for the introduction of a full charge of mixture; and a governor arranged to close said valve a sufficient number of strokes to adjust the engine to the load.

10. In a gas-engine, the combination with the cylinder comprising a combustion-chamber and the compression-chamber; and the piston separating said chambers; of a passage connecting said chambers opened by the operation of the piston normally with each complete traverse thereof; a governor-valve in said passage, said valve being arranged to be normally open for the introduction of a full charge of mixture; and a governor connected with said valve and arranged to actuate said valve to close it a sufficient number of the strokes of the engine to adjust the engine to the load.

11. In a governor, for a gas-engine, the combination of a governor mechanism comprising the reciprocating part, f'; thrust-bar, K', having the L, k^2, said bar being pivoted on said part, f'; weight, K^2, hinged on said reciprocating part; a stop on said reciprocating part for preventing the movement of the weight in one direction; a spring tensioned against said reciprocating part for retarding the movement of the weight in the opposite direction; an arm on said weight engaging the L, k^2; and a spring tensioned between said reciprocating part and said L, k^2, for permitting a yielding movement of the thrust-bar, and a valve mechanism controlling the admission of mixture to said engine actuated by said governor mechanism.

12. In a gas-engine, the combination of a governor-valve actuated by an oscillatory movement of a rock-shaft; said rock-shaft connected with said valve; a spring tensioned to oscillate said shaft and to maintain said valve normally in an open position; arm, H^4, extending from said rock-shaft and having thereon a shoulder, h'; reciprocating part, f'; thrust-bar, K', having the L, k^2, said bar being pivoted on said part; the weight, K^2, hinged on said reciprocating part; a stop on said reciprocating part for preventing the movement of the weight in one direction; a spring tensioned against said reciprocating part for retarding the movement of the weight in the opposite direction; an arm on said weight engaging the L, k^2; and a spring tensioned between said reciprocating part and said L, k^2, for permitting a yielding movement of the thrust-bar.

13. In a gas-engine, the combination with the governor-valve, H, arranged to slide over

the admission-port of said engine; rock-arm, H^2, engaging said valve; rock-shaft, H^3, carrying said arm; spring, h, arranged to hold said valve normally open; rock-arm, H^4, on said rock-shaft and having thereon a shoulder, h'; the reciprocating part, f', having the arm, f^3, projecting therefrom; thrust-bar, K', pivoted thereon, and having the **L**, k^2; weight, K^2, pivoted on said reciprocating part, and having thereon the arm, k^{11}, with the flange, k^{13}, and the flange, k^9; stop, f^4, extending from the arm, f^3, and having thereon the adjustable nut, f^5; spring, k^7, tensioned against the flange, k^9, and the nut, f^5; set-screw, k^{14}, arranged in the flange, k^{13}, and in contact with the **L**, k^2; and a spring, k^{11}, tensioned against the arm, f^3, and the **L**, k^2.

In testimony whereof I affix my signature in presence of two witnesses.

EDWIN J. FITHIAN.

Witnesses:
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J. C. WEAKLEY.