(No Model.) 2 Sheets—Sheet 1.

A. B. GRIFFEN & W. C. CLARKE.

PROCESS OF CARBURETING AIR.

No. 487,617. Patented Dec. 6, 1892.

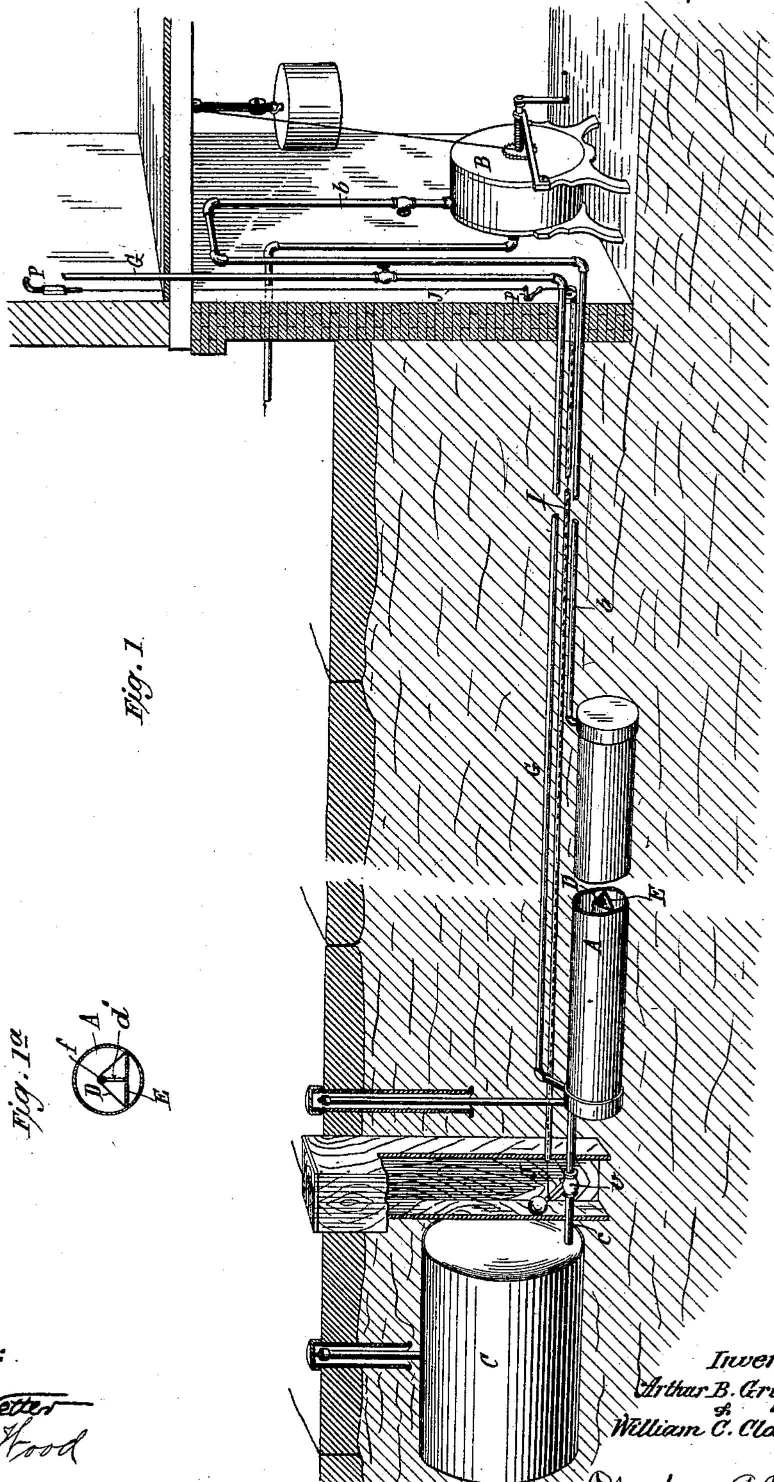

Fig. 1

Fig. 1a

Witnesses:
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Jesse T. Wood

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(No Model.) 2 Sheets—Sheet 2.

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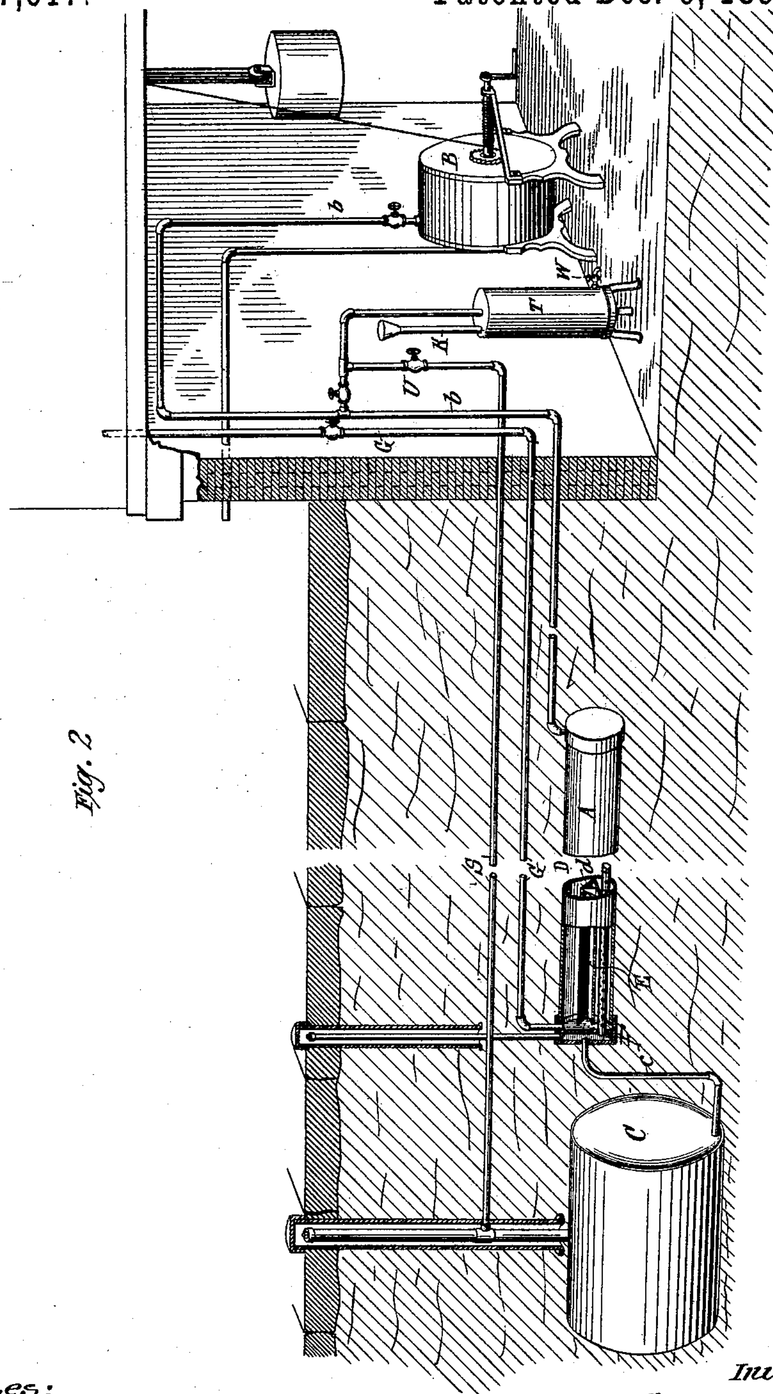

Fig. 2

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UNITED STATES PATENT OFFICE.

ARTHUR B. GRIFFEN, OF NEWARK, AND WILLIAM C. CLARKE, OF BLOOMFIELD, NEW JERSEY.

PROCESS OF CARBURETING AIR.

SPECIFICATION forming part of Letters Patent No. 487,617, dated December 6, 1892.

Application filed April 7, 1892. Serial No. 428,248. (No model.)

To all whom it may concern:

Be it known that we, ARTHUR B. GRIFFEN, of Newark, and WILLIAM C. CLARKE, of Bloomfield, New Jersey, both citizens of the United States, have jointly invented a certain new and useful Process of Carbureting Air, of which the following is a specification.

Our invention relates to the manufacture of that form of illuminating-gas commonly called "gasoline-gas," which is formed of a mixture of atmospheric air with the vapor of some volatile hydrocarbon, such as gasoline or naphtha; and it consists in a method of carbureting the air or impregnating it with the hydrocarbon vapor in such a manner that the quality or illuminating power of the gas produced is regulated or adjusted to a practically-uniform standard.

The general type of apparatus ordinarily used for making illuminating-gas by carbureting air with hydrocarbon vapor and which we propose to use in the practice of our invention consists of a closed vessel placed outside the building to be lighted and containing gasoline or some other proper liquid hydrocarbon, usually termed a "gas-generator or carburetor," and an air-forcing apparatus, commonly termed an "air-pump," the two being connected by a suitable pipe and the generator or carburetor being also connected by a suitable pipe with the distributing-pipes of the building to be lighted. Atmospheric air is forced by the air-pump under uniform pressure through the generator or carburetor, and in its passage over or through the liquid hydrocarbon contained therein takes up or becomes impregnated with the vapor of such hydrocarbon, and this vapor is carried on to the burners and produces light when burned. The amount of light produced from burning such a gas depends upon the proportion of the hydrocarbon vapor mixed with the air in the carburetor, and one of the most serious difficulties which has been encountered in the use of illuminating-gas produced in this way has been the great variation in the amount of hydrocarbon vapor taken up by a given volume of air under varying conditions. The main conditions affecting this are the extent of surface of the liquid exposed to the air in the carburetor, the temperature of the liquid and of the air, and the volatility or density of the hydrocarbon liquid. Variations in the condition last mentioned have been found the most troublesome to deal with in the practical use of such apparatus.

As is well known, gasoline and the other lighter products of petroleum are not homogeneous in the sense that all the parts or molecules of a given volume of the liquid are of the same specific gravity or volatility; but the liquid is made up of a great number of grades differing from each other in specific gravity and volatility, which are intimately mixed together mechanically, and, while the specific gravity of the liquid, as indicated by measuring-instruments, is in all parts the same, this is merely the average specific gravity of the different grades composing it. Ordinary commercial gasoline, for instance, having a specific gravity of about .63, is composed of a great number of different grades, some having a considerably-higher specific gravity and some having a considerably-lower specific gravity than that of the liquid taken as a whole, the specific gravity of .63 indicated by the measuring-instrument being merely the resultant or average of the various densities of all the different grades mixed together and forming the liquid. When a liquid of this composite character is placed in a gas-generator and atmospheric air is forced over or through it, the more volatile portions evaporate much more rapidly than the less volatile portions, and it results from this that the specific gravity of the gasoline constantly changes, becoming higher and higher during the process of evaporation of a given charge in the carburetor, and its volatility becomes less and less until the residuum becomes quite dense and evaporates quite slowly. Each cubic foot of air passed through the carburetor under these conditions will vaporize more of the gasoline, the temperature remaining constant, than any succeeding cubic foot of air. When the carburetor is first filled and the specific gravity of the gasoline is at its lowest point, a given volume of air will carry to the burners several times as much vapor as it will when the gasoline is nearly used up and its specific gravity is at its highest point. This results in a great variation in the quality of the gas produced, and if such a variable gas is burned through a fixed burner the character of the flame necessarily undergoes great variation.

If the burner is provided with a small orifice, so as to be suitable for burning the gas when it is rich in hydrocarbon vapor and of a high illuminating power, it will give a poor light when the gas becomes of lower illuminating power, and, on the other hand, if the burner used is provided with a large orifice, so as to be suitable for burning the gas when it is of a low illuminating power, the flame produced will be too large and will give off smoke when the gas is of a high illuminating power. The principal ways heretofore proposed for obviating this difficulty have been the use of adjustable burners and the use of what are termed "mixers." The adjustable burners employed for this purpose are so constructed that the effective orifice may be increased or diminished or the capacity of the burner otherwise adjusted so as to enable it to burn a gas of variable illuminating power. Such adjustment of the burner is troublesome and annoying to the consumer, and it is difficult, if not impossible, to construct a burner which can be adapted by any adjustment to produce the best results in illumination with any considerable range of variation in the illuminating power of the gas.

The mixer is a device for mixing air with the gas, which is interposed between the carburetor and the burners. In using devices of this kind fixed burners are employed having a sufficiently-large orifice to burn gas of low candle-power under proper conditions, and the air-mixing device is operated in such a way as to dilute the gas coming from the generator with air to a greater or less extent, so as to reduce it at all times to a substantially-uniform standard of low illuminating power. When the generator is first filled and the gas produced is rich in hydrocarbon vapor, a considerable quantity of air is introduced by the mixer; but as the density of the gasoline increases and the quantity of vapor taken up by the air in the carburetor diminishes the amount of air introduced by the mixer is reduced correspondingly until the gasoline in the carburetor is nearly used up, when no air at all is introduced by the mixer. This has proved to be a marked improvement upon the first plan, and, while the results produced by it are good when skillfully used, the apparatus employed is necessarily a somewhat complicated and expensive one, the cost being relatively greatest when applied to small machines.

By our improved method we are enabled to obviate the difficulty above referred to without the use either of adjustable burners or of any air-mixing device.

Instead of adjusting the burners so as to enable them to consume a gas of variable quality or manipulating a mixing device so as to correct variations in the quality of the gas produced in the generator, we regulate the production of the gas in the generator itself in such a manner that the gas produced is of a practically-uniform candle-power and suitable for combustion in fixed burners under conditions of the best efficiency and economy.

Our method consists, broadly stated, in regulating the specific gravity or the volatility of the liquid hydrocarbon contained in the generator so as to keep it at the point requisite for producing the proper amount of evaporation to impregnate or charge the air passing through the generator to a uniform degree by admitting to the carburetor fresh supplies of liquid hydrocarbon at proper intervals and in the required amounts, as determined by observation of the burners supplied.

Gas of uniform quality might theoretically be produced by admitting continuously to the generator a supply of hydrocarbon liquid of proper quality accurately proportioned in quantity to the volume of air passing through the generator at the time; but this would involve the constant presence of an attendant at the generator or the use of complicated and delicate automatic mechanism for graduating the supply of the liquid, either of which would be objectionable in the practical use of the apparatus, and we have found that substantially the same result may be reached by partially charging a carburetor of considerable capacity with a denser liquid which will act as an absorbent for the volatile hydrocarbon employed and admitting a supply of such volatile liquid to the carburetor at intervals instead of continuously.

We prefer to use as the absorbent liquid one of the heavier products of petroleum—such as benzine or kerosene—which will not vaporize to any substantial extent under the ordinary conditions of use of the apparatus, but will remain as a substantially-permanent charge in the carburetor. When gasoline is mixed with such heavier oil, it is dispersed through the entire mass of the heavier oil and becomes thoroughly incorporated with it mechanically by reason of the well-known physical law of affinity existing between the molecules of the different products of petroleum, and when air is passed through a carburetor charged with such a mixture the volatile part is evaporated, leaving most, if not all, of the heavier oil behind. The rate of evaporation, and consequently the amount of the vapor taken up by a given volume of the air, depends upon the amount of gasoline mixed with the heavier oil or absorbent liquid, and by varying the amount of the gasoline admitted to the carburetor under these conditions the rate of evaporation may be adjusted so as to produce any quality of gas required. What the proportions of the two liquids must be at any given time or under any given conditions in order to produce the desired result depends, among other things, upon the construction of the burners, the surface exposed to the air in the carburetor, and the temperature of the liquid and of the air; but the proportions can always readily be adjusted by observing the burners and admitting to the carburetor partially charged with the absorbent liquid just enough of the gasoline or other volatile liquid to bring the gas up to the standard required by the burners.

The absorbent liquid apparently acts in a certain sense as a balance-wheel to regulate and steady the evaporation of the more volatile liquid. If, for instance, a certain quantity of commercial gasoline relatively small as compared with the capacity of the apparatus were admitted to the carburetor by itself at intervals and each charge were evaporated, or nearly so, before the next was admitted, the quality of the gas produced would vary greatly during the consumption of each charge, being too rich at first and not rich enough near the last part of the operation; but we have found that this variation is much less and may readily be reduced within the practical limits of variation permissible with fixed burners when the same operation is performed with the carburetor partially charged with an absorbent liquid. This is probably due in part to the fact that the comparatively-large mass of the absorbent liquid serves to maintain a more uniform temperature by preventing the great lowering of the temperature which would otherwise be produced by rapid refrigeration due to evaporation in the relatively-small mass of the active liquid and in part to the maintenance of a more uniform surface of evaporation.

It is not necessary in order to produce a gas suitable for burning with fixed burners that the quality of the gas should be maintained at an absolutely-uniform standard, since such burners admit of a certain limited range of variation in the quality of the gas without materially affecting their operation, and our method of adjusting or regulating the quality of the gas consists in admitting to the carburetor partially charged with the absorbent liquid supplies of the gasoline or other volatile liquid in such quantities and at such intervals as are requisite for keeping the variations in the quality of the gas within such permissible limits. We have shown in the drawings a form of apparatus which we have devised for practicing this method and which we have found convenient for this purpose; but it will be understood that our present invention is not limited to this or any particular form of apparatus.

Referring to the drawings, Figure 1 shows an elevation of one form of apparatus which may be employed in carrying our process into effect. Fig. 1[a] shows a transverse section of the carburetor shown in Fig. 1; and Fig. 2 shows an elevation of a somewhat-different form of apparatus, the outer shell of the carburetor being indicated as broken away to show its interior construction.

The same letters of reference indicate corresponding parts throughout the drawings.

A is a carburetor, consisting of a closed tubular vessel.

B is an air-pump, which may be of any well-known form—such as a meter-wheel driven by a weight—and from which a pipe *b* extends to the carburetor.

C is a storage or supply tank for containing the gasoline or other volatile hydrocarbon. It is connected with the carburetor by a pipe *c*. The pipe *c* may discharge directly into the carburetor, or, as shown in Fig. 2 of the drawings, it may discharge into the upper part of a chamber F, from the bottom of which a perforated pipe *g* extends lengthwise through the carburetor. By this means a quicker admixture of the liquid is secured and the siphoning of the liquid from the carburetor back into the storage-tank, where the latter is located below the level of the carburetor is prevented.

In the form of the apparatus shown in Fig. 1 a valve *v* is placed in the pipe *c*.

In order to give a greater evaporating-surface, the carburetor may be supplied with sheets of fibrous material D, stretched over frames *d* and fastened to a board E, running lengthwise through the carburetor.

In starting the apparatus the carburetor A is first partially filled with benzine or other similar heavy product of petroleum, which serves as an absorbent for the gasoline. Air is then passed through the carburetor from the air-pump B, and gasoline is admitted from the supply-tank C by opening the valve *v* until such an amount is present in the carburetor that the air passing through is sufficiently charged with the gasoline-vapor to give a clear illuminating flame at the burners, when the valve *v* is closed and the further admission of gasoline is cut off. The apparatus will now run without sensible deterioration in the quality of the gas for a certain length of time, which is dependent upon the amount of gas used and other conditions, the absorbent liquid in the carburetor serving to equalize the evaporation of the gasoline until the greater part of it has been consumed. When by reason of the diminution of the amount of gasoline in the carburetor the rate of evaporation decreases to such an extent that the quality of the gas is sensibly lowered, as indicated by the flame of the burners becoming bluish, the valve *v* is again opened until by the admission of a fresh supply of gasoline the quality of the gas is restored to the required standard, as indicated by the normal operation of the burners, and the operation is repeated from time to time, as may be required.

The valve *v* is manipulated in accordance with the indications of the burners, and in order that this may be done conveniently where, as is usually the case, the storage-tank and carburetor are outside the building lighted and at some distance from it the valve must be connected with some device in the building or in the vicinity of the burners operated by the machine for manipulating it.

We have shown the valve as provided with a counterweight for closing it and a bell-pull P in the building for opening it. The wire J connecting the bell-pull with the valve is inclosed in the pipe I. We do not wish, however, to be limited to the particular device described for manipulating the valve from the building lighted, since the same result may be accomplished in a variety of other ways—as, for instance, the valve may be operated by pneumatic or hydraulic pressure or by electro-magnetism under the control of a suitable device in the building, or a loop of the pipe connecting the tank with the carburetor may be taken into the building and the valve itself be placed in the building.

In Fig. 2 we have shown a form of apparatus by which the same result may be secured without the use of any valve in the pipe connecting the storage-tank with the carburetor. The storage-tank is placed at a lower level than the carburetor, and an air-pressure pipe S extends from the building to the upper part of the storage-tank. Within the building the pressure-pipe is connected with the upper part of a closed vessel T. This vessel is provided with a pipe K, extending to near the bottom of the vessel T, and has a funnel at its upper end. When water or some other heavy liquid is poured into the funnel, the air is displaced from the vessel T, and, passing through the pressure-pipe S, exerts a pressure on the gasoline in the storage-tank and drives a certain part of it into the carburetor. The amount of gasoline so transferred depends upon the amount of water admitted into the vessel T, and may thus be graduated to any desired amount. When the vessel T is full, the water may be drawn off at the cock W at the bottom and used over again in the same way, the valve U in the pressure-pipe being closed when the water is drawn off to prevent the backflow of air from the storage-tank. This form of apparatus is used in substantially the same way, so far as our method is concerned, as that shown in Fig. 1. The essential point, so far as this part of our apparatus is concerned, is that the admission of fresh supplies of gasoline to the carburetor shall be under control from the building lighted, so that it may be manipulated by observation of the burners.

It will be observed that all the mechanical manipulation required by our method of regulation is extremely simple and does not require any special skill, any person of ordinary intelligence being able to tell when the burners are not giving a proper flame and to graduate the admission of fresh supplies of gasoline with very little practice, so as to keep the quality of the gas at the required standard.

While we have found the use of benzine as the absorbent liquid to be employed advantageous, we do not limit ourselves to the use of this liquid or of any particular liquid as an absorbent, but may employ other of the heavier distillates of petroleum or petroleum itself or such other liquid as will act as an absorbent of and will readily release the volatile hydrocarbon employed to carburet the air.

In cases where a comparatively-heavy not-easily-vaporizable residuum is left after the partial evaporation of such a hydrocarbon liquid as is sometimes sold under the name of "gasoline" such residuum may be used under proper conditions as the absorbent liquid; but we prefer to use in all cases an absorbent liquid which does not vaporize to any appreciable extent under the ordinary conditions of use of the apparatus, but remains in the carburetor as a substantially-permanent charge, since we have found this to produce the best results in practice.

It is obvious that our invention is applicable to carbureting coal-gas or other forms of illuminating-gas, as well as to carbureting air.

We are aware that storage-tanks have been used in connection with gas-generators; but so far as our knowledge goes the gasoline has not been admitted from the tank to the carburetor in such a way as to regulate the quality of the gas, as contemplated by us, and the admission of the gasoline has not been under control from the building lighted or the vicinity of the burners. Where automatic regulators have been used for controlling the admission of gasoline to the carburetor, they have been designed to operate in such a manner as to maintain a substantially-constant quantity of gasoline or other hydrocarbon in the carburetor, and this would not result in the production of a uniform quality of gas, since at different seasons of the year and with variations in the draft on the apparatus it is necessary to vary the charge of fresh gasoline in order to maintain the required standard of volatility. By our method of admitting the fresh supplies of gasoline in accordance with the indications furnished by the burners themselves we are enabled to compensate for all disturbing causes affecting the quality of the gas, and we also dispense with the use of all automatic controlling devices, which are especially objectionable in apparatus of this character.

We do not claim herein any features of the apparatus described herein, but have made the same the subject of an application for Letters Patent filed October 27, 1892, Serial No. 450,130, and of other applications filed of even date herewith, Serial Nos. 428,249, 428,250, and 428,251.

What we claim is—

1. The method of producing from the lighter products of petroleum gas of substantially-uniform illuminating power, which consists in charging a carburetor located outside the building lighted or at a distance from the burners with an absorbent liquid not sufficiently vola-

tile to produce the desired quality of gas, charging such absorbent liquid with a more volatile hydrocarbon, passing air through the carburetor charged with such mixture, and regulating the amount of hydrocarbon vapor in the resulting product by admitting fresh supplies of the volatile hydrocarbon at proper intervals and in proper amounts, as determined by observation of the burners, and by manipulations performed in the vicinity thereof, substantially as described.

2. The method of regulating to a practically-uniform standard the volatility of the hydrocarbon liquid in a carburetor for carbureting air, which consists in charging the carburetor with an absorbent liquid not sufficiently vaporizable to produce the desired quality of vapor and charging such absorbent with supplies of volatile hydrocarbon at proper intervals and in proper amounts, as determined by observation of the burners, and by manipulations performed in the vicinity thereof, substantially as described.

3. The method of regulating to a practically-uniform standard the volatility of the hydrocarbon liquid in a carburetor for carbureting air, which consists in charging the carburetor with an absorbent liquid which is substantially unvaporizable under the ordinary conditions of use and charging such absorbent liquid with supplies of volatile hydrocarbon at proper intervals and in proper amounts, as determined by observation of the burners.

4. The method of producing carbureted air of substantially-uniform illuminating power, which consists in charging a carburetor with an absorbent liquid which is substantially unvaporizable under the ordinary conditions of use, charging such absorbent liquid with a volatile hydrocarbon, passing air through the carburetor charged with such mixture, and regulating the amount of hydrocarbon vapor in the resulting product by admitting fresh supplies of the volatile hydrocarbon at proper intervals and in proper amounts, as determined by observation of the burners, and by manipulations performed in the vicinity thereof, substantially as described.

In testimony whereof we have hereunto subscribed our names this 8th day of February, A. D. 1892.

ARTHUR B. GRIFFEN.
WILLIAM C. CLARKE.

Witnesses:
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JESSIE T. WOOD.