Dec. 6, 1960 B. SPIETH ET AL 2,963,083

GAS BURNER STRUCTURE

Original Filed Oct. 4, 1952 3 Sheets-Sheet 1

Fig. 2

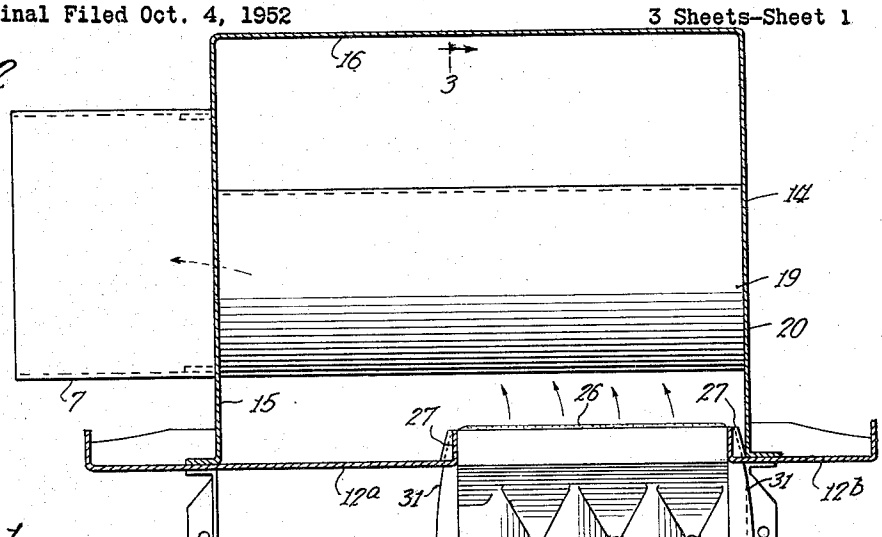
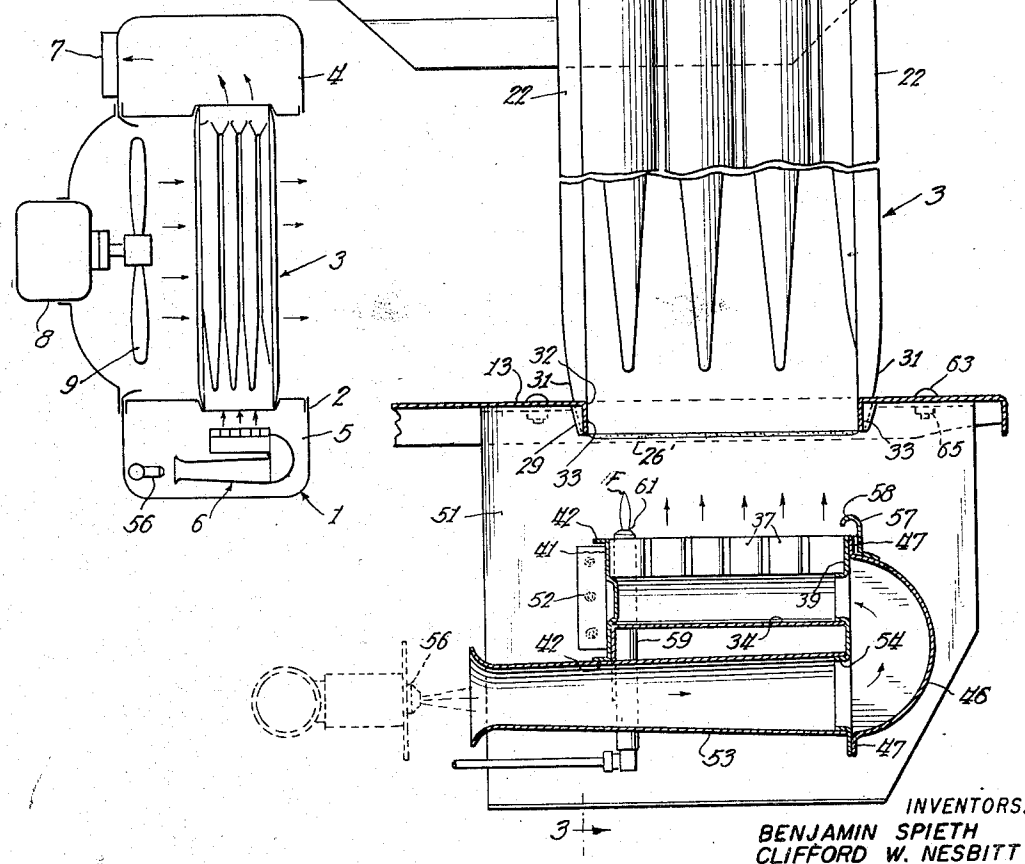


Fig. 1



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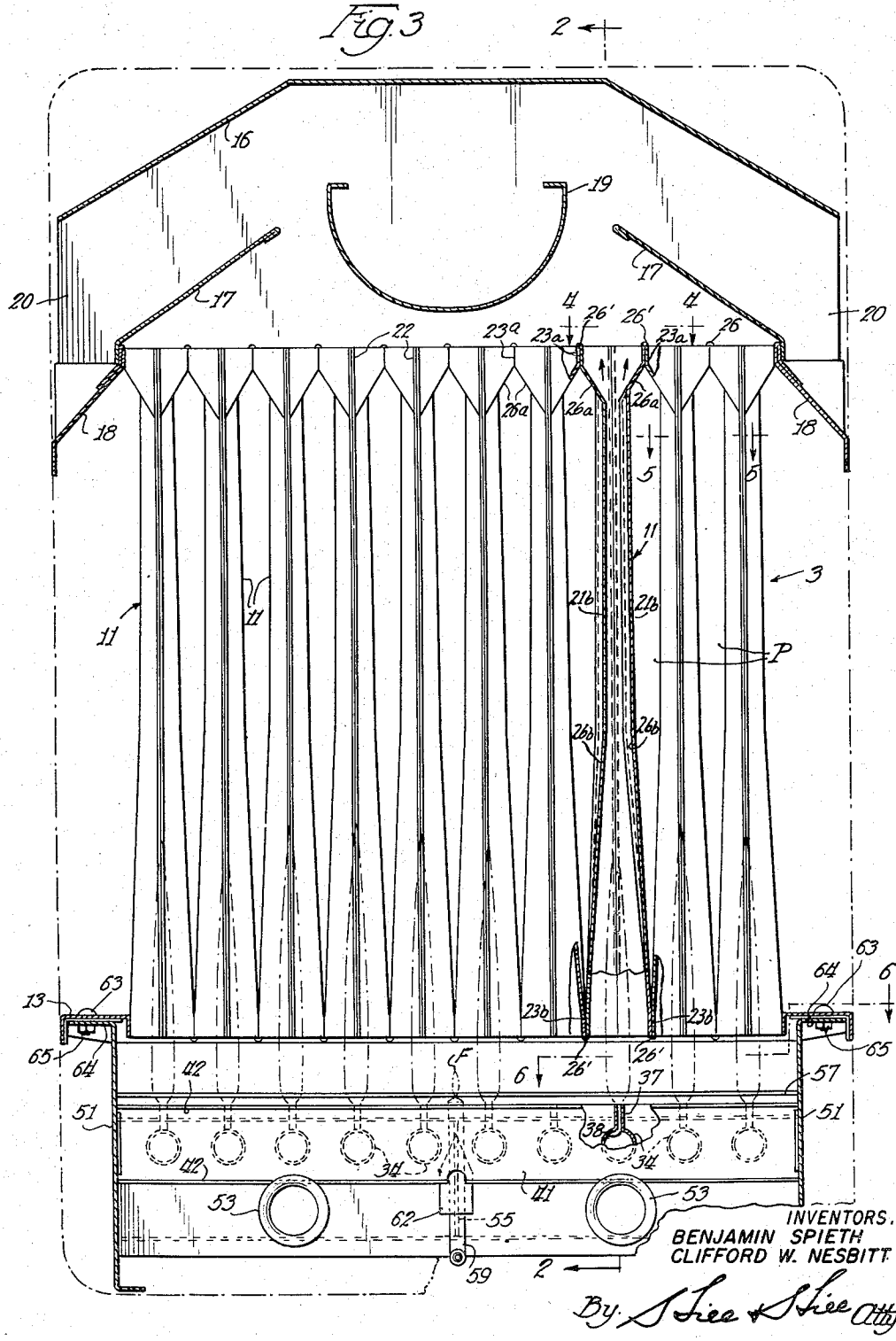
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Fig. 3



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GAS BURNER STRUCTURE

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Fig. 4

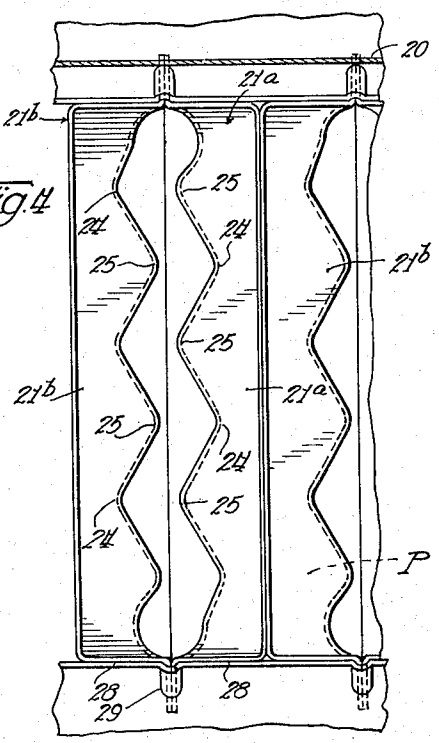


Fig. 5

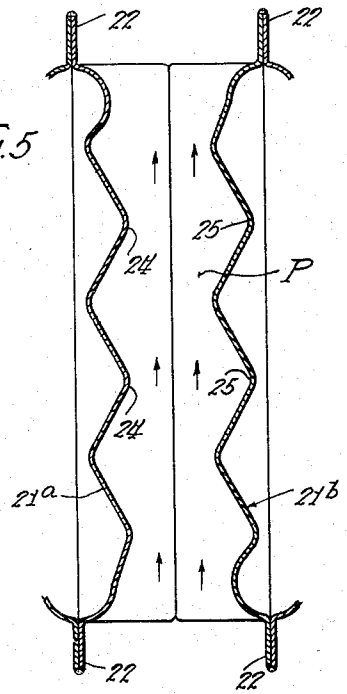


Fig. 6

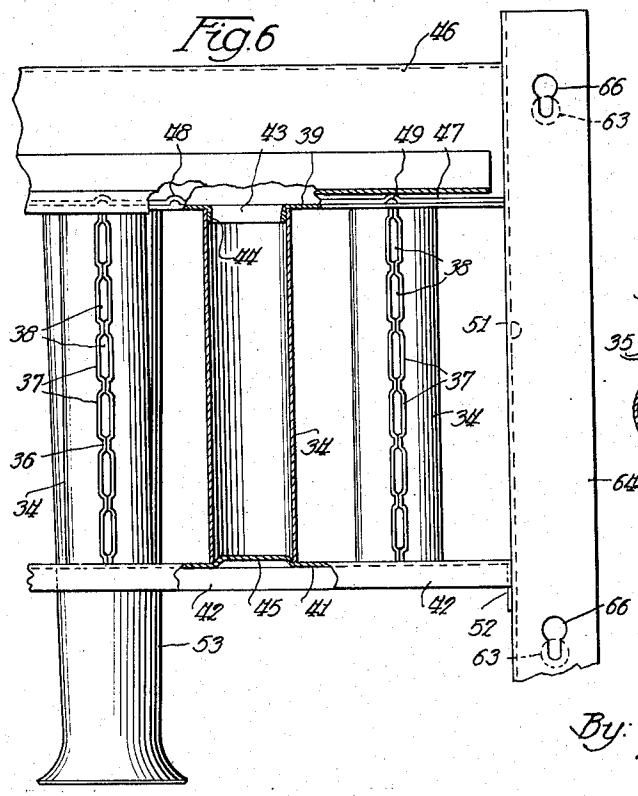
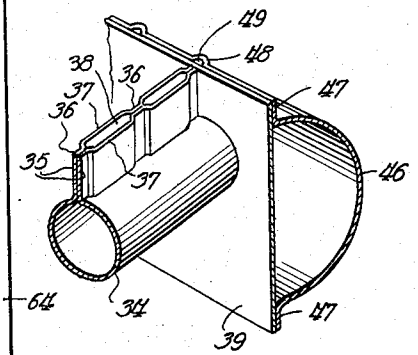


Fig. 7



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2,963,083

GAS BURNER STRUCTURE

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Original application Oct. 4, 1952, Ser. No. 313,132. Divided and this application Mar. 23, 1956, Ser. No. 574,361

1 Claim. (Cl. 158—104)

The invention relates generally to a heat exchange structure, and more particularly to an exchanger of the combustion type as, for example, employing gas or similar fuel. This application is a division of our co-pending application Serial No. 313,132, filed October 4, 1952 for Gas Fired Combustion Type Heater Structure, now abandoned.

The invention has among its objects a heat exchanger of the combustion type utilizing a novel burner and a heat exchange structure in which combustion is completed within the body of the heat exchanger flues, whereby not only sensible heat is transferred, but also radiant heat of combustion providing maximum efficiency of the structure and, at the same time, reducing temperature differentials between the bottom and top of the heat exchanger flues.

Another object of the invention is the production of a gas burner structure for a gas burning heat exchanger particularly adapted for use in self-contained unit heaters, whereby the entire heat exchange and burner structure may be produced from relatively simple sheet metal stampings resulting in a very efficient but inexpensive device.

A further object of the invention is the production of a novel burner construction which likewise may be formed entirely from relatively simple sheet metal stampings to provide a burner unit having a plurality of spaced burner elements in connection with one or more cooperable manifolds, which structure utilizes a minimum of individual elements, at the same time providing a very light weight efficient and durable burner structure.

Many other objects and advantages of the construction herein shown and described will be obvious to those skilled in the art from the disclosure herein given.

To this end, my invention consists in the novel construction, arrangement, and combination of parts herein shown and described, and more particularly pointed out in the claim.

In the drawings wherein like reference characters indicate like or corresponding parts:

Fig. 1 is a diagrammatic sectional view of a combustion type unit heater embodying the present invention;

Fig. 2 is a sectional view taken approximately on the line 2—2 of Fig. 3;

Fig. 3 is a sectional view taken approximately on the line 3—3 of Fig. 2;

Fig. 4 is a sectional view taken approximately on the line 4—4 of Fig. 3;

Fig. 5 is a sectional view taken approximately on the line 5—5 of Fig. 3;

Fig. 6 is a sectional view taken approximately on the line 6—6 of Fig. 3; and

Fig. 7 is a perspective view of a portion of the burner manifold and one individual burner member.

It has been customary in the past in heat exchange structures of the type here involved to utilize with a combustion burner, as for example, a gas burner of this invention, a combustion chamber in which the combustion of the gas mixture takes place, following which the

products of combustion flow through a suitable heat exchange structure, and are subsequently exhausted to the atmosphere through a suitable stack, or the like. The present invention of this gas burner structure contemplates therewith the use of a plurality of flues which are assembled to form a cross flow heat exchange structure, the respective flues being so shaped that the lower portion thereof forms a combustion chamber or zone which is relatively large in cross sectional area at its lower end, diminishing in area towards its upper end to provide an upwardly tapering combustion zone. The intermediate portions of the flue are so constructed that a passageway of relatively smaller area is provided for the products of combustion, with the exterior surfaces of the flue preferably being shaped to create a turbulence in air flowing between adjacent flues. The upper and lower ends of the flues are preferably so designed that adjacent walls at the upper and lower ends of adjoining flues may be directly connected together to eliminate the necessity of extending a header or crown sheet therebetween.

Employed in combination with such heat exchange structure is a novel burner unit of this invention which is so designed and arranged with respect to the heat exchange flue assembly that the greater portion of the flames of combustion of the gas, and thus combustion of the gas itself, takes place within the respective flues, thereby eliminating the use of a common combustion chamber. Referring to the drawings, and particularly to Figs. 1, 2, and 3, the reference numeral **1** indicates generally a combustion type heat exchange device of the unit heater type having a suitable casing **2** in which is positioned a heat exchange structure, indicated generally by the numeral **3**, the latter being vertically positioned, and communicating at its upper end with a plenum chamber **4**, and at its lower end with a burner chamber **5**. Positioned in the burner chamber **5** is a burner assembly of this invention, indicated generally by the numeral **6**, and communicating with the plenum chamber **4** is a stack connection **7** through which the products of combustion may flow following their passage through the exchanger structure **3**. Suitably carried by the casing **2** is a motor **8** which actuates a suitable fan **9** operable to force air through the heat exchanger **3** in a transverse direction to the flow of the products of combustion through the exchanger.

The heat exchange structure **3**, used in conjunction with the gas burner structure of this invention comprises a plurality of individual flue assemblies, respectively indicated generally by the numeral **11**, which are rectangular in cross sectional shape at their upper and lower ends, whereby a plurality of like flues may be assembled with adjacent rectangular end portions abutting one another. The upper and lower ends of such assembly are, in turn, secured to upper sheets **12** and **12*b*** and lower sheet **13** which, for the purpose of this description, will be designated as upper and lower header sheets although, other than as to location, such header sheets do not correspond to the commonly used header sheets which are provided with a plurality of apertures therein, each of which receives an individual heat exchange tube or flue. Associated with the respective upper sheets **12*a*** and **12*b*** is a front wall **14** and a rear wall **15** connected at their upper edges by a top wall **16** and as illustrated in Fig. 3, secured to the upper ends of the outermost flues **11** are respective baffle members **17** and **18**, which cooperate with the side walls **14** and **15** and top wall **16** to form, in effect, a plenum chamber with which the upper ends of the flues **11** communicate, the latter being shielded from the stack **7** by a semi-cylindrical baffle **19** which extends between the walls **14** and **15**. This construction forms what is commonly termed a draft diverter, the plenum chamber having air passages **20**

between the baffles 17 and top wall 16 which operatively connect the interior of the chamber with the exterior, the baffles 17 and 19 and associated elements and ports being so arranged as to prevent any interference in the normal flow of combustible gases or products of combustion within the unit by variations in drafts within the vent stack 7 which communicates with the plenum chamber through the rear wall 15.

As illustrated in Figs. 3, 4, and 5, each flue member 11 is constructed from a pair of like sheet metal stampings 21*a* and 21*b* which are provided with vertically extending, abutting flanges 22, the latter being welded or otherwise secured together to provide a fluid-tight connection between the respective halves. Each half is formed from a rectangular metal blank and, as clearly illustrated in Figs. 4 and 5 the end portions 23*a* and 23*b* are rectangular in cross section, with the transverse dimensions of the rectangular top portions 23*a* and bottom portions 23*b* being the same. The faces of the plates 21*a* and 21*b* forming the side walls of the flue are corrugated to provide a plurality of ribs or beads 24 in their outer surfaces, and a plurality of intermediate recesses 25 thererbetween, the corrugations extending throughout the intermediate portion of the flue and merging into the flaring portions 26*a* which connect the corrugations with the rectangular portions 23*a* at the upper end, and at the downwardly flaring portions 26*b* which connect the corrugations with the rectangular portion 23*b* at the lower end, Fig. 3.

Referring to Figs. 4 and 5, it will be noted that the three vertical ribs 24 are not symmetrically arranged with respect to the vertical center line of the flue half, two of the ribs 24 being positioned at one side of the center line, and the third rib at the opposite side thereof, the location and spacing of the ribs 24 being so selected that, when an identical flue half 21*b* is positioned in opposed relation as illustrated in Figs. 4 and 5, the recesses 25 on the member 21*b* will be transversely aligned with the beads or ribs 24 on the members 21*a*, and in like manner, the beads 24 on the member 21*b* will be aligned with the ribs 25 on the member 21*a*, and as the inner surfaces of the aligned portions of the respective members are substantially complementary in shape to each other, the passage formed between the members 21*a* and 21*b* will be substantially of a zig-zag cross section and of substantially of zig-zag cross section and of substantially uniform width.

Similarly, as illustrated in Figs. 4 and 5, the passageway P adjacent surfaces of adjoining flues are substantially complementary in shape with the ribs 24 on the one flue being transversely aligned with a recess 25 of the adjoining flue, whereby the air passages are likewise of a generally zig-zag shape in transverse cross section, producing a high degree of turbulence in air passing between the adjacent flue surfaces. The particular shape of the corrugations and rectangular portions of the flues are also so co-related that total width of the material along any transverse cross section of the flue members 21*a* or 21*b* is substantially equal, whereby the members may be readily formed from rectangular blanks without undue stretching or working of the metal. It will also be apparent that the corrugated structure thus produced possesses considerable rigidity and strength in the assembled flue structure so that a relatively light gauge metal may be employed in its fabrication, at the same time providing adequate strength in the resultant structure. The weight and mass of the flue structure is thus reduced, resulting in improved heat transfer efficiency, particularly during warm-up periods, which are reduced to a minimum in duration.

In assembling the heat exchange structure, the cooperating halves of the respective flues 11 are welded, or otherwise bonded, along the flanges 22, following which the flues are positioned in assembled relation, and bonded together along their upper and lower adjoining edges, as indicated at 26. The upper header sheets 12*a* and 12*b* are then secured to the upper end edges of the heat exchanger bundle thus formed, the sheets 12*a* and 12*b* each being provided with a vertically extending flange 27 which butts against the end faces 28 of the respective flues, the flanges 27 and adjacent portions of the plates 12*a* and 12*b* being formed with identations 29 adapted to receive the tapering end portions 31 of the flanges 22. In like manner, the plate 13 is provided with an opening 32 therein of a size to receive the heat exchanger bundle composed of the flues 11, such opening having a downwardly extending peripheral flange 33, such flange likewise being provided with corresponding indentations 29 of a size to receive the lower end edges 31 of the flanges 22 of each respective flue. It will be apparent that upon welding, or other bonding of the flue members to the plates 12*a*, 12*b*, and 13, a rigid, air-tight structure is produced.

The construction of the burner 6 is illustrated in Figs. 2, 3, 6, and 7, and as the construction illustrated in the drawings employs ten flues 11, a like number of individual burner elements is also employed. Each burner tube or element comprises a tubular member 34 formed from sheet metal and provided with oppositely disposed, longitudinally extending flanges 35 which are similarly corrugated or crimped to provide spaced pairs of abutting portions 36 which are suitably secured together by welding, or the like, and a plurality of intermediate portions 37, each opposed pair of portions 37 being spaced from one another to form a passage or port 38 therebetween, whereby gas may flow from the interior of the tube 34 to the exterior thereof. Each tube 34 therefore has a series of burner ports 37 longitudinally extending the length of the tube. The burner tubes 34 are secured at their opposite ends to respective front and rear plates or sheets 39 and 41, the plate 41 having longitudinally extending flanges 42, as clearly illustrated in Fig. 2. The plate 39 is provided with a plurality of apertures or openings 43, each defined by a cylindrical flange 34 of a size to enter the adjacent end of each burner tube, whereby the latter may be snugly seated on the flange. In similar manner, the plate 41 is provided with a plurality of bosses 45 of a size to be positioned in and snugly receive the opposite end of each burner tube. Each tube is rigidly secured at its respective ends to its corresponding flange 44 and boss 45 by welding, or other suitable means, whereby fluid-tight joints are produced. Thus each tube is sealed at the end adjacent the plate 41, and open at the opposite end. Associated with the plate 39 is a manifold member 46 which is semicircular in transverse cross section, and provided with longitudinally extending flanges 47 which are secured to the plate 39 by welding, or other suitable means, thereby enclosing the openings 43 in the plate 39 and forming a manifold for the distribution of gas to the respective burner tubes 34. As illustrated in Figs. 6 and 7, the upper flange 47 adjacent the top edge of the sheet 39 may be provided with a series of spaced, outwardly extending ribs or beads 48, forming carryover gas ports or passages 49 along the upper edge of the plate 39, such passages communicating with the interior of the manifold formed by the member 46 and the plate 39.

The plates 39 and 41, and manifold member 46 are secured at their ends to respective end plates 51, the member 41 having end flanges 52 which are suitably secured by spot welding, or the like, to their respective end plates, while the end edges of the plate 39 and manifold member 46 are secured by welding, or other suitable means, to the end plates 51 to prov.de air-tight joints therebetween. As clearly illustrated in Figs. 2, 3, and 7, the manifold formed by the plate 39 and member 46 extends below the burner tubes, and positioned below the plate 41 and burner tubes are a pair of inspirator tubes 53 which are secured at their front end to the plate

39 by a cylindrical flange 54 corresponding to the construction employed on the adjacent ends of the burner tubes 34, the tubes 53 forming the supply ducts for combustion gas fed to the manifold and burner. In the construction illustrated, each inspirator tube 53 supplies gas to half of the total number of burner tubes 34, the manifold comprising the plate 39 and member 46 being longitudinally divided by a partition plate 55. As illustrated in Figs. 1 and 2, gas is admitted to the inspirator tubes 53 and burner structure from a suitable gas discharge valve or nozzle 56, the details of construction of which forms no part of the present invention.

Secured by suitable means to the manifold member 46 is a longitudinally extending carryover hood 57, the latter having a generally horizontally extending portion 58 which is spaced from, but overlies the carryover ports 49 extending along the upper edge of the plate 39. Positioned adjacent the central burner tubes 34 is a pilot light assembly, indicated generally by the numeral 59, provided at its upper end 61 with a burner port. This construction is disclosed in a co-pending application of Clifford W. Nesbitt, Serial No. 313,131, filed October 4, 1952, now United States Patent No. 2,875,820 granted March 3, 1959. The burner assembly 59 may be suitably supported from the plate 39 by a bracket 62 suitably secured to the plate 39 and the pilot assembly. The end plates 51 are secured in fixed relation with respect to the sheet 13 and heat exchange structure 3 by any suitable means associated with the casing 2, or as illustrated in Figs. 2 and 3, by suitable bolts 63 extending through the sheet 13, and the outwardly extending flange 64 extending along the top edges of the respective plates 51 and nuts 65. To facilitate easy removal of the burner assembly from the rest of the heat exchange structure, the flanges 64 may be provided with keyhole-shaped openings 66 therein, whereby following loosening of the nuts 65, the entire burner assembly may be moved rearwardly with respect to the heat exchange structure to align the large portions of the keyhole-shaped openings 66 with the nuts 65, thereby permitting disengagement of the flanges 64 from the fastening means without completely disconnecting the respective nuts and bolts.

In operation of the device, the combustible mixture of gas and air is fed through the inspirator tubes 53 and the manifold, from which it is distributed to the respective burner tubes 34 and discharged through the burner ports 37 and 49, as clearly illustrated in Fig. 3. The relation of the burner ports 38 with respect to the lower ends of the flues 11 is so selected that the greater portion of the flame of combustion resulting from ignition of the combustible mixture extends well into the lower ends of the flues. Thus, the bulk of combustion takes place directly within the tapering lower end portions of the respective flues, resulting in both sensible and radiant heat being absorbed by the walls of the flues and, in turn, absorbed by the air passing between adjacent flues. Likewise, as a considerable portion of each flue is exposed to the flame of combustion, considerably smaller temperature differentials exist between the bottom and top of the flue as compared to the usual construction, wherein combustion takes place in a chamber or fire box prior to the entry of the products of combustion into the flue passages; in which case, only sensible heat is transferred to the flue walls. Consequently, the present construction results in higher heat transfer efficiency.

The entry of the gas from the valves or nozzles 56 is generally controlled by an electrically actuated valve which is responsive to a thermostatic control device governed by the temperature within the enclosure to be heated by the unit, whereby operation of the burner is intermittent. Gas flowing from the ports 38 following reactivation of the unit is adapted to be ignited by the flame F of the pilot burner, which is continuously burning, the flame F igniting gas from the adjacent tubes 34 from which the flame will travel to the manifold end of such tubes. As such action is taking place, gas also will flow through the carryover ports 49 and be more or less trapped below the horizontal portion 58 of the carryover hood 57, and following ignition of such gas from the two burner tubes initially ignited by the pilot 59, the flame will travel along the hood 57, igniting the gas passing through the carryover ports 59, and thus igniting gas flowing from each of the other burner tubes 34.

As illustrated in Fig. 3, the combustion of the gas mixture will take place primarily in the lower portion of each flue 11, thereby heating the latter, such heating, in turn, being absorbed by air passing between adjacent flues under the action of the fan blade 9. The gases of combustion then flow into the chamber 4 and through the duct 7 into the associated stack. As the chamber 4 is also connected to the exterior by means of the passageways 19, air may also flow through these passages into the chamber 4 and out the exhaust stack, and in the event of any back draft in back pressure resulting therefrom, would be dissipated through the passageways 19, and not reversely through the flues 11, thereby resulting in proper combustion and flow through the flues at all times.

It will be apparent from the above description that we have provided a novel heat exchange and burner structure wherein the heat exchanger flues also form primary combustion chambers for the gas burner, which flues may be formed from two like stampings, requiring at most—two seams. It will also be noted that we have provided a novel burner construction likewise formed from stampings which, while exceedingly simple in design, is very efficient for the purposes intended.

Having thus described our invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of our invention; hence, we do not wish to be understood as limiting ourselves to the exact form, construction, arrangement, and combination of parts herein shown and described, or uses mentioned.

What we claim as new and desire to secure by Letters Patent is:

In a sheet metal burner construction for combustion-type heat exchangers, the combination of a longitudinally extending tubular manifold structure including a flat sheet and a semi-cylindrical sheet including longitudinally extending flanges extending lengthwise of the longitudinal axis of the semi-cylindrical sheet and secured to said flat sheet to form the tubular manifold structure, end plates secured to and sealing the ends of said tubular manifold structure, a plurality of co-extensive tubular burners arranged in spaced parallel relation and operatively connected to the manifold structure, each tubular burner formed from sheet material and including a pair of opposed generally parallel flanges extending along the longitudinally extending edges of the sheet forming the tubular burner, said pair of opposed generally parallel flanges including oppositely disposed corrugations extending radially from the longitudinal axis of the tubular burner, opposite inwardly extending portions of the corrugations on the opposed generally parallel flanges being secured together and the opposed outwardly extending portions thereof defining burner ports therebetween, one end of each tubular burner being secured to said flat sheet of the manifold structure, the flat sheet of the manifold structure having an opening therein operatively connecting the interior of the respective tubular burner with the interior of the manifold structure, a member connected at its ends to said end plates and extending across and sealing the free end of each tubular burner, and an inspirator tube positioned below said tubular burners and operatively connected at one end

to and communicating with the interior of the manifold structure.

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