Jan. 27, 1953 DE WITT H. WYATT 2,626,656

GAS BURNER AND INTERNAL BAFFLE FOR GAS DISTRIBUTION

Filed April 16, 1947 4 Sheets-Sheet 1

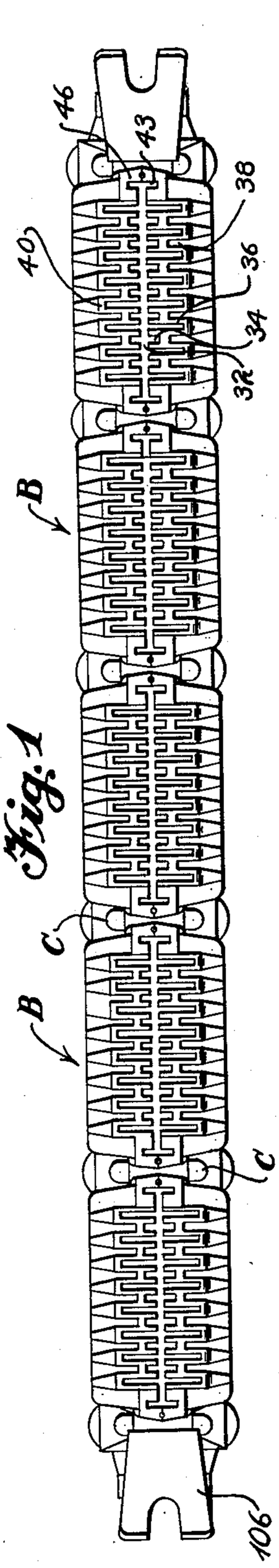

Fig. 1

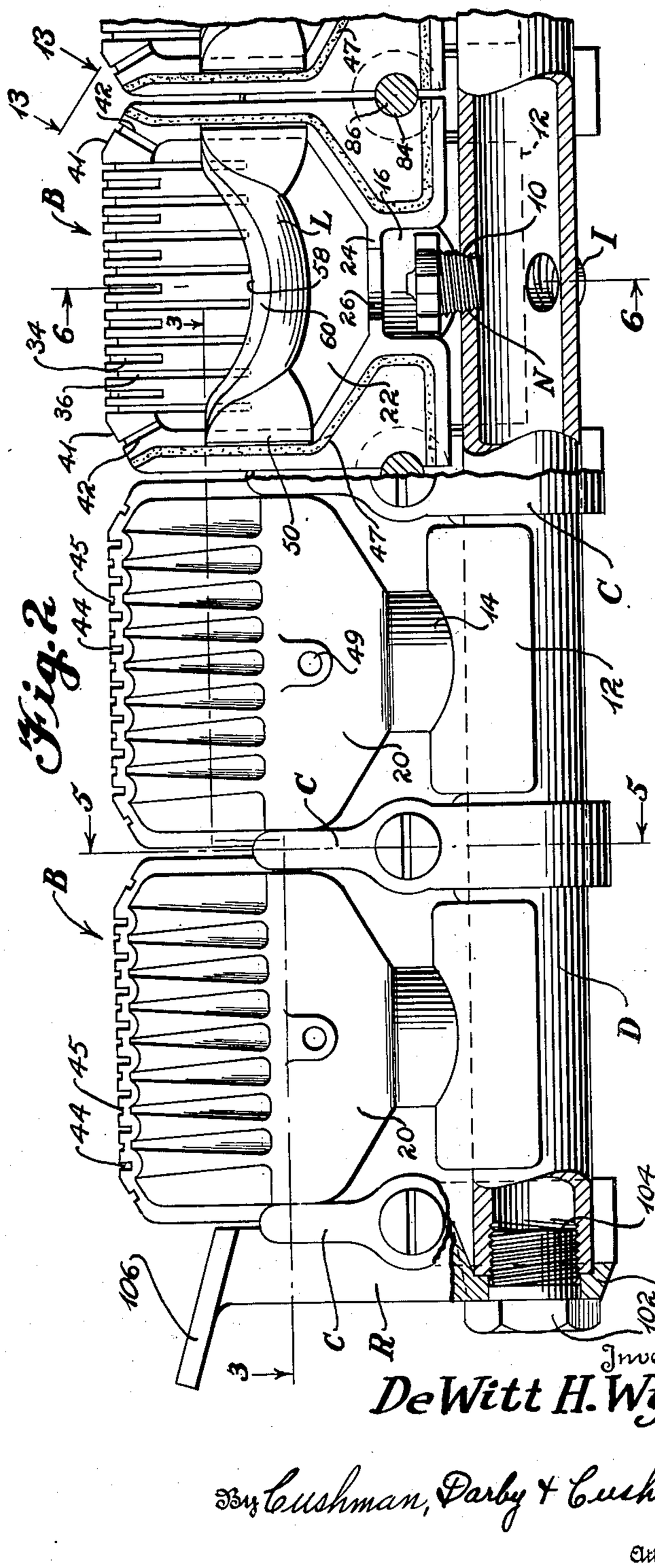

Fig. 2

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Fig. 3

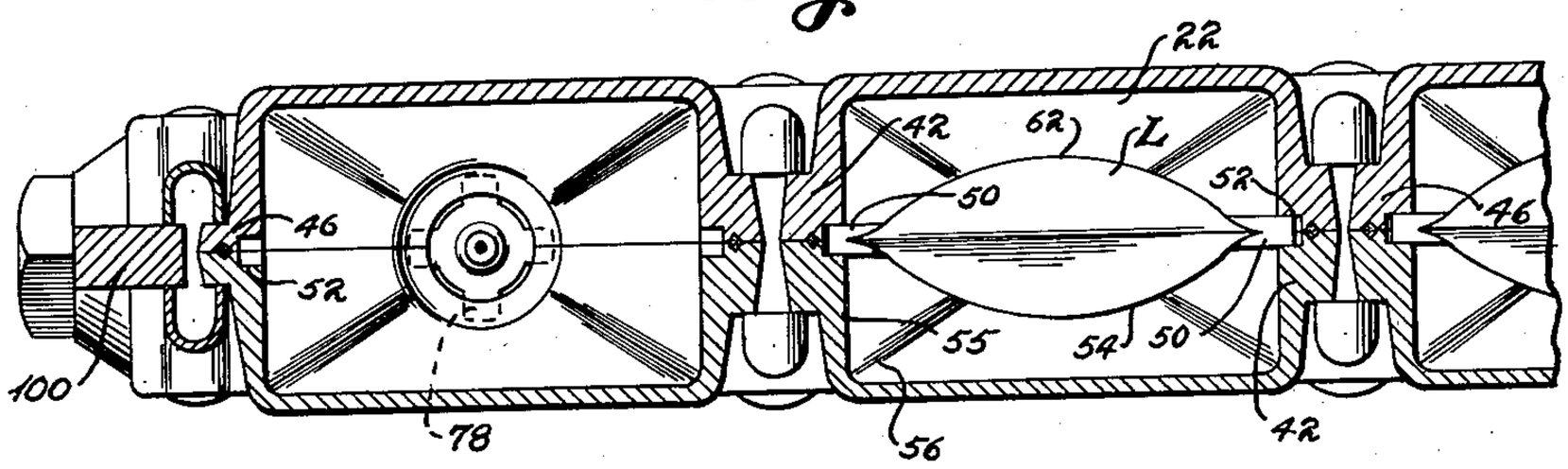


Fig. 4

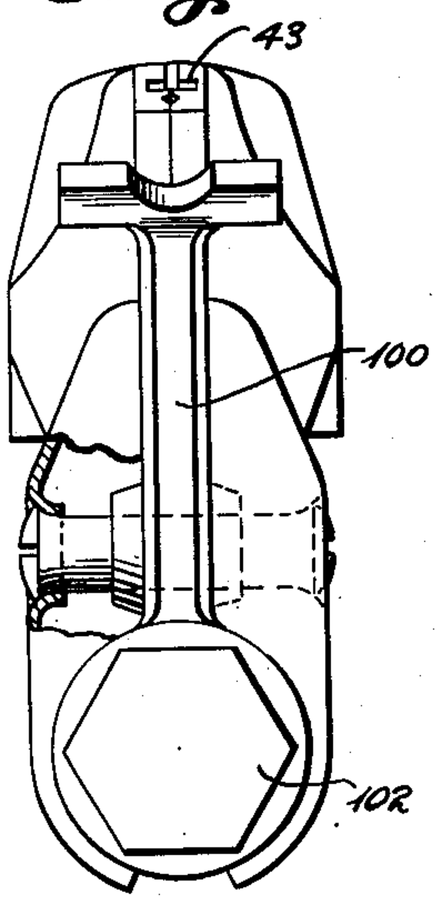


Fig. 5

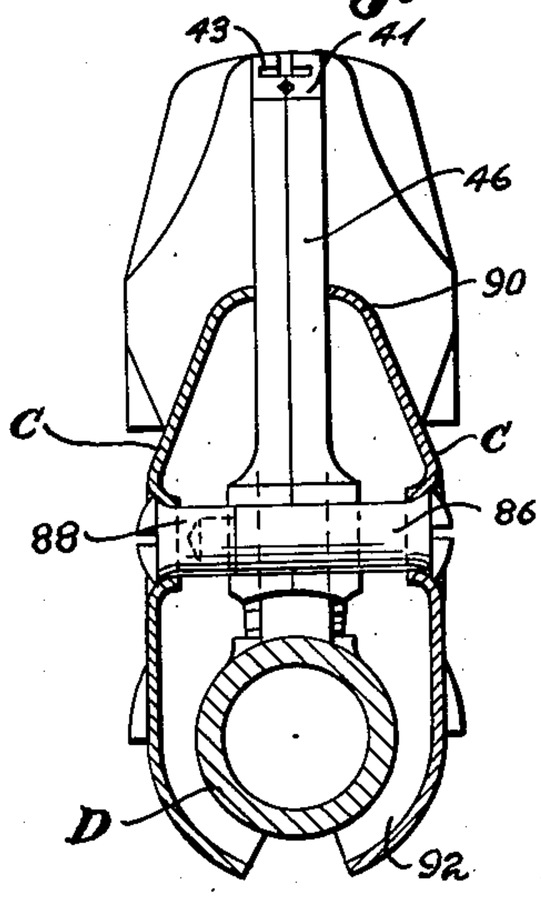


Fig. 6

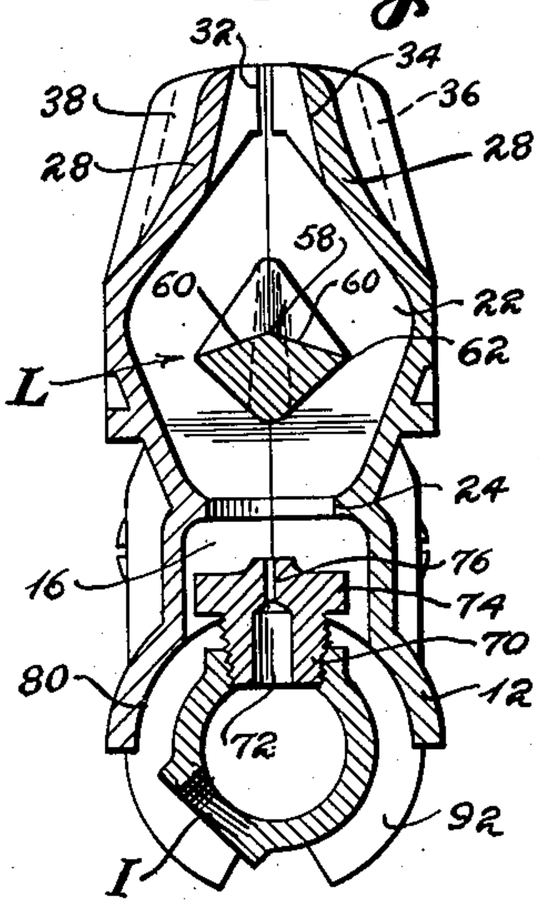


Fig. 15

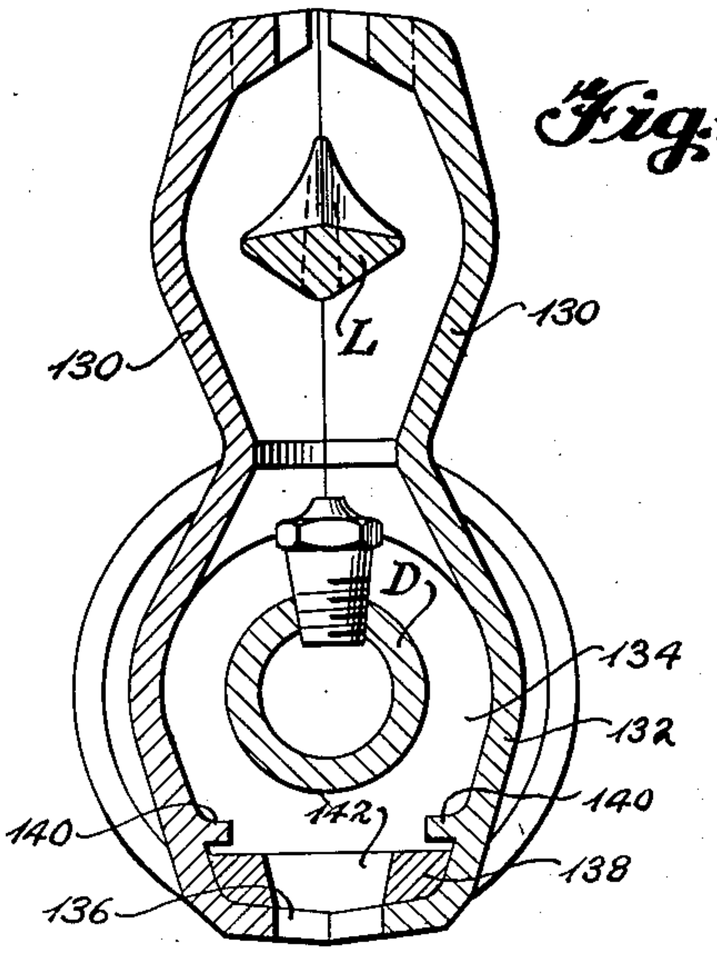


Fig. 11

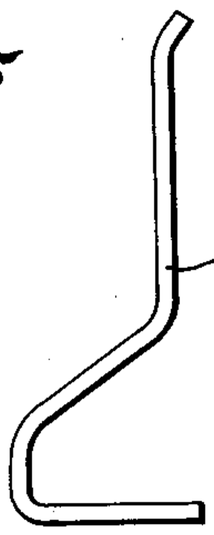
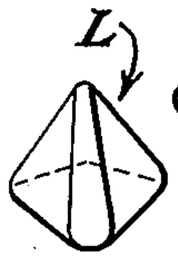


Fig. 10



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GAS BURNER AND INTERNAL BAFFLE FOR GAS DISTRIBUTION

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Fig. 7

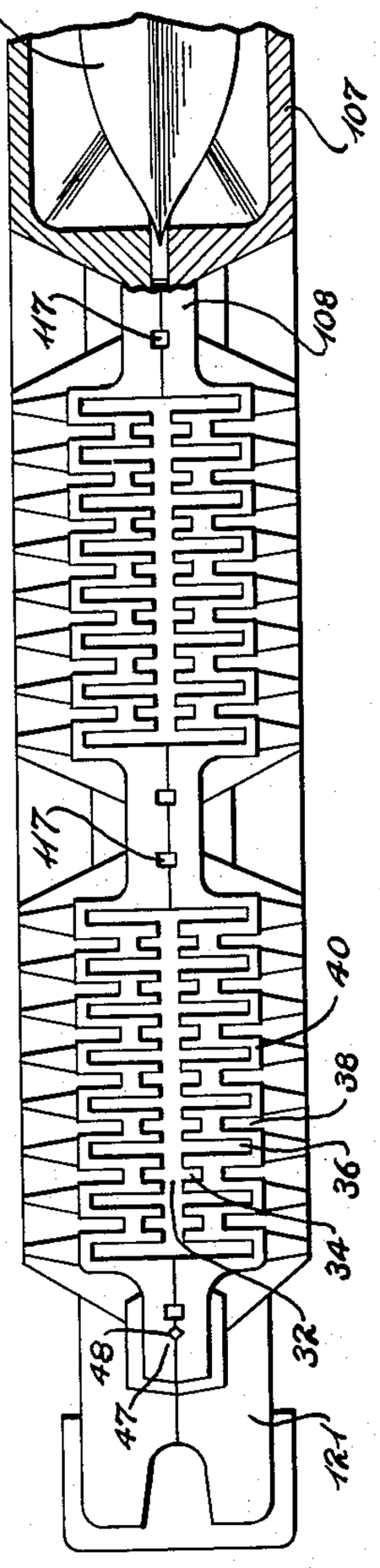


Fig. 8

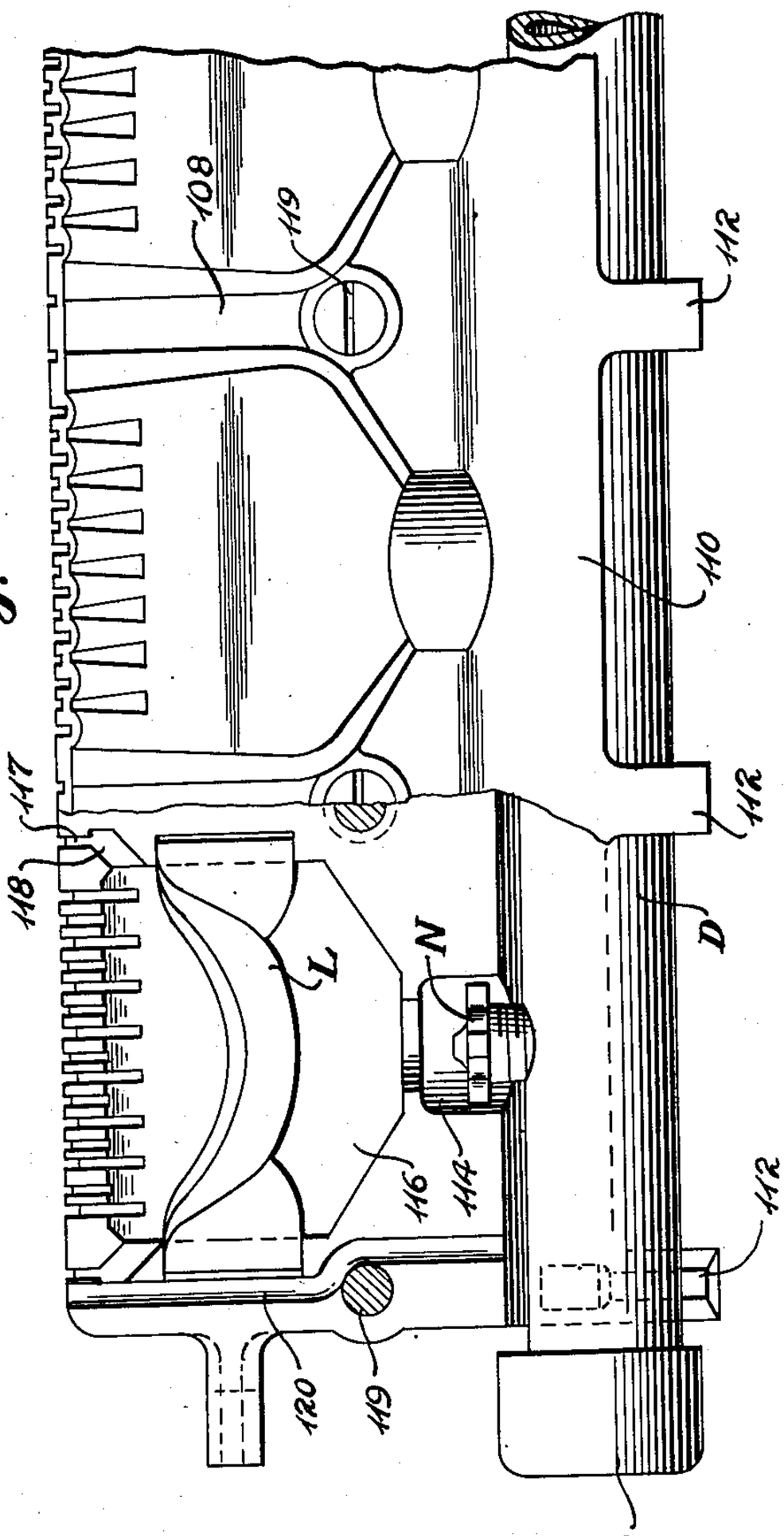
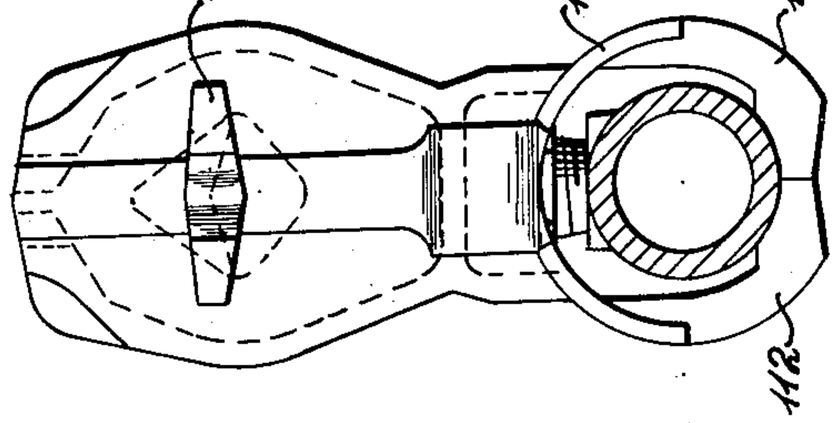


Fig. 9



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GAS BURNER AND INTERNAL BAFFLE FOR GAS DISTRIBUTION

Filed April 16, 1947 4 Sheets-Sheet 4

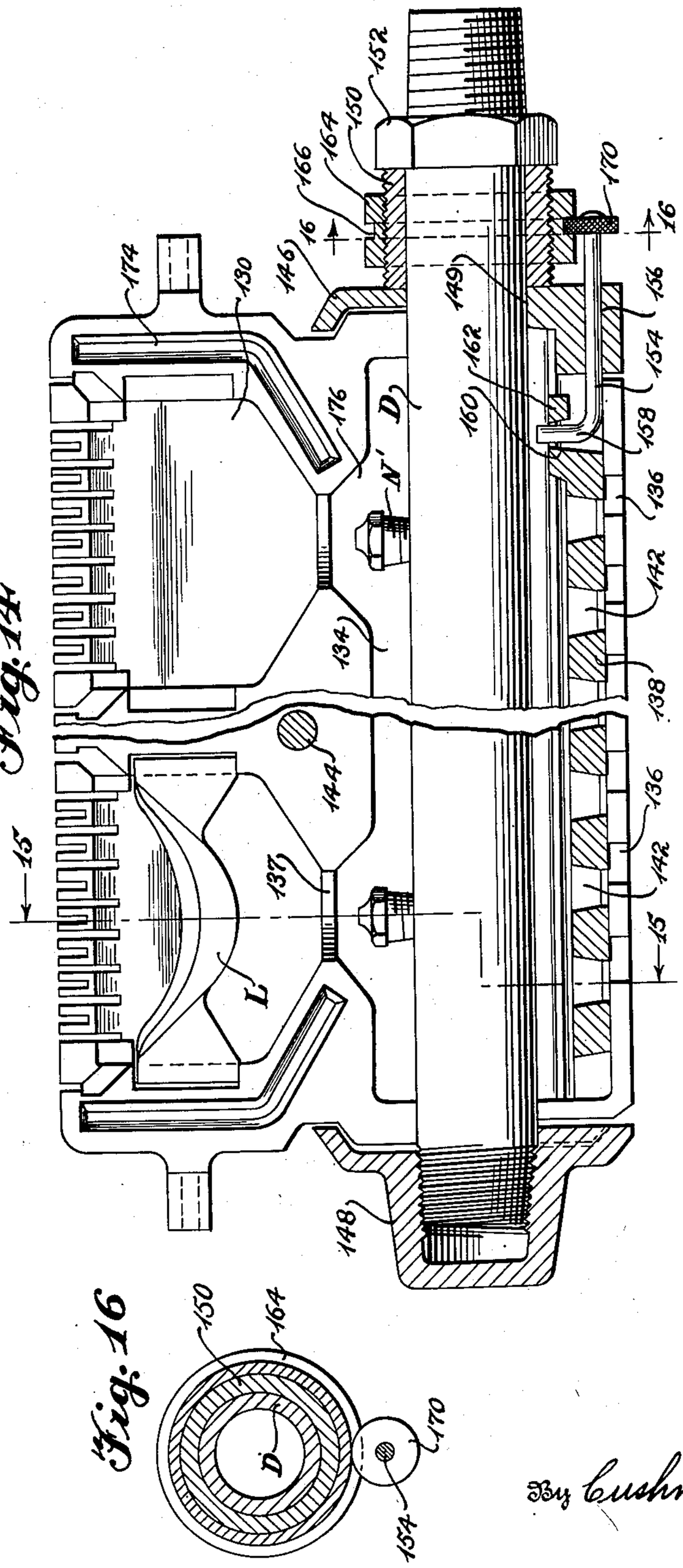

Fig. 14

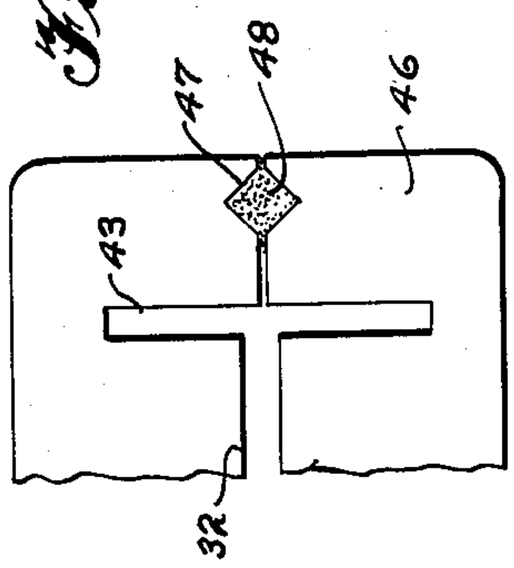

Fig. 13

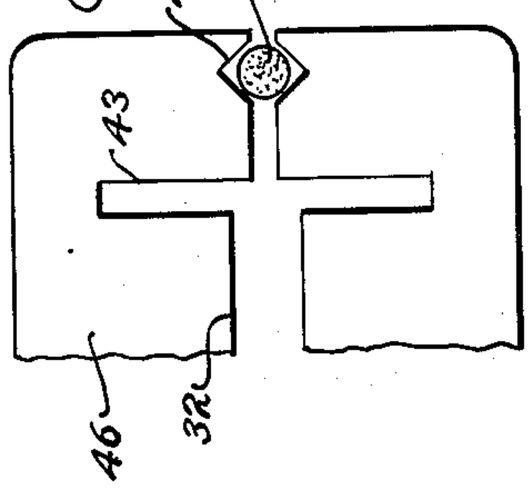

Fig. 12

Fig. 16

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UNITED STATES PATENT OFFICE

2,626,656

GAS BURNER AND INTERNAL BAFFLE FOR GAS DISTRIBUTION

De Witt H. Wyatt, Columbus, Ohio

Application April 16, 1947, Serial No. 741,781

6 Claims. (Cl. 158—114)

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The present invention relates to a gas burner assembly of improved type. A principal object of the invention is to provide such an assembly comprising a minimum number of parts of simple design characterized by the convenience and economy with which they may be manufactured, and which are arranged for mounting on a gas distributing pipe and to be carried in the base or stand of such as ordinary household gas heater.

The parts referred to are designed so that they may be assembled on a distributing pipe to form a burner assembly of any selected number of Bunsen type burner heads of novel and efficient design. One burner head is intended to supply the required combustion for one double size radiant mantle. When using my burner assembly, the mantles are appropriately spaced along and above the burners, being carried within the body of the heater in a manner which will be apparent to those skilled in the art, the disclosure herein being confined to the burner assembly, rather than illustrating the remainder of the heater including the radiants referred to.

As an example of one use to which the present burner may be put, reference is made to my co-pending application Serial Number 697 686, filed September 18, 1946, now Patent No. 2,517,071, which broadly discloses a type of heater in which the present burner assembly might be used.

It will be understood that the burner heads disclosed herein may be put to other uses, such as for domestic water heating boilers, and for many other commercial uses. They may be used with many modifications of refractory elements or radiants, particularly when used in floor furnaces, circulator heaters, for space heating, and various other commercial and domestic applications.

A very important object of the invention is to provide a burner having a mixing chamber and baffle of novel design which avoids the necessity for a long neck venturi and burner throat assembly. As disclosed herein, the mixing operation avoids turbulence while providing an orderly mixture without excessive pressure areas. The baffle disclosed herein is formed to evenly distribute the mixed gas and air over the whole length of the burner top without turbulence.

One of the principal features of the invention is to provide a burner assembly comprising a selected number of burner elements, each burner element comprising two half castings of symmetrical design which are assembled and secured to one another face to face. The engaging faces of said half castings are machined to fit one another and have appropriately arranged aligned

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slots therein, said slots forming ports which provide uniform and complete combustion of properly mixed gas and air rising from the mixing chamber of the burner. It is an objective of the invention to provide a burner having a slotted top of such design as to provide maximum gas discharge.

The invention also provides a novel baffling arrangement within the burner heads, said arrangement comprising a baffle of novel design which is supplied as a separate element, but which is assembled within the burner head when the two halves of the latter are connected together. The invention contemplates a novel and simple arrangement for properly aligning and connecting the burner halves in position along and above the gas distributing pipe.

Another important feature of the invention is a burner which provides for the supply of secondary air to the flame as it emerges from the top burner surface, and particularly to provide for the supply of such secondary air to central points with respect to the emerging flame, at a plurality of spaced points along the burner. This is accomplished by an arrangement of secondary air slots at the burner top, which also provide a cooling fin arrangement to prevent puff-back and back-flash explosions.

It is also an object of the invention to provide novel adjustable means for regulating the supply of air into and around the gas outlet nozzle from the distributing pipe of the burner. A further feature of importance is to provide orifice plugs of novel design along the distributor pipe, at and within each of the burner heads referred to.

It will be apparent that by reason of the novel construction referred to, my burners may be used effectively in confined spaces and may permit reduction in the height of heaters in which they are used.

Various other novel and useful features of the invention will be apparent as the description herein progresses. While the burner parts are referred to as being made of cast aluminum alloy or cast iron, formed in the symmetrical halves referred to, it will be understood that in certain instances it may be found convenient to make the burner halves of suitable ceramic materials. This is also true of the burner mixing baffle.

In the drawings:

Figure 1 is a top plan view of an assembled burner arrangement, comprising in the instance shown, five of the burner heads as referred to.

Figure 2 is an enlarged side elevational view,

partly in section, of several of the burner heads assembled on the distributing pipe.

Figure 3 is a horizontal sectional view, taken along the line 3—3 of Figure 2.

Figure 4 is an end elevational view of the assembly, looking inwardly from the left toward such an assembly as is shown in Figure 2.

Figure 5 is a transverse vertical sectional view through the assembly, taken between adjacent burner units, and along the line 5—5 of Figure 2.

Figure 6 is a transverse vertical sectional view taken centrally through a burner unit and along the line 6—6 of Figure 2.

Figure 7 is a view similar to Figure 1, of a modification of the invention, wherein several of the burner halves are formed as an integral casting. This enlarged view serves to show, however, the formation of the slots which form the burner top ports as found also in the embodiment of Figure 1. Figure 8 is a side elevational view of the modified assembly as shown in Figure 7.

Figure 9 is an end elevational view of the arrangement shown in Figure 8.

Figure 10 is an end elevational view of one of the mixing baffles.

Figure 11 is a view of a welding rod of the type used to effect a union between the end edges of the two halves of each of the burner units.

Figures 12 and 13 are enlarged top views of the end edges of the burner halves of the type shown in Figures 1 to 6, viewed generally from the position indicated by the line 13—13 of Figure 2, and disclosing the manner in which the welded union is effected.

Figure 14 is a side elevational view, partly in section, of a further modification of the invention wherein adjustable damper means is provided to regulate the inlet or air into the space surrounding the distributing pipe.

Figure 15 is a transverse vertical sectional view taken along the line 15—15 of Figure 14.

Figure 16 is a detailed transverse sectional view through the adjusting means for the damper previously referred to, taken along the line 16—16 of Figure 14.

Referring to Figure 2, the distributing pipe is shown at D, it being understood that this is the pipe which is customarily supported in the base of a gas heater, and through which the gas is distributed to the various burners. The distributing pipe may be cut to any appropriate length, depending on the number of independent burner units to be mounted thereon, as hereinafter described. In any event, the distributing pipe has connected thereto a gas inlet pipe I, preferably centrally along the length thereof, and this inlet pipe or connection may be controlled by any suitable type of valve, such as one of the rotary plug type, and having provision for the connection of any suitable attachment, such as safety lighter attachments. For these purposes, and as shown in Figure 6, the gas inlet pipe connection is arranged extending downwardly at a 45° angle from the horizontal plane passing through the axis of the distributing pipe.

Disposed at spaced points along the top of the distributing pipe are threaded openings 10, and it is over these openings that the respective burner units B are mounted. The burner units comprise a hollow chamber, formed for convenience of manufacture and installation in two vertical longitudinal symmetrical halves, the said halves being formed with cooperating aligned slots to divide the mixture of gas and air uniformly along the top of the burner as it is discharged to insure that maximum combustion is obtained. The burner units are designed to receive primary air into the lower part of their chambers and to mingle this air with gas entering their chambers from the opening 10, and to baffle the mixture of air and gas as it ascends through the burner. This mixture of air and gas is discharged at the top of the burner where the flame is located and where secondary air is supplied at spaced points along each burner to accelerate the combustion of the mixture.

As stated, the burner consists of symmetrical opposed half portions, each comprising a lower half saddle portion 12 which is supported slightly spaced above the top of the distributing pipe, surmounted by a half cylindrical portion 14, the interior of which is hollowed out as at 16 to fit over the head of a gas orifice plug (which is threaded into the outlet opening 10) and an outwardly diverging body portion 20 which is likewise interiorly hollowed out as at 22 to provide a substantially diamond-shaped mixing chamber for the gas and air. A mixing baffle L is mounted in the chamber 22 as hereinafter described. The interior of each burner is formed with a semicircular ledge 24 defining a somewhat restricted Venturi throat 26 centrally above the gas orifice plug N. It will be understood that the inner faces of the burner halves are machined to evenly fit against one another to form the chambers referred to, as well as the discharge ports to be hereinafter described.

Referring to Figures 3 and 6, it will be noted that the walls of the burner units are so designed that the mixing chamber 22 is substantially rectangular in horizontal section, and that it widens outwardly above the throat 24 up to a point in horizontal alignment with baffle L. Above this point, as indicated in Figure 6, the opposite walls of the burner units generally taper inwardly toward the top surface of the burner, where a plurality of gas outlets are formed by the symmetrical design of the two opposed halves of the unit. The top lips of the burner halves are so formed as to leave a continuous slot 32 throughout the length of each unit. In alternate sequence along the longitudinal slot 32, there are opposite relatively shallow transverse slots 34 and relatively deep transverse slots 36 in the lips of the opposite sections, through which gas and air mixed in the chamber 22 may escape while being burned, thus providing a grid or grill-like top along each burner. In line with the relatively shallow slots 34, and on the outside of the burner sections, are inwardly directed slots 38, said slots being arranged alternately between the relatively deep slots 36, and having inner edges which terminate closely adjacent to the outer edges of the shallow slots 34, whereby secondary air is brought in a multitude of narrow channels inwardly to the center of the flame or burning area which constitutes the top of the assembled burner unit.

By reason of the above construction, the top surface of the burner unit comprises a web of opposed H-shaped members, whose legs are spaced from one another to provide the continuous central opening 32, the outer ends of the legs of adjacent H members of each half section being connected by a web 40, the space between the outer legs of the H constituting the secondary air inlets 33.

In the embodiment of Figure 2, each burner half is provided with a downwardly tapering end portion 41, and there are similar registering outlet slots 42 in the engaging faces of said portions

which join with transverse slots 43 to provide relatively small combustion areas at opposite ends of each unit, the slots 42 leading from the mixing chamber 22.

As best shown in Figure 2, the top edges of the burner halves are so formed that lateral channels 44 and 45 open outwardly along the burner top from the deep and shallow slots 36 and 34 respectively.

It will be apparent that the method of forming the burner in half castings, as described, will permit the cutting or milling of the slots, as referred to, with convenience, accuracy and precision, and substantially all of the slots may be cut in one operation with a tool of proper design. Similarly, the engaging faces of the burner halves may be evenly machined.

The inner faces of the burner units, at opposite ends, are provided with abutting flanges 46 which contact one another, there being a circuitous groove 47 along said flanges conforming to the shape of the mixing chamber 22 within the burner unit, which groove is adapted to receive a welding rod 48 such as copper wire of the configuration shown in Figure 11. When the burner units are assembled as indicated in Figures 1 and 2, with the baffle L positioned in a chamber and with the respective welding rods 48 in the grooves 47, the assembly may be set into a conventional welding fixture, clamped onto welding bosses 49 provided on the sections, and commercial welding equipment of well known type can be employed to automatically weld the units together. It will be understood that the units will be welded together before being assembled on the distributing pipe D.

The baffle L is designed to insure an intimate mixture of the gas and air. It has longitudinally extending central end wing members 50 (Figure 3) which serve to hold the baffle between the opposed sections of the burner unit in vertical end slots 52 formed in the inner faces of burner halves on opposite sides of the chamber portion 22. Viewed from the top, the baffle tapers outwardly as at 54 from its ends toward its lateral center line, giving it a somewhat flat elliptical form, so that the rising gases will be evenly distributed toward all walls of the chamber 22 of the burner unit including the end walls 55 thereof and into the corners 56. Looking inwardly toward the side of the baffle, its top surface is downwardly concave as shown at 58 in Figure 2. In transverse cross section, the baffle is substantially diamond-shaped and the top surface of the baffle slopes gradually upwardly on each side of its longitudinal center lines as at 60 to the longitudinal downwardly concave center-line 60. It will be noted in Figure 6, that the widest portion of the baffle is in a vertical plane substantially at the level of the widest lateral portion of the chamber 22. With this arrangement, the mixture of gas and air rising upwardly will be caused to mix intimately before exiting from the top of the burner, being deflected outwardly in the chamber 22 through the length of the baffle, and toward all walls of said chamber including the end walls thereof. After passing around the side edges 62 of the baffle, the relieved upper face thereof permits the combined gas and air to flow freely into the center of the burner, whereby it may pass upwardly through the central continuous longitudinal port 32, the outwardly directed portions of the mixture passing freely upwardly along and adjacent the walls of the chamber 22 and exiting through the ports provided by the adjacent shallow and deep slots 34 and 36 respectively. It will be apparent that when a flame is applied to the top of the burner units, a hot fire will be present over the entire top surface thereof, same being fed by gas and air mixed in the chamber 22, with further secondary air being added throughout and within the area of combustion by the rising of air in the exterior slots 38. The burner formed as described comprises a top grill-like surface of staggered ports, and a side radiator-like wall which provides for the rise of fresh air to the combustion point, as well as providing for cooling the end of the burner to prevent puff-back and backflash explosions.

The gas orifice plug 10 has a threaded lower end 70 with an enlarged bore 72 therein, and a top flange 74 of wider diameter than the threaded part 70 having a restricted nozzle opening 76 therethrough. Referring to Figures 3 and 17, it will be observed that the flange 74 is not continuous, but comprises spaced radial outwardly extending arms 78, separated by relatively wide spaces, whereby the outside air may freely rise through the space 80 (Figure 6) between the saddle portion 12 of the burner and the outer wall of the distributing pipe, and upwardly through the inlet chamber 16 where it joins with the gas from the nozzle opening 76. The initial mixture passes through the restricted Venturi throat 24 of the burner. The effectiveness of the mixture is insured by the outwardly and inwardly deflected rising action previously described in connection with the design of the baffle member L, whereby the mixture is in proper condition for complete combustion when it discharges from the top of the burner.

The gas orifice plug N meters both primary air and gas and is made to suit the gas specifications of any particular area or application. The outer rim of the plug is notched in accordance with the amount of air required, and for the application of an appropriate socket wrench to secure or remove the plug. The neck chamber 16 of the burner fits over and around the air ports provided by the outside notches in the plug. The skirt 12 of the burner extends downwardly to the center line of the distributing pipe to prevent turbulence by cross air currents or drafts across the floor.

The orifice 76 in the plug N is drilled in accordance with the B. t. u. characteristics of the gas to be used. When the plug characteristics are established, as to volume of air (by size of outside notches) and gas (by size of orifice 76) for a given locality or application, no service or adjustment is needed, although obviously the plugs may be replaced with others of different characteristics as necessary.

The edges of longitudinally adjacent burner unit halves are provided with semi-circular cut-outs 84, as shown for instance in Figure 2, and appropriate stamped metal clamping members C are disposed on opposite sides of the assembly and locked to one another by bolts 86 which thread into an opposed bolt head 88 as shown for instance in Figure 5. The bolts pass through the clamping members and through the openings formed by the cut-outs 84. The clamping members C have inwardly turned upper ends 90 which engage the end flanges 46 of the burner halves, and lower ends provided with webs 92 which clamp around the discharge pipe, as shown in Figure 5. With this construction, the various previously assembled and welded burner units

(formed of their two halves) are held in proper position along and above the distributing pipe, in register with the outlet openings 10 and gas plugs N, and with the saddle-like air hood 12 spaced above the distributing pipe to provide the air space 80 through which air is caused to rise and mix with the gases as previously described.

At each end of the assembly, the clamp C locks the outer end of the sections of the end burner together in a manner similar to that just described, the parts of this clamp also contacting opposite sides of the shank 100 of an end bracket member R, the lower end of said member having an eye 101 therein of size to embrace the distributing pipe, and being held against the end of the distributing pipe by a nut 102 having an inner end 104 threaded into the end of the distributing pipe. The top end 106 of the bracket R may be formed in any appropriate manner to support the entire assembly on the cooperating parts or frame of the gas heater with which this burner arrangement is to be employed.

While I have disclosed a preferred form of the invention, from a manufacturing standpoint, as comprising burners fabricated individually from halves which are assembled and welded together, it will be understood that two or any plural number of the burners may be formed of connected multiple half portions in the manner illustrated, for instance, in Figures 7, 8 and 9. In these figures, the design from an operating standpoint is substantially the same as that previously described, except that the end flanges 108 of adjacent burner halves are connected together, so that one casting forms a half portion of several burner units. As shown in Figure 8, these burner half portions are equipped with a lower depending semi-cylindrical hood-like member 110 which overlies the distributing pipe D, there being supporting webs 112 on opposite sides of and at spaced points along the hood portion, to grip the distributing pipe and support the hood in spaced relation above the distributing pipe leaving an air space under the hood, so that primary air may rise around the gas orifice plug and through the small interior chamber 114, and thence into the larger mixing chamber 116 beneath the baffle L. The multiple half burner portions are provided with the grill-like gas outlet openings along the top burner surface in the same manner as described in connection with the principal embodiment of the invention, except that intermediate slots 117 all provide for discharge of gas between the main burner portions, these slot-ports being fed by passages 118 from the mixing chamber 116. Disposed along the length of the multiple half burner portions, and between the burner units thereof, there are aligned openings through which are passed bolts 119 to secure the half burner portions together. At opposite ends of this assembly there are vertical aligned grooves 120 of the configuration shown in Figure 8, thus forming end sealing seats in which a gasket or furnace cement may be disposed when the parts are assembled and connected together, to form end seals at opposite ends of the assembly. The ends of the half castings may be formed to provide extending lugs 121 to support the assembly on the base of a heater. Gas may be admitted to the distributing pipe through one end thereof, the opposite end being closed by a cap 122. In all other substantial respects, the arrangement disclosed in Figures 7 through 9 is the same as that described in the principal embodiment of the invention.

Referring to Figures 14 through 16, a further modification is shown wherein controlled primary air supply is substituted for the air supply provided by the hoods 12 in the case of Figure 2 or the hood 110 as in the case of Figure 8. In Figure 15, the multiple opposed burner halves 130 pass downwardly entirely around the distributing pipe D as shown at 132 providing an air space 134 around the distributing pipe. In the bottom of the multiple burner units thus formed there are a plurality of longitudinally aligned air inlet openings 136, and a damper plate 138 is mounted for longitudinal movement beneath opposed longitudinal ledges 140. The plate 138 is provided with longitudinally spaced openings 142 which are adapted to be moved into and out of register with the openings 136 to regulate the amount of air which can pass into the space 134 around the distributing pipe D, and thence upwardly through the throat 137 into the mixing chamber beneath and around the baffle L. In a manner similar to that described in Figure 8, the multiple burner sections are held together by spaced lateral bolts 144, and at opposite ends, there are appropriately formed end locating and clamping washers 146 and 148, the former having an opening 149 therethrough for the distributing pipe and the latter being closed and threaded onto the protruding end of the distributing pipe D. At the inlet end of the distributing pipe, an exteriorly threaded sleeve 150 is held against the clamp 146 by a nut 152 threaded onto the end of the distributing pipe.

Means are provided for adjusting the register plate 138 longitudinally of the distributing pipe, comprising an operating arm 154 passing longitudinally through an opening 156 in the end clamp 146, and having an upwardly turned end 158 which passes through an opening 160 in an end flange 162 on the plate 138.

Threaded for longitudinal movement on the sleeve 150, is an adjusting nut 164, this nut having a circular track 166 therein, in which rides a disc 170 on the end of the operating nut 164. The disc 170 rides in the track 166, and inward and outward movements of nut 164 are translated to the rod 154, thus adjusting the plate 138 longitudinally in the lower part of the chamber between the half sections of the burners, to adjust the degree of alignment of openings 136 and 142. As in the embodiment of Figure 8, there are end sealing grooves 174, for the reception of gasket material or cement to seal the opposite ends of the burner assembly. In this embodiment, a gas orifice plug N' of design omitting the outside air metering notches is shown, and the chamber 134 has spaced tapered outlets 176 leading to the throat 137, around this plug. Obviously the plug and chamber arrangements of the other embodiments could be employed, but in this embodiment, the air is controlled by the damper arrangement described. In all other respects, the embodiment last described is similar to that of the preferred embodiments.

I claim:

1. A burner head for attachment on and above a gas distributing pipe comprising a pair of substantially symmetrical half castings having mating faces adapted to be disposed in the vertical plane of the axis of the distributing pipe, said castings being hollowed out to form an interior gas mixing chamber, and having top inner edges formed to provide a number of openings along the top of the burner for discharge of gas from said chamber, said castings being formed to pro-

vide a gas inlet opening between their bottom inner edges, the mating faces of said castings having aligned sealing grooves therein surrounding said chamber, there being two of such grooves, one at each end of said chamber, each of said grooves extending from adjacent said top inner edges to adjacent said bottom inner edges, and wires of welding material positioned in said grooves to form a seal when said castings are clamped together and when welding heat is applied to said wires.

2. A gas burner comprising a metal casting having means for supporting same on and above a gas distributing pipe with a gas orifice in its upper surface, said casting having a lower and smaller mixing chamber adapted to fit over said orifice and being formed to admit air into said smaller chamber, said casting having parallel side walls adapted to be disposed to the axis of the distributing pipe and end walls forming an upper larger mixing chamber of substantially diamond-shape, said larger mixing chamber having a top provided with outlets for the gas mixture, said casting being formed with a resricted throat between said chambers, and a baffle of substantially diamond-shape in cross section positioned in the larger mixing chamber and having its widest portion in substantially transverse alignment with the widest portion of said larger chamber, said baffle extending between said end walls and spaced from said side wall so as to insure an intimate mixture of the air and gas passing through the burner.

3. A gas burner head for attachment on and above a gas distributing pipe comprising a pair of substantially symmetrical half castings having mating faces adapted to be disposed in the vertical plane of the axis of the distributing pipe, said castings forming a gas mixing chamber of substantially diamond-shape and having top inner edges providing a longitudinal opening therebetween and a number of transverse spaced slots communicating with said openings along the top of the burner for discharge of gas from said chamber, and a substantially diamond-shaped baffle mounted in said chamber adapted to extend in the direction of the axis of the distributing pipe, said baffle having its widest portion in substantially transverse alignment with the widest portion of said chamber, said mating faces and the end of said baffle member being formed to secure said baffle member in position when said castings are attached to one another, said baffle member being spaced from the side walls of said chamber and adapted to evenly distribute

the gas mixture rising from the distributing pipe in opposite directions laterally of the axis of the distributing pipe and through said chamber for egress throughout the whole length of the burner top.

4. A gas burner head as called for in claim 3 in which said transverse slots are alternately of different lengths.

5. A gas burner comprising a substantially diamond-shaped mixing chamber provided with an outlet in the top thereof having a longitudinal continuous opening and transversely spaced slots communicating with said opening, and a substantially diamond-shaped baffle in said mixing chamber, said baffle having its widest portion in substantially transverse alignment with the widest portion of said chamber and spaced from the side walls thereof to provide passages for insuring an intimate mixture of air and gas passing through the burner.

6. A gas burner as called for in claim 5 in which said transverse slots are alternately formed with shallow and deep slots to provide a plurality of substantially grill-like outlets.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
240,592	Houchin	Apr. 26, 1881
393,077	Pew	Nov. 20, 1888
419,444	Holden	Jan. 14, 1890
706,761	Koegle	Aug. 12, 1902
1,330,048	Baker	Feb. 10, 1920
1,406,925	Britten	Feb. 14, 1922
1,536,590	Kielberg	May 5, 1925
1,642,426	Risinger	Sept. 13, 1927
1,670,191	Deck	May 15, 1928
1,828,779	Marasco	Oct. 27, 1931
1,941,466	Dodge	Jan. 2, 1934
2,050,728	Ost	Aug. 11, 1936
2,057,216	Sonner	Oct. 13, 1936
2,182,238	Rasmussen	Dec. 5, 1939
2,215,176	Forster	Sept. 17, 1940
2,248,932	Anderson et al.	July 15, 1941
2,469,074	Mueller	May 3, 1949

FOREIGN PATENTS

Number	Country	Date
426,984	France	May 16, 1911
757,003	France	June 15, 1933
526,476	Great Britain	Sept. 19, 1940