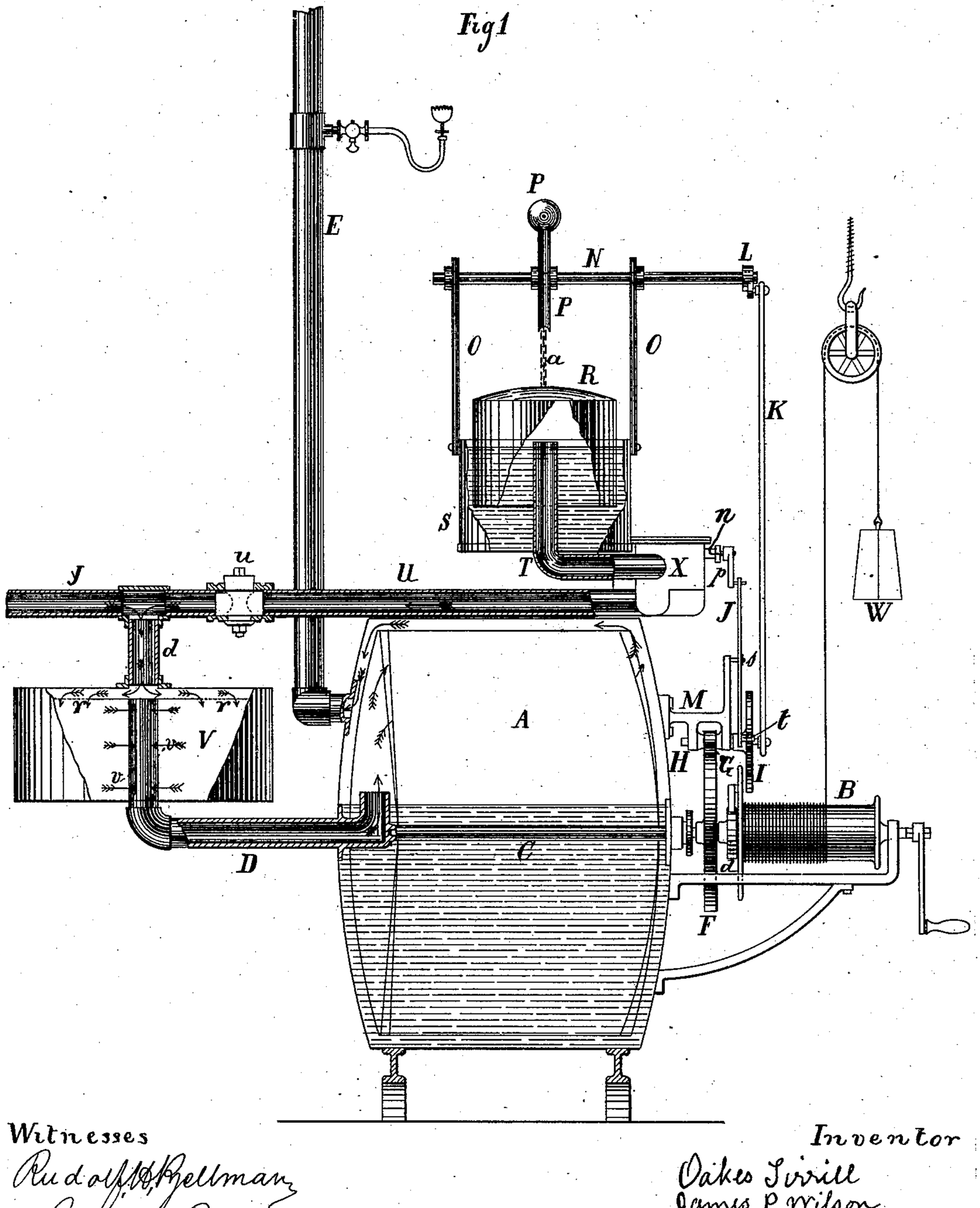
(No Model.) 2 Sheets—Sheet 1.

O. TIRRILL & J. P. WILSON.

CARBURETING MACHINE.

No. 294,527. Patented Mar. 4, 1884.

Fig 1



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(No Model.) 2 Sheets—Sheet 2.

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Fig 3

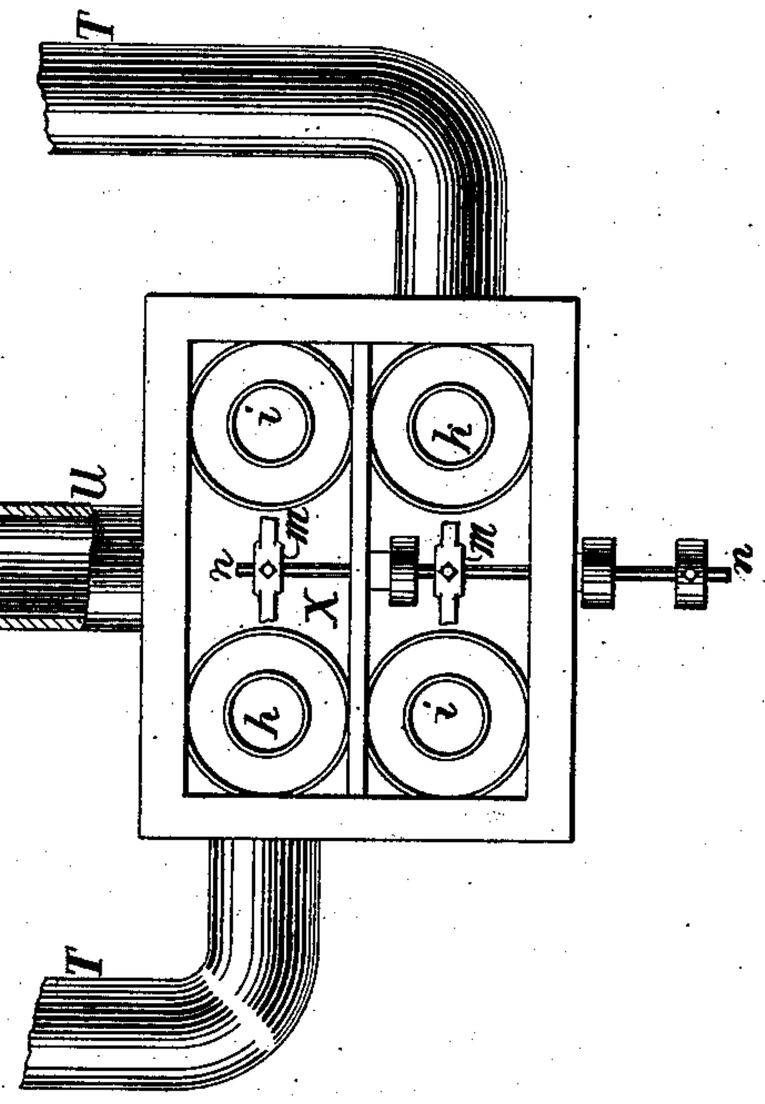


Fig 4

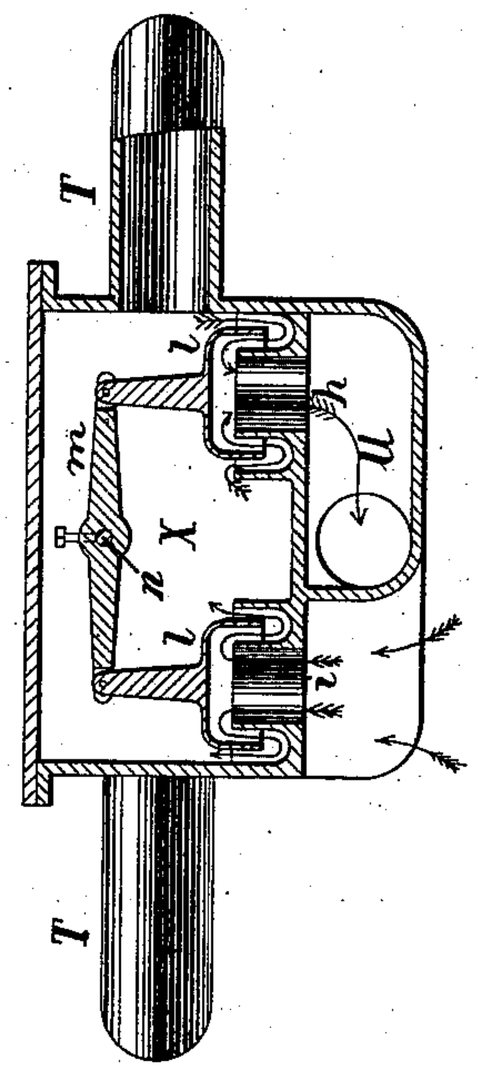
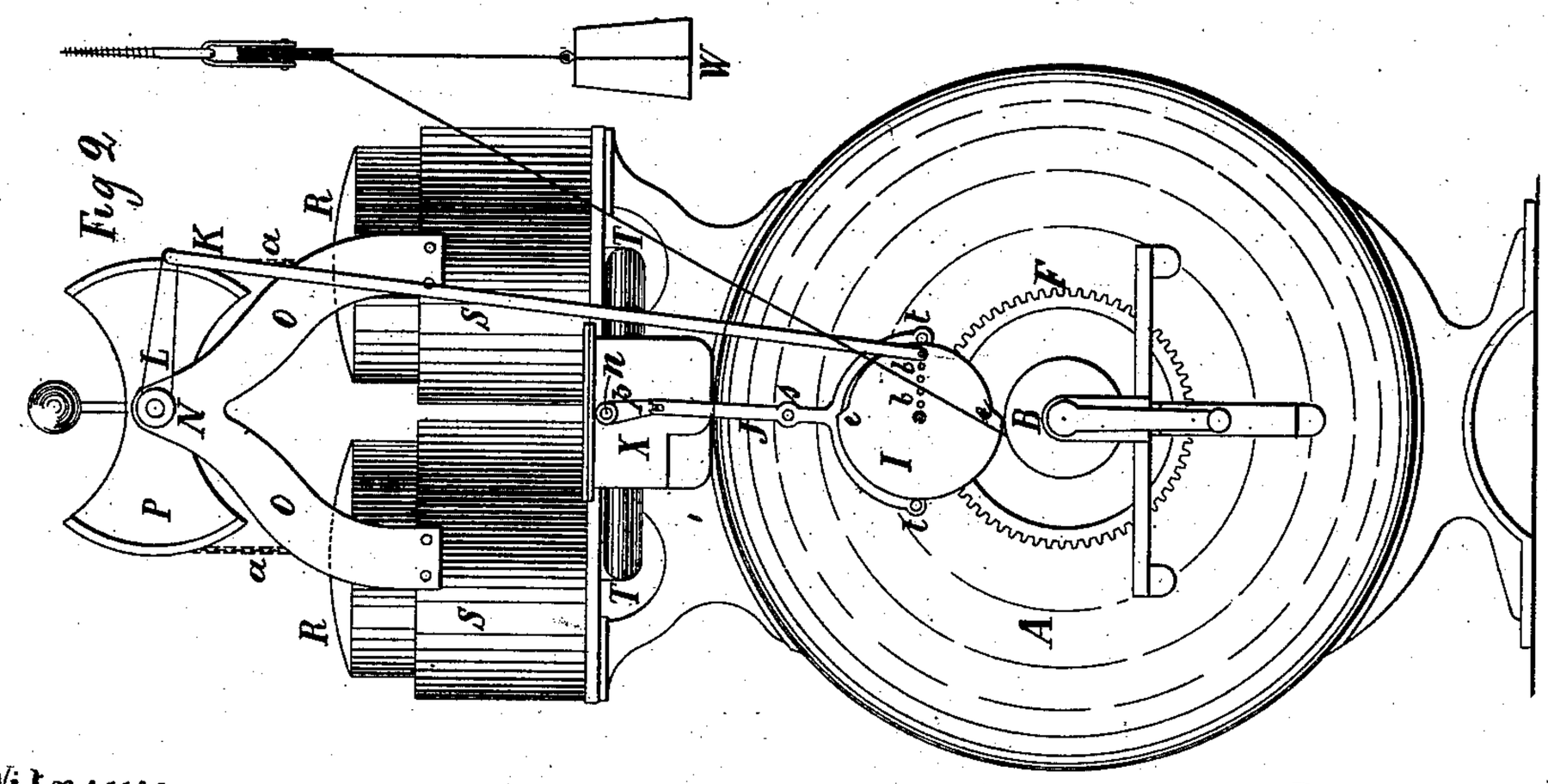


Fig 2



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UNITED STATES PATENT OFFICE.

OAKES TIRRILL, OF NEW YORK, N. Y., AND JAMES P. WILSON, OF NEWARK, NEW JERSEY.

CARBURETING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 294,527, dated March 4, 1884.

Application filed January 16, 1883. (No model.)

To all whom it may concern:

Be it known that we, OAKES TIRRILL, of the city, county, and State of New York, and JAMES P. WILSON, of the city of Newark, State of New Jersey, have invented a new and useful Improvement in Carbureting-Machines, commonly known as "gasoline-gas machines," of which the following is an explanation and description.

This invention relates to and is to be employed in connection with gasoline-gas machines, particularly with those which consist, essentially, of two parts, a generator and a meter-wheel pump. The generator of such a machine, when in operation, is charged with gasoline, (a high grade of naphtha, which rapidly evaporates in the open air,) while the meter-wheel pump is employed, in connection therewith, to force a current of air into contact with the gasoline in the generator. This air is thus impregnated with the vapor of gasoline, the degree of impregnation depending on the gravity of the fluid, its temperature, and the temperature of the air introduced. By the action of the machine and its connecting-pipes this mixture of the vapor of gasoline and atmospheric air is carried to the burners, and is the illuminating-gas generated and furnished by the machine. Such machines, of various forms and arrangements, are in general use throughout the United States. Both the manufacturers and the users of such machines are fully cognizant of a serious objection to their employment, and this objection has in a multitude of instances prevented their introduction, especially where large institutions were to be lighted. In order to understand what this objection is and how it lessens the value of those in use, and why it often prevents their adoption, the following explanatory illustrations of the practical working of such a machine will be found useful in connection with the description of the present invention. Suppose, then, a gas-machine of the character named to be set and ready for operation, the generator having been filled with gasoline of the highest gravity—say 90°. For reasons which hereinafter will be seen to be pertinent, let the burners employed in this supposed experiment be twelve-feet bat-wing burners—that is, burners that consume twelve feet of gas per hour. The weight propelling the meter-wheel pump being now wound up and the burners turned on, the gas-machine is at once in active operation. Air is forced through the generator, and becoming there charged with vapor is forced to and through the burners. The twelve-feet burners thus lighted at once exhibit a flame as large as an open hand, from which arises a cloud of dense black smoke. If the burners are turned down to a suitably-sized flame, each burner will resemble a smoky torch, demonstrating at once that the use of such a burner is impracticable, as well as destructive of comfort. Why this burner delivers such a blaze will be understood by considering these well-ascertained facts.

A single cubic foot of pure vapor of gasoline under an ordinary tension of one inch water-pressure is a sufficient quantity, when mixed with the proper amount of air, to furnish a fair gas-light for one hour. It is also a fact easily verified by experiment that when a gas-machine generator is charged with gasoline of the highest grade the air which is first passed through it will be as absolutely saturated with its vapor as a sponge is with water when immersed in it. It is further capable of demonstration that two cubic feet of air thus saturated will contain the one foot of pure vapor required to support a fair light for one hour. In the supposed experiment twelve feet of saturated air were passing through the burner per hour, when only two were needed. It would seem, then, that if a two-foot burner had been employed, instead of a twelve, the result would have been a satisfactory light, and such is an undoubted fact. It remains to prove that the use of a two-foot burner in the example named would have been as utterly impracticable (except for a very brief time) as the use of the twelve-foot burner supposed. A consideration of the following facts will show how certain would have been the failure of the two-foot burner to continue its first success. Gasoline is not a homogeneous fluid. The instant evaporation begins the unevaporated portion left behind becomes denser, until the last drop disappears. Every foot of air forced through the generator of such a machine

as has been described will absorb less vapor than the foot of air that preceded it, because the fluid has become heavier, and therefore evaporates less readily. In the experiment supposed two feet of air absorbed vapor enough at first to afford a good light for an hour. Shortly it would have taken three feet of air to absorb an equal amount, and a three-feet burner would have been required to deliver it. Very soon, as the fluid again became denser, four feet of air would only have taken up what the two feet did at first, and a four-feet burner would have been needed. Finally, just before the generator became exhausted of fluid it would have required twelve feet of air to absorb the quantity of vapor originally taken up by two feet. As the small burner could deliver only two feet of gas per hour, whatever might be its grade, in a few days it would have blown itself entirely out by not being adapted to the gas then being made. On the other hand, if the twelve-feet burner had been put on just before the generator was exhausted, when twelve feet of air absorbed precisely what two feet did at first, it would have been found that the twelve-feet burner delivered a beautiful clear flame, entirely free from smoke and in every way satisfactory.

It is evident from the preceding explanation that no gas-machine of the kind named can deliver a homogeneous gas. Its character must vary day by day and hour by hour. Now, the general remedy for this constantly-varying gas has been to use burners which could be easily adjusted to the grade of gas being made by the machine, and some of these burners have been so successful that if dwelling-houses alone were to be lighted the user of such a machine would have comparatively little cause to complain of its variable gas. The case is different when factories and large edifices are to be lighted. The varying quality of the gas has been a source of great annoyance, and has not only seriously interfered with their introduction in new places, but has in many cases caused them to be discarded after being tried. Even for dwelling-houses, a gas-machine generating, without the use of heat, a regular gas, like coal-gas, would always have the preference at a considerably enhanced price, if for no other reason than its entire freedom from a liability of smoke. It is therefore evident that a gas-machine generating a homogeneous gas requiring no special burner possesses marked advantages over one delivering a variable gas and requiring adjustable burners to be carefully watched.

Several very ingenious machines have been invented and patented which possessed the advantages referred to—as, for example, the one known as "Maxim's gas-machine." The one great objection to the use of such a machine has been, and is, that it requires heat at all times to generate the gas, and the suspicion that this use of heat is attended with danger has seriously interfered with its general introduction. The sale, therefore, of gas-machines which generate gas without the use of heat has far exceeded that of the others, notwithstanding their disadvantages in the respect named. Plainly, then, if the gas-machine which now delivers a variable gas could by any practicable device be enabled to deliver the same grade of gas at all times, a given quantity always affording the same light, it would have a decided advantage over others not possessing this characteristic, and would allow of its introduction when otherwise it would not be even considered. The invention we are about to describe is intended to produce this precise result—that is, to compel a machine generating a constantly-varying gas to reform its conduct altogether, and to deliver at all times through the burner an exact homogeneous gas, like coal-gas. Now, gas suitable for a twelve-feet burner, when generated by such a machine as has been described, is equal to and resembles fine coal-gas, and is generated by it for only a short period, and usually just before the generator is exhausted of fluid and needs replenishing. If, therefore, the over-rich gas first generated, and all that succeeded it, could be reduced to the quality of that last generated, then a twelve-feet bat-wing burner could be successfully used at all times. To accomplish this is the purpose of our present invention.

In the accompanying drawings our improvement is represented as applied to a gas-machine in which a meter-wheel pump is used to induct the air through it by suction.

In the drawings, Figure 1 is a sectional elevation of the apparatus. Fig. 2 is an end elevation of the same. Fig. 3 is a plan of a valve-box and its appurtenances, the cover of the box being removed; and Fig. 4 is a vertical section of the valve-box and appurtenances.

Similar letters of reference designate corresponding parts in all the figures.

A designates a meter-wheel pump. Its wheel is rotated in the usual manner by means of a weight, W, the rope suspending which is wound upon a drum, B. The said drum B is connected to the axial shaft C of the meter-wheel by means of the usual pawl and ratchet-wheel, *d*, or its equivalent, for transmitting the motion of the weight W to said shaft C, and thence to the meter-wheel inside the shell, which is fast to the shaft C. The revolving of the meter-wheel, when the meter is properly weighted and charged with water, will cause it to draw air and gas into itself through the pipe D and discharge the same through pipe E under pressure proportionate to the weight and water-seal used in the ordinary manner. Nothing whatever is here claimed as new or novel about the meter itself, and any of its numerous forms can be used; but its operation should be referred to in order to more fully explain the effect of this invention. To

begin with, the simple and primal purpose of this invention is to properly admit air into the gas made by such a machine as has been described.

R R designate the air-holders of two aerometers, and S S designate outside cases containing fluid in which the air-holders R R can rise and fall. Such holders may be placed over or in convenient relation to the meter-wheel pump, and are to be alternately filled with air and discharged of air. The air discharged mixes with the gas delivered from the generator in order to produce the result desired. Coming through and above the water stands the pipe T. This pipe is first to admit the air into the air-holders and then to allow of its being discharged into the gas. Connected with each air-holder is a chain, *a*, that is fastened to the extremity of the oscillating beam P, and fits in a guiding-groove thereof, as illustrated. The beam P is affixed to a shaft, N, which is supported by standards O. It is evident that as one holder R rises to be filled the other must have the ability to discharge its air; otherwise no motion could be maintained. It is equally evident that whatever orifice allows the ingress of air into either of these holders R while it is rising must be closed the instant that that holder begins to fall; otherwise it would be discharged back by the same orifice by which it entered. Vice-versa, the outlet through which the air is discharged into the gas must be closed the instant the holder begins to rise; otherwise the gas might follow back into the holder. In fine, two valves are required for each aerometer, one allowing the entrance of air and the other its exit. These valves must be precisely arranged, so that the inlet-valve of each shall open and the outlet-valve close when the corresponding holder R turns to rise; and, on the other hand, the inlet-valve must close and the outlet-valve open when the holder turns to fall. These four valves, *i i h h*, are displayed in Figs. 3 and 4. All of them work in a tight box, *x*, through the center of which runs a close partition, separating each set of valves from the other set. The valves themselves, *i i* and *h h*, in our invention, are preferably inverted cups, the mouths of which are immersed in any suitable liquid, and when down are hermetically sealed, although valves having seats can be employed.

Inside the valve-box *x*, and running across the center of each division, is the valve-shaft *n*, Fig. 3, which at one end projects through a stuffing-box beyond the chamber *x* to the outside of it, in order to allow of the proper movement of the four valves by a connection being made with this valve-shaft *n*. Fastened to this valve-shaft *n* are two levers, *m*, one extending across each compartment of the valve-box *x*. To the extremities of these levers are pivotally connected the stems of the valves referred to. By rocking the valve-shaft *n*, by hand or otherwise, from the outside it is clear that two of the cup-valves can be raised out of the fluid, and thus opened, while at the same time the other two will be projected into the fluid and closed. It remains to show how these aerometers and valves are connected with mechanism actuated from the wheel of the meter-wheel pump A and caused to so precisely operate in connection with each other that the desired effect can be perfectly produced. To accomplish this the following mechanical appliances are employed: To the axial shaft C of the meter-wheel A (see particularly Fig. 1) is fastened a spur-wheel, F, engaging with a pinion, G, rigidly affixed to a shaft, H. This shaft H is supported by a bracket, M, attached to the meter-wheel pump. Beyond the outer bearing this shaft H has fastened on it a disk, I, so that each revolution of the pinion G must also revolve the disk I. To the face and near the circumference of this disk I is pivotally connected a rod, K, by means of a bolt or pin, which may be easily taken out by the hand for the purpose of entirely disconnecting the rod K from the disk I. This rod K extends to and is pivotally connected to an arm, L, which is fastened on the shaft N. No further explanation is required to make it evident (on examining the drawings) that as the disk I revolves the shaft N and the cross-beam P will be oscillated, and that the air-holders R R will alternately rise and fall, one always ascending while the other is descending. Means are in this way provided for the required rise and fall of the said air-holders. The valves *i i h h* (see particularly Figs. 3 and 4) must now be made to work in proper conjunction with the air-holders, or be placed in such a position that the valves can be worked by a connection with the disk-plate I. On the projecting end of the valve shaft *n* is fastened an arm, *p*, which is pivotally connected to a lever, J, fulcrumed to a stud, *s*, and bifurcated so as to extend close to the periphery of a cam, I. Projecting through the extremity of the bifurcate arms of this lever are bolts or pins *t t*, which extend against the edge or near the edge of the cam I. The action of the cam I on these pins *t t* causes the lever J to oscillate, so as to cause the shifting of the valves *i i h h*. The cam I has part of its circumference cut away, as represented on Fig. 2, forming the projections *e e*, upon which the pins *t t* must rise at every revolution of the cam. Through the lever J a vibrating motion is imparted to the shaft *n*, running through the valve-box X, and thus again the valves *i i h h* are alternately shifted at every revolution of the cam I and at the precise time and point desired. The inlets and outlets of the box X are thus controlled by the valves *i i h h*.

Connecting with the outlet controlled by each valve *h* is a pipe, T, which extends into the aerometers to any desired height. As the motion of the air-holders R R and of the valves described is all derived through mechanical

leverages from the revolving cam I, it is a matter of mere adjustments of the means used to have the valves open and close at any point of the movement of the aerometers, and they can therefore be adjusted and regulated to the precise point required for successful operation. The rod K was supposed to be fastened to the cam I near the outer edge. Thus connected, it has the longest possible throw, raising each air-holder R to its full height, and hence discharging the entire capacity of each holder into the gas at each revolution of the cam. If this were a permanent connection, it would seriously interfere with the success of the entire device, for, as has been explained, the quality of the gas will so vary in the machines to which it is to be applied that different volumes of air will require to be admitted into the gas at different times. It is therefore an indispensable feature that the throw of the air-holders, and hence their capacity and the amount of air admitted into the gas, should be at pleasure susceptible of change to any desired degree. This is easily done. A series of holes, *b b*, Fig. 2, or their equivalents, are made through the disk I, in a straight line from the circumference to the center of the disk I, and at right angles to the projections *e e*. These holes may be so made as to represent percentages of air which will be mixed with the gas. Thus, for example, if ten per cent. less air were required than was given by the extreme throw of the air-holders, the pin connecting the end of the rod K to the cam could be moved to the next hole, nearer the center of the cam I, and thus the rise of each air-holder would be ten per cent. less than before. In this way, even while the apparatus was in operation, any desired change in the relative proportion of air and gas could at once be effected, and if no air were needed the rod K could be fastened to the center of the cam I, when all motion of the air-holders R R would cease. Thus by means of the devices described the filling and discharging of the air-holders R R are controlled by the revolution of the wheel of the meter-wheel pump A, and the amount of each discharge is capable of being easily varied.

The foregoing explanations, in connection with the drawings, should give a clear idea of the relation of the means employed to the end effected, which is to enable the user of a gas-machine of the kind described to regulate any quality of gas being made by his machine to a standard grade of gas which can at all times be used in a burner of fixed capacity.

V is a mixing-chamber of any desired dimensions. By means of a connecting-pipe, *d*, in the present case it is attached to the gas-service pipe Y of the generator or carburetor, and to the pipe U. Any other way of establishing communication between the mixing-chamber and the aerometers and generator may, however, be employed. Through the pipe Y the gas enters the mixer. Coming in the opposite direction through the pipe U is the current of air from the aerometers. Meeting at the mouth of the pipe *d*, the gas and air enter the mixing-chamber together. Just below the tight top of the chamber V is a perforated diaphragm, *r r*, over which the mixed air and gas spread, and through the perforations of which they are sifted into the chamber below. The pipe D rises into the center of this chamber V, and through it the mixed air and gas must pass out. The top of this pipe D is entirely closed, but from the top to the lower end of that portion which is within the mixing-chamber narrow slots *v v* or holes are made equaling in the aggregate about the capacity of this pipe. Suppose, now, the air and gas to lie in strata, or to be imperfectly mixed in the chamber V. The moment a draft was made upon it the mixture would be drawn through the entire length of the slots *v v* in the outlet-pipe D, as represented by the pointing-arrows in V, Fig. 1. By this device the air and gas would become thoroughly commingled and the mixture made homogeneous. We do not lay any claim to these means for mixing the gas and air.

The invention having been thus described, its practical operation is easily understood. The machine to which it is to be applied is made active by turning on a single light, or more. When started, if the gas is found to be too rich, then it follows that more air is required. By moving the end of the rod K one or more holes toward the periphery of the cam I this is at once supplied. If the gas is too thin, too much air is being introduced, which can be lessened by moving the rod K to the center of the cam I. A single minute suffices to change the position of the rod K on the cam I.

This invention, which can be properly called a "gas-equalizer," having been once set, neither the number of lights used nor the turning on or off of any number of them will cause any change in the quality of the gas. The proportions of the air and gas remain the same. The number of the revolutions of the pump increases or diminishes as the lights are turned off or on, and this increases or diminishes the volume of gas and air introduced into the mixing-chamber in precisely the same ratio. Hence a single light will be burning the same quality of gas that one hundred or more would. The leverage on the cam I is to be changed only when a different qualtity of gas is desired, or, in other words, when it becomes necessary to change the proportions of gas and air, and for no other purpose.

For convenience, the movements of both the air-holders R and their valves are imparted from a single plate described; but such movements can be separately obtained—as, for example, by having a separate cam or disk for each, and in other ways—but whatever devices are employed, they must take their motion from and be definitely related to the speed of

the wheel of the meter-wheel pump, which is the governing element in our invention, in whichever of the forms mentioned it may be applied.

In our invention we have described the air-holders R R as first taking in air and then admitting the air into the gas; but this relation can easily be reversed and the holders made to first receive the gas and mix it with air, accomplishing the same final results. The general movements of all parts of the apparatus would be the same, the connections of the valves with the air and gas pipes only being made to suit the desired application—as, for example, if it were desirable to first measure the gas into the holders R R, instead of the air, (in the machine delineated,) the valves *i i* would open into a gas-pipe connecting the holders and the generator, and the discharge-valves *h h* would open into the meter-wheel pump. In this arrangement, to increase the proportion of air to gas, the throw of the holders is decreased in the manner shown, and thus more air is allowed to enter the meter-wheel pump from its source of supply.

The aerometers employed form a regulator. They do not pump in air, but merely control the quantity which is passed through under the influence of the meter-wheel pump. A single aerometer may be employed in lieu of the two aerometers, or a double aerometer, such as we have shown.

We do not wish to be confined to the particular style of regulator or the particular type of pump shown, nor to the particular connections which are made between the pump and regulator, as many equivalents thereof may be used with good results.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In a gas-machine, the combination of a generator, a pump for inducing a current through the generator, and a regulator having a movement under control of the pump, substantially as specified.

2. In a gas-machine, the combination of a generator, a pump connected with the generator, so as to draw gas therefrom, a pipe or conduit, through which the pump draws air from the atmosphere, and a regulator having a movement controlled by the pump and serving to govern the quantity of air which passes through the air pipe or conduit, substantially as specified.

3. In a gas-machine, the combination of a generator, a pump connected with the generator, so that it will draw gas from the generator, a pipe or conduit, through which the pump will draw air from the atmosphere, a regulator serving to govern the quantity of air passing through the air pipe or conduit, and means connecting the pump and regulator, and made capable of adjustment, so that the operation of the regulator may be varied relatively to that of the pump, substantially as specified.

4. In a gas-machine, the combination of a generator, a pump connected with the generator, so that it will draw gas from the generator, a pipe or conduit, through which the pump will draw air from the atmosphere, a regulator serving to govern the quantity of air passing through the air pipe or conduit, a rotary disk deriving motion from the pump, and means for transmitting motion from the disk to the regulator, substantially as specified.

5. In a gas-machine, the combination of a generator, a pump connected with the generator, so that it will draw gas from the generator, a pipe or conduit, through which the pump will draw air from the atmosphere, a regulator serving to govern the quantity of air passing through the air pipe or conduit, and having a reciprocating part or parts, and also having valves, devices connecting the pump with the valves of the regulator, and means whereby the stroke of the reciprocating part or parts of the regulator will be controlled, substantially as specified.

6. In a gas-machine, the combination of a generator, a pump connected with the generator, so that it will draw gas from the generator, a pipe or conduit, through which the pump will draw air from the atmosphere, a regulator serving to govern the quantity of air passing through the air pipe or conduit, and having a reciprocating part or parts, and also having valves, devices connecting the pump with the valves of the regulator, and means whereby the stroke of the reciprocating part or parts of the regulator will be varied in length, substantially as specified.

7. In a gas-machine, the combination of a generator, a meter-wheel pump, A, connected with the generator, so that it will draw gas from the generator, a pipe or conduit, through which the pump will draw air from the atmosphere, a regulator, R S N P, provided with valves and serving to govern the quantity of air passing through the air pipe or conduit, the cam-disk I, the arm L, the rod K, the rock-shaft *n*, for operating the valves of the regulator, the arm *p* on the rock-shaft *n*, and the lever J, substantially as specified.

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