No. 634,642. Patented Oct. 10, 1899.

H. HOWARD.

HYDROCARBON BURNER.

(Application filed Mar. 28, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig: 1.

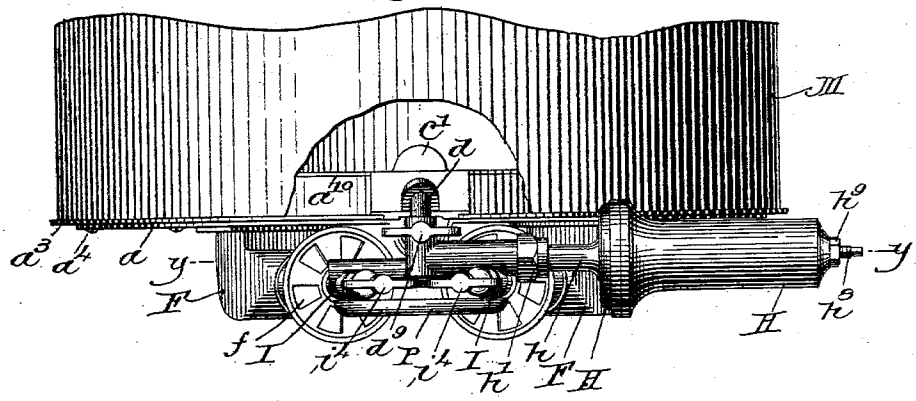
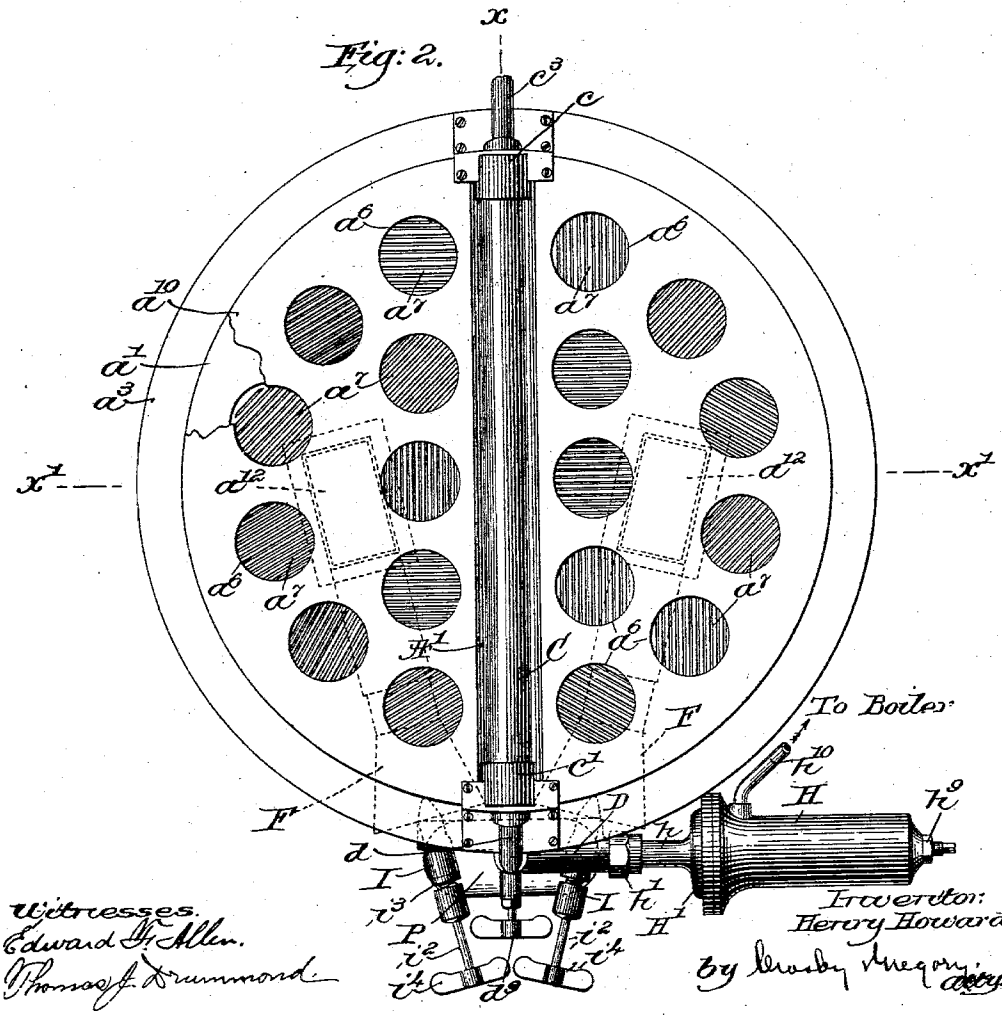


Fig: 2.



Witnesses.
Edward F. Allen.
Thomas J. Drummond.

Inventor:
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by Crosby Gregory & Perry's Attys.

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Fig: 3.

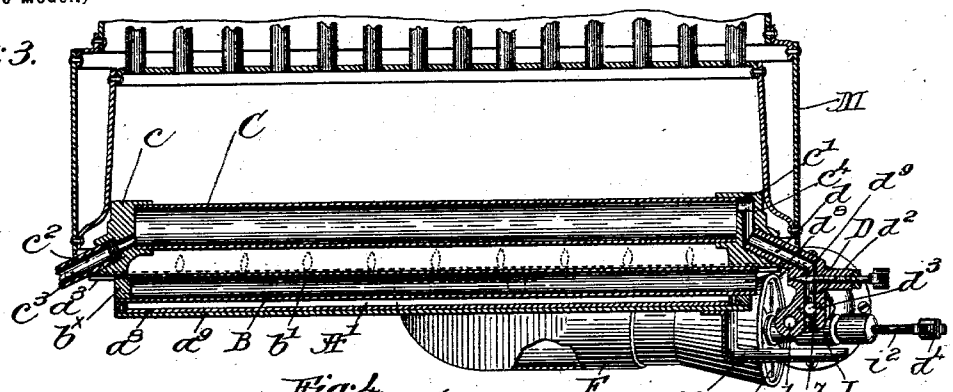

Fig: 4.

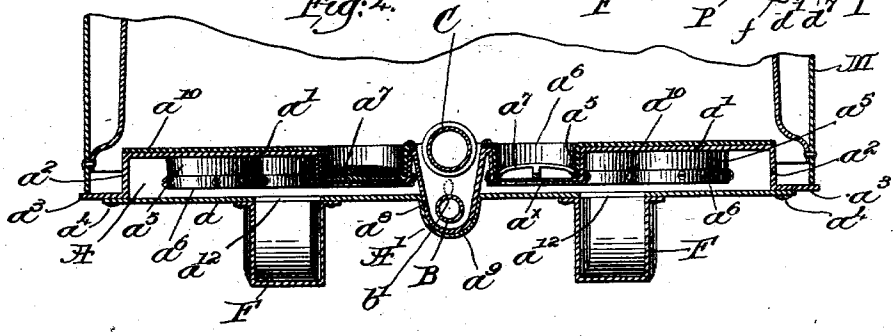

Fig: 5.

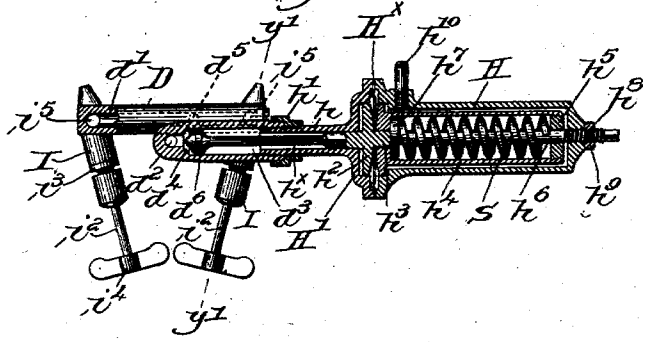

Fig: 6

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UNITED STATES PATENT OFFICE.

HENRY HOWARD, OF BROOKLINE, MASSACHUSETTS.

HYDROCARBON-BURNER.

SPECIFICATION forming part of Letters Patent No. 634,642, dated October 10, 1899.

Application filed March 28, 1898. Serial No. 675,413. (No model.)

To all whom it may concern:

Be it known that I, HENRY HOWARD, of Brookline, county of Suffolk, State of Massachusetts, have invented an Improvement in Hydrocarbon-Burners, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention has for its object the production of a novel hydrocarbon or liquid-fuel burner constructed and arranged to effect a greater economy of fuel with increased efficiency and capable of complete regulation and adjustment.

I will now describe one form of apparatus embodying my invention, and will particularly point out various novel features in the claims.

Figure 1 in elevation represents the lower portion of the combustion-chamber with a burner embodying my invention applied thereto. Fig. 2 is a top or plan view of the burner detached. Fig. 3 is a transverse sectional view thereof on the line x, Fig. 2. Fig. 4 is a sectional view of the burner, taken at right angles to Fig. 3, on the line x' x', Fig. 2. Fig. 5 is a horizontal sectional view of the fuel-controlling devices on the line y y, Fig. 1; and Fig. 6 is a sectional detail on the line y' y', Fig. 5, of one of the fuel-injectors.

In the practical construction of a highly-efficient hydrocarbon-burner a number of points must be considered, such as the vaporization of the fuel before its admission to the burner proper, the thorough admixture of the hydrocarbon with the requisite quantity of air before reaching the point at which combustion is effected, the ready regulation of the air admitted, and the capability of rapid production of heat after the combustion has begun, as well as the rapid return to maximum heating after temporarily shutting off the fuel-supply. I have had these various considerations in mind in the construction and arrangement of the burner, which will now be described.

Referring to the drawings, the burner is shown as comprising a closed distributing-chamber A, formed by a bottom plate a and a top plate a', bent circumferentially to form a side wall a^2 and outwardly flanged at its lower edge at a^3, Figs. 2 and 4, and attached by suitable bolts or rivets a^4 to the bottom plate. The top plate has a number of preferably circular openings therein, the adjacent portions of the plate being bent or stamped to form downturned cylindrical flanges a^5, provided at their lower ends, which approach the bottom plate a, with suitably-attached foraminous covers $a^\times$. Each of these cup-like portions or cells a^6 forms a burner proper, in which are inserted the usual metallic gratings a^7 common in hydrocarbon-burners.

In order to prevent undue heating of the burners, I prefer to cover the top plate a' and line the interior of the burner-cells a^6 with asbestos, as at a^{10}, or other suitable non-inflammable or non-heat-conducting material.

The top and bottom plates are provided, respectively, with diametral concavities a^8 a^9 to form a long subchamber A', completely separated from the distributing-chamber and containing two superposed pipes or cylinders B and C.

Castings c c', attached to the ends of the subchamber A', support the larger and upper pipe C, which communicates at one end, by an inlet c^2 in the casting c, (see Fig. 3,) with a pipe c^3, leading from the source of liquid-fuel supply, (not shown,) the said pipe C constituting a vaporizer.

The end of the pipe B adjacent the fuel-inlet c^2 is closed by a plug $b^\times$ and is provided along its top with a number of small holes or jet-openings b', Fig. 3, below the vaporizer C.

The casting c' has an outlet c^4 communicating with the vaporizer near its top, and a nozzle d, screwed into the said casting, leads from the outlet c^4 to the injectors, to be described.

I have herein shown two mixing-chambers F opening into the distributing-chamber through openings a^{12} in the bottom plate a, said mixing-chambers being shown as long conduits having at their outer ends butterfly-valves f, which regulate the admission of air to the mixing and distributing chambers, it being apparent from the drawings that air can only enter the distributing-chamber A through the mixing-chambers.

The nozzle d forms part of a casting D, having a transverse duct d', Figs. 3 and 4, com-

municating with the two injectors I, one for each mixing-chamber, and a passage d^2 leading from the nozzle d to a valve-chamber d^3 in the casting, having a valve-seat d^4, Fig. 5. A passage d^5 (see dotted lines, Figs. 3 and 5) leads from the valve-chamber to the duct d', the passage of liquid fuel or vapor from the vaporizer C to said duct being controlled by a valve d^6, which is automatically operated, as will be described.

As shown in Fig. 3, the passage d^2 is closed at its lower end by a screw-plug d^7 or otherwise, and, referring to Fig. 5, it will be seen that whether the valve d^6 is open or closed the passage d^2 is open to the vaporizer C.

The end of the pipe B adjacent the casting D is open at d^8, Fig. 3, and opposite this open end the casting D has an outlet communicating with the passage d^2 and controlled by a needle-valve d^9, so that some of the contents of the vaporizer can pass into the pipe B, mixing with sufficient air to support combustion when a lighted match or torch is applied to the jets b', the valve d^9 being open. This jet-pipe B may be termed a "heater," its object being to heat and vaporize to a greater or less degree the volatile contents of the vaporizer C when starting the apparatus and to maintain more or less of the contents of the vaporizer in a vaporized state when the burner is temporarily inoperative.

By means of the heater and vaporizer I am enabled to raise steam very rapidly in a boiler provided with the burner embodying my invention, for there will be enough of the vaporized fuel in the vaporizer, provided the heater is in operation, to mix at once with the requisite air in the mixers F as soon as the injectors are opened, the combustible mixture passing at once to the distributing-chamber and burners proper.

One of the injectors I is shown separately in section in Fig. 6, and comprises a case or shell having an outlet i opening into the mixing-chamber, the shell being shown as extended through the center of the valve f thereof, a suitable needle or other valve i' regulating the outlet, the valve-stem i^2, passing through a suitable stuffing-box i^3 and having a handpiece i^4, by which movement of the valve is effected. An inlet i^5 leads from the duct d' of the casting D to each injector-shell, whereby the vaporized fuel can pass from the vaporizer C to the injectors and thence to the mixing-chambers F.

In order to start the apparatus, heat is applied to the injectors and casting D, as by burning alcohol in a pan P, provided for the purpose, to volatilize some of the liquid fuel in the parts so heated, and then the valve d^9 is opened to permit the entrance of the vapor and air to the heater B, the jets b' being lighted by a match or otherwise. This rapidly vaporizes more or less of the contents of the vaporizer, and then the injector-valves may be opened and the air-inlet valves f, it being noted that the vaporizer-outlet c^4 leads from the upper part of the vaporizer, in order to draw off vapor as soon as possible. After the mixed air and fuel-vapor enter the distributing-chamber A the burners are lighted automatically by the heater-jets and the apparatus is ready for use, the air-supply being regulated entirely by the air-inlet valves f.

I have provided means to automatically regulate the supply of fuel by or through variation in boiler-pressure, so that when the said pressure passes beyond or falls below a certain pressure the fuel-supply will be reduced or increased, respectively.

Referring more particularly to Fig. 5, a case H has a cap H' attached thereto provided with a hollow boss h, through which the stem $h^\times$ of the valve d^6 is extended into the case H, the chamber d^3 of the casting D and the boss h being tightly connected by a screw-coupling and sleeve h'. A flexible diaphragm $H^\times$ is securely held between the case H of the regulator and its cap, and the valve-stem $h^\times$ has within the cap H' a disk-like enlargement h^2 resting on one side of the diaphragm, the stem being threaded at h^3 and extending through the diaphragm and screwed tightly into the bottom of a cylinder h^4, loosely held in the regulator-case. The other end of said cylinder is closed by a head h^5, through which is loosely extended a rod h^6, having at its inner end a head h^7, and threaded at its outer end at h^8 to engage a similarly-threaded hole in the end of the case, a check-nut h^9 on the rod preventing any accidental movement thereof in the case H. A strong spring S surrounds said rod within the cylinder h^4, bearing at its opposite ends on the head h^7 of the rod and the head h^5 of the cylinder and tending to move said cylinder to the right, Fig. 5, to thereby hold the valve d^6 off its seat d^4. From the boiler (not shown) a pipe h^{10} leads to and opens into the case H on the same side of the diaphragm as the spring and cylinder are located, the boiler-pressure thus acting on the diaphragm in opposition to the action of the spring. By moving the rod h^6 in or out of the case H the tension of the spring is varied to adjust it to the desired degree of boiler-pressure, and when such pressure passes beyond that point the tension of the spring is overcome and the valve d^6 is more or less closed to decrease the supply of fuel to the injectors, and thereby decrease the heat of the burner. When the boiler-pressure is reduced below the desired point, the spring operates to open the valve d^6 and admit more fuel to the injectors to thereby increase the heating effect of the burner. Whether the valve d^6 is open or closed, however, the passage of the fuel to the heater B through the duct d^2 and outlet d^8 is not interfered with or varied in the least, so that when the supply of fuel is cut off entirely from the burner the heater B is still operative. By means of this arrangement my

burner is particularly adapted for use with hydrocarbon-motors for horseless vehicles, yacht-engines, and the like, which are liable to more or less frequent stoppages, it being usually desirable to shut off the fuel-supply from the burner at such times.

In Figs. 1, 3, and 4 the burner embodying my invention is shown as attached to the bottom of the combustion-chamber M of a boiler of any desired construction.

While I have shown two mixing-chambers and injectors coöperating with the distributing-chamber of the burner, my invention is not restricted thereto, as a single mixing-chamber and injector may be used or more than two, as desired and according to the circumstances of the particular case.

By the construction herein shown it will be seen that in order to insure complete combustion no admission of air to the combustion-chamber of the furnace is required other than that which is mixed with the hydrocarbon-vapor in the mixing-chamber. This is a very important feature, for the minimum quantity of air requisite for complete combustion is used because it has been so intimately mixed with the vapor before combustion takes place. Obviously this adds greatly to the economy of the apparatus, because little or no useless air has to be heated, the heating of such air of course utilizing heat which otherwise would perform useful work. Not only this but by the construction described the combustion-chamber is provided with a regular "forced draft," obviating the use of a steam-jet in the downtake escape-flue to produce a draft, such a jet being necessary when air has to be sucked into the combustion-chamber in order to obtain complete combustion.

It is to be noted that the burners will light up from the flame-jets of the heater the combustible mixture of air and fuel-vapor being admitted to the burners, and this is a source of great utility and convenience, for the controlling-valve will frequently operate to completely shut off or open the fuel-vapor supply to the mixing-chamber, and when shut off of course the burner-flame will be extinguished. When the valve opens and admits the vapor again, the burners will automatically light from the heater-jets.

My invention is not restricted to the precise construction and arrangement herein shown, as the same may be varied or rearranged without departing from the spirit and scope of my invention.

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

1. In a hydrocarbon-burner, a closed distributing-chamber having in its top cup-like portions or cells each having in its bottom a grating, to form sunken burners communicating with the chamber, a mixing-chamber communicating with the distributing-chamber and provided with an adjustable air-inlet, and a fuel-vapor inlet opening into the mixing-chamber.

2. In an apparatus of the class described, a distributing-chamber having a closed bottom and sides and provided with burners in its top, said top and bottom being bent to form a trough, a vaporizer connected with the fuel-supply and mounted in the trough and a subjacent heater therefor, supported by and within the trough, said heater having means to supply it with fuel from the vaporizer, and a mixing-chamber communicating with the distributing-chamber, and provided with adjustable air and fuel inlets.

3. In a hydrocarbon-burner, a distributing-chamber having a closed bottom and sides, a cellular top provided with gratings in the cells to form burners communicating with the chamber, a vaporizer connected with the liquid-fuel supply and mounted on said chamber, to be heated normally by the burners, a heater for the vaporizer, operative when the burners are active or inactive, air and fuel-vapor inlets for said heater, means to introduce a mixture of air and fuel-vapor to the distributing-chamber, a connection between said means and the vaporizer, and a valve to regulate the supply of fuel-vapor to said means independently of the supply to the heater.

4. In an apparatus of the class described, a closed distributing-chamber having burners communicating with its interior, the top and bottom of the chamber being bent to form a trough, a heater and a superposed vaporizer for the fuel, mounted in said trough, a mixer for air and fuel-vapor, connected with the chamber, a duct or passage leading from the vaporizer and branched to supply said heater and mixer respectively with fuel-vapor, and a valve in the mixer branch, whereby the supply of fuel may be cut off from the burners without affecting the supply to the heater.

5. In an apparatus of the class described, a distributing-chamber, a fuel-vapor inlet, a controlling-valve for said inlet, and means to operate the valve, said means comprising a case, having a flexible diaphragm therein and to which the valve-stem is connected, a spring in the casing having a fixed, adjustable support for its inner end, adjacent the diaphragm, a rigid connection between its outer end and the valve-stem, the spring normally tending to maintain the valve open, and a fluid-pressure inlet for the casing, on the spring side of the diaphragm, to move the latter in opposition to the spring and tending to close the valve.

6. A valve-controller for hydrocarbon-burners, comprising a casing having a transverse flexible diaphragm therein between its closed ends, a valve-stem attached to the diaphragm and extended loosely through one end of the casing, a spring, its holder oppositely extended within the casing and also attached to the diaphragm, a spring-support for the inner end

of the spring, adjustably mounted in the outer end of the casing and loosely extended through the spring-holder, an inlet in the casing at the spring side of the diaphragm, whereby fluid-pressure in said casing will act upon the diaphragm to move the valve oppositely to the action of the compression-spring.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HENRY HOWARD.

Witnesses:
JOHN COUPER EDWARDS,
AUGUSTA E. DEAN.