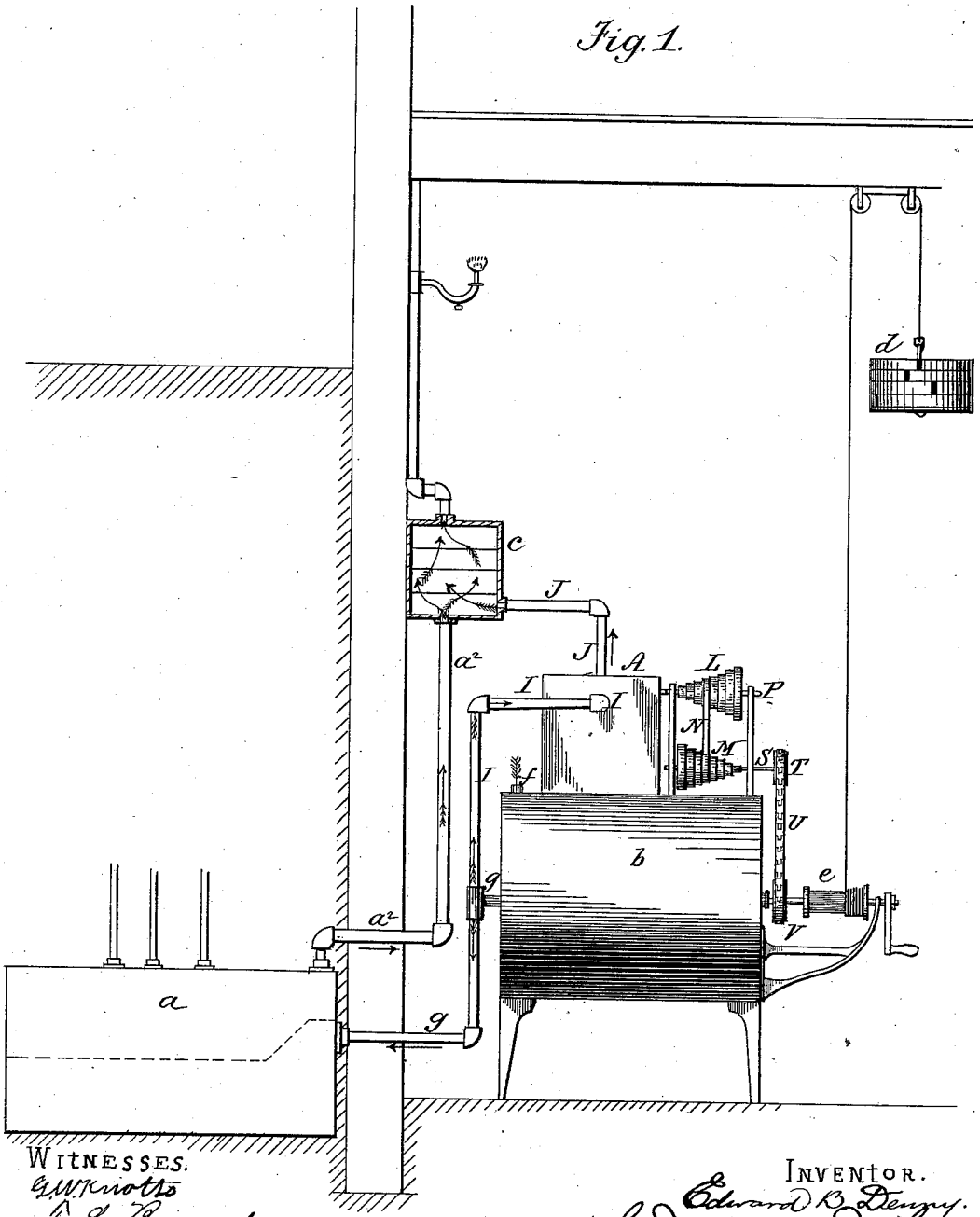
(No Model.) 3 Sheets—Sheet 1.

E. B. DENNY.

DEVICE FOR MIXING GAS AND AIR.

No. 382,076. Patented May 1, 1888.

Fig. 1.



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his Attys.

(No Model.) 3 Sheets—Sheet 2.

E. B. DENNY.

DEVICE FOR MIXING GAS AND AIR.

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Fig. 2.

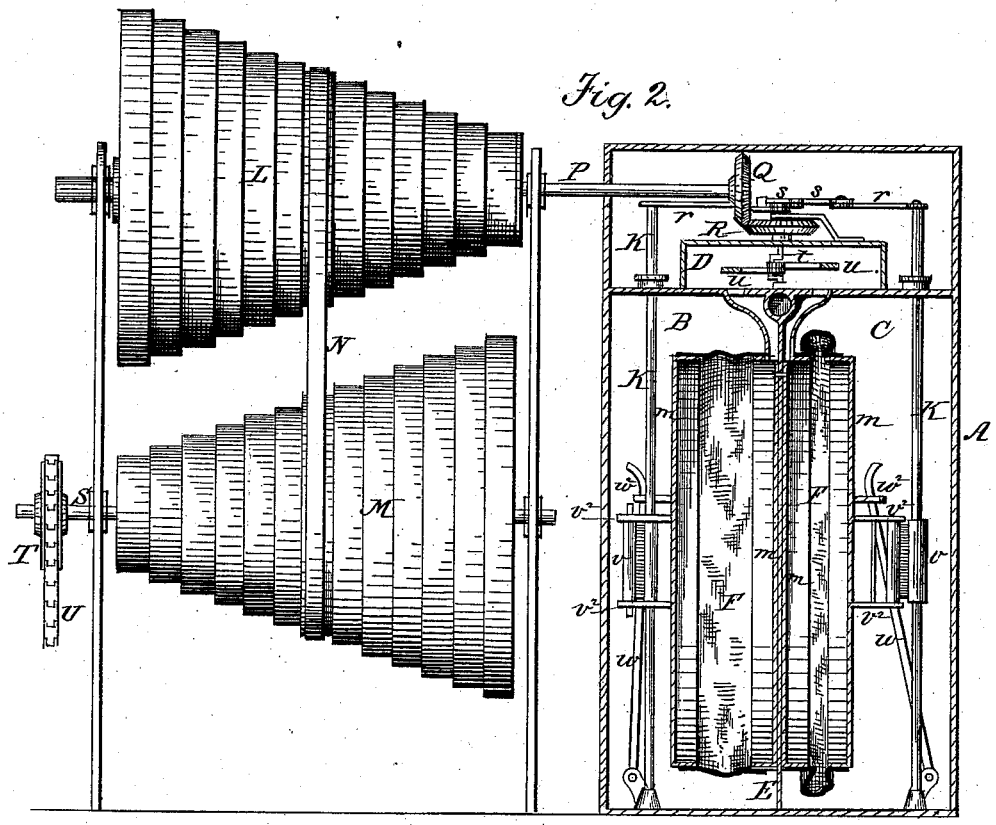
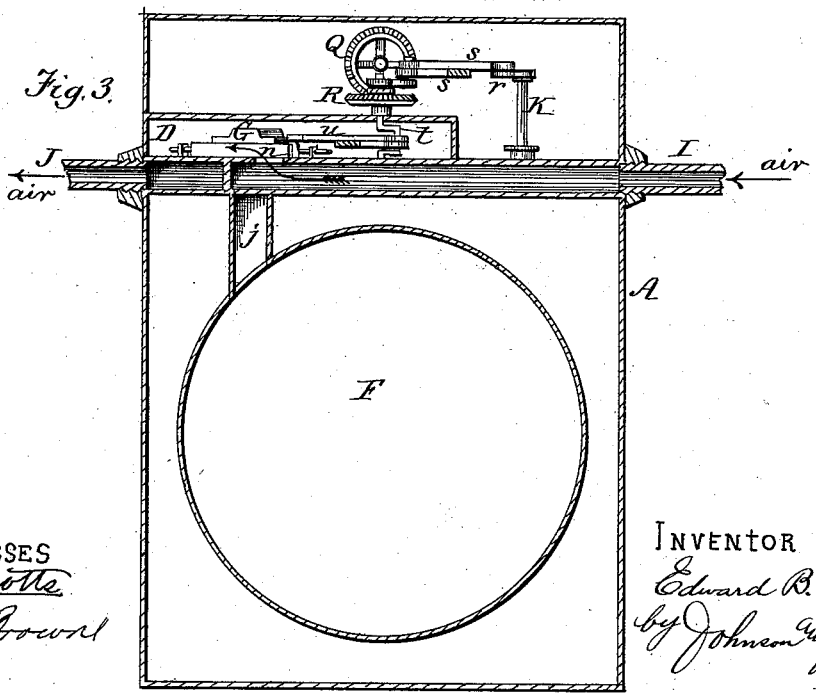


Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

E. B. DENNY.

DEVICE FOR MIXING GAS AND AIR.

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Fig. 4.

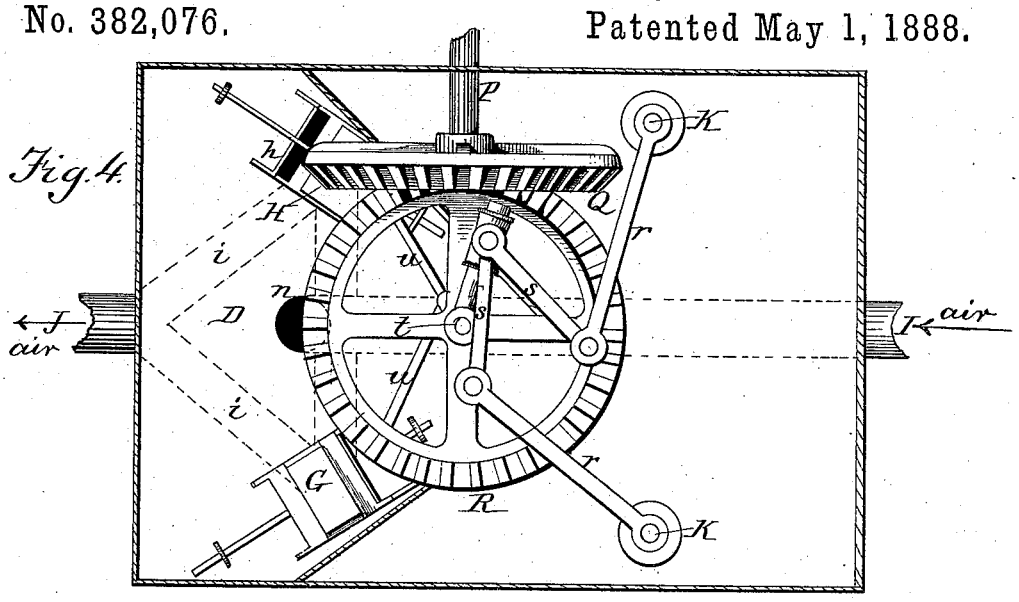


Fig. 6.

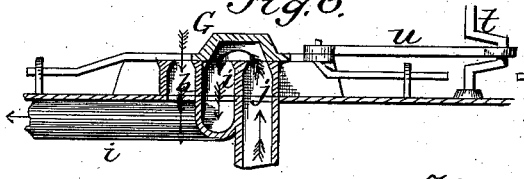


Fig. 7.

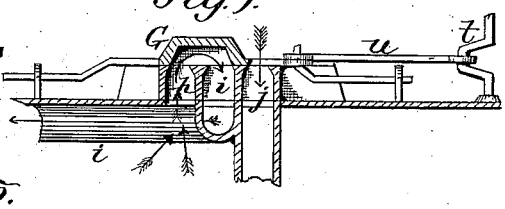
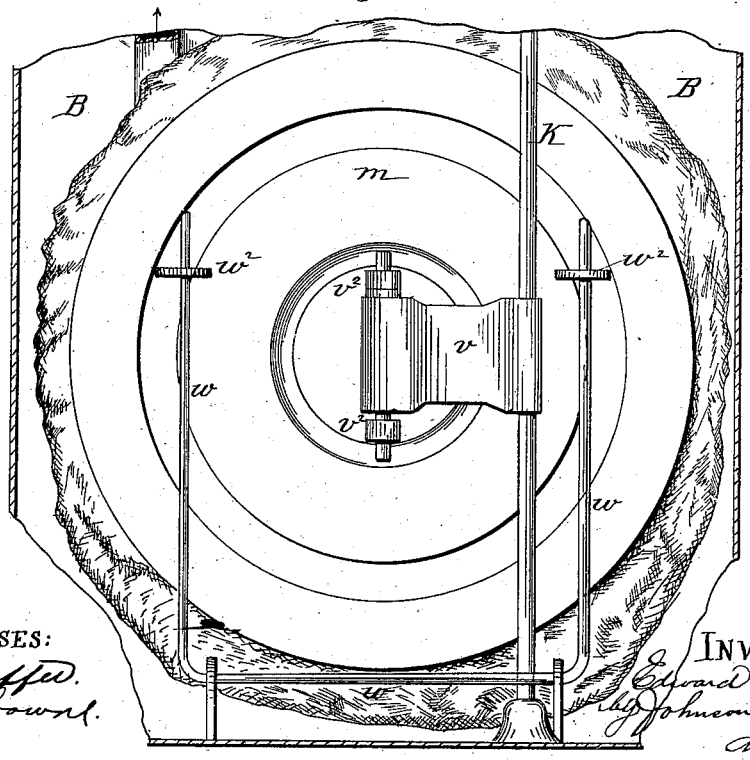


Fig. 5.



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UNITED STATES PATENT OFFICE.

EDWARD B. DENNY, OF NEWARK, NEW JERSEY.

DEVICE FOR MIXING GAS AND AIR.

SPECIFICATION forming part of Letters Patent No. 382,076, dated May 1, 1888.

Application filed October 25, 1884. Serial No. 146,474. (No model.)

To all whom it may concern:

Be it known that I, EDWARD B. DENNY, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented new and useful Improvements in Devices for Mixing Gas and Air, of which the following is a specification.

My invention relates to improvements in what are known as "air-carbureting machines," in which atmospheric air is charged or mixed with the vapor of a volatile hydrocarbon oil for the production of gaseous vapor for illuminating and heating purposes. It is well known that gas produced by such gas-machines is of variable density—that is to say, it is more or less highly charged with carbon in proportion, first, to the specific gravity of the hydrocarbon; second, the quantity of the hydrocarbon exposed to the mixing or evaporating process, and, third, the temperature of the air and vapor in process of mixing. In the working of a gas-machine it has been found impracticable hitherto to control the conditions stated in the production of such gas, and hence the necessity for making the carburetor large enough to produce a good illuminating-gas when these conditions are the most unfavorable. Under the usual conditions, therefore, the gas produced is too dense for economical consumption or for perfect combustion.

The object of my improvement is to automatically reduce the density of gas made under the usual conditions by mixing with it a sufficient quantity of air to effect economy in consumption and perfect combustion, and to accomplish this result by means which will be positive in their operation, without regard to the variable pressures under which the fluids may be delivered to the mixing-chambers or the quantity of gas consumed.

Referring to the accompanying drawings, Figure 1 represents in elevation the several connected parts of a gas-machine embracing my improvements; Fig. 2, a vertical cross-section taken through the flexible air-measuring chambers, and showing the cone-pulleys connecting with the valve mechanism thereof, by which combination the quantity of air required for reducing the density of the gas is absolutely controlled by and in proportion to the revolutions of the air-pumps; Fig. 3, a similar section taken through one of the flexible air-measuring chambers at right angles to Fig. 2, showing the air inlet and outlet pipes for said measuring-chambers; Fig. 4, a top view of the valves communicating with the flexible air-measuring chambers and the valve-operating connections; Fig. 5, an elevation of one of the flexible air-measuring chambers, showing the valve-operating connections therewith, a portion of the casing being removed to expose these parts; and Figs. 6 and 7 show in different positions one of the valves of the air-measuring chambers and its connection with the crank of the connecting mechanism of the cone-pulleys.

The generator or carburetor *a*, which contains the gasoline and wherein its evaporation takes place to impregnate the air with the vapor of gasoline, according to the conditions previously stated, may be of the usual or any approved construction, and has connections with an air-pump, *b*, and a mixing-chamber, *c*, with which the burner-pipes connect. The pump, *b*, for supplying the air may be the ordinary meter-pump, and driven in the usual manner by means of a weight, *d*, the rope suspending which is wound upon a drum, *e*, on the shaft of the meter-wheel. The usual pawl-and-ratchet connections are employed for transmitting the motion of the weight to said shaft and thence to the meter-wheel, which revolves in a water-seal inside the shell. The revolving of the meter-wheel will cause it to take air at *f* and discharge it under the requisite pressure through the pipe *g* to the generator. With these old members of a gas machine I combine an air-measuring attachment for diverting a portion of the air in its passage to the generator into the said measuring attachment A, whence it is delivered into the mixing-chamber *c* in measured quantities for the purpose of reducing the density of the gas passing into said mixing-chamber *c* from the generator. This measuring attachment A is normally automatic in its operation, requiring no power to operate it other than the pressure of the air which it receives from the meter-pump, and delivers in measured quantities into the mixing-chamber. Under certain other conditions hereinafter mentioned its operation is effected

by the temporary interposition of the power that drives the air-pump. The principal member of this air-measuring attachment consists of a shell or case having its interior divided into three separate and distinct communicating chambers, B C D—two below and one at the top. Upon the opposite walls of a vertical partition, E, which forms said lower chambers, are arranged, one in each, a flexible chamber, F. The top chamber, D, contains two slide-valves, G H, each operating ports *h i j*, Figs. 6 and 7, one set of said ports communicating, respectively, with the top chamber, D, the lower chamber, B, and its flexible chambers F, and the other set communicating in like manner with the chambers D C F. These chambers and their valves are connected and arranged to work in unison in the same manner as the identical parts of a dry gas-meter, their operation being rendered automatic by the flow and pressure of the air through them.

I is the air-inlet pipe, which connects the air-pump with the top chamber, D, at *n*, Figs. 3 and 4, and J is the air-outlet pipe, which connects both the flexible chambers F with the mixing-chamber *c* by the ports *i j*, Figs. 4 and 6.

The flexible chambers F F (shown in Fig. 2) consist of two annular plates or heads, *m*, connected together by leather or other suitable flexible material fastened in any suitable manner to the rims of the heads. Each chamber F communicates with the top chamber, D, by the valve-port *j*, Fig. 7, by which said chamber F fills with air from said chamber D, while each chamber B C communicates with the top chamber, D, by the valve-port *h*, Fig. 6, and is filled from said top chamber. When the valve G opens the port *j*, the air, being under pressure in chamber D, will pass down said port into the chamber F and inflate it, and said valve then closing said port *j* and opening the port *h*, the air will pass from the top chamber into the chamber B or C around the outside of the flexible chamber, thereby displacing the air within the flexible chamber by outside pressure through the ports *i j* beneath the valve, whence it passes by the pipe J into the mixing-chamber *c*, as stated. In this way both chambers, by the operation of the valves, alternate in their inflating and collapsing movements, so as to keep up a continuous flow of air to the mixing-chamber.

The movements of the heads of the flexible chambers are transmitted to the slide-valves G H by means of two rock-shafts, K K, that so actuate arms *r r s s*, connected to each other above the chambers B C, as to give a rotary motion to a crank-shaft, *t*, mounted vertically in bearings in the top of the case. The rotation of this crank-shaft operates the slide-valves alternately by the connecting-rods *u*, Figs. 2, 3, 6, and 7, the throw of the valves being such as to open and close the ports *h i j*, as stated.

The automatic alternately-operating flexible chambers and their co operating valves, which I have just described, constitute the principal member of what I have called the "air-measuring attachment," and the secondary element is the co-operating cone-pulleys for regulating the rapidity with which the movements of the air-measuring chambers are caused to receive and discharge the air into the mixing-chamber, which secondary element I will now describe. The cone-pulleys L M are for this purpose arranged in the usual manner, with the base of one opposite the apex of the other and connected by a belt, N, at the side of the case of the air-measuring chambers. They are mounted in a suitable frame, so that the shaft P of the upper cone-pulley shall be directly connected by a bevel-gear, Q, thereon with the gear R on the upper end of the vertical crank-shaft *t* of the valve-operating connections.

The shaft S of the lower cone-pulley, M, is provided with a sprocket-wheel, T, from which a chain belt, U, leads to a sprocket-wheel, V, on the shaft of the air-pump, so that the discharge of air from the measuring-chambers into the mixing-chamber is controlled by the revolutions of the air-pump. When the belt is placed upon the largest pulley of the upper cone and the smallest pulley of the lower cone, then the operation of the measuring-chambers will be comparatively slow, and therefore but a small proportion of air will be discharged into the mixing-chamber. When the belt is placed upon the other extreme position of the cones, then nearly all the air that is discharged by the meter-pump is received into and discharged from the measuring-chambers into the mixing-chamber—that is to say, the quantity of air thus supplied to the mixing-chamber will be sufficient to reduce the density of the richest gas to a degree suitable for economical and perfect combustion. Between these two extremes any proportionate mixture can be obtained by the adjustment of the belt upon the graduated pulleys.

Under the normal conditions of a gas-machine while in operation the pressure in the air-supply pipe I and chamber D of the measuring attachment will be in excess of the pressure in the gas-pipe a^2 near the mixing-chamber *c* because of the closer proximity of the former to the meter-pump *b* and the greater specific gravity of the gas. It is this excess of pressure in the air-supply pipe I that usually operates the measuring attachment. This operation is checked or controlled by the connection of such attachment with the meter-pump, which acts as a governor thereto; but there are abnormal conditions in the operation of a gas-machine when the pressure in the gas-supply pipe a^2 will be in excess of the pressure in the air-supply pipe I, as when the gasoline is expanded by excessive heat, because it is well known that the least increase of temperature causes gasoline to expand rapidly. Under such abnormal conditions, therefore,

there will be no excess of air-pressure to operate the measuring attachment, which is then operated by the belt connecting it with the shaft of the meter-pump.

It is well known that in the operation of a gas-machine the air-pump revolves with a speed in exact proportion to the quantity of gas consumed, and since the operation of my measuring attachment is controlled and governed by the revolutions of the air-pump, it follows that such operation will be in exact proportion to the number of burners lighted, and the same quality of gas will be produced without regard to the number of burners in use. This result is effected without any manipulation or readjustment of the apparatus, so far as relates to the amount of gas consumed. The machine being properly adjusted for operation, the meter-pump takes in air at the opening *f* and delivers at each revolution a definite quantity of air, a portion of which goes through the pipe *g* to the gas-generator *a*, the balance passing through the pipe I into the measuring attachment A. That portion of the air which goes to the generator is charged with the vapor of the oil therein, and passes thence through the gas-pipe a^2 into the mixing-chamber *c*, where it is diluted by mixing with the measured quantity of air received into and delivered by the measuring attachment. Should it be found that the gas is not of a quality to burn with the best results, the quality may be speedily and easily changed by shifting the belt on the cone-pulleys, as stated, so as to allow the measuring-chambers to operate faster or slower, according as it is desired to increase or diminish the density or quality of the gas.

I have shown and described the cone-pulleys for determining the proportions of air delivered respectively to the generator and to the flexible measuring attachment for the mixing-chamber; but it is obvious that I may use adjustable gearing or equivalent devices for regulating the speed of the measuring-chambers.

It will be understood that the discharge of the required amount of air from the flexible chambers does not depend solely upon their capacity, but also upon their rapidity of action, and it is the function of the cone-pulleys to regulate such action.

The flexible material of the chamber-heads *m* is connected to the circumference of said heads, and, bending only in one direction, is not liable to injury by cracking. The moving heads are guided straight by yokes *w*, hinged to the bottom of the case, having their free upper ends looped in slotted ears w^2 on the outer face of each moving head near its circumference, and an arm, *v*, hinged at one end to brackets v^2, rigidly attached to the center of the head *m*, and at the other end said arm *v* is rigidly attached to the rock-shaft K, as shown in Fig. 5.

The valve-operating arms are long and give an easy movement, and the valves operate with the ports like an ordinary D-valve, there being one valve to each measuring-chamber.

I have shown and described the air-pump as operating to force a current of air into and through the generator; but it is obvious my improvements can be used with a machine in which the pump may operate to suck the gas from the generator and discharge it into the burner-pipes, and for such adaptation it would only be necessary to connect both the generator and the mixing-chamber to the inlet-pipe *f* of the meter-pump, so that it would suck gas from one and air from the other. The proportionate quantities could be controlled by belt-connection with the shaft of the air-pump. It is also important to notice that, while the air-measuring attachment is never under the control of the pressure in the generator, it is normally operated by such pressure, and is always under the control of the air-pump, and that is why the air-measuring attachment is positive in its operation, and that such measurement is effected without the use of water or other liquid seals.

I know that in gas-machines it has been proposed to measure the air-supply under atmospheric pressure and wholly by mechanical devices to deliver the same grade of gas at all times, so that a given quantity will always afford the same light; that a regulator for such air-supply measurer has been employed having its movement controlled by the air-pump, so as to govern the quantity of air for the purpose stated, and that such regulator has been provided with means for adjustment, so that its operation may be varied relatively to that of the pump; but while measuring air at atmospheric pressure to render the gas homogeneous under all conditions in gas-machines is not new and not claimed by me, yet my improved gas-machine embraces an operation in which the air-measuring device is operated both automatically and mechanically to render the operation of the machine continuous under different conditions of pressure of the air and of the gas. In my machine under one condition the air-measuring device is actuated by the excess of air pressure from the pump over the gas-pressure, while under a different condition the air-measuring device is actuated by positive connection with the pump, and, so far as I know and can find, such a continuous operation has never been effected before in a gas-machine having an air-measuring device.

I claim—

1. In a gas machine, the combination of an air-pump, its operating-motor, a generator, a mixing-chamber, a closed air-measuring device, and suitable pipe-connections for these parts, arranged to supply air under the same pressure to the generator and to said closed measuring device, with a regulator operating to control the movements of said measuring device in the way described.

2. In a gas-machine, the combination of a generator, an air-pump, and an air-measuring device with a governor device consisting of connected cone-pulleys and suitable connections, with the valves of the air-measuring device, for regulating the speed of the latter, substantially as described, for the purpose specified.

3. In combination, in a gas-machine, the generator *a*, the air-pump *b*, the case A, the flexible air-measuring chambers F, their operating connections, the valves G and their operating-connections with said chamber-connections, the cone-pulleys L M, their connecting-belt N, the gear-connections Q R for the cone-pulley L with said valve-connections, a motor for the pump, and the belt V, connecting the cone-pulley M with said pump shaft, substantially as described, for the purpose specified.

4. The combination, in a gasoline gas machine, of a generator and an air-pump, an air-measuring device consisting of flexible chambers having controlling-valves and connected to each other, the belt-connected cone-pulleys, suitable gear-connections for the latter and for said valves, a motor for said pump, and suitable connections for said pump-shaft with one of said cone-pulleys, all constructed and arranged to operate in the way described.

5. The combination, in a gas-machine, of the flexible air-measuring chambers, their valve-controlling mechanism and air-pump, with the belt-connected cone-pulleys having suitable connection with said valve mechanism, whereby to control the quantity of air required for reducing the density of the gas, substantially as described.

6. The combination, in a gas-machine, of an air-pump and a mixing-chamber, with an air-measuring attachment consisting of co-operating flexible chambers, the belt-connected cone-pulleys, and valve mechanism connecting said chambers with said cone-pulleys, substantially as described, for the purpose specified.

7. The combination, in a gas-machine, of an air-pump, its operating-motor, flexible air-measuring chambers, their controlling-valves, and a mixing-chamber having pipe-connections with said generator and said measuring device, with a regulator composed of the belt-connected cone-pulleys, one of which is connected to the said flexible chambers by intermediate gear mechanism and the other to the pump-shaft by a belt, all constructed and arranged to operate in the way described.

8. The combination, in a gas-machine, of the air-pump *b*, the generator *a*, and the mixing-chamber *c* with the flexible air-measuring chambers, the air-supply pipes I *g*, the connected cone-pulleys, and valves connected with said pulleys and with the said flexible chambers, substantially as described, for the purpose specified.

9. In a gas-machine, the combination of a generator, a pump for supplying air thereto, an air-measuring attachment consisting of flexible chambers operated by air under pressure from said pump, and valves controlling the movements of said chambers, with a regulator connected with and controlling said valves, and suitable connections for positively operating said regulator from the air-pump-driving mechanism, substantially as described, for the purpose specified.

10. A gas-machine having in co operative combination the following instrumentalities, viz: an air-pump, flexible air-measuring chambers having direct connection therewith, the regulating cone-pulleys, valves controlled by said cone-pulleys, a generator connected with said air-pump, and a mixing-chamber connected with said air-measuring chambers, the operation being such as to cause the air-measuring chambers to be operated by an excess of air-pressure over the gas-pressure in the normal working of the machine, substantially as herein set forth.

11. The combination, in a gas-machine, of suitable air-measuring chambers having controlling-valves, an air-pump forcing air under pressure through said measuring-chambers, and a generator receiving air under pressure from said pump, with a governor device consisting of connected cone-pulleys and suitable mechanism connecting the latter with the said valves and with the air-pump, substantially as described, for the purpose specified.

12. In a gas-machine, the combination of a generator, an air-pump, its operating-motor, flexible air-measuring chambers, pipes for supplying air under pressure to the generator and to the measuring-chambers, a regulator composed of stepped cone-pulleys placed in reverse relation and connected by an adjustable belt, and having connection with said flexible chambers and with the pump-shaft, for operation in the way described.

13. The combination, in a gas-machine, of a generator and an air-pump and measuring and mixing chambers for the fluids, suitable pipe-connections for said parts, and valves arranged to control the operation of the air-measuring chambers with the cone-pulleys and their connecting-belt, all operating to control the movements of the measuring device, as described.

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

EDWARD B. DENNY.

Witnesses:
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H. B. ZEBELY.