No. 854,981.

PATENTED MAY 28, 1907.

W. F. BREHM.

GAS ENGINE.

APPLICATION FILED AUG. 17, 1905.

4 SHEETS—SHEET 1.

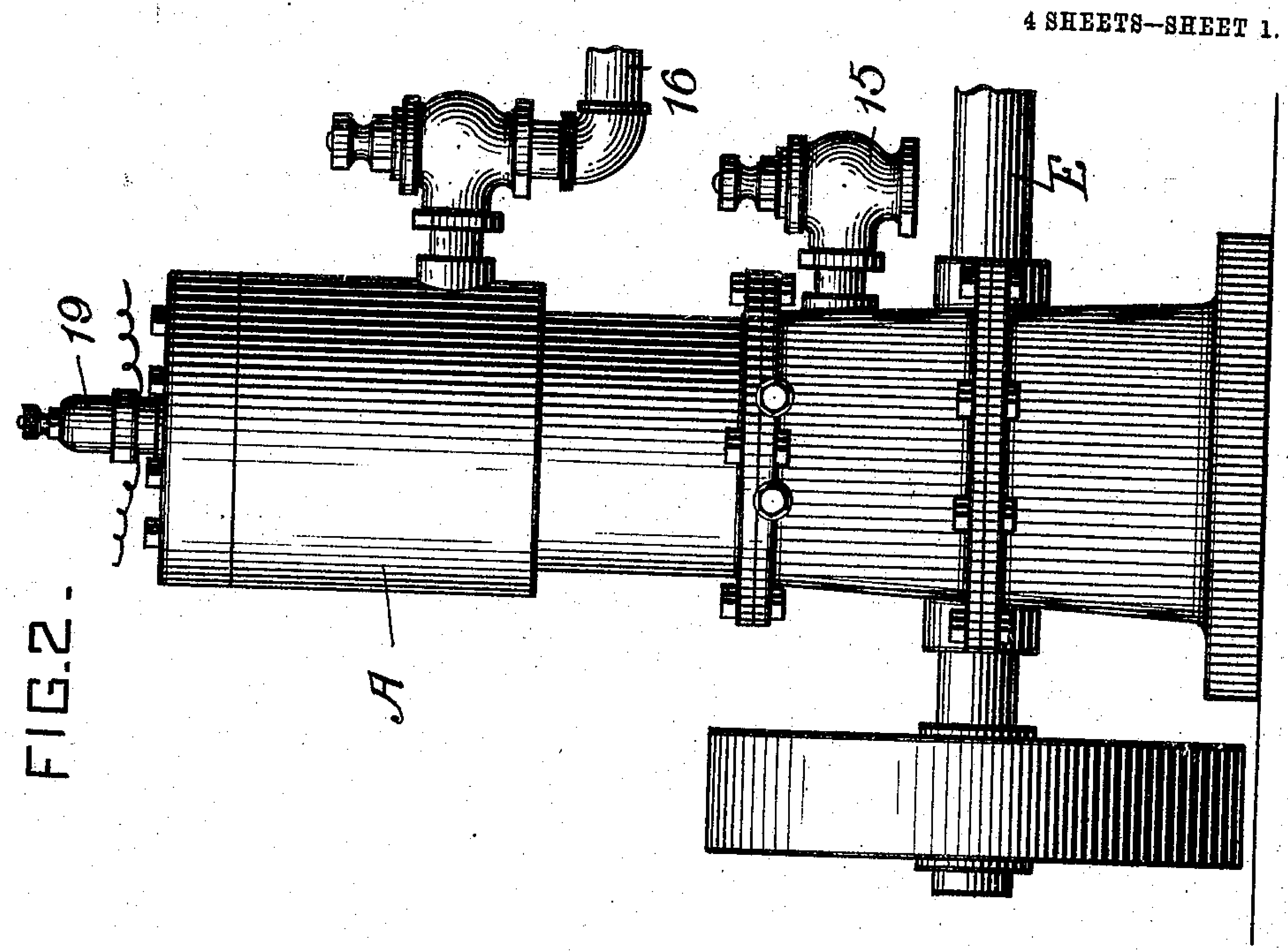

FIG.2.

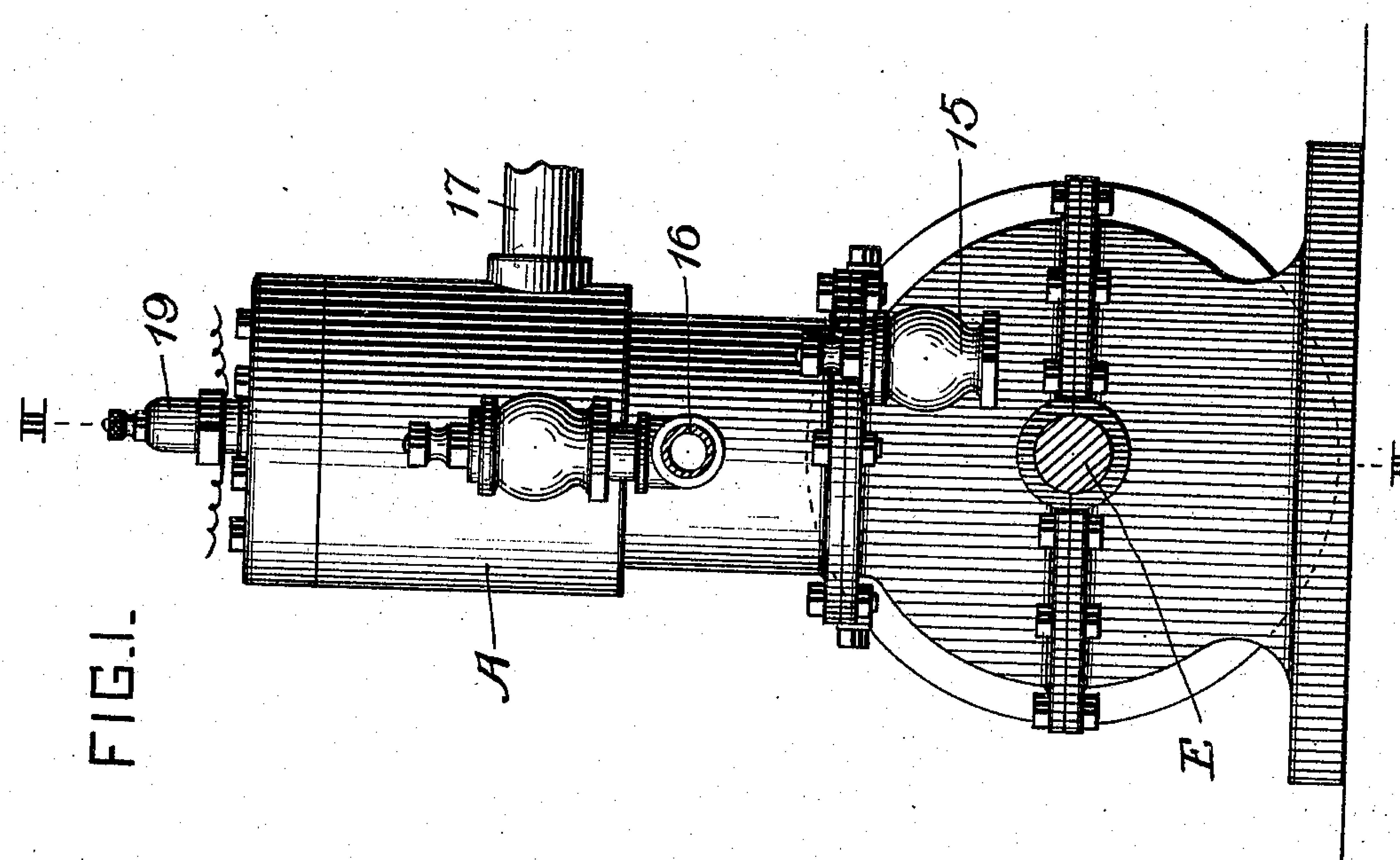

FIG.I.

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William F. Brehm INVENTOR
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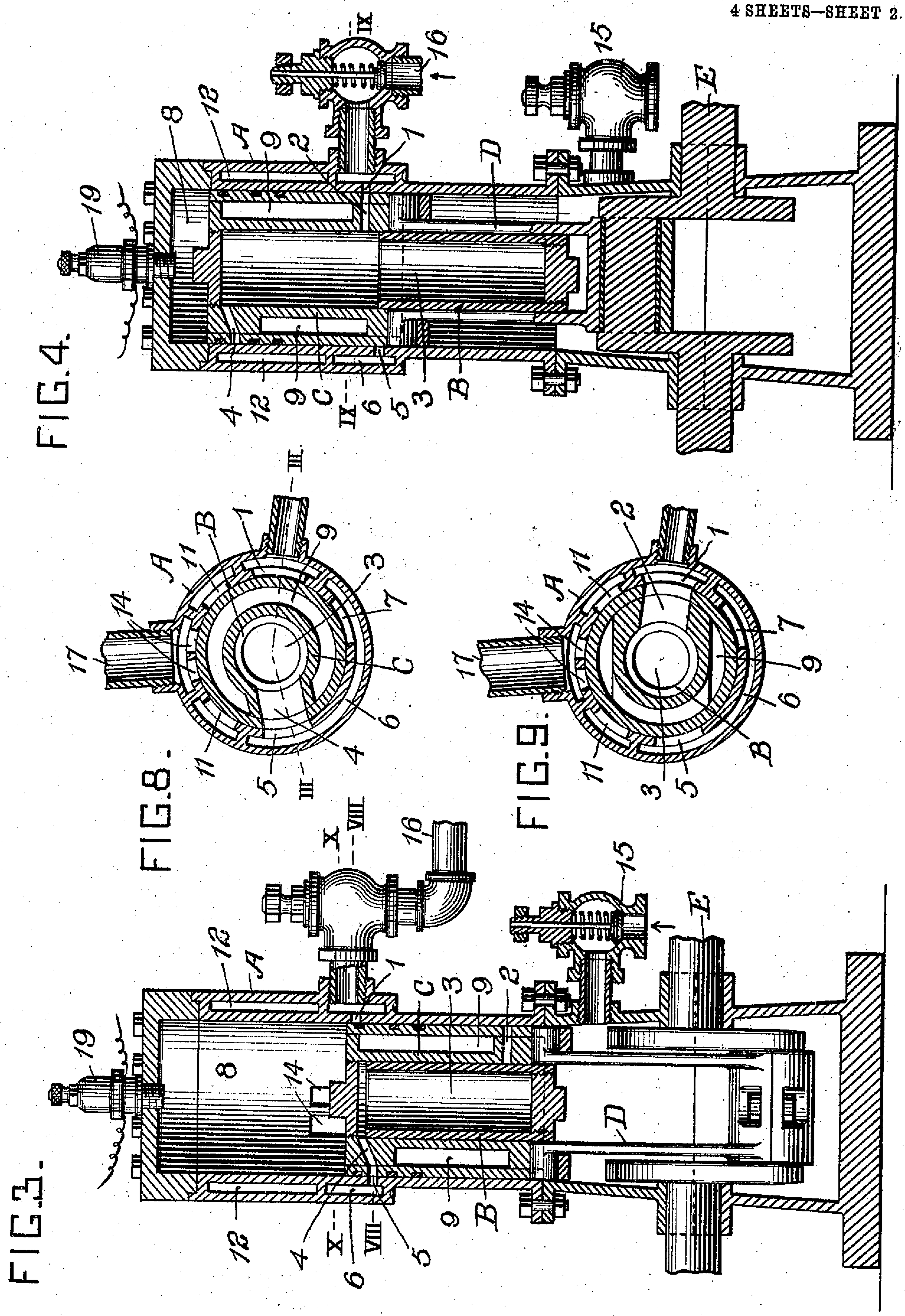

FIG. 4. FIG. 8. FIG. 9. FIG. 3.

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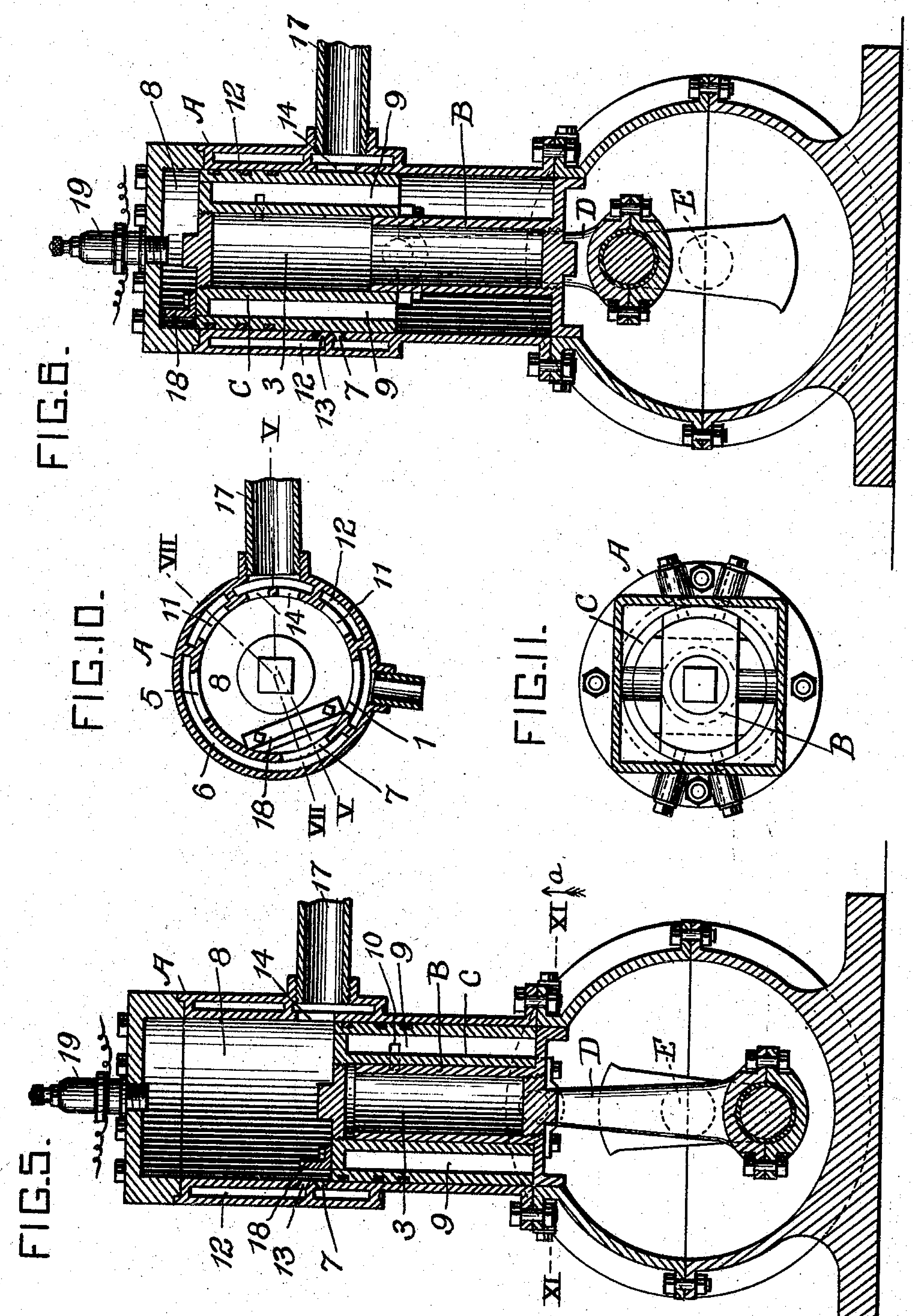

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4 SHEETS—SHEET 4.

FIG. 7.

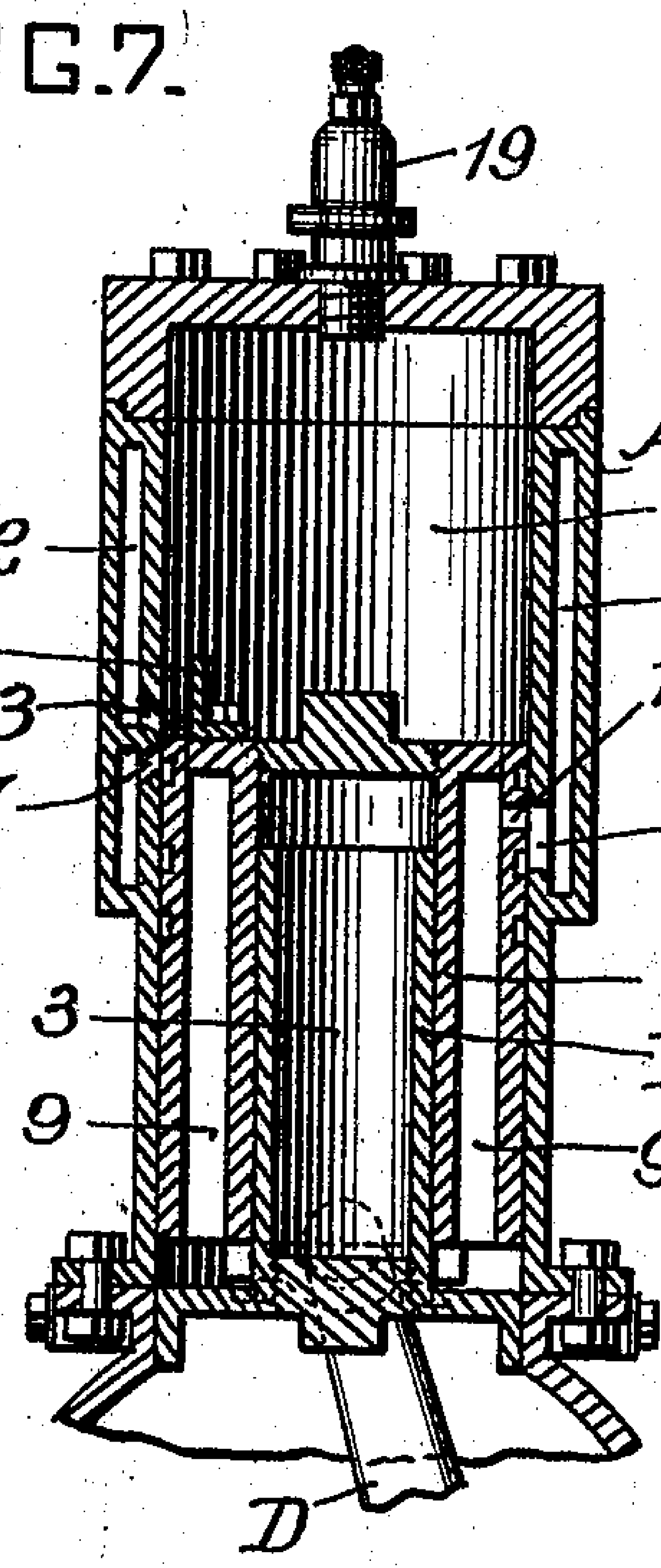


FIG. 12.

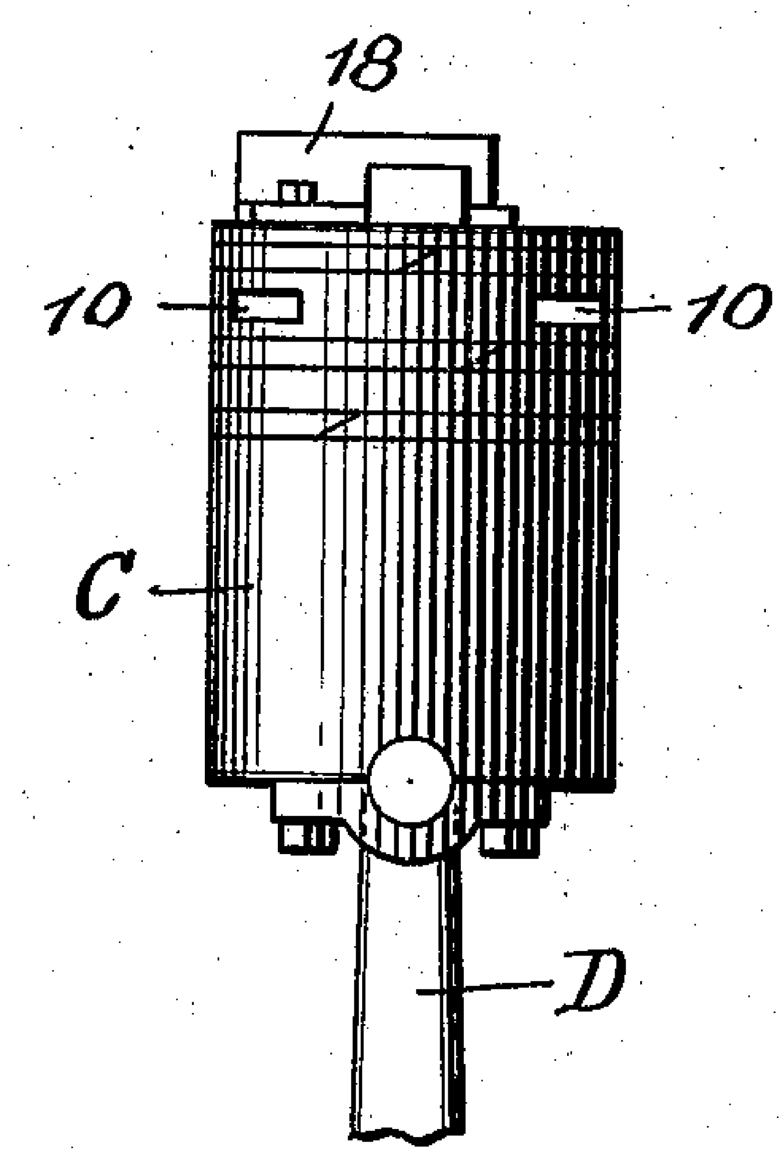
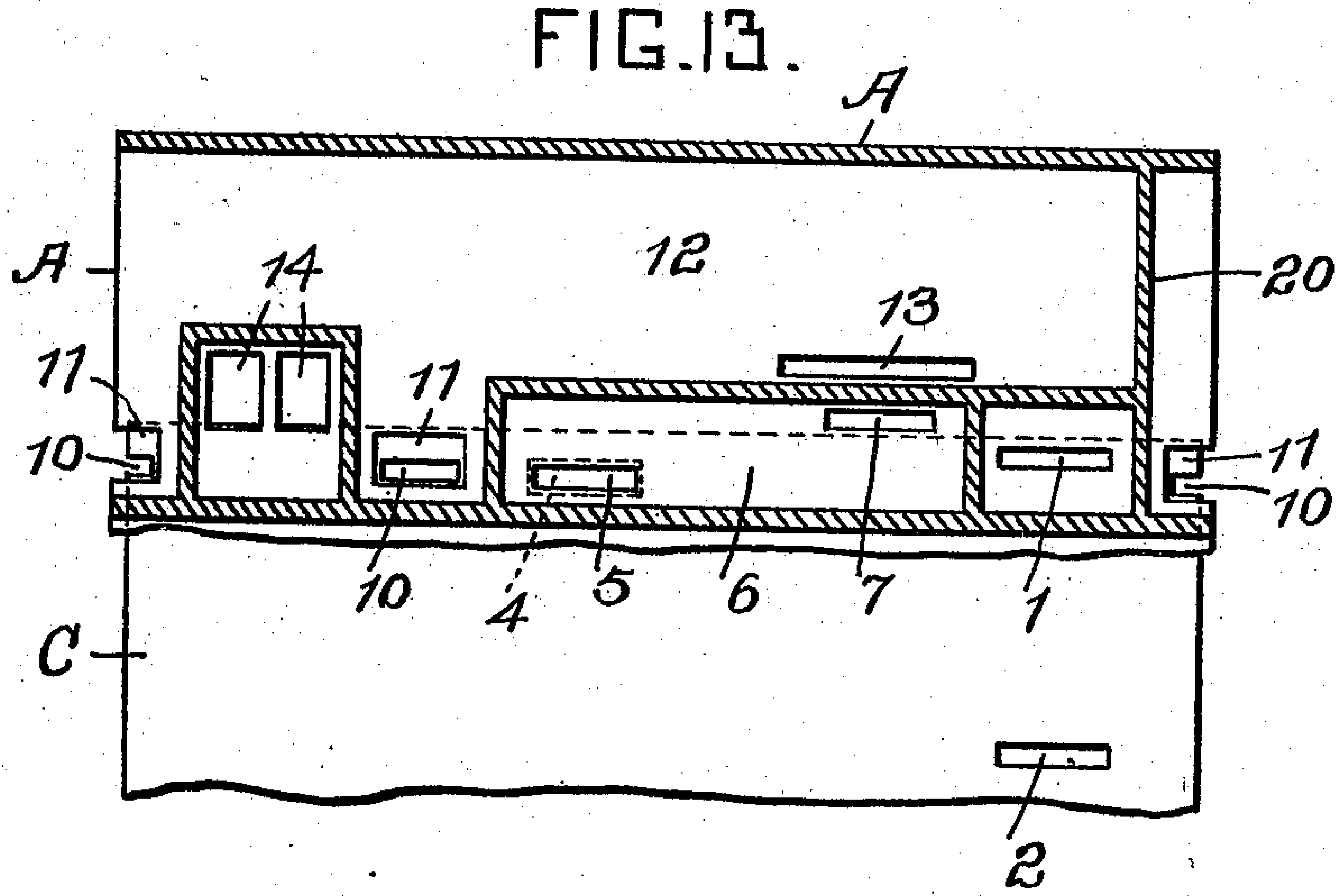


FIG. 13.



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UNITED STATES PATENT OFFICE.

WILLIAM FREDRICK BREHM, OF ROCHESTER, PENNSYLVANIA.

GAS-ENGINE.

No. 854,981. Specification of Letters Patent. Patented May 28, 1907.

Application filed August 17, 1905. Serial No. 274,603.

To all whom it may concern:

Be it known that I, William Fredrick Brehm, residing at Rochester, in the county of Beaver and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Gas-Engines, of which improvements the following is a specification.

In the accompanying drawings which form a part of this specification Figures 1 and 2 show my improved machine in elevation and from points at right angles to one another; Figs. 3 and 4 are longitudinal sections thereof but on a plane which is broken and which is indicated by the lines III—III in Figs. 1 and 8, the relative positions of the moving parts in these several figures are different as will be hereinafter explained; Figs. 5 and 6 are also views in longitudinal section of my engine and in this case also the plane of section is a broken one on lines indicated by the line V—V of Fig. 10, the relative positions of moving parts are again different in these two figures; Fig. 7 is a view in vertical section of part only of the engine, the plane of section being again an irregular one and being slightly different from the section upon which Figs. 5 and 6 are made, the purpose being to show the arrangement of ports not elsewhere adequately illustrated, the plane is indicated by the line VII—VII in Fig. 10; Figs. 8, 9 and 10 are transverse sections of the engine and the planes of these sections are also irregular and necessarily so in order to illustrate the arrangement of the ports; the locations of the section planes are however indicated by the lines VIII—VIII, IX—IX and X—VIII of Figs. 3 and 4; Fig. 11 is a horizontal sectional view on the line XI—XI of Fig. 5, as seen in the direction of the arrow *a;* Fig. 12 shows the piston of the engine detached, and Fig. 13 is a diagrammatic view illustrating the arrangement of the ports, and it may be said to be a section in cylindrical path through the wall of the outer casing, and spread upon a single plane for purposes of illustration.

Parts which are repeated in the several figures bear the same reference numerals in each case.

The engine consists essentially of an outer casing, A, which is cylindrical in form, an inner casing, B, which also is cylindrical in form and is concentrically arranged within casing A and extends from one end of cylindrical casing A part way throughout the length thereof, and of a piston, C, arranged to reciprocate within casing A and provided with a cylindrical extension which engages interiorly the outer surface of inner casing B throughout the range of the piston's reciprocating movement. Coöperating with these several parts is an arrangement of the ports and passages herein to be described, means for exploding the gas to impart movement to said piston, and suitable connections between said reciprocating piston and the shaft of the engine which is driven by its reciprocation.

Referring to the drawings piston C, as will be seen, divides the space within the casing A into three separate chambers, namely, an upper chamber, 8, on one side of the piston termed the compression and explosion chamber; a lower centrally arranged chamber, 3, and a lower surrounding chamber, 9, these two chambers last named being termed displacement chambers for reasons which will hereinafter appear, one of them arranged to receive gas and the other arranged to receive air. These two displacement chambers are, it will be observed, on the opposite side of the piston from the compression and explosion chamber; that is, the expansive power of the contained gases tends to drive the piston in a direction opposite to that in which the piston is driven by the expansion gases in the compression and explosion chamber. By the reciprocating of this piston C it will be understood that the volumes of these several chambers are caused to vary. Piston C, as will be seen in the drawings, is connected with a power shaft, E, (the driving of which is the purpose of this engine) by means of a crank connection, D. Gas from a suitable source of supply passes through an inlet pipe, 16, (which may preferably be controlled by an outwardly-closing check-valve, as is indicated in Fig. 4) and thence passes through an orifice 1 in the cylinder A and through a port 2 in piston C into the inner central displacement chamber 3, when the orifice and port, 1 and 2, are by the movement of the piston brought into an alinement one with the other. The gas admitted may contain no air; or it may, and, when gas comes from a carbureter, does contain a relatively small admixture of air; but in such case the ratio of air to the quantity of gas is so small that the mixture is not of itself explosive. While my invention may still be employed though the gas be diluted with air to such an extent as to form in the displacement chamber an explosive mixture, I preferably employ gas undiluted or diluted to a slight extent. Air enters chamber 9 from the open atmosphere through a suitable inlet pipe, 15, the opening whereof is controlled by an outwardly closing check-valve as is indicated in Fig. 3, and thence without other obstruction passes freely into the surrounding displacement chamber 9.

From chamber 3 gas is caused to pass into chamber 8 through a port, 4, in piston C (see Fig. 3) and an orifice, 5, into a passage, 6, within casing A itself, and thence through a port, 7, (see Fig. 5) directly into compression and explosion chamber 8. It will be understood and will hereinafter be explained that this passage of gas from chamber 3 to chamber 8 occurs when the ports and passages are brought into alinement one with another and this takes place in consequence of the traverse of piston C. In similar manner air is caused to pass from the surrounding displacement chamber 9 to the compression and explosion chamber 8 through orifice 10 which is formed in the walls of the piston, a port 11 and a passage 12 formed in the body of the outer casing A itself, and port 13 directly into chamber 8 (see Fig. 7.)

The inlet ports for the air and gas to chamber 8, though separate, deliver the air and gas at adjacent points in the chamber wall. From chamber 8 a suitably arranged exhaust 17 leads to the point of discharge, which may conveniently be the open air, and passage to this exhaust is had through ports 14 suitably arranged in the walls of the chamber 8. The ports for air and gas, 7 and 13, which lead into chamber 8 are preferably arranged at a point approximately diametrically opposite to the ports 14 which lead to the exhaust. This is best illustrated in Figs. 5 and 8. For purposes which will presently appear a baffle-plate 18 is mounted upon piston C and when the said several ports are opened by the stroke of the piston, this baffle-plate obstructs the direct flow from entrance to exit, and deflects such flow toward the center of the chamber. Suitable means are employed for exploding the gas contained within chamber 8, as for example the spark-plug 19, which by an arrangement well known in the art ignites the contained gas at the desired point in the operation of the machine.

It will be observed that my engine differs from the engines which are now in usual service, first, in that the supply of air and the supply of gas are kept separate up to the time when they are introduced into the explosion chamber. In consequence of this separation it will be understood that explosion of the gas within the passage which leads to the explosion chamber is rendered impossible and flashing-back is thereby guarded against. In the second place it will be observed that, whereas the gas-passage 6 in the wall of the outer casing through which the gas flows from chamber 3 to chamber 8 is formed in that portion of the outer casing A which extends below the lower limits of chamber 8, passage 12 through which the air flows from chamber 9 into chamber 8 is formed in that portion of casing A which forms the cylindrical wall of chamber 8. This passage 12 extends substantially all the way around casing A, and in fact constitutes an air-jacket for chamber 8. This air-jacket is in the course of the operation of the engine (presently to be described) supplied at recurring intervals with a current of air at approximately atmospheric temperature passing through it; and thus it serves to reduce the temperature of the casing, which is heated by the successive explosions within. To further this end, ports 11 and 13, through which the current of air passes into and out of this passage 12, are preferably placed upon either side of a dividing web which is diagrammatically shown at 20 in Fig. 13 of the drawings. The passing air is thus caused to travel substantially all of the way around the casing and thereby to afford the maximum cooling effect.

It remains to be pointed out that the ports 7, 13, and 14 which lead to and from chamber 8 are so arranged that, in the descent of the piston, ports 14 are first opened, and the openings of port 13 and port 7 follow successively. The purpose here is that by uncovering the exhaust port first any excess pressure of the exploding gases within chamber 8 will be relieved; next, an in-rush of air will follow through port 13. This in-rush of air will (as I understand it) be effective to extinguish the gas which may still be burning, and will thereby guard further against any premature explosion of the gas about to be introduced, and it will further serve to drive the products of the former explosion from chamber 8. The baffle-plate 18 will in this connection serve to deflect the flow of air from port 13 and cause it to circulate through chamber 8 to more effectually remove the gases remaining from the prior explosion. Following immediately upon the entrance of the air is the entrance of the gas through port 7; the air however having been first admitted, loss of gas through the exhaust port is forestalled or prevented.

The operation is as follows: Beginning first with the position of the parts indicated in Fig. 3, piston C is at the lower extremity of its stroke. In this position chamber 8 is opened through ports 14 to the exhaust; and ports 5, 10, 7, and 13 are open, and gas and air are flowing through them from chambers 3 and 9 into chamber 8. The return stroke of the piston carries it from the position shown in Fig. 3 to that shown in Fig. 4. In this return stroke the gas inlet, the air inlet and the exhaust are successively closed in the early part of the upward stroke, and throughout the remainder of the upward stroke the gases contained in the compression and explosion chamber 8 are compressed. When the piston reaches the limit of its upward movement, that is the position illustrated in Fig. 4, the chamber 8 is reduced to relatively small volume. During this stroke also chamber 3 has increased in volume to approximately double its former capacity. During this upward stroke this chamber 3 has been closed and consequently the gas which it contains has been correspondingly reduced in density or rarefied. At the same time chamber 9, being in open communication with the outer air through port 15, continues to take in air in consequence of the displacement caused by piston C; and when the piston reaches the upper limit of its stroke, this chamber 9 contains air at approximately atmospheric pressure. When however the piston reaches this position, port 2 comes into alinement with orifice 1 and gas flows into chamber 3 until the normal density of the gas is restored and gas pressure within the chamber is approximately that of the supply. (It will be understood that the pressure of the gas supply may be such as is found most desirable.) When the piston reaches this upward limit of its stroke the explosion occurs; and the mingled gas and air which the chamber 8 contains is ignited or exploded, and the force of that explosion drives the piston from the position in which it then is, through an entire traverse which is a downward and a return stroke. The piston passing downward first cuts off communication between port 2 and orifice 1 and at the same time closes the check-valve in the air supply pipe. Thereafter throughout the downward traverse of the piston, the gas contained in chamber 3 and the air contained in chamber 9 are compressed with a correspondingly increased density. When the piston approaches the lower limit of its traverse as is indicated in Figs. 3, 5 and 7 the exhaust ports 14 are uncovered causing a flow of the products of combustion from the chamber 8 to the exhaust 17; and gas and air flow through the route indicated by 4, 5, 6, and 7 and the route indicated by 10, 11, 12, and 13 from chambers 3 and 9 respectively into chamber 8. This flow is consequent upon the compression of the gas and air in chambers 3 and 9; it continues until chambers 3, 9, and 8 are filled with gas and air and with the mixture of the two at substantially normal pressure—that is, a displacement takes place from chambers 3 and 9 into chamber 8 consequent upon a compression due to the traverse of the piston. Chamber 8 being then filled again with the mixture of air and gas, the piston again rises to compress the mingled gas and air in chamber 8, and therein the operation is renewed.

The emptying of the products of explosion from chamber 8 when the piston reaches the lower limit of its traverse has been noted above. It remains only to observe that when the piston is in the position shown in Fig. 3, that is at the downward limit of its movement, chamber 3 contains a quantity of gas sufficient under the pressure of the gas supply to fill this chamber when at its maximum capacity. That is at its capacity when the piston is in the position shown in Fig. 4. At the same time chamber 9 contains air which has been compressed by the descent of the piston. It is the expansion of the gas and air confined in these chambers 3 and 9 which causes chamber 8 to be filled with the new and unburned mixture of air and gas. It will be understood that by proper proportion of parts the amount of this displacement in consequence of compression may be varied, and the amount of gas and air delivered into chamber 8 may be thus controlled; thus the amount found most desirable for thoroughly emptying chamber 8 and at the same time refilling it with unburned gas and air may be employed.

I claim herein as my invention:

1. In a gas engine the combination of a reciprocating piston, a chamber for compression and explosion arranged upon one side of said piston, displacement chambers for gas and air respectively arranged upon the opposite side of said piston, and communications controlled by such movement of said piston, for admitting air and gas to said displacement chambers, for permitting the air and gas to pass from said displacement chambers to said chamber for compression and explosion and for discharging the products of explosion from the last named chamber, substantially as described.

2. In a gas engine, the combination of an outer cylinder, a piston reciprocating therein and dividing the space within said outer cylinder into a chamber for compression and explosion and a space for receiving air and gas, an inner cylinder arranged within said outer cylinder and at one side of said piston and cooperating with said piston to divide the space for receiving air and gas into separate displacement chambers, a gas inlet, an air inlet, an exhaust, means for causing explosion of gas in said chamber for compression and explosion and several means operative on the traverse of the piston for admitting air and gas to the displacement chambers, for causing air and gas to pass from said displacement chambers to said chamber for compres-

sion and explosion and from the last named chamber to the exhaust, substantially as described.

3. In a gas engine including in its structure a chamber for compression and explosion closed by a movable piston ports opening into said chamber through which gas and air respectively are admitted and the products of explosion exhausted, said ports controlled by said piston and so arranged that the traverse of said piston will cause the successive opening of the exhaust, the air inlet, and the gas inlet, and their closure in inverse order, substantially as described.

4. In a gas engine including in its structure a chamber for compression and explosion closed by a movable piston, an arrangement of ports in said chamber such that air and gas enter said chamber unmingled at one side thereof and the products of explosion pass from said chamber at the opposite side thereof, and a baffle plate arranged to obstruct direct passage of gas and air from inlet to exhaust when both inlet and exhaust ports are open, substantially as described.

5. In a gas engine the combination of a cylinder of uniform diameter from end to end, a piston reciprocating in said cylinder and dividing the space within said cylinder into a chamber for compression and explosion, and a space for receiving air and gas, an inner cylinder arranged within said outer cylinder and at one side of said piston and co-operating with said piston to divide the space for receiving air and gas into separate displacement chambers, and communications controlled by said piston in its movement for admitting air and gas to said displacement chambers for permitting air and gas to pass from said displacement chambers to said chamber for compression and explosion, and for discharging the products of explosion from the last named chamber, substantially as described.

6. In a gas engine the combination of a cylinder and a piston reciprocating therein, separate chambers for gas and air on one side of said piston wherein gas and air are compressed by traverse of said piston in one direction and wherein gas and air are admitted on traverse of the piston in opposite direction, and an explosion chamber on the opposite side of said piston to which gas and air are admitted from said gas and air chambers and in which gas and air so admitted are exploded to drive said piston, substantially as described.

7. In a gas engine the combination of an outer cylinder, an inner cylinder concentrically arranged therein and extending from one end of the outer cylinder part way of the length thereof, a piston arranged within the outer cylinder and by a cylindrical extension bearing also upon the outer surface of the inner cylinder, and dividing the space within said outer casing into a compression and explosion chamber at one side thereof and central and peripheral chambers for gas and air at the other side thereof, and reciprocating to vary the volumes of said several chambers, an air supply leading to said air chamber and controlled by an inwardly closing check-valve, a gas supply leading to said gas chamber and a port for admitting gas from said supply to said chamber opened when the volume of said chamber is at its maximum, ports for admitting air and gas from said air and gas chambers to said compression and explosion chamber when the volumes of said gas and air chambers are at their minimum, a port opening from said compression and explosion chamber to an exhaust when the volume of said explosion and compression chamber is at its maximum, and means for exploding the gas within said explosion and compression chamber when the volume of said chamber is at its minimum, substantially as described.

In testimony whereof, I have hereunto set my hand.

WILLIAM FREDRICK BREHM.

Witnesses:
BAYARD H. CHRISTY,
HERBERT BRADLEY.