2 Sheets—Sheet 1.

A. J. WORKS & H. A. DANIELS.

APPARATUS FOR AND PROCESS OF GENERATING AND BURNING VAPOR FUEL.

No. 110,946. Patented Jan. 10, 1871.

Fig. 2.

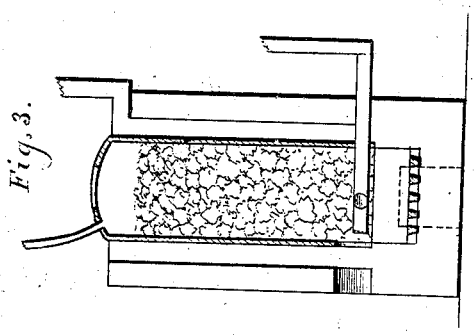
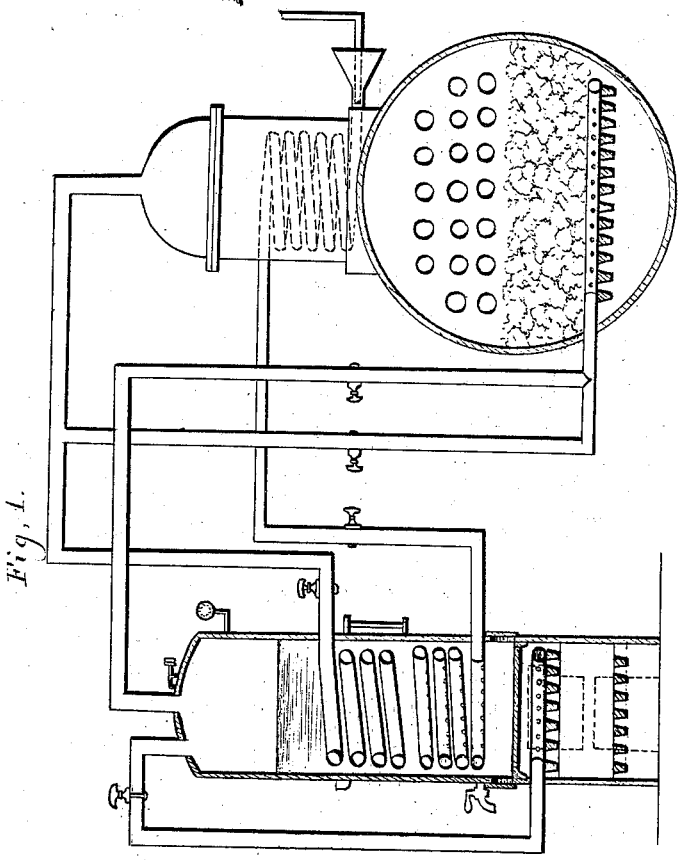


Fig. 3.

Fig. 1.



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2 Sheets—Sheet 2.

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APPARATUS FOR AND PROCESS OF GENERATING AND BURNING VAPOR FUEL.

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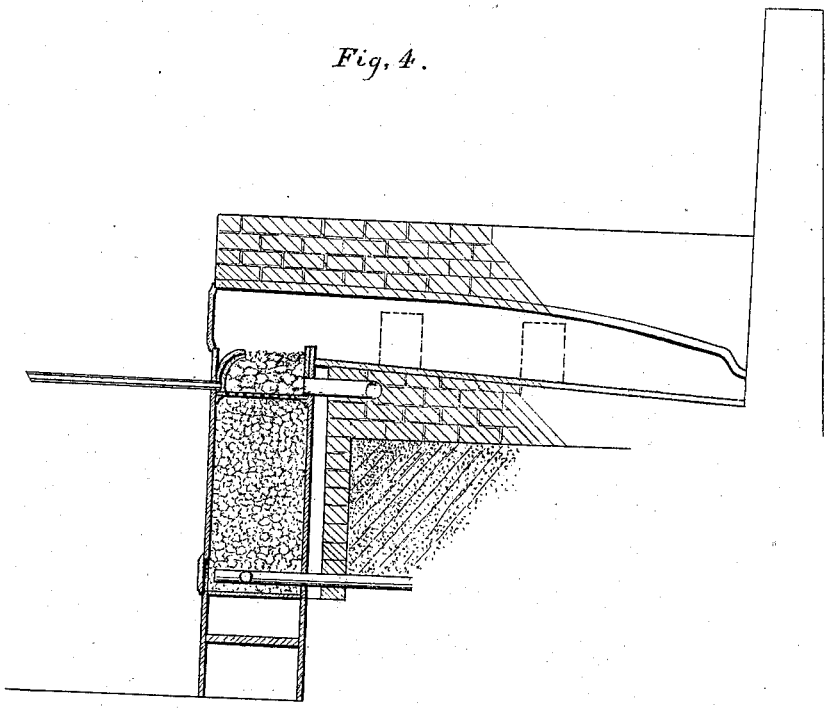
Fig, 4.



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United States Patent Office.

ALFRED J. WORKS, OF NEW YORK, N. Y., AND HENRY A. DANIELS, OF WASHINGTON DISTRICT OF COLUMBIA, ASSIGNORS TO THE UNITED STATES VAPOR-FUEL COMPANY, OF NEW YORK CITY.

Letters Patent No. 110,946, dated January 10, 1871.

IMPROVEMENT IN APPARATUS AND PROCESSES FOR GENERATING AND BURNING VAPOR FUEL.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that we, ALFRED J. WORKS, of New York City, N. Y., and HENRY A. DANIELS, of Washington, District of Columbia, have invented an Apparatus and Process for Generating and Burning Vapor-Fuel; and do hereby declare that the following description, taken in connection with the accompanying drawing, hereinafter referred to, forms a full and exact specification of the same, wherein we have set forth the nature and principles of our said improvement, by which our invention may be distinguished from others of a similar class, together with such parts as we claim and desire to secure by Letters Patent.

The nature of our invention relates to the production and method of burning what is denominated "carbureted oxy-hydrogen vapor" as fuel for metallurgic uses, for the generation of steam, and for other purposes; and its several features consists in—

First, generating gas and vapor by introducing into the body of the hydrocarbon liquid, in minute jets, a current of air from a superheater, which is located preferably in the dome of the steam-boiler simultaneously with the application of fire-heat to a generator containing the carbonaceous or olefiant substance;

Second, maintaining the contents of the generator at a very high temperature by the combination of steam-heat with a fire-heat, either from solid or vapor fuel;

Third, a self-feeding vapor-burner;

Fourth, providing a generator with double grate-bars, so that it may be heated either with solid or vapor-fuel, or both;

Fifth, employing steam to clean out the pipes and to promote combustion, and by a surplus thereof instantly to extinguish all fire in the combustion-chamber;

Sixth, passing the elements of combustion through refractory or incombustible material, at or near the the point of combustion; and

Seventh, combining a gas or vapor-purifier with superheating, decomposng, and refractory materials.

In the drawing accompanying this specification—

Figure 1 represents a vertical section of our apparatus;

Figure 2, a top view of the burner;

Figure 3, the gas-purifier; and

Figure 4, the apparatus as applied to metallurgic uses.

The three elements of combustion above named (carbonic, oxygen, and hydrogen vapors) we unite, by preference, at the place and moment of combustion, in the form of a compound gas or vapor. However, when more convenient, they may be combined at any earlier stage, all other conditions remaining the same.

In order to obtain the requisite amount of carbonic vapor, we use any liquid, semi-liquid, or liquefiable hydrocarbon whatever, such as tar, mineral-oils, the residuum of gas-works, of oil-refineries, the distillations from coal or shale, or any of the olefiant substance so liberally scattered over the world.

We are aware that the production and burning of the simple vapors from the above and similar materials is not new, and the manner of producing the oxy-hydrogen flame is also well known; but the method of obtaining in sufficient quantity these latter elements, and properly carbonizing them, all in a simple economical manner, and of combining and using this compound product constitute the chief features of this invention.

As another valuable feature of this invention illuminating-gas of excellent quality may be also produced from almost any liquid hydrocarbon.

In the manufacture of this gas steam is chiefly used, if at all, to heat or vaporize the liquid, rarely to mix with or dilute the product; fuel, of its own production, or any other, may be used to run the apparatus.

The only other material change from the foregoing to be noted here is, providing a suitable conduit, so as to convey the gas to a reservoir. Into said reservoir, by any of the ordinary methods, may be injected and properly intermixed, the requisite amount of atmospheric air necessary to reduce the hydrocarbon gas to the point of greatest economy, and thus develop its utmost brilliancy and illuminating power.

Whenever the basis of this gas or vapor is of that character that the product requires purifying, then such product is passed through a "purifier," which will be hereafter described.

The supply need only be limited by the demand, the capacity of the apparatus, and the material used in its manufacture.

The manner of operating our new fuel system, and of constructing the apparatus therefor, we will now proceed to describe.

A suitable generator, capable of holding from seventy-five gallons upward, is constructed of boiler-plate iron, and of sufficient strength to resist at least fifty pounds' pressure to the inch. This is filled about two-thirds full of whatever hydrocarbon it is designed to use.

To the generator, after the manner of steam-boilers,

must be attached regular steam and water-gauges, as well as a means of refilling, and also cleaning out, by steam or other well-known methods, the sediment, which after a time, may collect at the bottom.

Presuming the generator to be a vertical one, we fix therein, about six or eight inches from its base, a continuation of the conduit, which connects the generator with a metallic separator, arranged preferably within the dome of the steam-boiler, but which may be located within the smoke-stack or other convenient part of the furnace.

It is immaterial in what particular manner this conduit is arranged within the generator, care being taken, however, that it affords a surface sufficient for the heat from the superheater to assist most readily and effectually in the vaporizing process. Thus the current, passing through the conduit, first evolves a great quantity of heat, and afterward is minutely diffused in jets throughout the body of fluid hydrocarbon.

On the sides of this conduit are pierced numerous equidistant apertures, so that the current escaping thence is brought into the closest possible contact with the surrounding liquid.

The form of the superheater, as shown in fig. 1, is immaterial, though in this case it is constructed of pipe-work. It communicates with the air outside by means of a funnel-shaped opening. Into this funnel extends and terminates a small pipe, connected to the boiler, so as to discharge into the funnel an amount of steam sufficient only to produce a vacuum, whereby the current of air through the superheater is greatly accelerated, and is enabled to overcome readily the ordinary pressure within the generator.

The current passing through the superheater is kept intensely hot by the surrounding steam within the boiler. An important chemical change here takes place.

Whatever exhaust-steam may enter with the atmospheric air into this superheater is, by means of intense heat, sufficiently decomposed to unite with the other element, and flow through the pipes into the generator as a highly heated oxy-hydrogen vapor.

The object of the above-described arrangement chiefly is to raise the material in the generator as soon as possible to a vaporizing temperature, which thus becomes, as above stated, first heated, then volatilized, and uniting with the liberated vapor, rapidly ascends to the chamber or space above, forming a combustible hydrocarbon vapor.

Vaporization is also produced by direct fire-heat, either from vapor of its own generation, or by the use of solid fuel burned upon supplemental grate-bars.

In constructing generators, we advise that they be made, in all cases, with a deep fire-box and duplicate grate-bars, as above intimated, and thus so arranged that either vapor or solid fuel may be used when and where the other agencies are not always immediately available.

In such cases, water can be pumped in along with the other liquid, or a small supplemental generator or boiler may be used to furnish the requisite amount of steam, until otherwise attainable.

The flame in the fire-box is allowed to ascend through the upper grate-bars, and thus a sufficient amount of vapor fuel is soon accumulated wherewith to begin operations. The entire operation will thus become almost entirely automatic.

A feed-pipe is tapped into the top of the generator leading down into its fire-box.

Connecting with the main discharge-pipe from the generator, is another one, to be used for bringing waste or other steam, for the purpose of keeping the pipes and burners clear by a constant current of steam, to promote combustion, and when necessary, or in an emergency, to instantly extinguish the fire by throwing thereon a surplus of steam.

It is to be noted that this element is to be thrown into the fire-box sparingly at first, but as the interior and its contents become thoroughly heated a much larger supply can and should be used, thus securing at once greater intensity of heat and economy in fuel.

Waste or raw steam may, however, be discharged separately in the fire-box, or through the door of the ash-pit, along with the regular draught, or otherwise, without materially affecting the combustion.

At any convenient point or place in the pipe, connecting with the generator, should be inserted a double diaphragm, made of fine wire-gauze, or other equivalent porous material.

The feed-pipe or pipes on entering the fire-box, are coiled around the interior, preferably upon three sides, about three inches from the periphery thereof, and may rest upon the ordinary grate-bars or any similar contrivance.

Into this pipe so arranged, are set, laterally, for a fire-box, two and a half feet square, from forty to sixty gas-nipples, of the capacity of six or eight cubic feet per hour.

When the combustion-chamber is larger, there should be a proportional increase of these nipples, which may, if more convenient, be inserted in cross-sections of the pipe.

Equivalent holes pierced in the pipe will suffice if such nipples be not available.

There is then to be placed evenly over the whole a covering, about four or five inches deep, of broken fire-brick, old crucibles, or any similar refractive incombustible material of irregular form, averaging in size about three-quarters a cubic inch.

Hollow or thickly-perforated slabs or blocks, or of bricks or tile, asbestos, or any partial covering and filling in of similar material and similarly-arranged, will suffice, whereby the aforesaid elements of combustion are compelled, in their passage, at or just before ignition, to come in contact with and impinge closely upon the aforesaid or similar numerous irregular surfaces of such refractive materials. This is an essential feature of this invention.

The ordinary fire-door must be hermetically closed and the principal supply of air made to pass upward, or at all events, through the heated mass of refractive materials.

When about to begin, we allow at first a moderate amount of oxy-hydrogen vapor to flow into the generator, and as its contents become heated, the fuel-vapor accumulates, and the steam-gauge, soon showing the presence of sufficient hydrocarbon vapor, the stop-cock of the feed-pipe is gradually opened, and the vapor allowed to flow in among the refractive material, care being always first taken to place thereon some light ignited substance, to be kept burning for a few seconds, until combustion of the vapor takes place. The volume of fire may now be enormously increased or entirely extinguished.

As the refractive material and whole interior of the fire-box become fully heated the supply of carbonic vapor may be gradually diminished, while that of the raw steam, direct from the boiler, may be proportionally increased.

When the whole fire-box is thus aglow, the steam being brought into repeated contact with said heated refractive material, is thoroughly decomposed, and hence, in combination with the atmospheric air constantly flowing or forced in, there is regularly made and condensed an "oxy-hydrogen" gas, which, with the small amount of carbonic vapor, thenceforth re-

quisite, produces a flame of the greatest intensity and purity, free from all appearance of soot or smoke, and of the utmost attainable economy.

An artificial blast may be used when desirable, and dampers, valves, or other suitable means employed to regulate both forced and natural draughts.

Though the fire-box dimensions given above are for only a twelve or fifteen horse-power boiler, yet it should be borne in mind that the same generator and pipes, by a proper increase of steam, of vapor-liquid, and burner-jets, are capable of furnishing fuel for a one hundred and fifty horse-power boiler as well. Slight experience will suggest all needful modifications.

In cases requiring a large consumption of fuel, as in a series of iron furnaces, we use a hot-air blast, and also heat or superheat the vapor before it enters the combustion-chamber.

This may be done by any of the ordinary methods, and in such cases, or where a long-continued fire is necessary, we advise the employment of a separate generator, or a vapor-holder, whereby there may be always retained a sufficient supply to commence with.

Any tendency of the vapor to condense may be avoided by keeping a few jets burning under such gas-holder, thus keeping the supply of vapor moderately warm, or at a higher temperature.

Vapor-fuel may be used with great advantage and economy in connection with coal or other solid fuels, and by the same means we are enabled to utilize schist or shale, and all those lower grades of coal existing nearly everywhere in great abundance, and which, alone, are incombustible and now wholly worthless.

We effect this in the following very simple manner:

Leaving out or removing all the refractive materials, a duplicate set of grate-bars is placed directly over and upon the burner-pipes and nipples.

This is done mainly to protect them from the intense heat, but any equivalent arrangement will answer for regular grates.

The fire is kindled thereon in the usual manner, and thus the mass of burning coals or shale will be found to answer equally well the purposes of the other in decomposing the elements, and assisting in their more perfect combustion. Great economy in the use of all these materials will thus be secured.

For the higher grades of metallurgy, such as making cutlery, steel, and for other purposes, where a flame and heat of the utmost purity are required, we remove all traces of sulphur, phosphorus, and other impurities which may remain in the vapors of coal-tar, and some few other hydrocarbons in the following manner:

A vessel of suitable size and form is filled with any two or more of the following mixtures, viz., metallic shavings or scraps, and limestone, chalk, bones, charcoal, coke, or other calcareous substances, and the gas or vapor from the generator is led into the base of this receptacle, which we denominate a "purifier."

Thence percolating the entire mass of material it becomes cleansed of all noxious properties, and may be taken from the other end of the purifier and carried by a pipe wherever desired for use.

The purifier must be provided with suitable openings for removing refuse and recharging, when necessary.

Better results will be obtained if the purifier be kept at a red heat.

Two or more purifiers may be used when required, or instead of separate vessels the materials used for refining the gas may, by a proper arrangement, especially for metallurgic purposes, be combined with the refractive or decomposing materials in or near the furnace, as shown in fig. 4.

Here the purifier, superheater, and decomposer are combined in a single apparatus, working in connection with a heating or reheating furnace, but it is equally applicable to any other.

In such cases, care must be taken that the upper and heat-exposed portion of the purifier and contents be protected by incombustible material, and that such upper part be filled to the depth of about six inches with decomposing material only.

At this point, on suitable flanges, is placed a closely-fitting perforated plate or fine bars. Above this are the decomposing materials, and all below, those used for purifying purposes.

Steam, and a hot or cold-air blast, are discharged into the purifier immediately above the plate or bars referred to, while the vapor from the generator is led in by a pipe at its base, all of which is clearly illustrated in the drawing.

The purifier is readily recharged through the furnace-door by first taking out the movable plate, &c., above referred to, as will be observed.

The top of the purifier is about on a level with the bed of the furnace, from which it only is separated by a light bridge-wall.

The front door of the furnace opens at and directly over the purifier, while other doors may be inserted as convenience requires.

In the foregoing general specification, there is found sufficient direction for working this fuel system, either in connection with the furnace shown or for any other metallurgic uses to which it may be applied.

Claims.

Having thus fully described the nature and operation of our invention,

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

1. A method of and apparatus for refining and reducing hydrocarbon and olefiant liquids by forcing into and minutely diffusing therein, fig. 1, a current of hot air, by the aid of pressure from a boiler, or by means of an ordinary blower.

2. An apparatus for and method of producing gas or other products, in a generator, from the above-described liquids, by means of a current of hot air driven and minutely discharged into the body of such liquid through the direct application of steam-power, substantially as and for the purposes herein shown and described.

3. A generator, constructed and arranged so that its contents may be raised and maintained at a very high temperature by means of steam-heat, in combination with single or double grate-bars, for using solid fuel, or a self-feeding vapor burner, substantially as and for the purposes herein set forth.

4. The generator, constructed with a fire-box, connected and fed by a pipe communicating with its vapor-chamber.

5. The generator, constructed with a fire-box and duplicate grate-bars, for the purposes above described.

6. A steam-pipe, connecting with the main feed-pipe, so as to blow steam through and clean out the burners, promote combustion, as well also as to instantly extinguish the fire, by throwing into the combustion-chamber a surplus of steam.

7. The arrangement of refractive or incombustible material at or near the point of combustion, so that either or all of the aforesaid elements of combustion shall pass through the said material, in the manner and for the purposes herein described.

8. The combination and arrangement of the burner and refractive material with a furnace or with a fire-box.

9. A gas or vapor-purifier, fig. 3, either with or without means of heating the same.

10. A gas or vapor-purifier, in combination with superheating, decomposing, and refractive materials, fig. 4, as and for the purposes above described.

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