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PATENTED NOV. 5, 1907.

G. W. BULLEY.
GAS PRODUCER.

APPLICATION FILED DEC. 18, 1906.

2 SHEETS—SHEET 1.

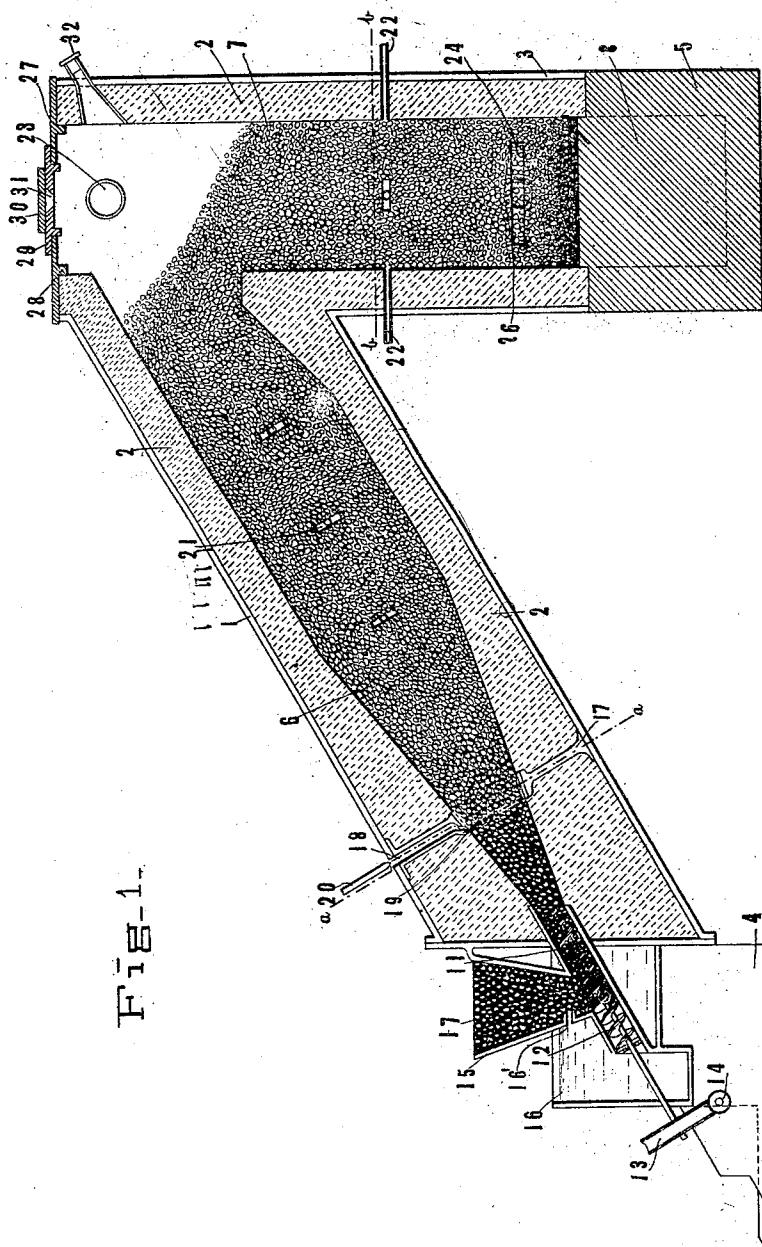


Fig. 1-

WITNESSES

Korringa
Arthur G. Frewin

INVENTOR

G. W. Bulley
BY
Arthur G. Frewin
ATTORNEYS.

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2 SHEETS—SHEET 2.

Fig-3-

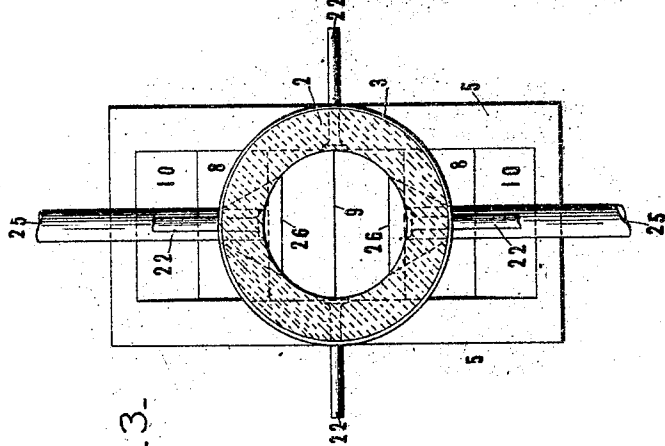


Fig-4-

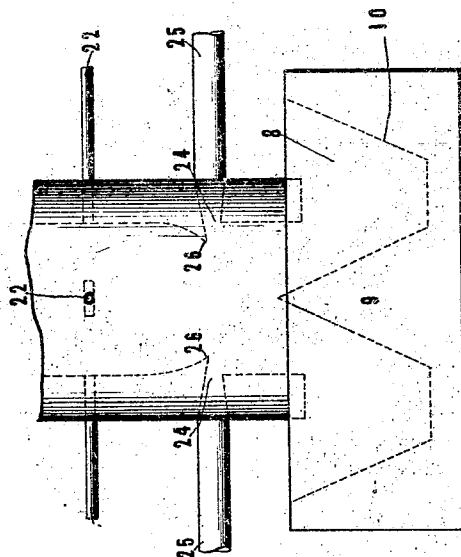
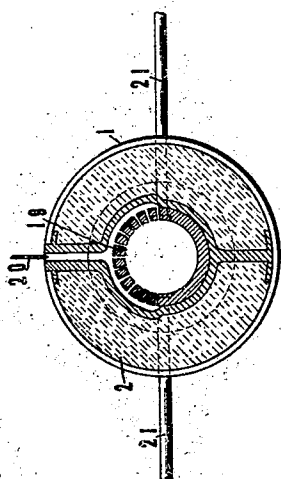


Fig-2-



WITNESSES

Arthur G. Previn

INVENTOR

G. W. Bulley
BY *Dual. Whorfild & Dual*
ATTORNEYS.

UNITED STATES PATENT OFFICE.

GEORGE W. BULLEY, OF NEW YORK, N. Y.

GAS-PRODUCER.

No. 870,271.

Specification of Letters Patent.

Patented Nov. 5, 1907.

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To all whom it may concern:

Be it known that I, GEORGE W. BULLEY, residing at New York, in the county of Kings and State of New York, have invented certain new and useful Improvements in Gas-Producers, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates broadly to the production of combustible gases, but more especially to apparatus employed for generating the same.

One of the objects of my invention is to provide a new and improved generator for producing gases of the above character by the incomplete combustion and dry distillation of coal, wood, peat or other solid organic substances.

Another object is to provide a generator wherein greater quantities of permanent inflammable gases may be produced than have been produced in generators as hitherto constructed.

Another object is to construct a gas generator of the above type from which may be taken producer gases and gases of a more permanent and stable character, the latter being suitable for gas engine work or for analogous purposes.

A further object is to provide a generator wherein a substantially continuous generation of gas may be obtained with a minimum amount of care and attendance.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts which will be exemplified in the apparatus hereinafter set forth, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, wherein is illustrated one of the various possible embodiments of my invention,—Figure 1 is a view in vertical section taken longitudinally of the generator. Fig. 2 is a sectional view taken substantially on line *a—b* of Fig. 1. Fig. 3 is a horizontal sectional view taken substantially on line *b—b* of Fig. 1, looking in a downward direction. Fig. 4 is a view in elevation of the lower portion of one end of the generator.

Similar reference characters refer to similar parts throughout the several figures of the drawings.

In the accompanying drawings, 1 represents a furnace constructed of fire-clay or other highly refractory material, one leg 2 of which is preferably set in an upwardly inclined position and having another leg 3 disposed vertically. These legs rest upon suitable masonry bases 4 and 5 respectively. The retort or generating chamber 6 is located in leg 2 of the furnace, and is shown as constricted at its lower end and increasing in diameter from the lower constricted portion toward the upper end, where it leads into a vertical chamber 7. Below the

lower end of vertical chamber 7 in the present instance is provided a receptacle 8 designed to contain water, which acts both as a water seal and as a medium for quenching spent carbonized material or ash which falls therein after passing downwardly through said vertical chamber. Arranged in the bottom of receptacle 8 in the central portion thereof and extending upwardly above the lower end of the vertical chamber is a tapering abutment 9 adapted to discharge the ash or spent material at either side of the receptacle, which has its inner walls divergent, as at 10, to permit of the convenient removal of the spent carbonized material from the receptacle. This latter operation may be readily accomplished by raking the ash up the divergent sides of the receptacle which, as shown, are located outside of the walls of the vertical chamber.

Leading into the lower end of generating chamber 6 is a conduit 11, in which is located the stoker employed for introducing fuel into said chamber. The stoker in the present instance is shown as an Archimedean screw 12 suitably driven, as by worm-wheels 13 and 14 which receive power from any suitable source of supply. The fuel, which in the present instance is shown as coal, is delivered from hopper 15 into conduit 11 and between the flights of the Archimedean screw, to be carried thereby upwardly into the generating chamber. The lower end of conduit 11 leads from a receptacle 16 which contains water, the level of which is kept above an opening 16' which communicates with the interior of hopper 15, thus effecting a water seal for the lower end of the generating chamber.

Located near the lower end of leg 2 of the furnace and preferably intermediate the ends thereof is a twyer block 17 recessed, as at 18, in its upper portion. Leading rearwardly and downwardly from the bottom or recess 18 of twyer block 17 are a plurality of twyer openings 19, said openings in the present instance being disposed within said twyer block through an arc of substantially 180°. It will be understood, of course, that the twyer openings may be disposed about the generating chamber through any desired arc or arranged entirely about the same. It will be noted that the form and disposition of the twyer openings are such that the entering air blast will be deflected in a downward direction toward the incoming fresh fuel, the purpose of which will be made apparent hereinafter. Steam may also, if desired, be forced into the generating chamber through the twyer openings by means of suitable jets 20, one of which is shown.

Auxiliary twyer openings 21 are also provided in leg 2 of the furnace which lead into the generating chamber at suitable locations throughout its extent, and similar auxiliary twyers 22 may lead into the vertical chamber.

Leading from the upper portion of the generating chamber is a gas exit opening 23 from which may extend a suitable conducting conduit, and second gas

exit openings 24 are provided in the lower portion of vertical chamber 7 from which lead conduits 25. The inner walls of the vertical chamber are preferably formed with shoulders 26 which project over the mouths of gas exits 24 and prevent the carbonized material from entering therein and thus choking the flow of gas. It will be noted that the gas exit openings provided in the lower portion of the chamber and the several auxiliary twyer openings which discharge into the generating chamber are formed rectangular at their inner ends but merge into circular form without the walls of the furnace.

The upper portion of the furnace is provided with a manhole 27 which leads into the generating chamber, said manhole in the present instance being closed by means of a plurality of superimposed plates 28, 29 and 30; the uppermost thereof covering a poke or sight hole 31 provided in the intermediate plate 29. A second poke or sight hole is shown at 32, and of course sight holes may be provided for the furnace at any desirable portion of the furnace, by means of which the condition of the interior may be observed.

Having thus described the construction of this embodiment of my invention, the operation thereof may now be understood.

In starting the operation of the generator, kindlings are first introduced into the lower portion thereof and the generator thereafter filled with coke, which may be conveniently introduced through manhole 27. The kindlings are then ignited and the coke brought to the required degree of incandescence. Fresh fuel is then introduced into hopper 15 and falls therethrough into conduit 11. The Archimedean screw, which in the present instance operates as a stoker, is then set in operation and the coal fed into the lower portion of the generating chamber behind the incandescent coke. The blast twyers are then set in operation. At this point it may be noted that inasmuch as the ingoing air due to the disposition of the twyer openings is deflected in a downward direction, the seat of combustion is to a large extent confined to the portion of the generating chamber between the point of introduction of fuel and said twyer openings. It may be also pertinent to note at this point that the air blast is regulated to admit only enough air into the combustion chamber to sustain an incomplete combustion of the carbonaceous material, and that distillation of the volatile constituents of the fuel takes place simultaneously with the incomplete combustion. The fuel, being constantly fed into the generating chamber behind the portion thereof carbonized at the seat of combustion, is fed progressively past the seat of combustion and along the incline of the generating chamber, and upon reaching the uppermost portion of said chamber it tumbles into the vertical leg thereof. The carbonized material or coke may be burned off to any desired extent by admitting air to the interior of the generating chamber through any or all of the auxiliary twyer openings which lead into the generating chamber. The admission of air through these latter twyer openings, as will be understood, will be suitably controlled by means of dampers.

The fuel, as it is fed through the inclined leg of the generating chamber past the seat of combustion, is carbonized by the incomplete combustion taking place thereat and by the distillation of its hydrocarbon con-

stituents, and these hydrocarbon constituents in the presence of the air issuing through the twyer openings are decomposed to form carbon dioxide. The carbonized material or coke is also forced from the seat of combustion through the generating chamber in a highly heated or incandescent condition, and the carbon dioxide infiltrating through this body of incandescent carbonized material is converted into carbon monoxide before reaching the upper portion of said chamber. The carbonaceous material within the generating chamber when the producer is in operation may be said to be divided into the portions, namely, an uncarbonized portion at the lower end of the generating chamber, a substantially carbonized portion in the upper portion thereof, and a partly carbonized portion between the uncarbonized and the carbonized portions.

The carbon monoxide generated at the seat of combustion through the incomplete combustion of the fuel, passes through the incandescent mass and reaches the upper portion of the chamber in an unchanged condition. It may also be noted that the coal when introduced into the generating chamber, being saturated by passing through the water seal, is introduced into the generating chamber in a saturated condition, and the hydrogen which results from the decomposition of the steam into which this water is formed passes up through the incandescent carbonized material unchanged. The gas produced in the generating chamber, from which a large portion of the incombustible impurities have been removed and which is suitable to be used as a producer gas, may be taken from the generating chamber through conduit 23, and the more permanent gases are preferably taken from the generating chamber through the exit openings provided in the lower portion of the vertical chamber inasmuch as these latter gases will be cracked or converted into more fixed or permanent gases by their further infiltration through the incandescent carbonized mass located within said vertical chamber. It will of course be understood that, if desired, gas taken from either of the exit openings 23 or 25 respectively may be led through suitable washing or purifying apparatus, or that they may be led directly to the apparatus in which they are to be utilized.

It will thus be seen that I have provided apparatus wherein the volatile constituents of coal, wood, coke or other preferably solid carbonaceous substances may be converted into producer gases or into more valuable permanent inflammable gases with practically no loss of the volatile constituents of said carbonaceous substances. The hydrocarbons present in the fuel are oxidized and converted into hydrogen and carbon monoxide, and any water present in the fuel is decomposed and the hydrocarbon constituents thereof liberated by the passage of the steam into which the water is formed through the incandescent body of carbonized material. Moreover, since the distillation of the hydrocarbons present in the coal takes place in a zone wherein free oxygen is present, some of them are decomposed and converted into carbon dioxide, which in its passage through the incandescent carbonized mass is converted into carbon monoxide before it reaches the exit opening.

One of the advantages accruing by reason of the construction of my apparatus as described resides in the fact that more pure stable gases such as carbon monoxide and hydrogen are generated than with apparatus hitherto-

to provided, thus largely obviating the necessity for the employment of purifying apparatus or operations to wash or otherwise separate the non-stable and decomposed constituents from the gas before the same may be economically utilized. The gas formed within said chamber is substantially free from water, tar and other unstable substances, and the portion of the hydrocarbon content of the fuel converted into carbon dioxide by the incomplete combustion taking place within the generating chamber is in turn converted into carbon monoxide by its contact with or infiltration through the carbonized incandescent material present in the generating chamber above the seat of combustion. Another important advantage obtained by reason of the employment of my improved apparatus as described lies in the fact that the fuel, being introduced behind the incandescent body of carbonized material, is gradually heated before its arrival at the seat of combustion and therefore does not affect the continuity of the generation of gas. The advantages of the continuous and uniform feed of fuel past the seat of combustion and the expense saved as regards the matter of care and attendance are obvious. Since the fuel is constantly fed behind the bed of coke, said bed is kept in a compact condition, thus eliminating the necessity for frequent poking to remove channels in the bed. Moreover, the inclined position of the combustion chamber furnishes a natural course for the gas to pass through the body of incandescent carbonized material therein. Still another important advantage inherent in my apparatus resides in the fact that I am enabled to draw from the generator two qualities of gas, one suitable for use in blast furnaces or for analogous purposes being withdrawn from the upper portion of the generator, while the permanent or fixed gases suitable for gas engine work may be withdrawn from the lower portion of the vertical chamber. This latter gas, being withdrawn from the generator in proximity to the water in the ash receptacle, will lose a large portion of its heat and consequently leave the generator in a comparatively cool condition.

It will be further understood of course that, if desired, steam may be introduced at the seat of combustion by means of the jets arranged above the tuyere openings, and although I now prefer to introduce air only through said tuyeres and feed the fresh fuel through the water seal, thus obtaining hydrogen to enrich the gas from the decomposition of the water carried into the generating chamber by said fuel, it may in some instances be desirable to omit the water seal and use a steam and air blast through the tuyere openings at the seat of combustion, or in certain cases to accomplish a similar result by admitting the air or air and steam through a hollow shaft which carries the flights of the stoker, the end of the shaft nearest the firing chamber having an opening in the form of an annular ring or a plurality of openings for directing the blast at an angle to the axis of rotation of the stoker. I wish it also to be understood that in practice the angle of the inclined leg of the furnace may be changed at will to meet different conditions, although for obvious reasons it will be preferably retained inclined with respect to the vertical.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without

departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense. It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a gas producer, the combination of a furnace having an upwardly inclined generating chamber adapted to contain a body of incandescent carbonized material, said chamber being provided with a seat of combustion intermediate the ends thereof, a water seal provided at the lower end of said chamber, and means for introducing fresh fuel through said water seal into said chamber adapted to feed the same progressively past said seat of combustion.
2. In a gas producer, in combination, a furnace having an upwardly inclined generating chamber adapted to contain a body of incandescent coke, said furnace being provided intermediate its ends with a plurality of blast tuyeres adapted to deflect the entering air in a downward direction, and means for introducing fresh fuel into said generating chamber behind said incandescent coke and for feeding the same progressively past said blast tuyeres.
3. In a gas producer, the combination of a generating chamber adapted to contain a body of incandescent coke, a water seal in the lower portion of said generating chamber, means for introducing fuel into the lower portion of said generating chamber through said water seal and behind said incandescent coke, said means being adapted for progressively feeding the fuel in an upward direction within said chamber, a receptacle leading from the upper portion of said chamber into which said coke is continuously discharged, and a water seal located at the bottom of said receptacle.
4. In a gas producer, the combination of a generating chamber having an upwardly inclined leg and a vertically disposed leg leading therefrom, said chamber being constructed to receive a body of incandescent coke, means for introducing fresh fuel into said upwardly inclined chamber at the lower portion thereof and for feeding the same in an upwardly direction, whereby said coke is continuously discharged into said vertical leg, a gas exit opening located at the upper end of said upwardly inclined leg and a gas exit opening located at the lower portion of said vertical leg.
5. In a gas producer, the combination of a retort comprising an upwardly inclined leg and a vertically disposed leg leading from the former at the upper portion thereof, said retort being adapted to contain a carbonaceous material in a carbonized state, means for introducing fresh carbonaceous material behind the carbonized portion thereof and progressively feeding the same through the upwardly inclined portion of said retort, whereby the carbonized portion thereof is discharged into said vertical chamber, a gas delivery opening in the upper end of said upwardly inclined chamber, and a second gas delivery opening at the lower portion of said vertical chamber.
6. In a gas producer, the combination of a retort having an upwardly inclined chamber and a vertically disposed chamber leading therefrom, a water seal provided at the lower portion of said upwardly inclined chamber, and a water seal provided at the lower portion of said vertical chamber, said retort being adapted to contain a carbonaceous mass in an incandescent condition, a seat of combustion formed within the upwardly inclined portion of said retort intermediate the ends thereof, means for introducing fresh carbonaceous material behind the carbonized portion thereof and for feeding the same progressively in an upward direction past said seat of combustion, whereby the carbonized portion of said mass is discharged into said vertical chamber, and gas delivery openings provided in each of said chambers.

7. In a gas producer, the combination of a retort having an upwardly inclined generating chamber and a vertical chamber leading therefrom at the upper end thereof, said retort being adapted to contain carbonized material in an incandescent carbonized state, means for introducing fresh carbonaceous material behind the carbonized portion thereof, and means for discharging air into said retort at a point between the carbonized and uncarbonized portions of said carbonaceous material and for directing the same towards the point of introduction of said carbonaceous material.

8. In a gas producer, the combination of a retort having an upwardly inclined chamber and a vertical chamber leading therefrom at its upper end, said retort being constructed to contain carbonaceous material in an incandescent carbonized condition, a plurality of blast tuyers located intermediate the ends of said upwardly inclined chamber, and means for introducing fresh carbonaceous material into the lower portion of the latter chamber and for feeding the same progressively past said blast tuyers.

9. In a gas producer, the combination of a retort comprising an upwardly inclined chamber and a vertical chamber, said retort being adapted to contain a mass of incandescent carbonaceous material, a fuel receiving opening in the lower portion of said upwardly inclined chamber, an ash delivery receptacle at the lower portion of said vertical chamber, means for introducing fresh carbonaceous material into the former chamber and for feeding the same progressively therethrough, whereby said carbonaceous material when carbonized is continuously discharged into said vertical chamber, and water seals provided at the lower end of each of said chambers.

10. In a gas producer, the combination of a retort comprising a vertical chamber and an upwardly inclined chamber leading thereinto, said retort being constructed to contain carbonaceous material in an incandescent condition, means for introducing fresh carbonaceous material into the lower portion of said upwardly inclined chamber, a plurality of blast tuyers located in said retort above the point of introduction of said carbonaceous material and below the carbonized portion thereof, said last named means being adapted to feed said fuel progressively past said blast tuyers whereby the carbonized portion thereof is continuously discharged into said vertical chamber, means for discharging gas at the upper portion of said retort, and means for discharging gas at the lower portion of the vertical chamber thereof.

11. In a gas producer, the combination of a retort having a vertical leg and an upwardly inclined leg leading thereinto, a water seal for the lower end of said vertical chamber, a water seal for the lower end of said upwardly inclined chamber, a fuel receiving opening leading into said chamber from said last-named water seal, an ash receiving receptacle located in the lower portion of said vertical chamber, blast tuyers located intermediate the ends of said upwardly inclined chamber, a gas delivery opening located in the upper portion of said retort, and a gas delivery opening leading from the lower portion of said vertical chamber.

12. In a gas producer, the combination of a retort having a vertical chamber and an upwardly inclined chamber leading thereinto, said retort being adapted to contain carbonaceous material in an incandescent condition, means for feeding fresh carbonaceous material behind the incandescent portion thereof, blast tuyers located above the point of introduction of said carbonaceous material and below the incandescent portion thereof, auxiliary blast tuyers located above said first named blast tuyers, gas exit openings leading from said retort at the upper portion thereof and at the lower portion of said vertical chamber, and a water seal provided at the lower portion of said upwardly inclined chamber and at the corresponding portion of said vertical chamber.

13. In a gas producer, the combination of a retort having a vertical chamber and an upwardly inclined chamber leading thereinto, said retort being adapted to contain carbonaceous material in an incandescent state, means for feeding fresh carbonaceous material behind the incandescent portion thereof, blast tuyers located above the point of introduction of said carbonaceous material and below the incandescent portion thereof, auxiliary blast tuyers leading into the upwardly inclined chamber, auxiliary blast tuyers leading into the vertical chamber, gas exit openings leading from said retort at the upper portion thereof and other gas exit openings leading from the vertical chamber at its lower portion, and a water seal for said vertical chamber below the latter gas exit openings.

In testimony whereof I affix my signature, in the presence of two witnesses.

GEORGE W. BULLEY.

Witnesses:

C. H. WILSON,
H. M. SEAMANS.