(No Model.)

3 Sheets—Sheet 1.

J. W. & J. R. HOUCHIN.

Hydrocarbon Furnace.

No. 240,592. Patented April 26, 1881.

Fig. 1

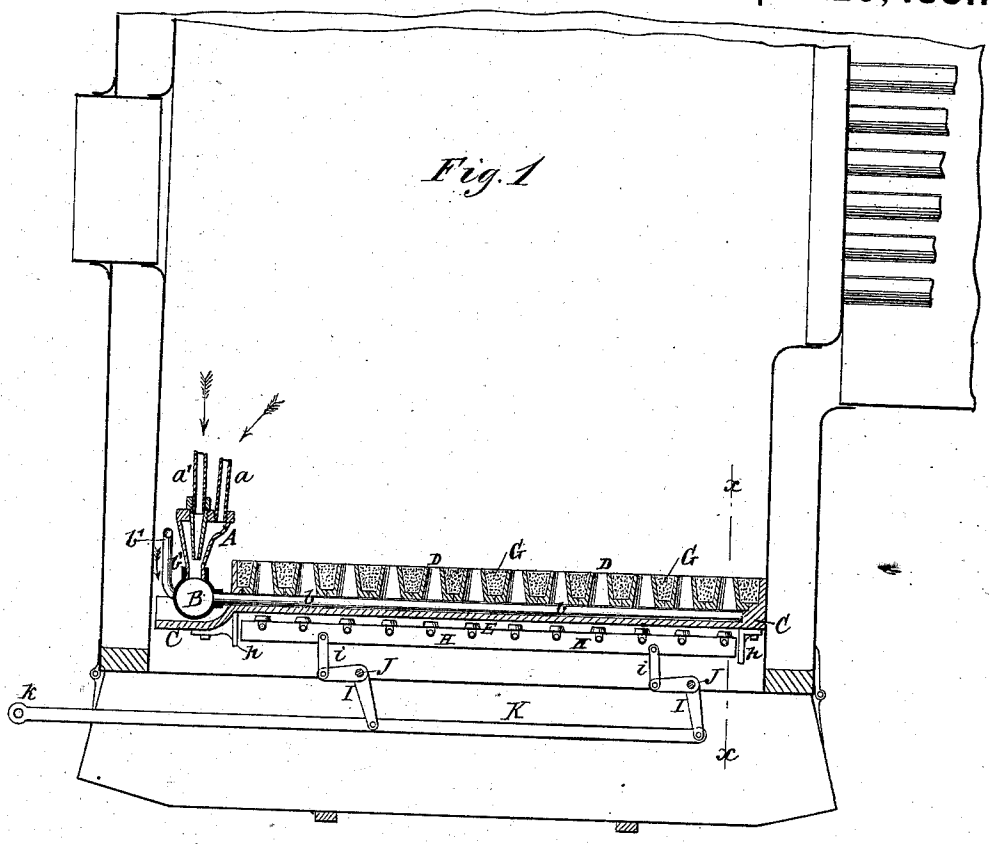
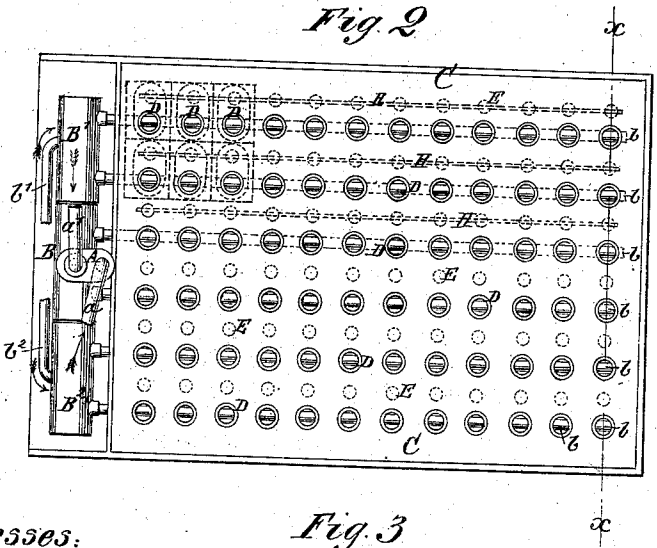


Fig. 2

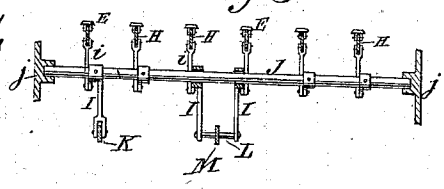


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Fig. 3



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(No Model.) 3 Sheets—Sheet 2.

J. W. & J. R. HOUCHIN.

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No. 240,592. **Patented April 26, 1881.**

Fig. 4

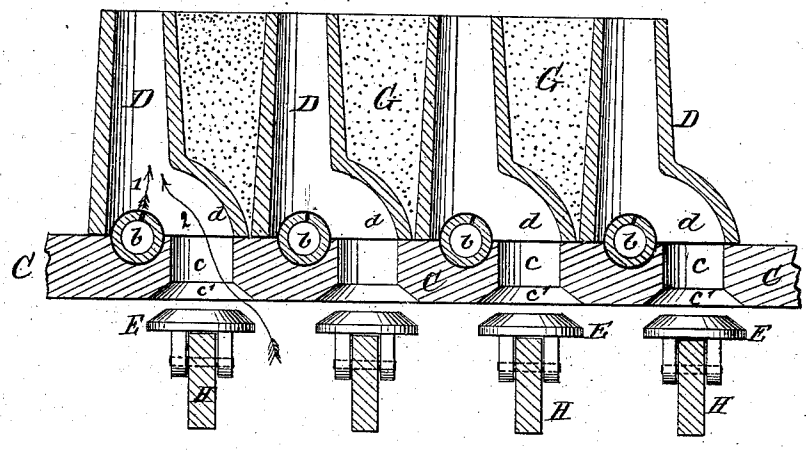


Fig. 5

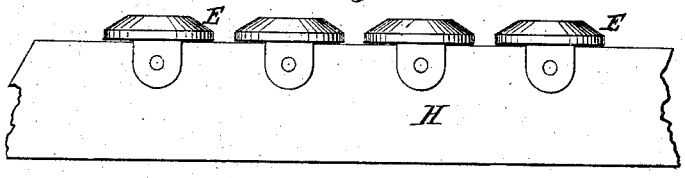


Fig. 6

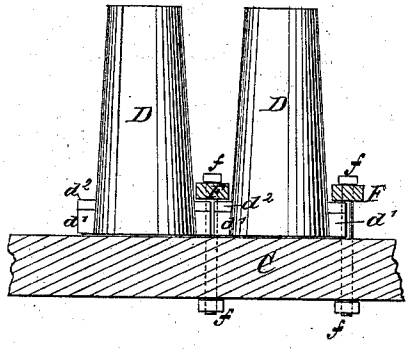


Fig. 7

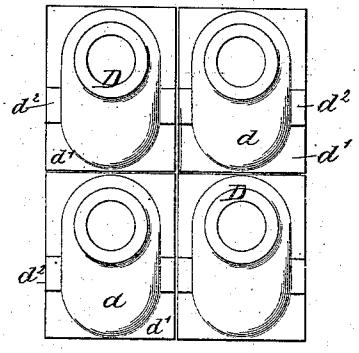
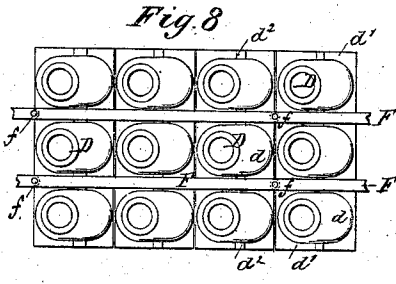


Fig. 8



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3 Sheets—Sheet 3.

J. W. & J. R. HOUCHIN.

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Fig. 9

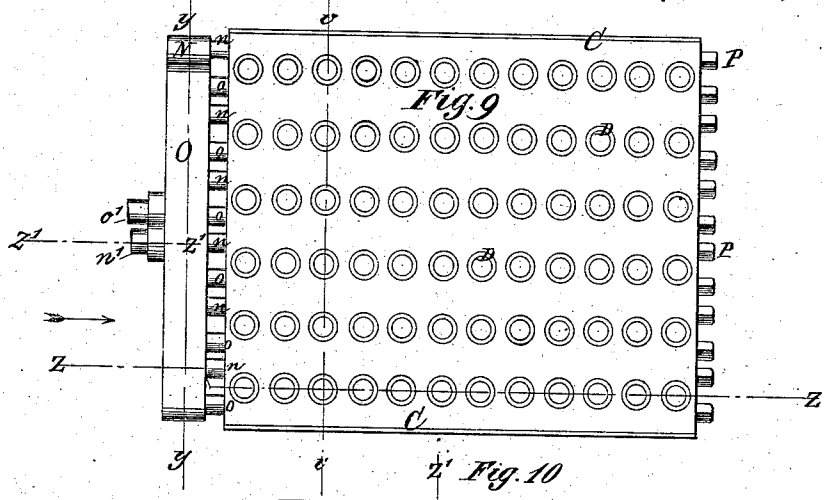


Fig. 10



Fig. 11

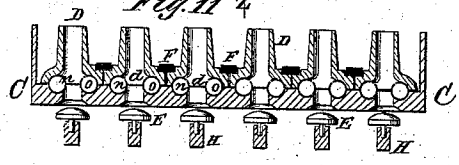


Fig. 12

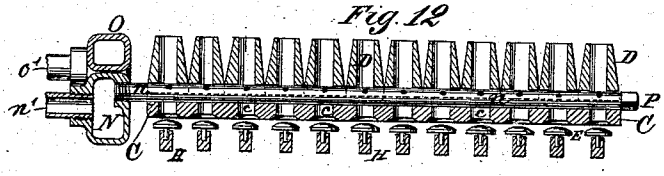
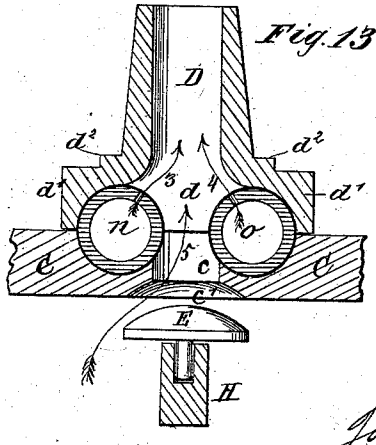


Fig. 13



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UNITED STATES PATENT OFFICE.

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HYDROCARBON-FURNACE.

SPECIFICATION forming part of Letters Patent No. 240,592, dated April 26, 1881.

Application filed July 31, 1880. (No model.)

To all whom it may concern:

Be it known that we, JOSHUA W. HOUCHIN and JOSHUA R. HOUCHIN, of the city of Brooklyn, in the county of Kings and State of New York, have invented a new and useful Improvement in Hydrocarbon-Furnaces, of which the following is a specification.

Our invention relates to apparatus by which any combustible gas—such as ordinary coal-gas, or gas formed by the vaporization, by heat or otherwise, of gasoline, naphtha, or other liquid hydrocarbons alone, and propelled by its own force of expansion, or mixed before or at its point of combustion with steam—may be consumed as fuel in a boiler-furnace, in order to generate the requisite amount of heat without the annoyance of dust, smoke, and cinders always accompanying the use of solid fuel. For this purpose various devices have been at times proposed. In one of these the liquid has been caused to evaporate by dropping upon a heated iron plate, taking the place of the ordinary furnace-grate. In another no grate-plate is used, but an injector is fastened in the furnace-wall, through which the liquid fuel is atomized by steam, and thus introduced in jet shape is ignited in the furnace.

To use hydrocarbon liquid mixed with steam as fuel for water-boilers or cooking-pots was proposed as early as in the year 1863, in which short gas-pipes, provided with burners or jets at intervals, were attached radially around a central gas-chamber; but apparatus of this class, as heretofore made, if used in steam-boiler furnaces would rapidly be destroyed by exposure to the flame; nor were proper provisions made to utilize the full heating power of the gases by the necessary admittance and regulation of a suitable supply of air. We have ascertained, however, that the best result is obtained when the liquid is not atomized, but converted into real gas by heat in a suitable retort, and burned in numerous jets distributed uniformly over the grate-surface.

To this end our present invention is specially designed, its object being to provide a new and improved apparatus by which the defects and objections of such apparatus as heretofore made will be remedied and overcome.

The construction of our said apparatus will be fully understood with reference to the accompanying drawings, in which—

On Sheet 1, Figure 1 represents a longitudinal vertical section of a boiler-furnace embodying our present invention as arranged for mixing the gases, before their exit, in the jet-tubes. Fig. 2 is a plan view of the grate or main portion of the apparatus detached from the furnace. Fig. 3 is an end view of the air-valve-regulating mechanism.

In Sheet 2, Fig. 4 represents an enlarged section of part of the grate, taken on the line *x x* of Fig. 2, and drawn to a scale of one-half of the full size. Fig. 5 is a detail side view of some of the air-valves and the bar which supports them. Fig. 6 is an outside end elevation of two of the gas-jet tubes, showing, also, the mode of securing them to the grate-plate. Figs. 7 and 8 are top views of the said tubes as they are arranged on the grate-plate, the latter view showing two of their fastening-bars.

In Sheet 3, Fig. 9 represents a plan view of the apparatus as arranged for mixing the gases at their points of exit into the jet-tubes. Fig. 10 is a cross-section of the same through the line *y y* of Fig. 9. Fig. 11 is a cross-section through the line *v v* of Fig. 9. Fig. 12 is a longitudinal vertical section through the line *z z* of Fig. 9, the gas-chambers being sectioned through one of the inlet-pipes on the line *z' z'* of Fig. 9. Fig. 13 is a vertical central section of one of the gas-jet tubes, taken on the line *v v* of Fig. 9, and drawn to a scale of one-half of the full size.

Like letters of reference denote like parts in the different figures.

The invention comprises two modifications of the same generic features, to adapt the apparatus to mixing the gases, either before or at their exit, in the jet-tubes of the grate. The first of these modifications is illustrated in Sheets 1 and 2 of the drawings, and the second in Sheet 3.

For fuel we use either ordinary coal-gas in stationary boilers, or gas made by heating liquid hydrocarbon in retorts within or without the boiler-furnace, according to availability.

The retorts, not forming a part of the invention, are not shown in the drawings.

The gas is introduced through the pipe *a*, and the steam through the pipe *a'* of the injector A into the central receiver, B, and gas and steam are similarly introduced together by another injector, (not shown in the drawings,) through connecting-pipes *b' b²*, into two separate receivers, B' B², which latter are placed in line with the central receiver, B, across one end of the furnace and grate, as shown in Fig. 2. The gases thus mixed are distributed from the receivers or chambers B B' B² through a series of parallel pipes, *b*, arranged in the same plane and extending to the opposite end of the furnace. These pipes *b* rest in semicircular grooves formed in the upper surface of the cast-iron grate-plate C, and are provided with perforations, at suitable distances apart, to connect each perforation with a corresponding gas-jet tube, D, issuing from which latter the gaseous fuel is ignited. The tubes D are, preferably, of a slightly conical shape, and are provided at their base with a lateral or central channel, *d*, of ample size to admit a sufficient supply of air from underneath the grate-plate C to insure complete combustion. For this purpose the plate C has a suitably large perforation, *c*, directly underneath each air-passage *d*, and in the lower end of the opening *c* is formed a valve-seat, *c'*, to receive an air-valve, E.

Around the lower end of each tube D is formed, in the casting, a rectangular base-flange, *d'*, by which the tube is supported evenly and in upright position upon the plate C, a semicircular groove being also formed across the under side of the base-flange *d'* to fit the upper semicircle of the pipe *b*, while the lower semicircle of the pipe *b* rests in the groove of the plate C, as before stated.

The tubes D, with flanges *d'*, being all of the same size and shape, it is evident that, in order to place them in proper position upon the plate C relatively to the air-passages in the said plate and to the perforations in the pipes *b*, it is only necessary, after having adjusted one of them in position, to place them all side by side, as shown in Figs. 7 and 8. In a stationary boiler they will retain their position without further fastening, but in locomotive-boilers the jolting and jerking on the rails require them to be provided with extra fastening. For this purpose shoulders *d²*, of equal height, are formed upon the flange *d'*, on opposite sides of the tube, and iron bars F are placed upon the rows of shoulders tranversely, as in Figs. 6 and 8, or longitudinally, as in Fig. 11, and secured to the grate-plate by bolts *f* at intervals, as shown in Figs. 6 and 8.

The grate, being thus composed of the plate C, pipes *b*, and tubes D, is completed by filling all the interstices between the tubes D and between them and the vertical edge flanges of the plate C by fire-clay G, until the surface becomes even with the upper end plane of the tubes D. This affords to the body of the tubes D and to the pipes *b* a suitable protection against deterioration by the intense heat of the flames.

In order to admit the gaseous fuel only to the central portion of the grate-surface, or only to the side portions, or to the whole surface at once, according to the intensity required of the fire, the receivers or chambers B B' B² are separated from each other, as before stated and shown in Fig. 2, and such arrangement we consider more desirable; but the three chambers B B' B² may be formed into one, extending across the width of the grate, as shown in Figs. 9 and 10.

It is well known that, while the illuminating capacity of gas decreases with an admixture of air beyond a certain amount, the intensity of the heat increases for a considerable range of proportions above that amount, and as the heating capacity, or proportion of carbon to hydrogen, varies in different gases which may be used as fuel, it is of the utmost importance to provide for a proper regulation of the air-supply, not only for obtaining the maximum amount of heat, but also for lowering the fire or lessening the heat, which frequently becomes necessary. For this purpose we have provided to every one of the air-channels *c* a valve, E, fitting, when closed, the corresponding seat *c'*. All the valves E for each longitudinal row of valve-seats *c'* are secured upon one common bar, H, so that they may be operated equally and simultaneously by evenly raising and lowering the said bar. The bars are guided vertically by suitable cleats or guides, *h*, attached to the under side of the plate C, and are connected, as shown in Figs. 1 and 3, by pivoted links *i*, (two for each bar,) to bell-cranks I, fulcrumed upon a rod, J, which latter is placed horizontally underneath the bars H, at right angles to them, and is supported in end bearings, *j*, attached on opposite sides to the furnace-walls. The lower ends of the bell-cranks I are pivoted to a lever, K, so that by pulling or pushing the handle *k* of the latter the row of valves may be uniformly raised or lowered respectively. The bell-cranks for the bars H of the four outer rows of the valves (operating in conjunction with the pipes *b* connected to the receivers B' B²) are fastened by set-screws or pins to the shaft or rod J, as shown in Fig. 3, so that they may all be operated together by the same lever K, and the bell-cranks for the bars H of the two central rows of valves (working in conjunction with the pipes *b* connected to the central chamber, B) are allowed to turn loose upon the rod J, and are interconnected by cross-rods L, to which a common lever, M, (similar to K,) is attached, so that by the said lever M the two central valve-rows may likewise be operated together independently of the outer rows.

The valves E may be fastened to the bars H either by lugs and cross-pins, as shown in Figs. 1, 4, and 5, (which is preferable,) or by being pivoted in a socket in the bar by means of a pin or shank under the valve, as shown in Figs. 11, 12, and 13.

The mixed gas and steam at the point of exit from the pipe *b*, in direction of arrow 1, (see Fig. 4,) mingles with the air, entering as

indicated by arrow 2, and is ignited at the upper end of the gas-jet tube D.

Instead of mixing steam and gas by the injector A, we have found it expedient and advantageous to keep them separate until they issue from the horizontal pipes into the tubes D, and both simultaneously commingle with the air through the valves E. For this purpose, instead of using only one pipe, *b*, along each row of tubes D, we place two pipes, *n* and *o*, (see Sheet 3,) alongside of each other, with the row of air-passages *d* intervening, the said pipes being fitted between the tube-base and the grate-plate in the same manner as before described, and connect all the pipes *n* to one chamber, N, (with or without partitions for separate central and side fires,) for receiving gas, which enters the said chamber through the inlet *n'*, and likewise connect all the pipes *o* to a similar steam-chamber, O, having the inlet *o'*.

In order to keep the pipes *n o* in the same horizontal plane, the chambers N O are formed as shown in Fig. 10, their adjoining surfaces intermeshing, whereby, also, the steam and gas pipes get into positions alternate to each other, as they should be. By this modification the gas, steam, and air meet and commingle first in the tube D, as indicated by the arrows 3, 4, and 5 respectively in Fig. 13.

The closed ends of the pipes *n o* may be provided with nuts P, to facilitate their being turned by means of an ordinary wrench, and thus unscrewed from their respective chambers N O, in order to replace or repair one or more of them without taking the grate apart.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. In a boiler-furnace, provided with one or more chambers having attached to them a series of perforated distributing-pipes arranged in a plane parallel with the grate-surface, the combination of the series of separate gas-jet tubes D, having air-channels *d*, the grate-plate C, having perforations *c*, and the series of air-valves E, having their seats in the perforations *c*, the tubes D being placed on the grate-plate C side by side, one above each perforation of the distributing-pipes, with their air-channels *d*, one above each channel *c* and its subjacent valve E, substantially as hereinbefore set forth.

2. In a boiler-furnace, the combination of the gas-chamber N and the steam-chamber O, provided with their respective perforated distributing-pipes *n o*, arranged as in Fig. 10, alternately in the same plane parallel with the grate-surface, with a series of gas-jet tubes placed above every pair *o n* of the said gas and steam pipes, and provided with valved air-channels adjacent to said perforations and pair of pipes for the purpose of commingling the gases at or above their points of ignition, substantially as hereinbefore set forth.

3. A fire-grate for gaseous fuel, consisting of the combination of the perforated plate C, the pipes *b* or *n o*, the gas-jet tubes D, having air-channels *d*, and the fire-clay filling G, substantially as and for the purpose set forth.

4. The combination, with the perforated grate-plate C, tubes D, and pipes *b* or *n o*, of the series of air-valves E, attached to a common supporting-bar, H, operated by suitable levers *i* I K to raise and lower the said valves uniformly and simultaneously, substantially as set forth.

5. The combination shown in Fig. 3 of the side bars, H, of the lateral series of valves E, having their bell-cranks I secured upon the rock-shaft J and operated by the lever K, with the intermediate bars, H, of the central series of valves E, having their bell-cranks I fitted to turn loosely upon the said shaft J and operated by the lever M, for the purpose of regulating the air-supply to the sides and to the middle part of the furnace separately or simultaneously, substantially as set forth.

6. The gas-jet tubes D, having rectangular base-flanges *d'*, of uniform size, to adapt them to being brought in proper position relatively to the gas and air opening in the pipes *b* and grate-plate C by simply placing them side by side, as in Fig. 7, substantially as set forth.

7. The tubes D, provided with rectangular base-flanges *d'*, having shoulders d^2, of equal height at opposite sides of the tube, in combination with the bars F, bolts *f*, and grate-plate C, for securing the tubes D to the said plate C, substantially as set forth.

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