(No Model.) 4 Sheets—Sheet 1.

R. B. AVERY.

APPARATUS FOR GENERATING AND BURNING GASEOUS FUEL.

No. 398,873. Patented Mar. 5, 1889.

Fig. 1.

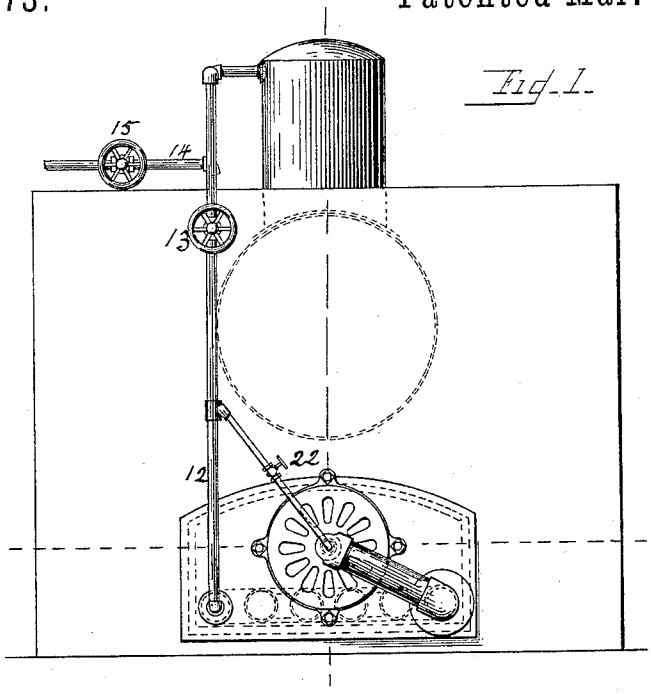
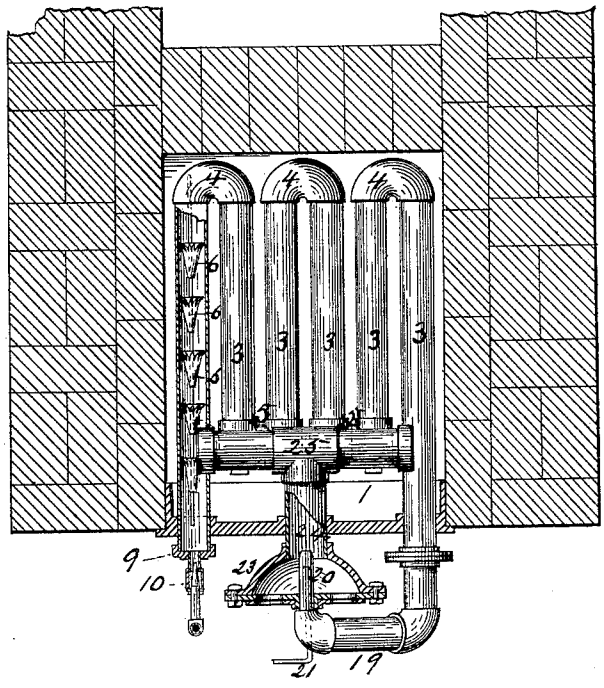


Fig. 2.



Witnesses,

G. A. Tauberschmidt,

Edwin S. Clarkson.

Inventor,

Richard B Avery

By his Attorney F. W. Ritter

(No Model.) 4 Sheets—Sheet 2.

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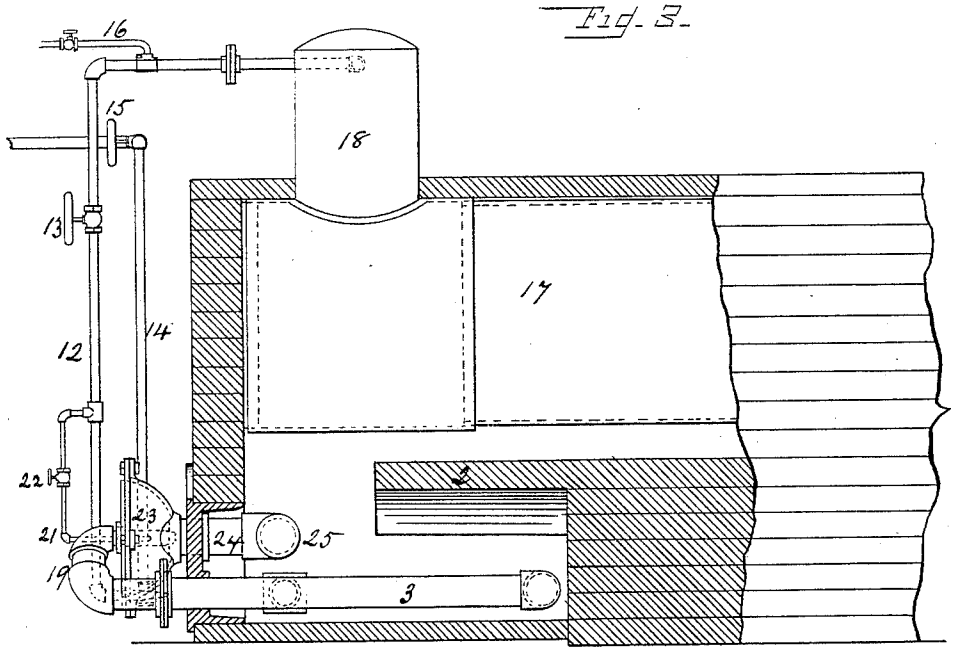
Fig. 3.



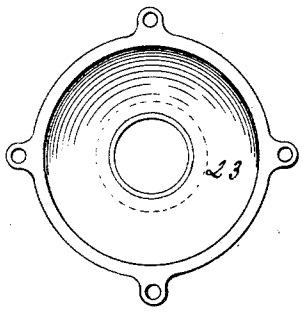


Fig. 4.

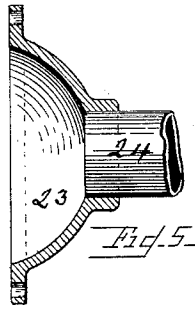
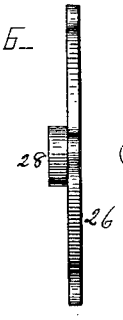


Fig. 5.

Fig. 6.



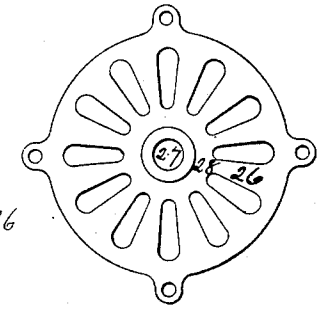


Fig. 7.

Fig. 8.

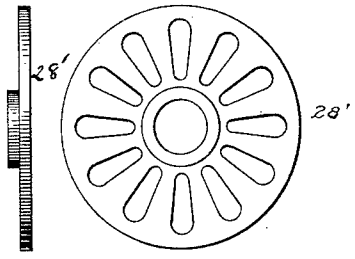


Fig. 9.

Witnesses.

G. W. Taubenschmidt.

Edwin S. Clarkson.

Inventor.

Richard B. Avery

By his Attorney F. W. Ritter Jr.

(No Model.) 4 Sheets—Sheet 3.

R. B. AVERY.

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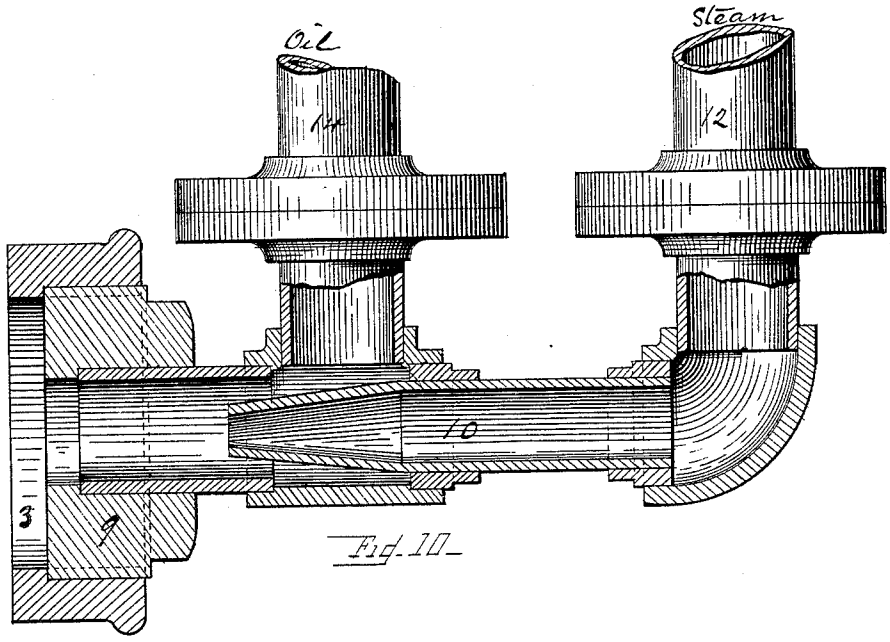


Fig. 10.

Fig. 11.

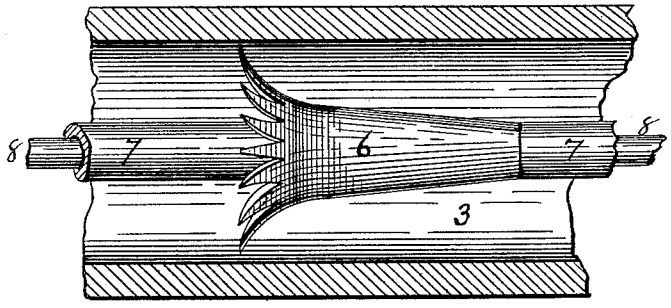
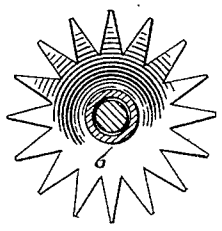


Fig. 12.



Witnesses
G. A. Tauberschmidt,
Edwin S. Clarkson.

Inventor,
Richard B. Avery
By his Attorney F. W. Rettig

(No Model.) 4 Sheets—Sheet 4.

R. B. AVERY.

APPARATUS FOR GENERATING AND BURNING GASEOUS FUEL.

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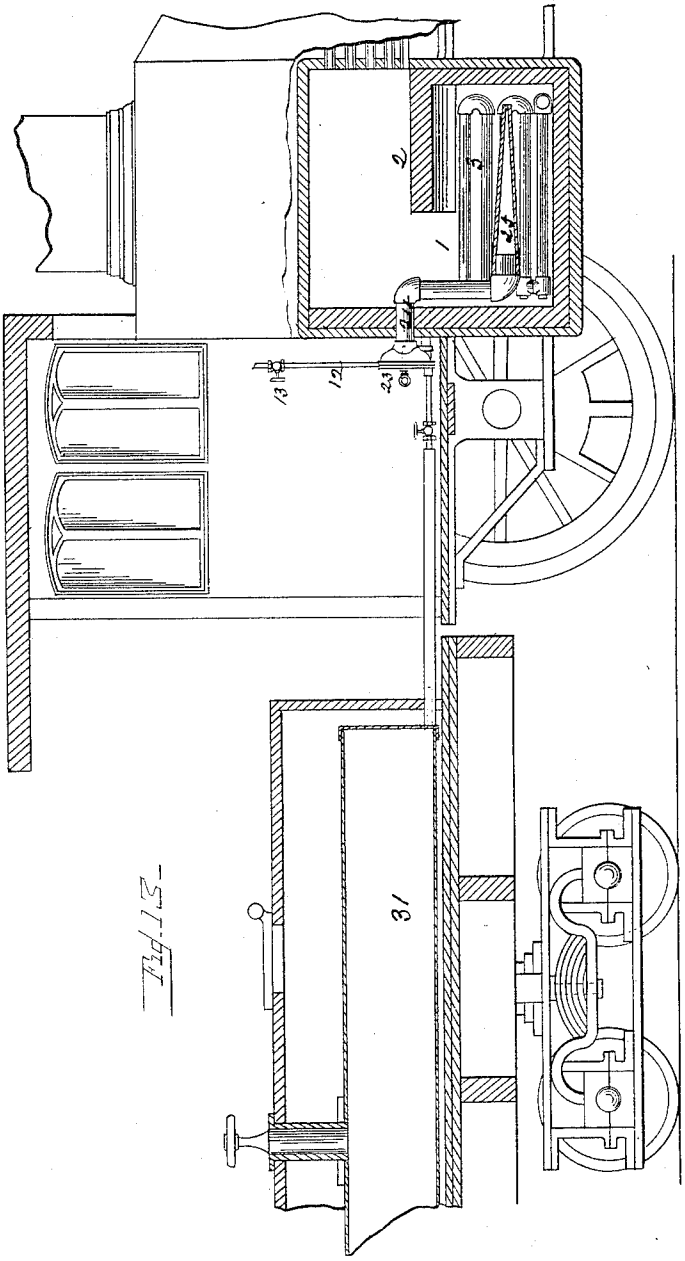

Fig. 13.

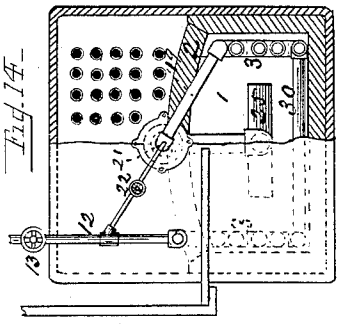

Fig. 14.

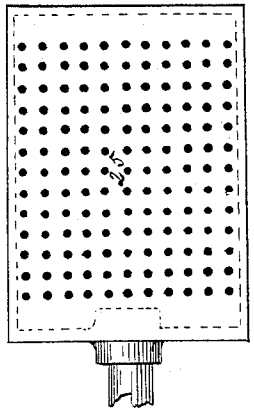

Fig. 15.

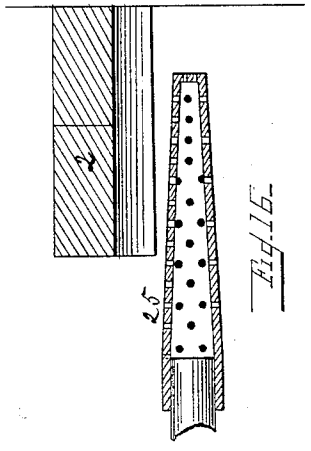

Fig. 16.

Witnesses.
Edwin L. Clarkson.

Inventor,
Richard B. Avery
By his Attorney F. M. Ritter

UNITED STATES PATENT OFFICE.

RICHARD B. AVERY, OF NEW YORK, N. Y.

APPARATUS FOR GENERATING AND BURNING GASEOUS FUEL.

SPECIFICATION forming part of Letters Patent No. 398,873, dated March 5, 1889.

Application filed September 17, 1887. Serial No. 249,932. (No model.)

To all whom it may concern:

Be it known that I, RICHARD B. AVERY, a citizen of the United States, residing in the city of New York, State of New York, have invented certain new and useful Improvements in Apparatus for Generating and Burning Gaseous Fuel; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, wherein—

Figure 1 is a front elevation of a boiler-furnace having my invention applied thereto. Fig. 2 is a horizontal section of the same on the line *x x*, Fig. 1. Fig. 3 is a section of the brick-work on the line *y y*, Fig. 1, the apparatus embodying my invention being shown in elevation. Fig. 4 is a front elevation of the cup-section of the air-chamber. Fig. 5 is a sectional view of the same. Fig. 6 is an edge view of the slotted fixed head of the air or mixing chamber. Fig. 7 is a plan view of the same. Figs. 8 and 9 are similar views of the movable slotted disk or register of the air or mixing chamber. Fig. 10 is an enlarged sectional view of the injector used for supplying oil to the retorts or generating-pipes. Fig. 11 is an enlarged view of one of the deflectors or cones used in the retorts or generating-pipes. Fig. 12 is an end view of the same. Fig. 13 is a sectional view of a locomotive fire-box and part of a tender, showing my invention applied thereto. Fig. 14 is an end view, partly in section, of the locomotive fire-box shown in Fig. 13. Fig. 15 is a plan view of a hollow flat burner which may be used instead of the perforated pipe-burner shown in Figs. 2 and 3, and Fig. 16 is a sectional view of the same.

Like letters refer to like parts wherever they occur.

My present invention relates to the construction of apparatus for generating and consuming gaseous fuel for heating, generating steam, and like purposes; and, generally stated, it consists in the combination, with a closed fire-box which forms a retort-chamber, of a series of connected retorts or generating-chambers, an air-chamber into which the generating-retorts deliver and wherein the gas is intermingled with the air which is to support combustion, an exhaust arranged in the delivery end of the generator, and a burner to which the mixed air and gas is delivered for consumption.

The preferred construction and arrangement of the devices will now be more specifically set forth.

In the drawings, 1 indicates the fire box or chamber of a boiler or other furnace with which my devices are to be employed, said chamber being a closed chamber or one which can be closed, so as to prevent the direct admission of the external air, and which is preferably provided with an arch, 2, for confining the gases until combustion is complete, and also for storing heat and deflecting it on the generating-pipes 3.

Within the closed fire-box 1 of the furnace are placed a series of retorts, pipes, or tubes, 3, which are connected by either a series of return-bends, 4, or elbows 5, or both, as may be preferred or rendered necessary by the form of the fire-box, the whole forming a continuous generating-chamber. These pipes or tubes 3 may be two-inch pipes, or larger, if desired, and all except the last one or two of the series are provided in the interior with a series of conical deflectors, 6, having serrated or perforated bases and arranged at short intervals with their apices toward the current to break up and intermingle the gases, &c., in the generating-chamber and to force the gases to pass in contact with the walls of the retorts or pipes 3. These deflectors or cones may be separated by spacing-sleeves 7 and supported on a central rod, 8, or otherwise secured in the retort at the will of the constructor.

The receiving end of the generating-chamber is closed by a head, 9, through which projects an injector, 10, (see also Fig. 10,) the jet of which is connected with a steam-boiler by a suitable pipe, 12, provided with a valve, 13, and the oil-supply is also connected with said injector by means of a pipe, 14, having a valve, 15. As a supply of steam is essential to start as well as to maintain the operation of these devices, a separate steam-generator must be provided in case the devices are used with other than boiler-furnaces, and a separate connection (as, for instance, branch pipe 16, Fig. 3) should be provided leading to some source of steam-supply for starting boiler-fur-

naces when cold unless provision is made for employing an ordinary fire in the fire-box as a starter.

17 indicates a boiler provided with a steam-dome, 18, from which in the present instance the steam for the injector is taken to maintain the operation of the devices. The opposite or delivery end of the generator 3 projects beyond the fire-box 1, and is provided with a bend or continuation, 19, of substantially the size of the generator, and this bend terminates in a short pipe or nozzle, 20, of greatly-reduced diameter—say about one (1) inch, or having about one-fourth the cross-area of the generators 3 and bend 19.

The object of reducing the size of discharge-nozzle 20 is to obtain a pressure-jet or injector action; but as the reduced pipe or nozzle 20 will not at all times accommodate the gas as rapidly as it is generated in the pipes or retorts 3, I prefer to combine therewith a central steam-jet, 21, (see Figs. 1, 2, and 3,) which may be supplied from the main steam-pipe 12 and provided with a suitable valve, 22, and will operate as an exhaust on the generators 3.

The nozzle or pipe 20 delivers the gas from the pipes or retorts 3 into an air or mixing chamber composed of a funnel, cup, or bowl, 23, which is exterior to the closed fire-box 1, but provided with a pipe or tube, 24, that extends through the walls of the closed fire-chamber and terminates in a burner, 25, so arranged as to heat the generating retorts or pipes 3.

The head of cup or funnel 23, (see Figs. 4 and 5,) constituting the air-chamber, is provided with a slotted head or spider, 26, (see Figs. 6 and 7,) which is bolted thereto, and the spider is provided with a central orifice, 27, for the passage of the pipe or nozzle 20, and a hub, 28, for a rotatable slotted plate or disk, 28′, (see Figs. 8 and 9,) constituting a register by which the amount of air admitted to the air-chamber to mingle with the gas can be regulated and controlled at will.

The pipe or tube 24, which connects the air or mixing chamber with the burner 25, should be about five times the diameter of the nozzle or pipe 20, which delivers the gas to the air or mixing chamber—say about five inches diameter, more or less—first to accommodate the additional volume of air which is to be mixed with the gas, and, secondly, to avoid back-pressure in the nozzle 20 and pipe or generator 3.

The burner 25 may be of any desired pattern—for instance, the common T-pipe shown in Figs. 2 and 3 or the flat hollow form shown in Figs. 15 and 16, and if of the latter it may be of either cast-iron or fire-clay made in two sections and bolted together. In either case it is desirable that the aggregate area of the perforations in the burner should be at least double the cross-area of the pipe or tube 24, leading from the air-chamber to the burner, in order to provide for friction, obtain uniform flow of gas, and to avoid back-pressure.

On the relative adjustment of the proportions of nozzle 20, mixing-tube 24, and the discharge-orifices of burner 25 will depend much of the effectiveness of the devices and the proper volumetric mingling of the air and gas, so as to obtain complete combustion and a proper heating of the generators.

A deficiency in the volume of air mingled with the gas in air-chamber and tube 24 might be supplied by admission of air to the fire-box direct; but, while this would aid combustion, it would be liable to chill the generating-pipes and render their operation irregular.

In most furnaces it is preferred to arrange the generating-pipes 3 upon the floor of the closed fire-box 1; but in others—as, for instance, locomotive fire-boxes, (see Figs. 13 and 14)—it may be desirable with the present form of fire-boxes to arrange the pipes 3 one above the other on both sides of the fire-box and unite the two sets by a cross-pipe, 30, at the back end of the fire-box or across the bridge-wall. 31 indicates an oil-reservoir connected by the pipe 14 with the injector 10.

The devices, being of substantially the character described, will operate as follows: Steam from a suitable source will be admitted to injector 10 through pipe 12, and also oil through pipe 14. The steam will induce the flow of the oil, and the two, mingling, will form a vaporous combustible fuel, which will flow through generator-pipes 3 to nozzle 20, where, mingling with air in the air or mixing chamber, the mixture will pass to the burner 25 and be consumed in the closed fire-box 1. The generating-pipes 3 will be gradually brought to an intense heat, and the mixture of steam and oil passing therethrough will in a short time cease to be a simple vapor, but will be converted into substantially a fixed gas, which gas as it is delivered into the air or mixing chamber will suck in and intermingle or intimately mix with itself the air necessary to support combustion, and the mixture before it reaches the place of ignition will be thoroughly heated, which previous mixture of the air and gas and the heating thereof to the point necessary for ignition or combustion will produce an intense fire with the minimum amount of fuel, will prevent the loss incident upon chilling or cool drafts in the fire-chamber and the deposit of soot, and will add to the durability of the devices themselves. Furthermore, the combination of the air-mixer and burner with the retort and closed fire-chamber preserves an even temperature in the closed fire-chamber, and that in its turn prevents irregularities in the operation of the retorts and insures the uniform volume and quality of gas for any given and regulated steam and oil supply.

Having thus described the nature and operation of my invention, what I claim, and desire to secure by Letters Patent, is—

1. In devices for generating and burning gaseous fuel, the combination of a closed combustion-chamber, a generating pipe or retort

arranged therein, an air or mixing chamber into which the generating-chamber delivers, said mixing-chamber arranged to deliver into the burner located in the closed fire-chamber, and a steam jet or exhaust arranged in the delivery end of the generator, substantially as and for the purposes specified.

2. In a device for generating and burning gaseous fuel, the combination of a closed fire-chamber, the series of generating-pipes 3 arranged therein, the nozzle 20 at the delivery end of the pipes 3, the central steam-jet exhaust, 21, the funnel-shaped air and mixing chamber provided with the register 26 28′, and a perforated burner, 25, substantially as and for the purposes specified.

In testimony whereof I affix my signature, in presence of two witnesses, this 15th day of September, 1887.

RICHARD B. AVERY.

Witnesses:
GEO. B. HULME,
ALFRED KIMBER.