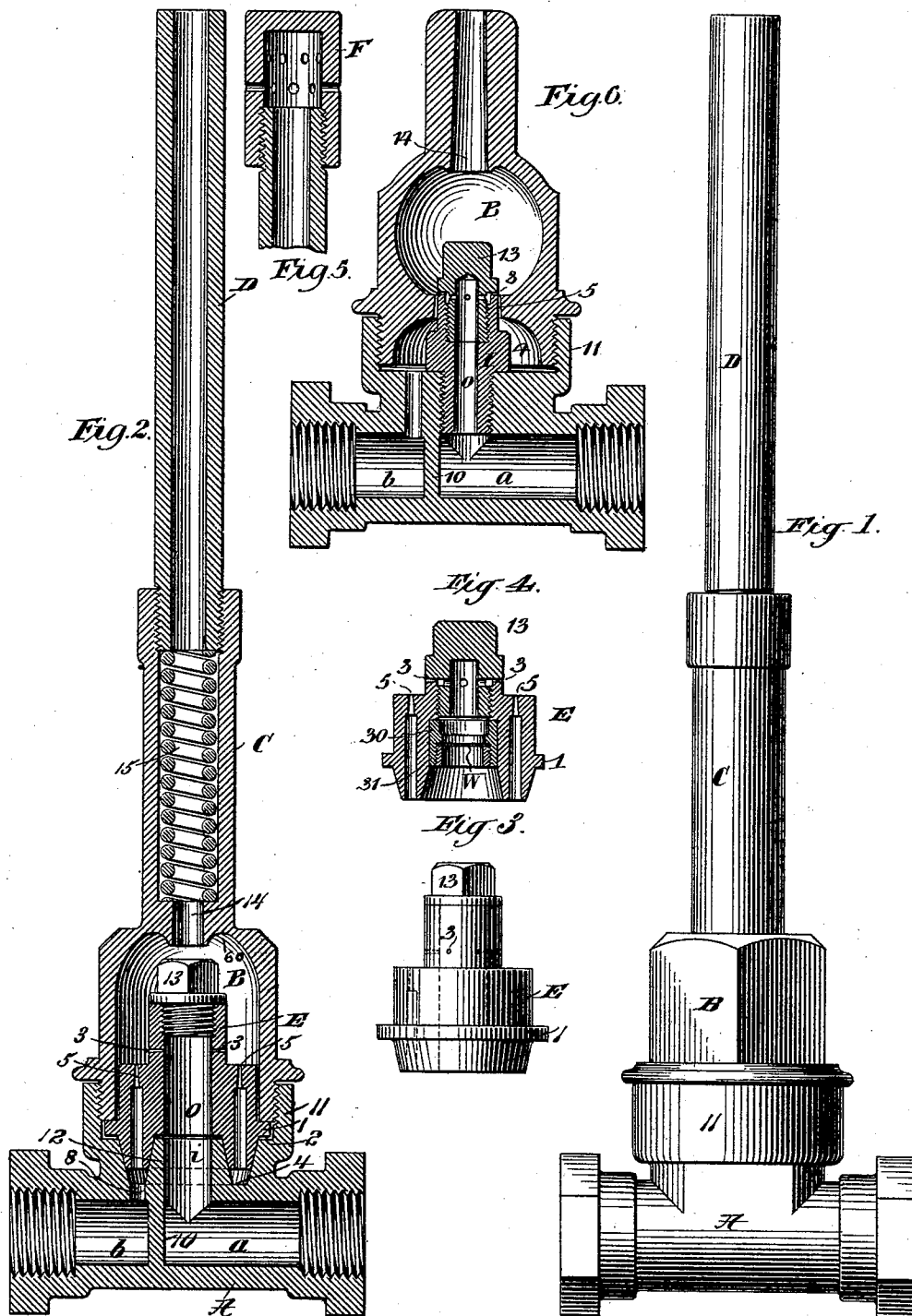


D. M. SOMERS.
HYDROCARBON BURNER.

No. 517,247.

Patented Mar. 27, 1894.



Witnesses:
Edward Thorpe.
T. A. Kehoe.

Inventor:
Daniel M. Somers
By Philip M. Mumford & Phelps
Att'ys.

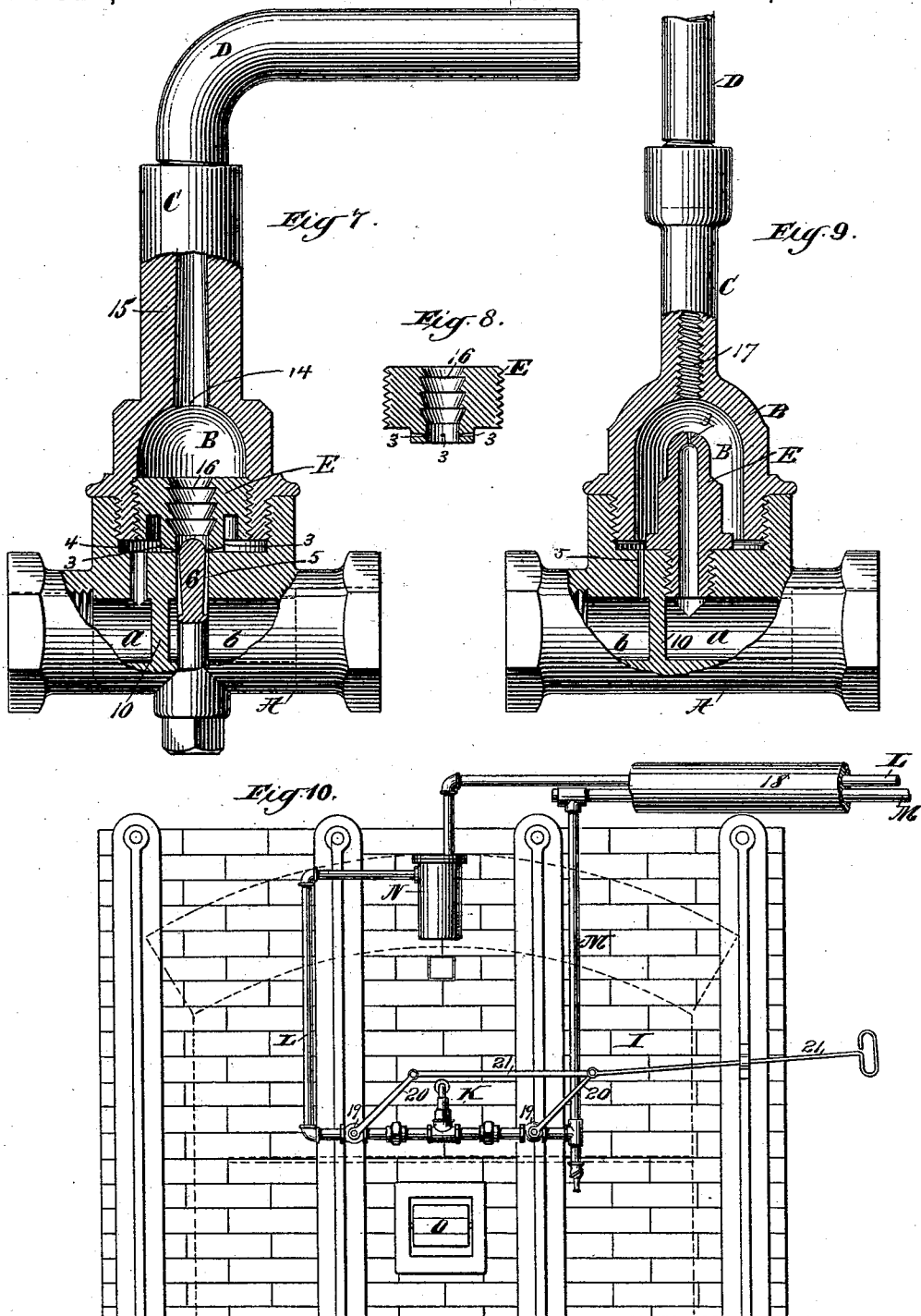
(No Model.)

2 Sheets—Sheet 2.

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UNITED STATES PATENT OFFICE.

DANIEL M. SOMERS, OF BROOKLYN, NEW YORK.

HYDROCARBON-BURNER.

SPECIFICATION forming part of Letters Patent No. 517,247, dated March 27, 1894.

Application filed January 6, 1893. Serial No. 457,458. (No model.)

To all whom it may concern:

Be it known that I, DANIEL M. SOMERS, a citizen of the United States, residing at Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Hydrocarbon-Burners, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

10 This invention relates to the art of forming a mixed vaporous gas for hydrocarbon furnaces, by combining what are known as fuel oils, either in their crude, refined or partially refined state, with steam, or air, so that the same may be burned for heating.

15 The object sought to be attained is the complete combustion of the fuel and the production of the greatest quantity of heat, and this object is accomplished by the mixing of the smallest or ultimate physical atom to which a hydrocarbon, such as oil, may be reduced, with such a larger relative quantity of steam, or hydrogen and oxygen, as is necessary to satisfy the chemical requirements. The mixing, referred to, is accomplished by mechanically reducing such oil by minute division to its ultimate physical atomic condition, by the use of minute passages or jets for the same through which it is measured and projected under pressure into impact with the steam, or air.

20 The invention consists in the means for so forming the mixed vaporous gas as to compose it of the least quantity of oil in combination with the greater quantity of steam, as will, in combustion, produce a high degree of heat, thus utilizing a large proportion of hydrogen and oxygen from the steam and economizing the carbon or oil.

25 It also includes an improved structure of burner, and apparatus for accomplishing the same.

30 As all of the features of invention are hereinafter fully explained and specifically claimed, no further preliminary description is requisite.

35 In the accompanying drawings forming a part of this specification I have shown apparatus of the preferred form for carrying out my improvements and embodying the features of my invention, and a full description thereof will now be given and the method and fea-

tures of construction forming my invention will be specifically pointed out and claimed.

40 In the drawings:—Figure 1 is an exterior view of the complete burner in one of the preferred forms. Fig. 2 is a longitudinal central section of the same. Fig. 3 is an external view of the jet block containing the steam and oil passages, detached from the burner. Fig. 4 is a longitudinal central section of a modified structure of the same. Fig. 5 shows a slight modification of the flame end of the burner. Fig. 6 is a modified form of the burner and its jet block in which the mouths of the steam and oil passages are contiguous. Fig. 7 shows a modified form of burner and jet block in which the steam is introduced centrally with respect to the oil and the mouths of the steam and oil passages are contiguous. Fig. 8 is a sectional view of the jet block in this construction, as slightly modified. Fig. 9 shows a modification of the burner suitable for use where small heat is required. Fig. 10 shows a convenient arrangement of my improved apparatus as applied to a furnace.

45 Referring now particularly to Figs. 1 to 5, the base A of the burner is constructed in the form shown of a T-shaped casting that provides ports or passages *a, b* for the conduction of the steam and oil, and screw connections for connecting pipes that lead there- 50 to from the sources of supply of the oil and steam respectively, these passages being divided by a central partition 10 so as to separate the oil and steam. The base A also provides a screw-threaded coupling flange 11 into which is screwed the projecting parts of the burner, the base end of which consists of an enlarged portion of a pipe that forms a dome-like mixing chamber B, while a reduced portion of said pipe forms a connection C between the mixing chamber B and a super- 55 heater D. The end of the enlarged portion of this pipe is screw-threaded for connecting it with the said flange 11 and this flange 11 is preferably provided with an annular shoulder 2 below which its side walls are inwardly inclined to constitute the outer wall of an annular conoidal chamber the inner wall of which is constituted by a cone 12 that rises centrally within said flange to the height of the shoulder 2. This annular conoidal cham- 60 ber, forms a seat for the reception of the jet

block E whose lower end is suitably shaped to enter therein and form a tight connection therewith, while its reduced upper end extends into the mixing chamber B.

5 The jet block E is introduced within the flange 11 with its conoidal end resting within the said conoidal chamber, whereupon when the enlarged end of the pipe is screwed into the flange 11 it presses against the flange 1
10 of the said jet block and forces its annular conoidal end to enter the similarly shaped chamber in the block A, said parts being thus pressed together so as to constitute an oil and steam tight connecting joint between the said
15 block and base. This jet block is perforated with a central passage *o* that connects with the oil passage *a* in the base A through the passage *i* in the cone 12 and the base A is perforated at a suitable point to provide a
20 passage 8 communicating with the steam passage *b* and the bottom portion of the annular conoidal chamber which thus forms a port 4 for the passage of the steam. This mixing
25 chamber is closed to the atmosphere and has a discharge port 14 that conducts the mixed gas outward for combustion, and this port is made small enough or so shaped as to restrain the discharge of the gas to an extent that will
30 cause about five pounds pressure, thus holding in suspension and thoroughly mixing the components of the gas before the same passes out of the mixing chamber.

The jet block E is perforated centrally to form a passage *o* in continuation of the oil
35 passages *i* *a*, and at its inner end this passage *o* is closed by a screw plug 13. The jet block E is perforated longitudinally with a series of circularly arranged steam passages connecting with the port 4 which passages terminate at their upper ends in smaller pas-
40 sages or steam jets 5 that communicate with the mixing chamber B, which passages 5 extend through a reduced portion of the jet block, and though shown as parallel with each other, may in some cases be inclined toward
45 or from the center of the burner.

Smaller and minute passages or oil jets 3 for the conduction of the oil, perforate radially the extended neck of the jet block E, and
50 are shown as pointed to deliver at right angles to the delivery of the steam passages, though they may advantageously be slightly inclined and preferably in a downward direction. The general direction of the steam jets
55 is thus longitudinal and that of the oil jets transverse, in the mixing chamber E, the jets of steam thus impinging the jets of oil substantially at right angles, and extending around about the same in annular form.

60 The supply of steam is under high pressure and direct from a suitable generator, and the supply of oil is either hydrostatic or otherwise under high pressure, a simple cock in each pipe acting as a mere gate controlling the supply
65 of each but not regulating it.

For regulation of the supply of the steam and oil both in quantity and force, the pas-

sages or openings through which the same enter the mixing chamber are alone used, and they are made of proper size and appropriate
70 relative size to secure the best results.

It will be found that the more minute the passages 3 and the less the quantity of oil passed through them under sufficient pressure, the better the oil is atomized and the
75 higher the economy secured.

In the drawings, the burner is shown full size, but the oil and steam jets or passages are necessarily shown exaggerated in size. It is found in practice that very good results are
80 secured with oil jets or passages of such size as to carry into the mixing chamber a gallon of oil in forty minutes under a pressure of eighty pounds to the square inch. The diameter of the said oil passages or jets should be
85 about twelve one thousandths of an inch, and the diameter of the steam passages or jets used is preferably about forty thousandths of an inch. It will be understood, however, that the size of these jets and the pressure under
90 which the oil and steam are introduced may be varied somewhat so long as high pressures are maintained. The number of the oil and steam jets will be varied in accordance with the size of the furnace and the amount
95 of heat desired. A burner of the size shown, with six jets, as in the drawings, is sufficient to heat a large re-heating or annealing furnace, or a steam boiler; and, one hydrocarbon, and one steam or air passage will produce
100 practical results, where but a small quantity of heat is required.

Satisfactory results are attained when the oil and steam are introduced under equal pressures of say eighty pounds. To atomize
105 the oil properly against the back pressure in the mixing chamber, a pressure of eighty pounds has been found to be necessary, but better results are attained by increasing both the pressure of the oil and the pressure of
110 the steam and greater power is exerted and a better atomization made. To burn the same quantity of oil with higher pressure would necessitate a corresponding reduction in the size of the outlets for the oil and the
115 steam. Also, if high unequal pressures are maintained on the oil and the steam, their respective outlets can be so proportioned to each other as to use the exact quantity of steam and oil required, and the only thing
120 affected will be the degree of atomization, it being true in all cases that the greater the atomization the better the result. Therefore the pressure of the oil may be lower than that of the steam, or vice versa, the steam
125 lower than the oil.

The desideratum to be obtained is: from a given amount of fuel oil to unite with its component atomic parts of carbon and hydrogen the atoms of hydrogen and oxygen in steam,
130 with the atoms of oxygen that are in the air, in such chemically exact atomic quantities, and under the conditions to produce the best chemical re-actions, commonly called combus-

tion, as to produce a very high degree of heat. Thus, if a small proportional quantity of fuel oil is projected with enough force directly against a larger and properly proportioned jet of steam, and having the greatest energy, its atoms will be forced apart into the greatest degree of divisibility and a fine vaporous gas will be formed from the hydro-carbon and steam, whose atoms of carbon will be the smallest attainable. The component parts of the carbon and hydrogen gas in the hydro-carbon with the additional hydrogen gas and oxygen gas that compose the steam, are exactly proportioned to each other, according to their chemical atoms, and with the exact amount of additional oxygen that is required and supplied from the air. When these compound gases are ignited in a properly constructed furnace, great chemical reactions take place, producing great heat. Under a high temperature the elementary gases have a stronger tendency to form new compounds than to remain in the forms in which they were introduced. Thus the carbon seeks the oxygen, liberating the hydrogen in the fuel oil, forming first the monoxide, or one part oxygen to one of carbon, and next the dioxide or two of oxygen and one of carbon, which is carbonic acid, and produces great heat.

As has been explained both the oil and steam are delivered to the burner under their initial high pressures, unrestrained by check valve or other modifying device, and hence as they emerge from the respective passages or jets 3 and 5, the steam under the boiler pressure, and the oil under suitable, preferably the same, pressure, the steam will enter the mixing chamber in jets of great projective force, and the oil will enter the same chamber in finely divided jets of great force and thus be converted into an atomic spray that is forcibly projected directly into the steam, the atomized oil and steam thus being driven together in opposite directions and into forcible impingement, whence results first, from the greater relative quantity of the steam, and second, from the realization of a nearly perfect division of the oil into its ultimate physical atoms, such an absorption of the atoms of the oil within the steam as to form practically a surcharging of what would appear a relatively large body of steam with a small quantity of oil so finely divided and taken up as to produce a true suspension of one within the other so that there is no tendency to separation whence would result the formation of globules of steam or oil. Thus there is produced in the mixing chamber a vaporous gas largely composed of hydrogen and oxygen in the steam, enriched by or surcharged with the suitable quantity of hydrogen and carbon in the oil, and a gas results which is capable of producing a very high degree of heat with great economy in the use of the oil. It will be seen that this construction provides a very simple and convenient means for adjusting the capacity of the

burner, as when a greater or less heat, or heat of a different character is required, it is necessary only to remove the jet block E and substitute therefor another such block with the desired number, size, and arrangement of oil and steam jets, to suit the volume and degree of heat desired.

The passages or oil jets will preferably be formed by reaming or milling whereby their minute dimensions may be determined with great accuracy, so that they will serve the important function of acting as measurers of the oil. The amount of oil consumed may thus be readily determined at any time from the capacity of the jets and the time during which the burner has been used. This capacity may also be tested at any time by drawing oil through it into a measure and timing its passage. This is an important feature of my invention and a burner thus constructed forms in itself a part of the invention.

From the mixing chamber B the mixed oil and steam of vaporous gas passes outward for combustion through the restraining port 14 and into a conducting pipe that discharges within the combustion chamber of the furnace. Although as herein shown this conducting pipe consists of a part C that is practically a continuation of the restraining port 14 of the mixing chamber B and of an extension D that forms a superheater, said conducting pipe might be a single continuous member leading to the combustion chamber, the size of the port 14 communicating between the chamber B and this pipe being made small enough to restrain the passage of the mixed gas from one to the other, as before explained, and in practice the size of this port 14 will be even less than is illustrated. The larger the diameter of the discharging portion of this pipe in its relation to the restraining port 14 the shorter will be the flame, and hence in order to be able to control the extent of the flame, the discharging end as D of said pipe should be adjustable, so that a length of the desired diameter may be attached. The simple arrangement of a detachable coil 15 held in place by the superheating pipe D may be employed to aid in controlling the flame, and forms a device that may be conveniently removed and exchanged for one of the desired size.

In order to modify the force of impact which the high steam will have in being projected directly upon the head of the mixing chamber, whence would arise a tendency to separate from it the atoms of oil which it has absorbed, by converting them into globules, the head of this chamber is preferably turned inwardly about the port 14 so as to form a recess 60 having curved surfaces, which recess thus not only forms a curved deflector changing the direction of movement of the vaporous gas and thus causing a churning effect but provides an elastic cushion for the direct reception of the impact force of

the steam jets. This is further assisted by having the port 14 small enough to cause such a back pressure as will hold the oil well in suspension. The mixed oil and steam will thus be kept in a state of mutual suspension in the mixing chamber in the form of a vaporous gas and during its passage from the mixing chamber to the superheater or discharge pipe, the oil will not only be prevented from passing out of its atomic into a globular state, but in traversing the superheater D will be raised to such a high temperature as to cause a volatilization which will tend to increase, promote and fix the atomic state of the components of the mixed gas, which gas by reason of this superheating will have its heating capacity increased, and be in proper condition as it enters the combustion chamber to seek and take up the necessary quantity of heated air therein to accomplish its perfect combustion, the air combined with it at this stage being highly heated by the furnace is better suited for the purpose than is air introduced through the burner. This superheater D may be of any suitable form, either straight or curved, or may be of any desired length to secure the desired heating surface for the oil, and it may be turned into any position and brought into the exact location desired for the application of the heat produced by the burning of the gas escaping at its end. The form of the end of the superheater, also, will be varied in accordance with the desired form and direction of the flame. As shown in Figs. 1, 2, 6 and 7, the pipe is simply open at its end so as to form a long jet of burning gas, but if a wider flame, adapted for heating a surface of greater extent is desired, the end of the pipe may be closed by a cap F provided with lateral perforations, as is shown in Fig. 5, or the pipe may be perforated throughout any suitable portion of its length, or gas jets of annular or other form may be produced in any manner desired, and in any of these forms it may be bent or coiled in any direction.

As has been indicated it is of the utmost importance that the passages 3 in the jet block E for the spraying of the oil shall be accurately made, not only to evenly and finely divide the same, but so that only a predetermined quantity of oil may pass through them. While this may be well effected by reaming, even this may be aided by the modified construction of jet block shown in Figs. 4 and 6. In this example the screw cap 13 is hollowed out so that the passages 3 may be formed partly in the screw-cap and partly in the upper surface of the neck of the jet block; or, be made wholly in the neck of the jet block, and the said flange have a plane surface resting over said passages. This enables said passages 3 to be cut to the smallest size required, and readily cleaned.

In the arrangement shown in Fig. 6, the passages 3 and 5 are shown as contiguous,

that is, their eduction ends are in close proximity. This is especially advantageous though said eduction ends may be somewhat separated as in Figs. 2 and 4, and yet produce good results. In this construction there is also shown a strainer W for the oil which is made of fine wire gauze, the meshes of which are smaller than the passages 3. This strainer is held in a carrier composed of an outer ring 30 and an inner ring 31, the latter screwing into the former and clamping the gauze in place. This holder is simply inserted into the body of the jet block, and will be held in place by the cone 12. This strainer and its accessories are, however, not claimed herein. In Fig. 6 is shown a modification of the jet block and adjacent parts, whereby the port 4 is enlarged, and the passages 3 and 5 are contiguous.

It is preferable, although not absolutely essential, that the steam should be introduced in the form of a series of jets arranged in an annular form about the oil jets and striking directly into the same, but this arrangement may be reversed, if desired, and the steam be introduced centrally to the oil. In Figs. 7 and 8 I have shown such a modified construction in which the oil and steam are introduced into the mixing chamber B centrally through a passage 16 formed in the jet block E that is arranged to close the outer end of the mixing chamber, the steam being admitted to this passage 16 which is a part of the mixing chamber, through passages 5 that are formed in the sides of a central stem 6 entered into the lower end of the passage 16, while the oil jets 3 are passages through the base of the jet block E extending transversely to the passage 16 and connecting outside the jet block with the annular chamber 4 between the end of the contracted lower end of the jet block and the base A, this annular chamber being connected with the oil passage a. The passage 16 is preferably made with annular inwardly extending shoulders so as to assist as does the coil 15, in breaking up the oil as the oil and steam pass through it into the mixing chamber. This construction, however, is not so efficient and economical as the one in which the steam is admitted about the oil, but would answer fairly well for a burner using oil and air.

In Fig. 9, I have shown a construction suitable for use where small heat is required, in which the steam is admitted to the mixing chamber B through a single passage or jet 3 formed in the end or side of the jet block E which in this example extends nearly to the inner end of the mixing chamber to which the steam is admitted near the base of the plug through a passage 5. This construction also shows the wire coil 15 omitted, a screw thread 17 formed on the inside of the pipe C being employed for the same purpose. This arrangement of the oil jet parallel with the line of movement of the steam is not so effective or economical as either of the con-

structions previously described, but may be used, as above stated, when small heat is required.

It will be understood that my improved burner may be used generally in furnace constructions, and as such arrangements of furnaces are well understood, they need not be here described in detail. In Fig. 10, however, I have shown an arrangement of furnace and connections for my improved burner which will be found convenient, and which in itself embodies certain features of my invention. In this construction I is the furnace proper and K the burner set upright, L is the oil pipe and M the steam pipe, these pipes being shown as having a common covering 18 of any material suitable for retaining heat, the oil thus being warmed by the heat of the steam before reaching the burner. The oil is shown as passing through a filter N which, of course, need not be used, if previously filtered oil be employed.

The oil and steam pipes L, M, are controlled by throttles 19, the crank arms 20 of which are connected to a common operating bar 21. Both throttles are thus controlled to open and close the pipes L, M, simultaneously and exactly to the same extent. By this construction, it will be seen that no adjustment of the supply of oil and steam relatively to each other is made, but that it is necessary only to shift the bar 21 for opening or closing both pipes. The furnace is of the usual construction, O being the air supply, which is the same as usual, except that it will be found my improved burner requires somewhat less air than the burners now in common use.

While my improved apparatus has been described in connection with the use of steam, it will be understood that all the forms of burners shown may be used with air in place of steam. The oil is finally atomized by the high initial pressure of the air, and in some cases as in the burning of clays, &c., the use of air is desirable. With either steam or air, however, it will be found that a great saving is made in the amount of oil consumed for a given heat over constructions now in use.

It will be seen that my improved burner dispenses entirely with furnace-men as it involves no adjustment for regulating the heat, but a burner with oil and steam openings constructed for a given heat will burn uniformly at this heat. The proportions of oil and steam, also, are determined without regulating devices and the proper proportions secured so as to avoid incomplete combustion which frequently results from inaccurate adjustment in constructions now in use. The burner also is practically noiseless in operation.

It will be understood that many modifications may be made in the construction and operation of the parts of my improved burner and that I am not to be limited to any of the specific constructions shown.

What is claimed is—

1. An apparatus for forming a fuel for heating purposes having a mixing chamber, measuring jet orifices adapted to discharge into said mixing chamber, and oil and steam or air supply pipes communicating respectively with said jet orifices, in combination with means for producing adequate pressures in the supply pipes, substantially as described.

2. An apparatus for forming a mixed gas for heating purposes, which consists in means for conducting a hydrocarbon and steam or air under initial pressures into direct impingement one with the other, through passages leading to a mixing chamber, substantially as described.

3. An apparatus for forming a mixed gas for heating purposes, which consists in means for conducting a hydrocarbon through one or more minute passages, and steam or air through one or more comparatively larger passages into direct impingement within a mixing chamber, substantially as described.

4. An apparatus for forming a mixed gas for heating purposes, which consists in means for conducting a hydrocarbon and steam or air under high pressure into direct impingement one with the other through passages leading to a restraining mixing chamber, substantially as described.

5. An apparatus for forming a mixed gas for heating purposes, which consists in means for supplying a hydrocarbon and steam or air under initial pressures, a minute passage or passages for controlling the hydrocarbon, and a comparatively larger passage or passages for controlling the steam or air, said passages leading into a mixing chamber, and operating to bring the hydrocarbon and steam or air into direct impingement in measured quantities relatively predetermined by the areas of said passages, substantially as described.

6. An apparatus for forming a mixed gas for heating purposes, which consists in means for supplying a hydrocarbon and steam or air under high initial pressures, a minute passage or passages for controlling the hydrocarbon, and a comparatively larger passage or passages for controlling the steam or air, said passages leading into a restraining mixing chamber and operating to bring the hydrocarbon and steam or air into direct impingement in measured quantities relatively predetermined by the areas of said passages, substantially as described.

7. An apparatus for forming a mixed gas for heating purposes, which consists in means for supplying a hydrocarbon and steam or air under initial pressures, a radiating series of minute passages for controlling the hydrocarbon, and a radiating series of comparatively larger passages for controlling the steam or air, said passages leading into a mixing chamber and simultaneously discharging the hydrocarbon and steam or air into direct im-

pingement in measured quantities relatively predetermined by the areas of said passages, substantially as described.

5 8. An apparatus for forming a mixed gas for heating purposes, which consists in means for supplying a hydrocarbon and steam or
10 air under initial pressures, a minute passage or passages for controlling the hydrocarbon, and a comparatively larger passage or pas-
15 sages for controlling the steam or air, said passages leading into a mixing chamber, and operating to bring the hydrocarbon and steam or air into direct impingement in measured quantities relatively predetermined by the
20 areas of said passages, and a conducting pipe leading from said chamber for superheating and discharging the gas for combustion, substantially as described.

9. The combination with a burner composed
25 of two separable portions, of a jet block secured between the said portions of the burner, substantially as described.

10. The combination with the base A and the oil and steam or air passages therein, its
25 coupling flange 11 provided with a conoidal seat and a jet block having a ring like end with tapered sides, of a burner provided with a chamber for inclosing said jet block and with a threaded connection for holding the
30 block to its seat and forming a steam and oil tight joint between the parts, substantially as described.

11. The combination with the mixing chamber B and the base A, of the jet block E pro-
35 vided with minute oil passages 3 and comparatively larger steam or air passages 5, substantially as described.

12. The combination with the base having oil and steam or air passages *a*, *b* of passages
40 or jets 3, 5 connecting the same with a mixing chamber B, and a conducting pipe leading from said mixing chamber and communi-

cating therewith by means of a port 14 contracted to produce a suitable resistance to the
45 passage of the vaporous gas formed in said chamber and compelling it to escape under pressure, substantially as described.

13. The combination with base A having oil passage *a* and steam or air passage *b* and
50 with a mixing chamber B having a discharge port 14, of minute oil passages 3 and comparatively larger steam or air passages 5, communicating respectively with the said
55 passages in the base A and with the chamber B, substantially as described.

14. The combination with the base A having oil and steam or air passages *a*, *b*, of pas-
sages or jets 3, 5, connecting the same with
60 a mixing chamber B, and a conducting pipe leading from said mixing chamber and communicating therewith by means of a port 14 contracted to produce a suitable resistance
65 to the passage of the vaporous gas formed in said chamber the latter being also provided with a recess 60, substantially as described.

15. A jet block E provided with a main por-
tion in the top of which the minute oil pas-
sages are partially or wholly formed, and with
70 a removable cap or closure 13 whose shoulder forms in whole or in part one side of said passages, substantially as described.

16. The combination with a burner having
oil and steam or air passages that are propor-
tioned to measure the oil and steam or air, of
75 gates or valves that are connected to simultaneously open and close the main supply pipes, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

DANIEL M. SOMERS.

Witnesses:

H. T. MUNSON,
T. F. KEHOE.