May 5, 1959 R. R. TAYLOR 2,884,998

PARALLEL SLOT GAS BURNER

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Fig. 1.

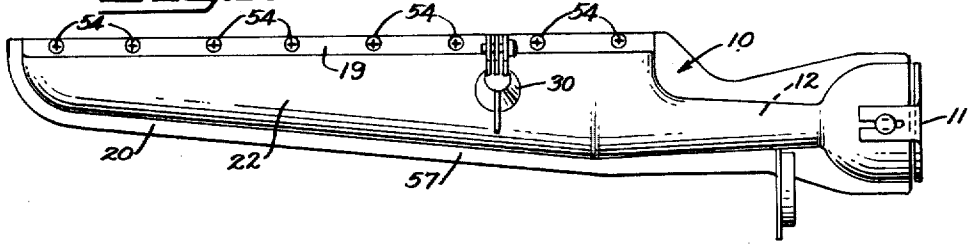


Fig. 2.

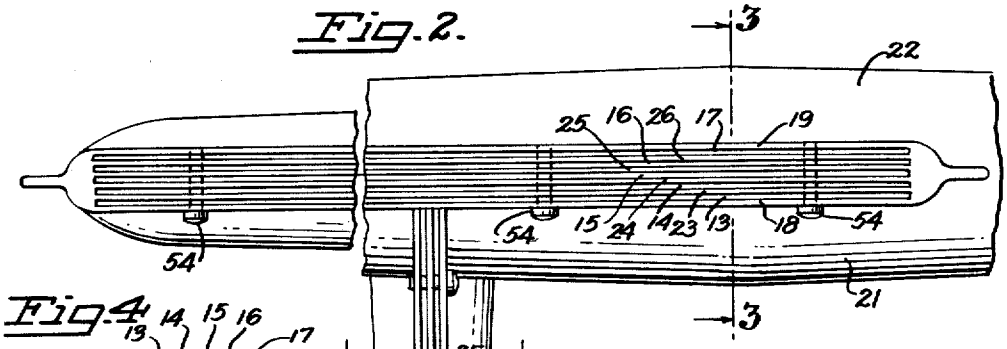


Fig. 4

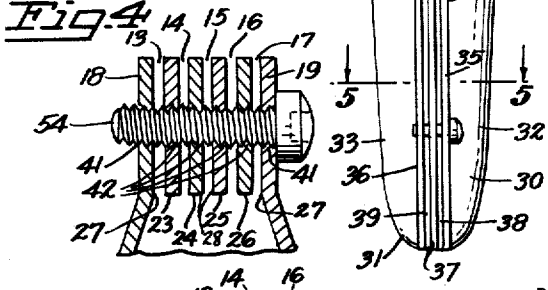
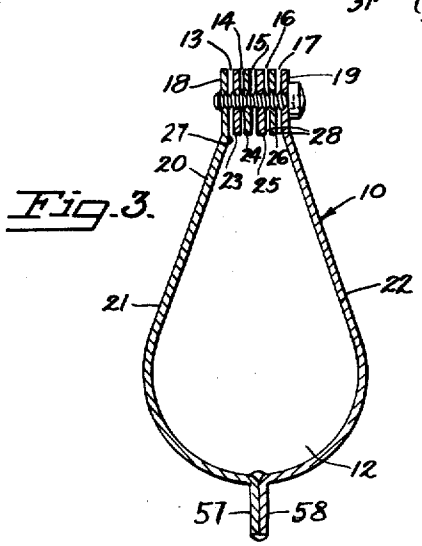


Fig. 3.



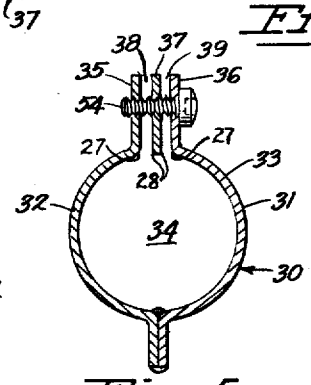
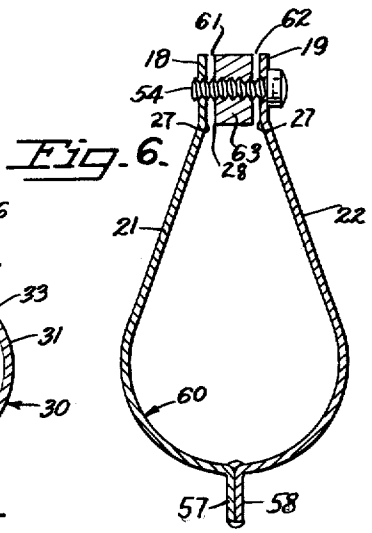


Fig. 5.

Fig. 6.



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PARALLEL SLOT GAS BURNER

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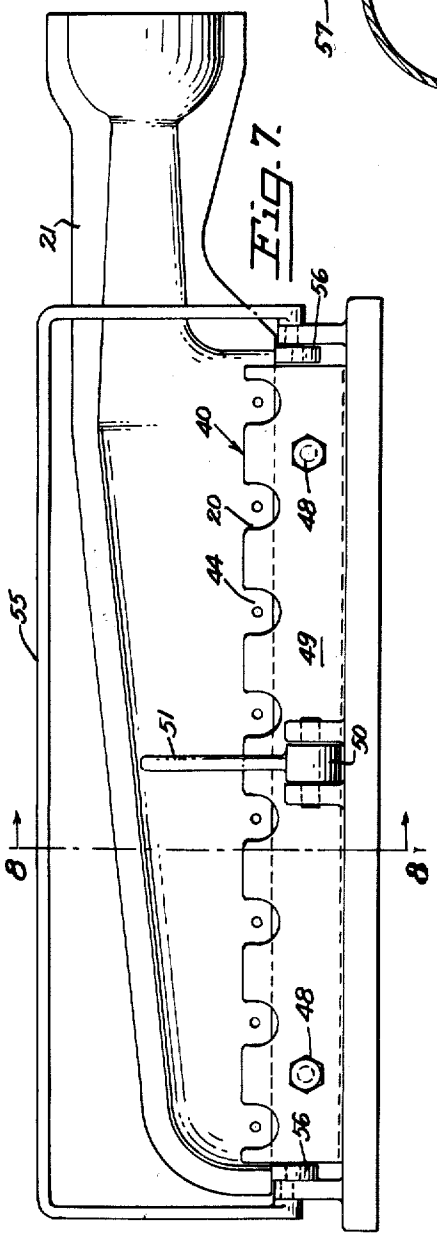


Fig. 7.

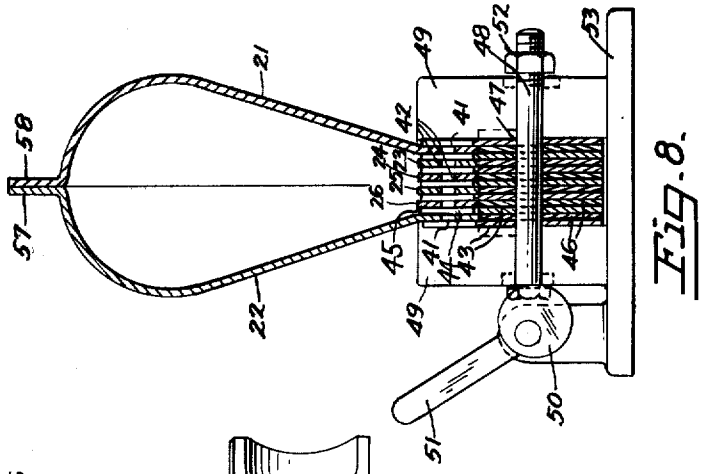


Fig. 8.

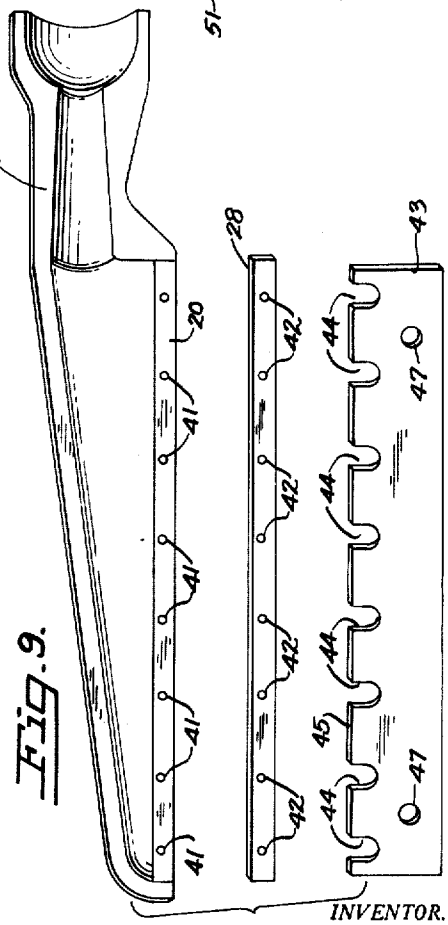


Fig. 9.

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PARALLEL SLOT GAS BURNER

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Application December 20, 1954, Serial No. 476,338

6 Claims. (Cl. 158—116)

This invention relates to an improved gas burner.

It has been a problem in gas furnaces to obtain enough port area in a small space for the large quantities of gas necessary to produce the required amount of heat. The conventional approach was to employ a cast-iron burner unit in which was drilled a large number of round holes. The size of any one hole is limited by the gas pressure being used and by the burning rate of the fuel, because fuels which burn very quickly tend to flashback inside the burner when the opening is large. It has been found that for most natural, liquefied petroleum, and manufactured gases the burner holes must be relatively small—about 0.120 inch in diameter or less—if flashback is to be avoided. It takes many such holes to give any significant port area. Thus when a burner is drilled with a No. 32 drill, each hole is about 0.01057 square inch in area. This is about as large a hole as is normally practical, and it takes about 100 of these holes to make one square inch of port area. One square inch is not sufficient for most burners; so normally there had to be about one hundred holes to each 15,000 B.t.u. input. In order for a burner to accommodate an input of 150,000 B.t.u., there would have to be 1000 of these drilled ports. This type of construction was objectionable for several reasons. In the first place such burners took up too much room and resulted in large furnaces. In the second place, the manufacturing costs were high. The holes could not normally be drilled by gang drill, because the rough cast material tended to break drill points very frequently; the time it took to replace drill points made it more feasible to drill each hole individually, and this increased the labor cost of manufacturing the burner.

It has long been known that, theoretically, improved results can be obtained by cutting a narrow slot instead of drilling holes. Such a slot was normally cut in a cast iron burner by a metal saw, a bridge being used at spaced locations to maintain the proper slot width and to keep the cast-iron burner housing from closing in at the slot. A single slot $\frac{1}{16}$ of an inch wide and 16 inches long, will provide a full inch of port area or as much as 100 holes of approximately $\frac{1}{10}$ of an inch in diameter, which cannot be gotten into a line less than 20 inches long. But the manufacturing cost of these slots in cast iron is very high, and an excessively long burner unit is required, because it is not feasible to drill parallel slots; the reason for this is that a center portion in between parallel slots would be free floating and would tend to close one slot and open the other, thereby causing flashback in one slot.

For these reasons, the problem of obtaining correct port area has for a long time remained unsolved. However, attempts were made to solve the problem by using sheet steel instead of cast iron and by forming several parallel slots instead of having only a single slot. The problem with sheet steel has been to obtain correct spacing without causing other problems and to arrive at a

practical and economically feasible method of doing this.

As already stated, it is important to keep the width of each slot constant at a rather critical amount. When the slot has been too wide (that is more than about $\frac{1}{16}$ of an inch) flashback has occurred, and this has sometimes resulted in serious explosions. On the other hand, the slot should not be too narrow, for there is a definite relation between the total slot area and the amount of gas the burner will effectively burn. For example, with natural gas, gas can be effectively burned at about the rate of 15,000 B.t.u. per square inch of port area. Best operation is obtained when each of the parallel slots is exactly the same width over its entire length.

In attempting to solve this problem the prior art has tried various types of spacing members, each of which had its disadvantages. For example, corrugated spacing members have been widely used, but they impeded the flow of gas and resulted in an uneven distribution of gas that significantly reduced the amount of gas that could be burned per total slot area, since these corrugated members extended the entire length of the slot. Nowhere near the theoretical value was obtained, even after accounting for the undesirable fact that the corrugated spaced members themselves consumed a substantial area. The slot thickness is not truly constant where corrugated spacers are used but varies at every point, causing further unevenness of flow. In fact, the effective slot area proved to be less than half of the theoretical value. For these reasons, most manufacturers who attempted this solution have now returned to drilling holes in cast-iron burners.

Other types of spacing members have been tried, but these spacers have generally occupied the whole width of the slot for their length, and therefore have greatly reduced the slot area per length of slot. Also these spacing members have had to be secured in place, and their installation has been a problem and an expense.

Still other attempts to provide constant spacing have involved a large amount of die work and welding, and yet these structures have not proven satisfactory. All the prior art attempts also had the disadvantage that they required excessive amounts of metal to insure proper spacing, and this, too, added further to the expense as well as to the weight of the finished burner.

The present invention solves this problem in an efficient and inexpensive manner. It provides slots of constant width with superior performance characteristics, produces the assembly without adding any significant amount of additional metal, and the structure operates with negligible interference with the flow of gas.

These important results are accomplished partly by employing screw threads in a novel manner both to hold in place metal members defining the slot and to space them apart. The spacing may be determined by temporary spacer jigs in the factory, which are withdrawn after the burner is assembled; so there is no need to introduce any permanent spacing members besides the screws themselves.

Thus the present invention obtains a maximum port area from a plurality of narrow slots. The importance of the present invention lies partly in its ability to provide exact spacing so that narrow slots can be used without causing additional problems and partly in its ability to obtain the maximum port area with any given width of slot, because of the fact that there is very little interference with the slot area.

The present invention also solves the lint problem. Chicago, in particular, has stringent laws against burners which become clogged with lint and the other materials that float around in furnace rooms. Heretofore, these materials got inside the burner along with the air taken

in to support combustion of the gas, and they clogged the narrow slots in sheet-metal burners. Members using corrugated spacers were particularly susceptible to lint-clogging because their many edges caught the floating particles, and the particles would build up until they partially choked the burner ports. When the ports are thus choked, the flow of air-gas mixture is reduced and the static pressure within the burner is increased. With increased static pressure the air aspiration is reduced, and a yellow sooting flame, results, clogging furnace and flue passages. At times the internal static pressure will get high enough to cause the gas to seep from the mixer of the burner, causing a fire outside the firebox.

In the present invention the lint problem has been solved by a combination providing the sheet steel burner walls with a smooth bend where the lint cannot lodge and providing the metal spacers with coined edges to smooth to catch lint. The importance of this construction is exemplified by the fact that until the burner described herein was submitted to tests, Chicago had disapproved every slot burner made from sheet steel; yet this new burner passed the test with flying colors.

Another important feature of the present invention is its adaptability to many different types of gases. Since gases differ in specific gravity, calorific value and in many other particulars, heretofore a burner which would give satisfactory results with all natural gases would not work satisfactorily with liquefied petroleum gases such as butane and propane.

The present invention makes it possible to use exactly the same burner with both natural and liquefied petroleum gases, simply by changing the size of the orifice where the gas enters the hollow burner. The burner itself can easily be modified in manufacture, without making any fundamental change of design, to accommodate manufactured gases. This is done simply by using thicker spacing members, to make fewer or smaller spaces between the same housing members. In fact, many manufactured gases can be accommodated by the identical burner that is used for natural gas by simply changing the orifice size. In tests on particularly difficult types of manufactured gases made at Portland, Oregon one of the burners described herein satisfactorily handled inputs of 20,000 B.t.u. up to and including 45,000 B.t.u. without any change being made in the burner. With this new burner, a narrow enough slot can be maintained accurately, and any desired number of slots may be provided.

The present invention also solves important problems concerning the manufacture of the burner. It does this by making it possible to use a small number of standard sheet steel parts and by simplifying their assembly. The burner's side walls can comprise one or two die pressed pieces, while the spacer elements themselves can be provided by a series of identical strips. The present method makes possible rapid and inexpensive assembly of these parts. Burners made according to this invention cost about two-sevenths as much as cast iron slotted or drilled burners— which themselves were cheaper to manufacture than any usable sheet steel burners heretofore on the market.

Other objects and advantages of the invention will appear from the following description of a preferred embodiment thereof.

In the drawings:

Fig. 1 is a view in elevation of a gas burner unit embodying the principles of the invention. This particular burner unit is an end burner having cross-over ports extending out from one side only, but it is to be understood that the invention applies where there are no cross-over ports at all and also where there are cross-over ports on both sides of the burner.

Fig. 2 is an enlarged top plan view of the burner unit of Fig. 1, the view being broken in the middle and at one end to conserve space.

Fig. 3 is a view in section, taken along the line 3—3

of Fig. 2 and showing the slot construction of the main burner.

Fig. 4 is a further enlarged view of the upper portion of Fig. 3.

Fig. 5 is a view on the same scale as Fig. 3, taken along the line 5—5 of Fig. 2 and showing the slot construction of the cross-over burner.

Fig. 6 is a view similar to Fig. 3 of a modified form of burner manufactured from the same burner housing blanks and differing only in the spacer, used to reduce port area.

Fig. 7 is a view in front elevation showing a burner unit like that of Fig. 1 being assembled in a jig, according to the method of the present invention.

Fig. 8 is a view in section taken along the line 8—8 in Fig. 7.

Fig. 9 shows the relation between one side piece of a burner housing, one spacing member, and one side plate of the jig of Figs. 7 and 8.

The burner unit **10** may be employed as part of a gas furnace, the burner unit alone being shown herein because the invention does not concern the structure of other parts of the furnace. As Figs. 1 to 4 show, the hollow burner unit **10** has a gas inlet **11**, a generally tubular passage **12**, and slots **13**, **14**, **15**, **16** and **17** from which the gas issues, the slots being formed by the upper side walls **18** and **19** of the metal housing member **20** (which comprises side pieces **21** and **22**) and by a series of generally rectangular metal strips **23**, **24**, **25** and **26**. The side members **18** and **19** are preferably integral with the pieces **21**, **22**, a smooth corner **27** being formed by bending, so that it is free from burrs or other lint-catching obstructions. Similarly, the edges **28** of the strips **23**, **24**, **25**, **26** are all coined by tumbling, so that they will be smooth.

The cross-over burner **30** includes a housing **31** formed from wall members **32**, **33** and providing a tubular passage **34**. A center strip **37** held between the upper ends **35**, **36** of the walls **32** and **33** divides the space between the two end members **35**, **36** into the two slots, **38**, **39**. This cross-over burner **30** serves to carry the flames from one burner unit **10** to a succeeding adjacent burner unit so that only one unit of the furnace need be ignited in order to light the whole furnace. It will be understood that the cross-over burner **30** could have more than two slots and that the main burner could also have more or fewer single slots.

The novel method of making the product of this invention makes it possible to produce the burner **10** at a fraction of the cost which former methods took. The method itself is disclosed and claimed in divisional application Serial No. 642,923, filed February 11, 1957. For example, a sheet steel burner formerly produced at one factory cost $3.50 per unit. The present invention is now being used at this factory to produce even better burners of the same capacity and otherwise substantially identical or better performance for $1.00 each.

In the method claimed in the divisional application, the burner housing side walls **21** and **22** and the spacer strips **23**, **24**, **25**, and **26** are placed in a jig **40** which properly positions the strips **23**, **24**, **25**, and **26** at the correct spacing from each other, from the burner side walls **18** and **19**, and longitudinally. To make this possible the side housing members **18** and **19** and the spacer strips **23**, **24**, **25**, and **26** are pre-punched to provide a series of holes **41** in the housing members **18** and **19** and a corresponding series of holes **42** in the strips **23**, **24**, **25**, and **26**. These holes **41** and **42** may be gang-punched, since they are in sheet steel, and all holes in each housing member or strip can be punched in one punch press operation. Both the spacer strips **23**, **24**, **25**, **26** and housing members **18**, **19** are punched with the same die, so that alignment will be perfect. This makes it possible to get accurate assembly of the burner unit **10**.

The jig **40** includes a series of spacer-setting plates **43**,

each provided with a series of notches 44 on their upper edges 45 corresponding in location to the holes 41 and 42 of the strips and housing members. The plates 43 are the thickness of the slots 13, 14, 15, 16, and 17 and separate the strips 23, 24, 25, 26 from each other and from the burner housing side portions 18 and 19 a distance exactly desired.

The jig 40 also includes a series of generally rectangular support plates 46, whose widths correspond to the burner housing portions 18, 19 and strip portions 23, 24, 25, 26 which they support. (Thus in the modification shown in Fig. 6, some of the plates 43 are removed from the jig and a single wide plate 46 (not shown) is used instead of the thinner plates 46 shown in Fig. 8.) The support plates 46 align the strips 23, 24, 25, 26, and burner housing elements 18, 19 to the correct vertical position and retain them there, and also aid in correctly spacing apart the plates 43. Both the plates 43 and 46 are provided with holes 47 through which are passed bolts 48, that secure the plates 43 and 46 together loosely and to heavy end jig members 49, which have notches 44 like the plates 43.

The housing members 21 and 22 have their portions 18 and 19 inserted in the jig, as shown in Figs. 7 and 8, and the strips 23, 24, 25, 26 are likewise inserted while the jig 40 is loose. Then they are aligned by inserting a metal rod (not shown) through one or two of the aligned series of holes 41 and 42, passing through both housing members 18, 19 and all strips 23, 24, 25, and 26.

Once accurate alignment is obtained, a cam 50 adjacent one jig end member 49 is turned by its handle 51 and serves to tighten the members 49, 43, and 46 together, against the nut 52 on the bolt 48, the members 49, 43, and 46 being slidable along the base 53. This action holds all the burner slot elements tightly in place, as shown in Figs. 7 and 8.

The next step is to tap the openings 41 and 42 and insert screws 54 which retain the burner elements 18, 19, 23, 24, 25, and 26 permanently in place. This step may be done in a single operation by using self-tapping screws 54, or the holes 41, 42 may be threaded in one operation and the screws 54 threaded in place afterwards. The notches 44 give access to the holes 41, 42 and prevent drilling of the jig members 43 and 49.

Once the screws 54 are in place, the burner housing 20 is complete, so far as its slot portion is concerned. The cam 50 may be turned to loosen the jig 40, and the burner unit 10 taken out. Preferably this is done by an ejector 55 having two end blocks 56 that raise the slot-forming portions 18, 19, 23, 24, 25, 26 of the burner housing 20 vertically out of the jig 40, this vertical movement serving to prevent any twisting of these members. From then on the threaded screws 54 both hold the metal strips 23, 24, 25, 26 in place, keep them aligned with the burner housing slot side members 18 and 19, and keep them spaced apart at precisely the correct distance. The screws 54 may have Phillips heads or any other type of head.

It will be seen that the screws 40 take up a relatively small amount of the slot area, and being round offer a negligible resistance to the flow of fluid around them. The effect is very nearly that of a spaced slot with no interference at all. The spacing is positive, and once the screws 54 are in place the spacing cannot be changed without removing the screws; so there is no chance of variation from the predetermined spacing which was selected at the time of assembly.

The burner housing 20 is completed by welding the seams 57, 58 together. Instead of doing this, the members 21, 22 may be made from a single piece, but the two-piece welded construction is far preferable, since it saves money on the forming operation.

The cross-over member 30 is assembled by the same method and is welded to the housing 20.

The burner housing 60 shown in Fig. 6 is like the housing 20, except that there are only two parallel slots 61 and 62, provided by a single wide spacer 63 held by the screws 54 in proper spaced relation between the burner slot sides 18 and 19 of the same housing blanks 21 and 22. This illustrates how adaptable this new burner is.

The exactly spaced slots are in all cases extremely practical, and the screws 54 maintain the exact spacing at all times. The coined edges 28 and smooth corners 27 will not catch lint, so very efficient operation becomes possible. Wide variations in fluid flow may be handled by any one slot arrangement, while new slot arrangements are inexpensively arranged in the factory.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

I claim:

1. A gas burner comprising a hollow housing including side walls each having planar portions, said planar portions being spaced apart and parallel to one another, plane parallel strip means disposed between said planar wall portions with the plane sides parallel to the wall portions and spaced therefrom to form a plurality of parallel slots, and screws threadably engaging said wall portions and said strip means, said wall portions, screws and their threaded engagement providing the sole means for holding said strip means in position between wall portions to thereby provide a plurality of spaced parallel slots.

2. A sheet-metal slotted gas burner comprising a hollow rounded sheet-metal housing bent adjacent its upper end to form a pair of planar wall portions spaced apart and parallel to one another to form a gas port, plane parallel strip means disposed between said planar wall portions in said port with the plane sides parallel to the wall portions and spaced therefrom to form a plurality of parallel slots communicating with the interior of the housing, and a plurality of screws threadably engaging said wall portions and said strip means, said screws and wall portions and their threaded engagement providing the sole means for holding said strip means in position between the wall portions to thereby form parallel slots.

3. A gas burner comprising a hollow housing including side walls each having planar portions, said planar portions being spaced apart and parallel to one another to form a gas port, a plurality of plane parallel strip means disposed between said planar wall portion with their plane sides parallel to one another and to the wall portions and spaced from one another and from the wall portions to form a plurality of parallel constant-width rectilinear slots having a desired spacing, and a plurality of screws threadably engaging said wall portions and said strip means, said screws, wall portions and the threaded engagement providing the sole means for holding said plurality of strip means in position between the wall portions to thereby provide the plurality of spaced parallel rectilinear slots.

4. A sheet-metal slotted gas burner comprising planar parallel sheet-metal housing sides, a plurality of flat sheet-metal strip means disposed between said planar housing sides with their plane sides parallel to each other and to the wall portion to provide a desired number of parallel constant-width rectilinear slots, and screw means threadably engaging said housing sides and said metal strips, said housing sides, screws and their threaded engagement providing the sole means for supporting and holding said strip means in position between the housing sides to thereby provide a plurality of spaced parallel slots.

5. A gas burner comprising a hollow housing including side walls each having planar portions, said planar portions being spaced from and parallel to one another, plane parallel strip means disposed betwen said planar wall portions with the plane sides parallel to the wall portions and

spaced therefrom to form a plurality of slots, said strip means being formed with rounded edges to thereby provide a lint-free operation, and screws threadably engaging said wall portions and said strip means, said wall portions, screws and their threaded engagement providing the sole means for holding said strip means in position between the wall portions to thereby provide a plurality of spaced parallel slots.

6. A sheet-metal slotted gas burner comprising a hollow housing having a pair of bowed-out sheet-metal sides bent along their upper end to provide planar wall portions and welded together at their lower end to provide a bottom seam, said planar portions being spaced apart and parallel to one another to form a port, a plurality of plane parallel metal strips disposed between said planar wall portions with their plane sides parallel to each other and to the wall portions and spaced from one another and from the wall portions to form a plurality of constant-width rectilinear parallel slots, each of said strips

having their edges rounded, and screws threadably engaging said planar wall portions and said strip means, said screws, planar wall portions and their threaded engagement providing the sole means for supporting and holding said strip means in position between the planar wall portions to thereby provide a plurality of spaced rectilinear parallel slots.

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