(No Model.)

2 Sheets—Sheet 1.

E. D. SELF.

GAS MACHINE.

No. 396,768. Patented Jan. 29, 1889.

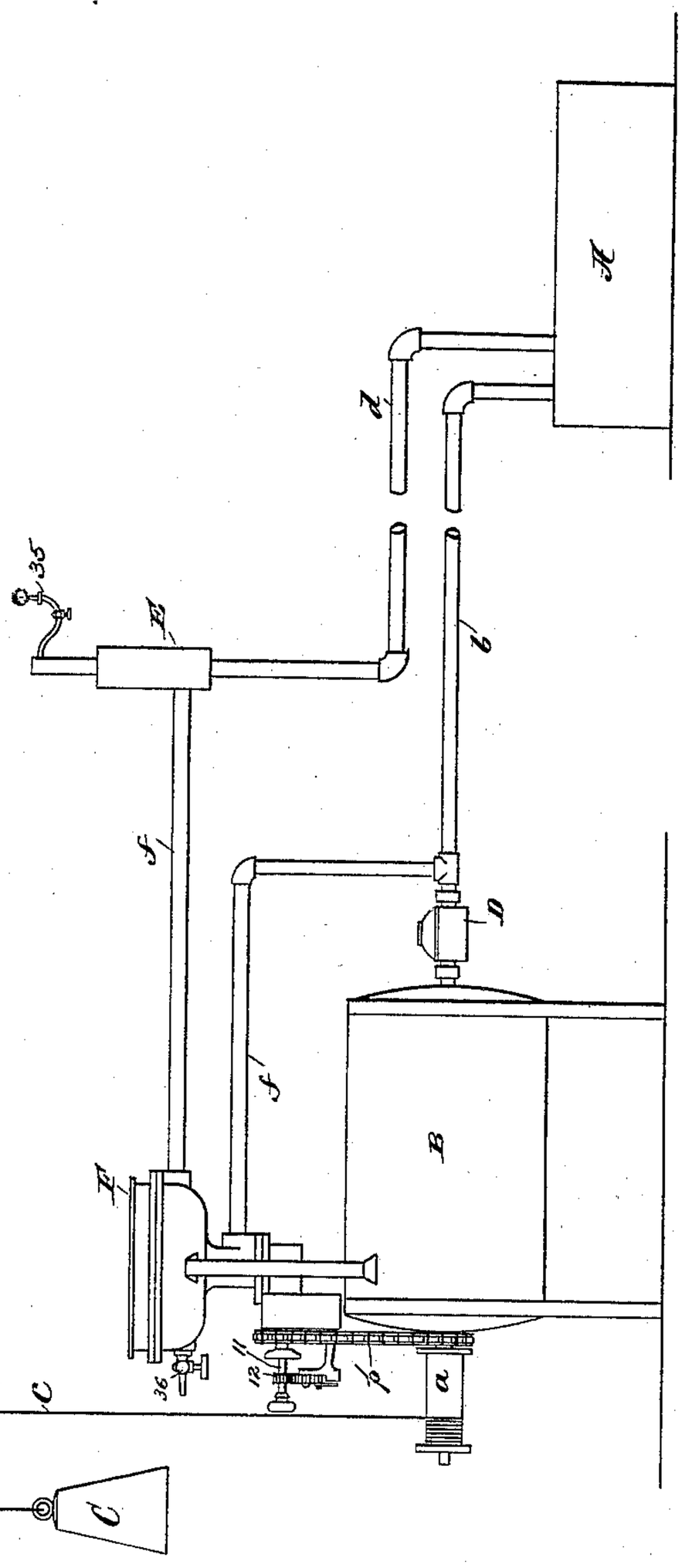

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

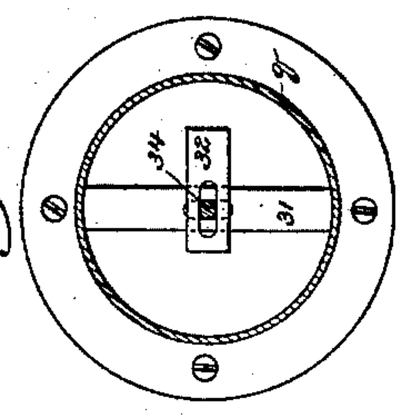


Fig. 4.

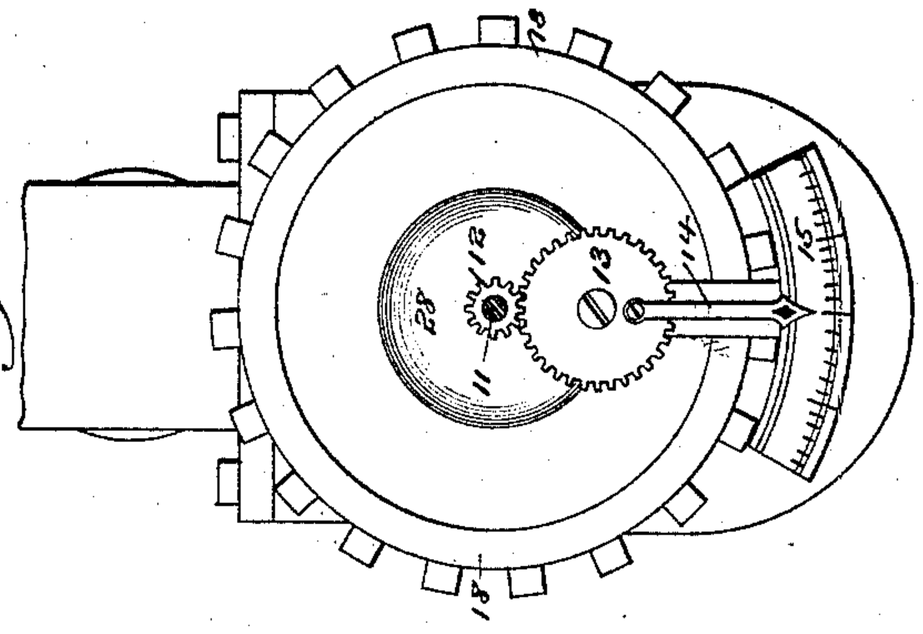
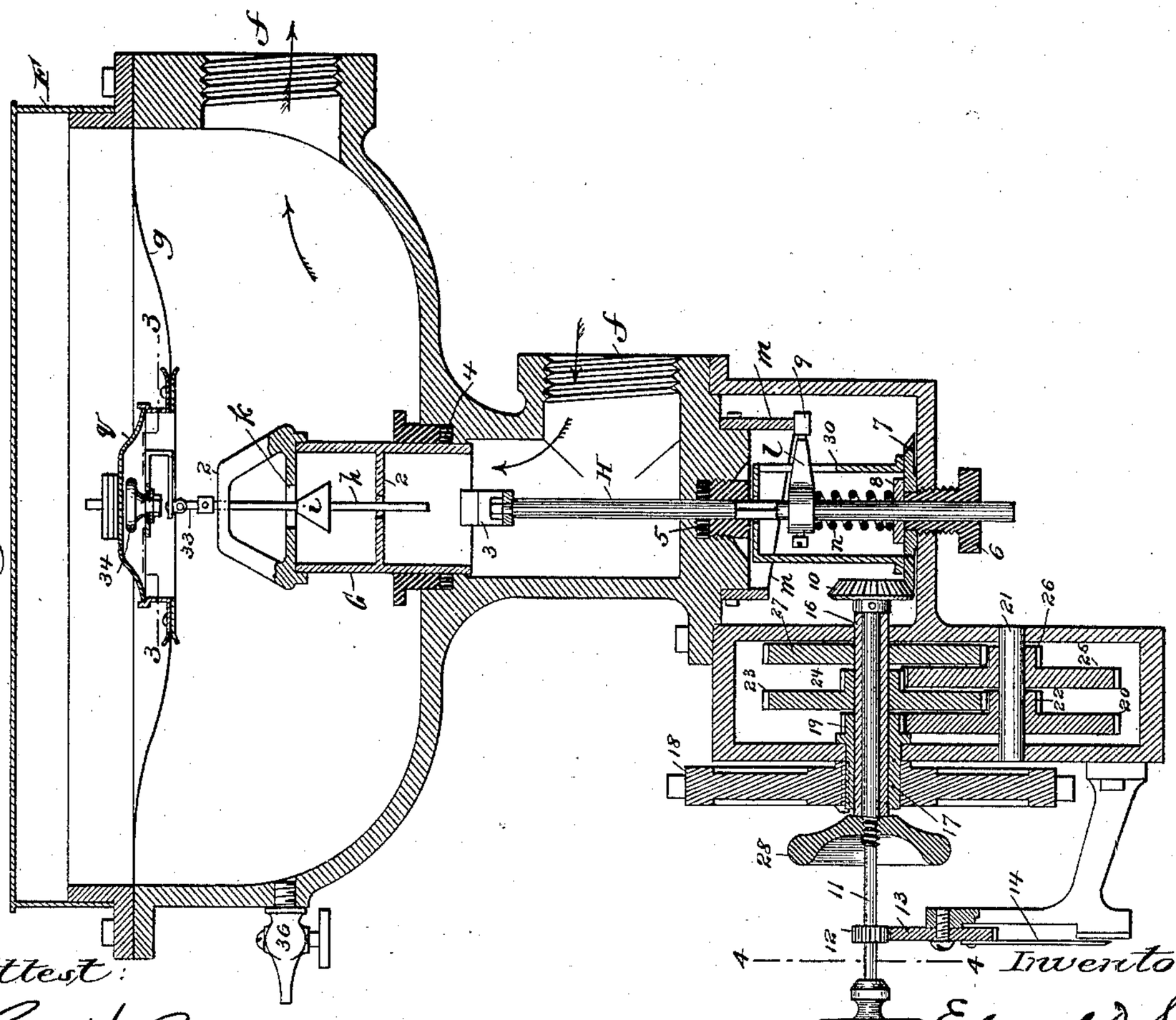


Fig. 2.



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UNITED STATES PATENT OFFICE.

EDWARD D. SELF, OF SOUTH ORANGE, NEW JERSEY.

GAS-MACHINE.

SPECIFICATION forming part of Letters Patent No. 396,768, dated January 29, 1889.

Application filed July 19, 1887. Serial No. 244,686. (No model.)

To all whom it may concern:

Be it known that I, EDWARD D. SELF, a citizen of the United States, residing at South Orange, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Gas-Machines, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to that class of gas-machines in which atmospheric air is enriched or saturated with the vapor of volatile hydrocarbons to produce what is popularly known as "illuminating-gas," and which for convenience will be herein termed "gas." The gas-machines of this class as ordinarily constructed consist, substantially, of two parts, a tank, usually called a "generator" or "carburetor," which contains a net-work of burlap, canton-flannel, or other absorbent material, which is saturated with gasoline or other hydrocarbon, and which is provided with suitable pipes for conveying the gas to the place of use, and a pump or other air-supplying apparatus, which is arranged to force atmospheric air into the carburetor, where the air, passing through the interstices of the absorbent material, becomes saturated with the volatile hydrocarbon contained therein, thus forming gas which passes through pipes to the place of use.

In using gas-machines thus organized it has been found in practice that when the operation is commenced and the absorbent material in the carburetor is saturated with the most volatile portions of the gasoline or other hydrocarbon the air forced into the carburetor becomes saturated with a vapor which is very rich in carbon, and as a consequence the gas made during this part of the operation when burned gives off a large amount of smoke. As the gas-making continues, however, the gasoline in the carburetor becomes less and less volatile, and as a consequence the amount of carbon contained in the gas produced is gradually diminished until, finally, the gasoline becomes so destitute of volatile matter that the air which passes over it does not take up sufficient carbon to give proper illumination. When this stage is reached, it becomes necessary to replenish the carburetor. To avoid the smoke resulting from the excess of carbon which enters the gas during the first part of the gas-making operation, which has just been described, it has been proposed to introduce a sufficient quantity of pure air into the gas after it leaves the carburetor to reduce or dilute it to such an extent that it will burn without producing smoke; and the present invention relates particularly to a regulating apparatus by which the amount of pure air so introduced into the gas during the different periods of the gas-making process can be regulated and varied, so that the air introduced is at all times just sufficient to properly dilute the gas and reduce it to such a condition that it will not produce smoke in burning—that is to say, the apparatus being so adjusted that the quantity of air introduced into the gas at the commencement of the gas-making operation, when the gas produced is richest in carbon, is sufficient to properly dilute the gas and prevent it from giving off smoke in burning, and the quantity of air can, as the gas-making proceeds, be gradually reduced in exact proportion as the richness of the gas is reduced, thereby maintaining the gas at a uniform grade or quality during the whole operation.

As a full understanding of the invention and the manner in which it can be applied to actual use can be best understood by a detailed description of the construction and operation of the apparatus embodying it, all further preliminary description will be omitted and a detailed description given, reference being had to the accompanying drawings, in which—

Figure 1 is an elevation of an ordinary gas-making machine, showing the present invention applied thereto. Fig. 2 is an enlarged sectional elevation of the apparatus for automatically controlling the supply of air to the gas. Fig. 3 is a horizontal section taken on the line 3 3 of Fig. 2, and Fig. 4 is a vertical section taken on the line 4 4 of the same figure.

Referring to said figures, it is to be understood that A represents a carburetor of the ordinary form, constructed as before stated, and B a pump or other air-supplying apparatus, also of any of the ordinary forms.

As herein shown, the air-supplying apparatus is a rotary pump, and is driven by a

weight, C, which is connected by a cord, *c*, to a drum, *a*, on the shaft of the pump. The drum *a* is connected to the shaft of the pump by a pawl and ratchet, (not shown,) so that the cord can be rewound upon the drum without revolving the pump. The pump is connected with the carburetor by a pipe, *b*, through which the air is forced from the pump to the carburetor, and the gas passes from the carburetor through a pipe, *d*, to the burners or other place of use. The pipe *b* is provided with a pressure-regulator, D, through which the air from the pump passes, and which serves to compensate for irregularities in the action of the pump and to maintain a uniform pressure in the carburetor and in the gas passing therefrom. The pipe *b* is provided with a branch, *f*, which communicates with a mixing-chamber, E, located in the pipe *d*, and through which branch a quantity of pure air is allowed to pass, so as to mix with the gas from the carburetor to properly dilute it. Located in the branch *f* is the governing apparatus F, which serves to automatically vary the quantity of pure air introduced into the gas during the different periods of the gas-making operation.

Referring, now, to Figs. 2 to 4, the construction of this governing apparatus will be described. This apparatus consists, primarily, of a fluid-pressure regulator which is constructed upon the same general plan as the regulators in common use. As shown in the present case, the regulator is provided with a flexible diaphragm, *g*, which is acted upon so as to be made to rise and fall by the pressure of the air passing through the pipe *f*. The diaphragm *g* may, however, be in the form of an inverted cup, the rim of which is sealed in a reservoir of mercury or other fluid. This diaphragm is connected to the stem *h* of a valve, *i*, which controls an opening through which the air passes. The seat *k* of the valve *i* is carried upon a tubular support, G, which is arranged to have a vertical movement with relation to the valve and passes through a packing, 4, by which a tight joint is formed around it. The tubular support G is provided with guides 2 for the rod *h*, and is also provided at its lower end with a yoke, 3, to which is swiveled a rod, H, which passes downward through a packing, 5, located in the bottom of the regulator. The lower end of the rod H passes through a tubular guide, 6, which forms a stud, upon which is mounted a beveled gear, 7, which turns freely upon the stud. The rod H is provided with an arm, *l*, having a bowl, 9, which rests upon the edge of a circular cam, *m*, and the rod is provided with a spring, *n*, arranged between the arm *l* and a plate, 8, upon the top of the gear 7, the tendency of which is to move the rod upward, so as to hold the bowl 9 in constant contact with the edge of the cam *m*. The gear 7 is provided with a yoke, 30, which rises from the top of the gear and is provided with a square opening through which passes a square portion of the rod H. By this means the rod H is caused to turn with the gear 7, and at the same time is permitted to move freely up and down. The gear 7 engages with a similar gear, 10, which is mounted upon a shaft, 11, having a pinion, 12, which engages with a gear or segment, 13, carrying a pointer, 14, which is arranged to move over a scale, 15. The purpose of this arrangement will be made to appear when the operation of the apparatus is described.

Mounted upon the shaft 11 is a loose sleeve, 16, upon which is mounted a second loose sleeve, 17, to which is keyed a sprocket-wheel, 18, which is connected by a chain, *p*, to a similar sprocket-wheel upon the shaft of the pump B. The sleeve 17 is provided with a pinion, 19, which engages with a gear, 20, loosely mounted upon a shaft, 21. Secured to the face of the gear 20 is a small pinion, 22, which in turn engages with a gear, 23, mounted loosely upon the sleeve 16. The face of the gear 23 is in turn provided with a small pinion, 24, which engages with a second gear, 25, mounted loosely upon the shaft 21, and this latter gear is in turn provided with a small pinion, 26, which engages with a gear, 27, fixed to the sleeve 16, which, as before stated, turns freely upon the shaft 11. From this system of connection it will be seen that the sleeve 16 is driven directly from the pump, but at a greatly-reduced speed. It is to be remarked, however, that the relative speeds of the sleeve 16 and the pump can be still further varied by increasing or diminishing the number of the connecting-gears. The shaft 11 is screw-threaded just outside the end of the sleeve 16 and is provided with a nut, 28, which is arranged to abut against the end of the sleeve. By operating the nut 28 the sleeve 16 can be pinched between the nut and the hub of the gear 10, so as to lock the sleeve and cause its motion to be imparted to the shaft 11, and thence to the pointer 14 and gear 7 and rod H. The shaft 11 is also provided with a knob or handle, 29, by which it can be operated so as to move the index 14 and rod H by hand at such times as the sleeve is not locked to the shaft, as just explained.

The operation of the apparatus thus organized is as follows: To put the apparatus in condition for operation, the carburetor A will be filled with gasoline, the rod H and arm *l* will be adjusted to such position as to allow the spring *n* to raise the rod and carry the valve-seat K to the proper position above the normal position of the valve *i*, and the nut 28 will then be set up so as to lock the sleeve 16 to the shaft 11. The pump being then set in motion, which will be effected automatically whenever the cock or cocks controlling one or more burners are opened, the air will be forced by the pump through the pipe *b* and the carburetor into the pipe *d*. At the same time a portion of the air will pass from the pipe *b* into the pipe *f*, and, entering the regulator F below the valve *i*, as indicated by the arrow,

will pass through the valve-opening to the chamber beneath the diaphragm *g*, and thence outward through the pipe *f*, as also indicated by the arrow, to the mixing-chamber E, where it will mingle with and dilute the gas issuing from the carburetor through the pipe *d*. As the pressure in the pipe *f* is varied by turning on and off the lights, the diaphragm *g* will be raised and lowered according as the pressure varies, and will thereby operate the valve *i* so as to regulate the amount of air passing through the pipe *f* and make it conform to the number of lights burning.

At the commencement of the operation, when the carburetor has been freshly filled, the amount of carbon in the gas produced will, as before stated, be in excess of what is required, and the quantity of pure air allowed to enter the chamber E to dilute the gas will be greater than the quantity which will be required to properly dilute the gas after the operation has been continued for some time and the gasoline in the carburetor has become less volatile. At the commencement of the operation, therefore, the arm *l* is so adjusted as to allow the spring *n* to raise the valve-seat K to its highest position above the normal position of the valve *i*, so as to increase the size of the valve-opening to the maximum and allow the maximum amount of pure air to pass. As the operation continues, however, the movement of the pump-shaft will be communicated through the chain *p* and the train of gearing 19 20, &c., to the rod H, so as to turn said rod and move the bowl 9 gradually along the edge of the cam *m*, thereby gradually moving the rod H and the valve-seat K downward, so as to gradually contract the valve-opening and reduce the quantity of pure air allowed to pass through the pipe *f* to the mixing-chamber E to mingle with and dilute the gas. By this means the position of the valve-seat and, as a consequence, the area of the valve-opening for the passage of pure air to the mixing-chamber E are controlled directly by the movement of the pump, and the extent of the valve-opening will be greater or smaller, according as the pump has made a less or greater number of revolutions from the commencement of the operation, and as the amount of gas made from the commencement is determined by the number of revolutions of the pump the position of the valve-seat and the area of the valve-opening for the admission of pure air to the gas will always be automatically adjusted to conform to the quality of the gas produced at each particular period of the operation. As the operation proceeds and the valve-seat is gradually lowered by the connections which have been described, the pinion 12, acting on the gear 13, will gradually move the pointer 14 over the scale 15, so that the position of the pointer will indicate the position of the valve-seat K, and also approximately the number of revolutions made by the pump from the commencement of the operation, and by this means will also indicate approximately the quantity and roughly the quality of gas made and approximately the time when the carburetor must be replenished, thus serving as a gas-meter.

The diaphragm *g* in the case shown is secured at its edges by screws passing through a ring and entering the shell of the regulator. In the center of the diaphragm is located the device for bringing the point of connection with the diaphragm into line with the valve *i* and its rod *h*. For this purpose the diaphragm is provided at its center with an opening covered by a cap, *q*, and across which is arranged a slotted bar, 31, (see Fig. 3,) which supports a yoke, 32, which is connected to the valve-rod *h* by a link, 33. The bar 31 and yoke 32 are connected by a set-screw, 34, which passes through their intersecting slots. By this means the valve-rod can be readily adjusted so as to keep the valve in its proper position.

The cam *m* will preferably be separable from and adjustable with relation to the other parts, so that it can be changed or adjusted to vary the operation of the apparatus, as may be required.

The ratio of the gearing 19 20, &c., is such that twenty-five hundred (2,500) or some other large number of revolutions of the pump are required to make one complete revolution of the arm *l*.

The apparatus must be adjusted at the beginning of each of its cycles—that is, when the carburetor is replenished. To do this, the nut 28 will be loosened, so as to allow the shaft 11 to turn freely in the sleeve 16 until the arm *l* and the pointer 14 are set back to the proper position to admit the proper quantity of pure air to the gas, which can be determined by a test-light, as 35. The nut 28 being then tightened, the apparatus will be ready to begin again its operation. The regulator will preferably be provided with a test-cock, as 36, to which a pressure-gage can be applied to determine the pressure at any time.

In operating gas-machines of this class it is found that the richness of the gas is affected by the changes in the temperature of the surrounding atmosphere—that is to say, as the temperature rises the gasoline becomes more volatile, and as a consequence the gas produced is richer, and vice versa. The rod H is therefore made of a metal or a composition—such, for example, as vulcanite—which has a large coefficient of expansion by heat relatively to the other parts of the apparatus, so that the increase in the richness of the gas caused by any rise in the temperature will be counteracted by an increased amount of pure air admitted by the expansion of the rod and the consequent raising of the valve-seat, and vice versa.

The apparatus which has been described embodies the invention in its most complete and desirable form. It is to be remarked, however, that modifications may be made in

many of the details of the apparatus without departing from the essential features of the invention; also, that parts of the apparatus may be used without the whole.

The form of connections for transmitting motion from the pump or motor to the valve-seat K may of course be varied widely from those shown, and the form of the valve and seat may also be modified. In some cases the tubular portion which forms the valve-seat in the construction illustrated may be connected to the diaphragm and form in effect the valve, while the part which in the construction illustrated forms the valve may form the seat and be adjusted to vary the area of the valve-opening to increase or diminish the supply of air allowed to pass. Such a reversal of the parts would not be a departure from my invention.

Instead of employing the cam *m*, arm *l*, and spring for moving the valve-seat, the rod H may be threaded and work in a nut, and such a construction is to be considered as in a broad sense the equivalent of that shown.

The form of the indicating apparatus 14 15, when such apparatus is employed, and the manner of operating the same may also, of course, be greatly modified, and the same is to be remarked in regard to the cam *m*. Neither is it necessary that the valve-seat K of the regulator should be operated directly from the pump. In some cases this may not be practicable, particularly where the pump is not of the rotary form. In such case the valve-seat may be automatically shifted by means of an ordinary meter-wheel located so as to be acted on by the flowing gas or air, such meter-wheel being provided with any suitable form of connections for transmitting its motion at a reduced rate to the valve-seat. It is also to be remarked that the devices shown for centering the valve-stem and attaching it to the diaphragm may be of a different form from that shown, or may be wholly omitted without departing from the invention.

The pressure-regulating apparatus which is herein shown is not herein claimed, broadly, but only in combination with a gas-making machine, said apparatus, broadly considered, forming the subject-matter of and being claimed, broadly, in my prior application for Letters Patent, filed February 11, 1887, Serial No. 227,248.

What I claim is—

1. In a gas-machine, the combination, with the carburetor and the apparatus for supplying air thereto, of connections for supplying pure air to the carbureted air or gas, a valve apparatus for controlling the amount of pure air supplied to the gas, a motor the speed of which is controlled by or varies with the amount of gas delivered, and connections between said motor and said valve apparatus for operating the latter to gradually change the amount of air introduced into the gas as the gas-making progresses and the quality of the gas changes, substantially as described.

2. In a gas-machine, the combination, with the carburetor and a pump for supplying air thereto, of connections for supplying pure air to the carbureted air or gas, a valve apparatus for controlling the amount of pure air supplied to the gas, and connections, substantially such as described, between the valve apparatus and the pump, whereby the valve apparatus is operated to gradually change the amount of air supplied to the gas as the gas-making progresses and the quality of the gas changes, the rate of change being controlled by and proportioned to the speed of the pump, substantially as described.

3. In a gas-machine, the combination, with the carburetor and the apparatus for supplying air thereto, of connections for supplying pure air to the carbureted air or gas, a fluid-pressure regulator having a valve which is operated by and controls the pressure of the pure air supplied and having a movable valve-seat, and connections, substantially such as described, whereby the valve-seat may be gradually moved to change the amount of air supplied to the gas as the gas-making progresses and the quality of the gas changes, substantially as described.

4. In a gas-machine, the combination, with the carburetor and the apparatus for supplying air thereto, of connections for supplying pure air to the carbureted air or gas, a fluid-pressure regulator having a valve which is operated by and controls the pressure of the pure air supplied and having a movable valve-seat, and connections, substantially such as described, whereby the valve-seat is automatically moved to gradually change the amount of air supplied to the gas as the gas-making progresses and the quality of the gas changes, the rate of the change being dependent upon and proportioned to the amount of gas made, substantially as described.

5. In a gas-machine, the combination, with the carburetor and the pump for supplying air thereto, of connections for supplying pure air to the carbureted air or gas, a fluid-pressure regulator having a valve which is operated by and controls the pressure of the air supplied and having a movable valve-seat, and connections, substantially such as described, between the valve-seat and the pump, whereby the valve-seat is automatically moved so as to gradually change the amount of air supplied to the gas as the gas-making progresses and the quality of the gas changes, the rate of change being controlled by and proportioned to the speed of the pump, substantially as described.

6. In a gas-making machine, the combination, with the carburetor, of the pressure-regulator F, having the valve controlled by the diaphragm and the movable valve-seat for varying the amount of air supplied to the gas,

and the train of gears 19 20, &c., for communicating motion to the valve-seat and to the pointer-scale 14 15, substantially as described.

7. In a gas-machine, the combination, with the carburetor, its air-supplying apparatus, and connections for supplying pure air to the gas, of the pressure-regulator F, having the valve controlled by the diaphragm, and the movable valve-seat for varying the quantity of air supplied to the gas, the train of gears 19 20, &c., the shaft 11, having the loose sleeve 16, and the jam-nut 28, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

EDWARD D. SELF.

Witnesses:
T. H. PALMER,
J. J. KENNEDY.