No. 786,063. PATENTED MAR. 28, 1905.

H. F. SMITH.

SUCTION GAS PRODUCER.

APPLICATION FILED JUNE 16, 1904.

2 SHEETS—SHEET 1.

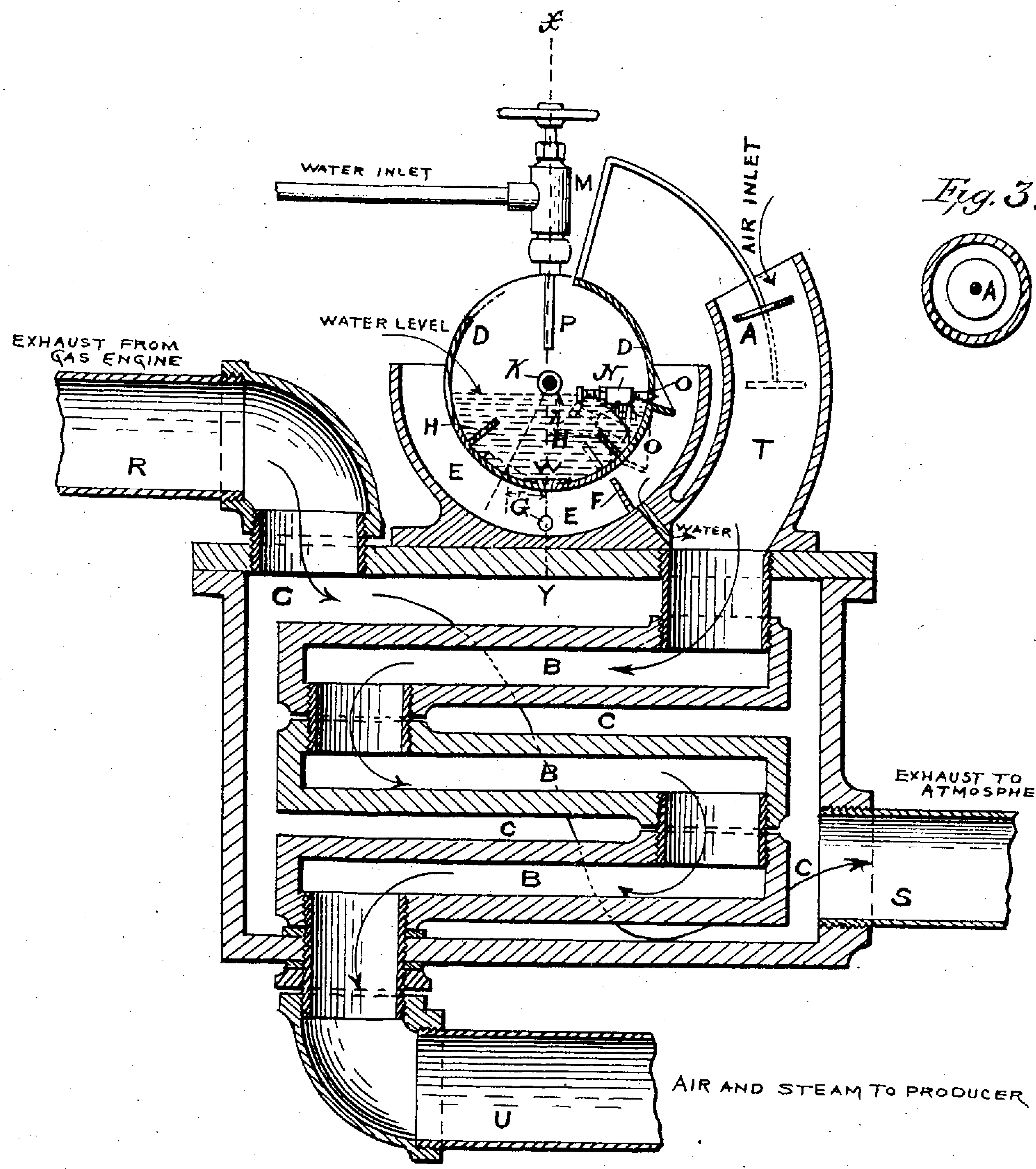

Fig. 1.

Fig. 3.

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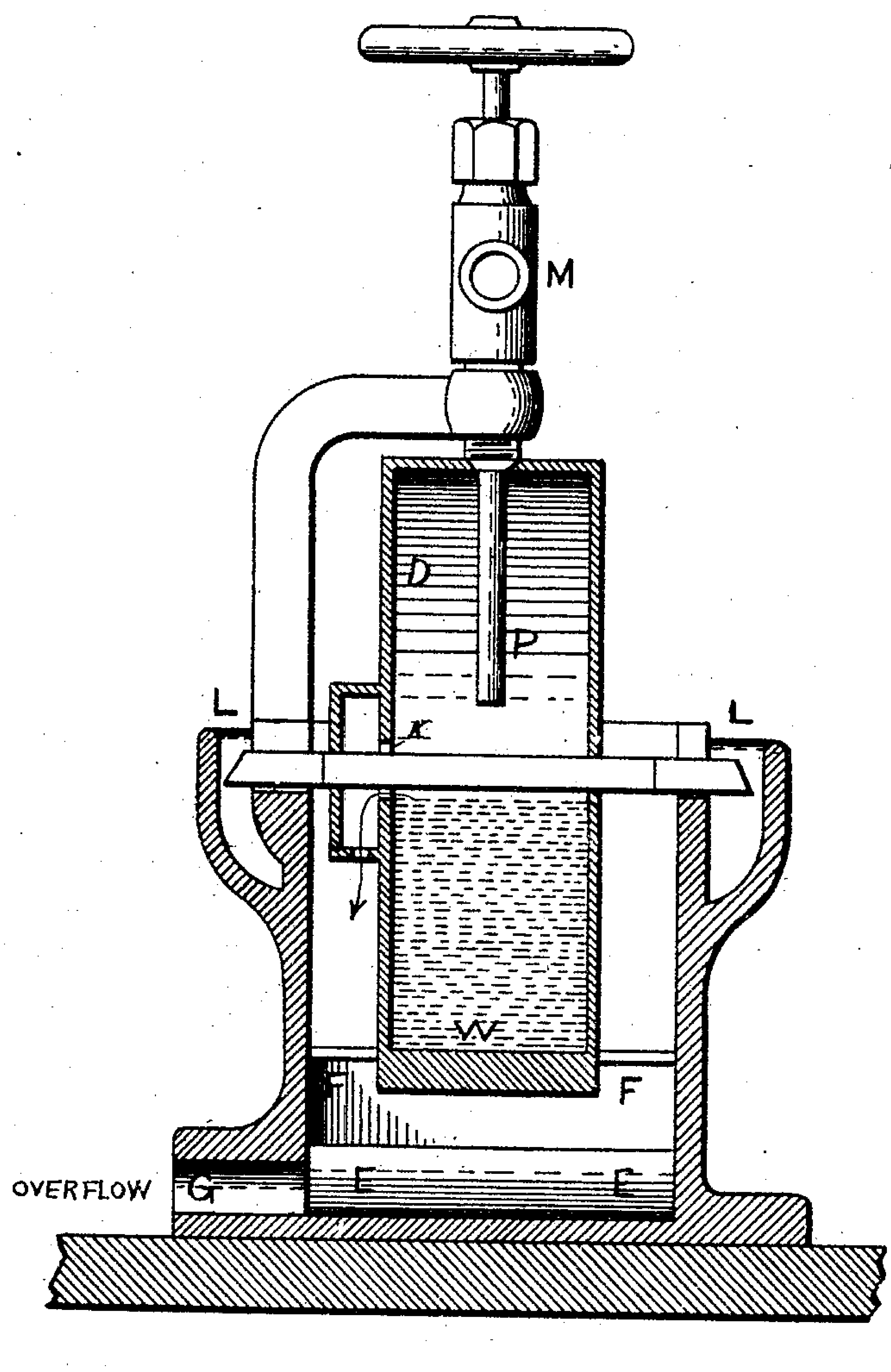
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

HARRY F. SMITH, OF LEXINGTON, OHIO.

SUCTION GAS-PRODUCER.

SPECIFICATION forming part of Letters Patent No. 786,063, dated March 28, 1905.

Application filed June 16, 1904. Serial No. 212,889.

To all whom it may concern:

Be it known that I, HARRY F. SMITH, a citizen of the United States, residing at Lexington, in the county of Richland and State of Ohio, have invented new and useful Improvements in Suction Gas-Producers, of which the following is a specification.

This invention has relation generally to suction gas-producers, and has reference particularly to means for providing the air supplied to the producer with a constant percentage of steam or moisture regardless of the actual quantity of air supplied or the rapidity with which this quantity may change to suit varying loads on the engine.

In other words, it is the object of this invention to provide an apparatus whereby the amount of steam or moisture in the air supplied to the producer may be regulated to agree to all intents and purposes with the amount required, whether the exact requirement at particular times varies or not.

Before proceeding to describe the construction and mode of operation of this invention it may be well, in order to give a clear understanding of the same, to explain that in suction or aspirating gas-producers which are used for power-gas generation no storage of gas is attempted, the gas as made passing directly from the producer to the engine.

Since mixtures of producer-gas and air mixtures are explosive only over a very narrow range of possibilities, it is readily seen that even a very slight variation in the quality of gas furnished to the engine will cause a serious loss in the power of explosion and will frequently require a readjustment of air to gas. It therefore becomes apparent that great uniformity in the quality of gas to its requirements is necessary; but uniform gas cannot be made unless there is a uniform percentage of steam incorporated with the air-blast to the furnace.

To maintain a uniform percentage of steam at varying loads on the engine, it is necessary that the supply of water from which the steam is generated should not only be proportioned to the load on the engine, but should vary quite as rapidly as the load changes—that is to say, the variation in the requirement should as quickly have a variation in effects to answer the requirement.

By long, careful, and intelligent experiment I have produced the apparatus or device shown in the accompanying drawings, forming a part of this specification, which apparatus, based upon the said experiments, does the work for which it is designed in a highly satisfactory manner and preserves the proper proportion of air to steam so nearly constant that no disturbance is observable in the operation of the producer.

In the said drawings, Figure 1 is a substantially vertical central sectional view of the entire apparatus or so much thereof as is necessary to give an understanding of the invention. Fig. 2 is a transverse vertical central sectional view of the apparatus designed to regulate the supply of air and water to the heating means to furnish the required air and steam to the producer. Fig. 3 is a sectional detail view hereinafter referred to.

In the drawings, D is a cylindrical vessel supported by the shaft L on suitable bearings, preferably "knife-edge," so as to rotate freely about its center through an arc of twenty degrees or thirty degrees. This vessel is provided with a slot in its circumference to admit the stationary water-pipe P, an annular overflow-outlet, arranged as an annular opening K, surrounding the central supporting-shaft in such a manner that its lower edge shall be tangent to the same horizontal plane in whatever position the cylinder may be rotated about its supporting-shaft.

O is an orifice whose size can be controlled by a valve N.

W is a weight so placed on the circumference of the cylinder as to be directly under the supporting-shaft when the orifice O lies in the plane of water-level—*i. e.*, the horizontal plane tangent to the lower edge of the overflow-orifice K. Vanes H H are arranged to act as dash-pots to steady the movement of the whole. A vane A is carried upon the extremity of a curved arm, so as to move freely and occupy a central position in the curved air-pipe T. This cylinder D is supported by and carried within a semicylindrical housing

E, which is divided nto two parts, one of which receives the drip from the overflow K and discharges it through the opening G into a waste-pipe (not shown) and another, above and to the right, which receives the water discharged from the orifice O and conducts it through the opening into the air-pipe T.

C is a chamber through which passes the hot gases, as the exhaust from the gas-engine, and which contains the hollow disks B, or it may be other extended heating-surfaces, which contains and conveys the air and water admitted into the air-pipe T.

The operation of the apparatus is as follows: The valve M is opened and water is admitted to the interior of the cylinder D until it is filled to the height of the overflow K, at which point the water-level is maintained, the surplus passing out of the overflow to waste. When air is passed or is caused to pass through the apparatus, the vane A is acted upon by the air-current passing through the pipe T. Numerous experiments have demonstrated the action of air-currents on a vane so exposed to be of the following nature: Let P equal pressure exerted on the vane, V equal velocity of air-current, C equal a numerical constant. Then P equals CV^2. Consequently, since for small pressures and velocities quantity equals area xV, quantity of air equals $C'\sqrt{P}$; but, similarly considering the flow of water through an orifice, quantity of water equals $C''\sqrt{H}$ where H is the head of water above the orifice. Comparing these equations (and perhaps we should before have noted that C' C'' C''' are different numerical constants,) we observe that if we made P equal C''' H, then Q air equals C'''' Q water, ("Q air" and "Q water," meaning quantity of air and quantity of water)—that is, if the head of water over an orifice is kept proportional to the pressure on the vane A then the flow of water through the orifice will always be proportional to the flow of air through the pipe T; but the pressure on the vane A is determined by the resistance it offers to displacement—*i. e.*, by the resistance offered by the cylinder D to axial rotation—since if no resistance were offered to such movement the vane would move with equal velocity with the air-current and no pressure would be exerted upon it. In this construction, however, the weight W tends continuously to return the vane A to its original position, and hence determines the pressure on the vane A; but for any given displacement, like that shown by the dotted lines, the turning moment exerted by W equals Wr where r equals perpendicular distance from center of gravity of W to the vertical line through the center of rotation. This turning moment is balanced by that exerted by the vane A—viz., Pr', where r' is the distance from the center of rotation to the center of pressure on A. Consequently Wr equals Pr', and since W and r' are constants r equals constant xP; but from the construction it is obvious that h—the head of water over the orifice O—is proportional to r. Consequently for this construction P equals constant XH, and for any rate of flow of air such a displacement of the vane and attached cylinder will occur as to cause a proportional flow of water from the orifice O. The actual quantity of water discharged per cubic foot of air can be regulated by the valve N. Since the water discharged at the orifice O is at once conveyed to the hot surfaces B and there entirely converted into steam, the percentage of moisture carried by the air to the producers will be constant and remain constant regardless of the quantity of the air passing.

The exact arrangement need not, of course, be that shown. For instance, the gases discharged from the producer could be used instead of the exhaust. The water from the orifice O could be vaporized in a separate chamber and afterward mixed with the air. However, the arrangement shown is desirable, since by the use of the exhaust considerable heat is returned to the producer that would be otherwise wasted.

It might be well to observe that in case it should be found that an exact proportion is not maintained, or if for any reason other than a direct proportion of water to air should be desired, suitable correction can be made or such other proportion secured by suitably varying the area of the tube T at the several sections successively occupied by the vane A.

In view of the fact that I have already constructed and operated a machine of the type described and claimed in this case, and in view of the further fact that it is understood that I am not limited in the manufacture of my machine to the detailed dimensions stated, and that further disclosures in this regard are not essential in order to enable those skilled in the art to make and use the machine, but that it might be helpful to them in making a machine to avoid tedious experiments, it may be further stated that in the machine in use at present by me the dimensions are as follows: diameter of vessel D, five and one-half inches; diameter of orifice O, nine one-hundredth inches; weight of weights W, fourteen hundred and fifty grains; diameter of pipe T, two and eleven-sixteenths inches; diameter of vane A, two inches.

I claim—

1. A means for supplying steam and heated air to suction gas-producers, consisting of a movable weighted water-holding vessel, provided with an orifice through which the water may be discharged; an air-pipe; a vane in the air-pipe, adapted to be moved by the action of the air thereon when passing into the pipe; connections between the vane and water-supply vessel, whereby by the movement of the former a predetermined and constant supply of water may be discharged from the water-

supply vessel into the air-pipe, and means for heating the air and water to convert the latter into steam, and means for conducting the air and steam to the producer, all substantially as described.

2. A means for supplying steam and heated air to suction gas-producers, consisting of a movable weighted water-holding vessel, provided with an orifice through which the water may be discharged; an air-pipe; a vane in the air-pipe adapted to be moved by the action of the air thereon when passing into the pipe; connections between the vane and water-supply vessel, whereby by the movement of the former a predetermined and constant supply of water may be discharged from the water-supply vessel into the air-pipe; a series of hollow disks to receive the water and air, means for conveying the exhaust from the gas-engine to heat the disks to convert the water into steam, and means for conducting the air and steam into the producer, all substantially as set forth.

3. The combination with a cylindrical weighted water-supply vessel, movable on knife-edge bearings; a valve-controlled orifice in said vessel; an overflow-port consisting of an enlarged hole surrounding the knife-edge journaled over the weight; means for conducting the waste water away; means for constantly supplying the vessel with water; an air-pipe; a vane in the air-pipe adapted to be moved by the action of the air thereon when passing into the pipe; connections between the vane and water-supply vessel, whereby by the movement of the former a predetermined and constant supply of water may be discharged from the water-supply vessel into the air-pipe, all substantially as described.

4. The combination, with a movable water-supply vessel; of an air-pipe; a vane in the air-pipe adapted to be moved by the air passing into the pipe; means connecting the vane with the water-supply vessel to move it to discharge water from the water-supply vessel into the air-pipe, all substantially as described.

5. The combination, with a movable water-supply vessel; of an air-pipe; a vane in the air-pipe adapted to be moved by the air passing into the pipe; means connecting the vane with the water-supply vessel to move it to discharge water from the water-supply vessel into the air-pipe, a series of hollow disks to receive the water and air, means for conveying the exhaust from the gas-engine to heat the disks to convert the water into steam, and means for conducting the air and steam into the producer, all substantially as set forth.

6. The combination, with the producer proper, of a movable water-supply means from which water is supplied to generate steam proportioned to the load on the engine, and in time with the changes of the load; the air-pipe; a vane in the air-pipe, and movable therein coincident with the air acting thereon and the aforesaid demands on the engine; and means connecting the vane with the water-supply, whereby the latter may be moved by the former, all substantially as and for the purposes hereinbefore set forth.

7. The combination, with the producer proper, of an oscillating water-supply means and its knife-edge bearings, from which water is supplied to generate steam proportioned to the load on the engine, and in time with the changes on the load; the air-pipe, curved concentrically with the said knife-edge bearings; a vane in the air-pipe, and movable therein coincident in time and distance with the strength of the air-current acting thereon; and an arm also curved concentric with the said knife-edge bearings, connecting the vane with the water-supply, all substantially as set forth.

8. A means for heating air and water to convert the latter into steam for suction gas-producers, consisting of a chamber, a series of hollow disks in said chamber connecting with the air and water supply at one point and with the producer at another point, a conduit for the exhaust from the gas-engine connected with the air-chamber, and an exhaust-port leading from the said chamber, all substantially as set forth.

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

HARRY F. SMITH.

Witnesses:
A. B. BEVERSTOCK,
H. B. SOWERS.