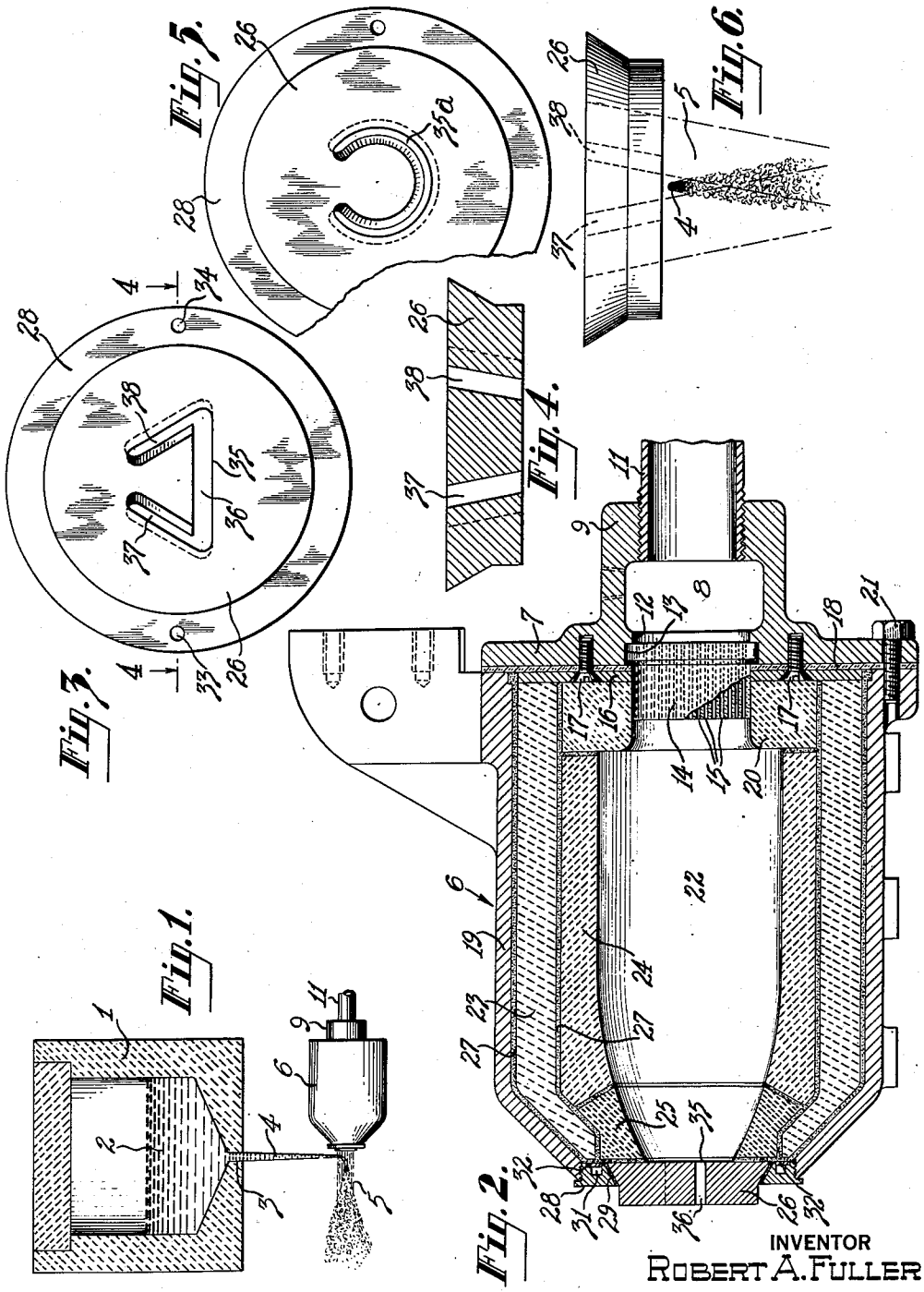
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BURNER AND NOZZLE TIP FOR PROJECTING HOT PRODUCTS OF COMBUSTION

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BURNER AND NOZZLE TIP FOR PROJECTING HOT PRODUCTS OF COMBUSTION

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The present invention relates to high temperature gas burners.

It is an object of the invention to provide a gas burner which will produce a high velocity stream of hot gases in the general form of a hollow, truncated pyramid or cone. It is a further object of the invention to provide a gas burner, the nozzle or tip of which will direct the hot, high velocity products of combustion from a gas burner in a hollow converging pattern.

According to the present invention, a thread of molten material is permitted to fall vertically into a horizontally directed stream of hot, high velocity gases which are so patterned that the thread is completely enveloped by the gases. Consequently the thread is carried by the gases and is, in effect, exploded by them into a plurality of fine fibers of uniform quality.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:

Figure 1 is a view, partly in section, showing the apparatus required to make fibers;

Figure 2 is a section through the burner;

Figure 3 is a front view of the burner tip;

Figure 4 is a section through the burner tip, taken along lines 4—4 of Figure 3;

Figure 5 is a figure showing a different shape port in the burner tip; and

Figure 6 is a top view of the burner tip showing the manner in which the gas blast is formed.

In the manufacture of fine fibers according to the present invention, there is provided a suitable melting furnace that has a forehearth 1 in which is located the molten material 2. The lower portion of this forehearth is provided with an orifice 3 of approximately ⅛'' in diameter through which a stream or thread of molten material may fall. As the material falls it will gradually be reduced in diameter to approximately $\frac{1}{16}$'' at a point about 8'' below the orifice. By the time it reaches this point it will still be molten but slightly more viscous than it was at the exit of orifice 3. At this point the thread 4 is enveloped in a blast of hot gases 5, that are shown diagrammatically, which gases are ejected from a burner 6.

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Burner 6 is similar to prior burners of the type in the manner in which the fuel is burned and the hot gases of combustion are produced. The tip or nozzle of the burner through which the gases are ejected, however, is of a novel shape, and produces a pattern of gases by means of which the method of blowing fine fibers according to this invention may be followed.

Referring to Figure 2 of the drawing, it will be seen that the burner 6 included in this invention has a ring-shaped base member 7 formed to provide an inlet chamber 8 and an extension 9 that is threaded, and into which may be connected a pipe 11 carrying a suitable supply of combustible mixture. The base member 7 is formed with an inwardly extending shoulder 12 at its top to receive the lower flanged end 13 of a cricular burner screen 14 having a plurality of small apertures 15 extending therethrough.

At the top face of the base member 7 a ring-shaped clamping plate 16 is secured by some suitable means, such as screws 17, with the inner end of the plate overlying the flanged end of the burner screen. In order to obtain a gas tight seal about the screen, a gasket 18, such as asbestos, is interposed between the plate and the base member.

The large end of a cup-shaped shell or outer casing 19 is removably secured to the base member by bolts 21. Within the metal shell is provided a hollow body having a cavity forming a combustion space 22 terminating at its upper end in a discharge orifice or outlet. In the burner illustrated the hollow body comprises a number of parts of high temperature refractory material including an annular member 20 which snugly fits around the upper portion of the burner screen.

About the annular member 20 is disposed the lower end of a cylindrical member 23 which bears against the clamping plate 16 and extends upwardly therefrom to the sloping or tapered upper end portion of the shell 19. Within this member and forming therewith a part of the refractory space is disposed a second hollow cylindrical member 24, also of refractory material. The lower end of this member bears against the top surface of the annular member 20 and the upper end thereof bears against the larger end of an annular member 25 which forms a restricted discharge space. This member projects to a point substantially even with the end of the metal shell and has its opening closed by a burner tip or nozzle 26.

In order to withstand the high temperatures produced in the combustion space during the

operation of the burner, the inner cylindrical member **24** and the upper annular member **25** may be formed of suitable refractory material, such as beryllium oxide which possesses rigidity and strength at high temperatures. The outer cylindrical member **23** is preferably formed of refractory material, such as aluminum oxide, possessing good insulating properties and having adequate strength to serve as the outer portion of the refractory wall. The burner screen **14** itself, may be formed of refractory material, such as aluminum oxide. Tip or nozzle **26** is shown herein as being formed of a high temperature resistant metallic alloy, but it could be made of a suitable refractory if desired.

The refractory wall parts just described, are secured to one another and in the outer shell **19** by any suitable firebrick cement as indicated at **27**. Such high temperature cement produces a rigid and unitary burner structure in which all of the refractory wall parts are united to form the combustion space.

As is shown in Figure 2 of the drawing, the outer end of the metal casing **19** is threaded to receive an annular collar **28** having in it a conical opening **29**. This opening receives in turn the burner tip or nozzle **26**. It will be noted that the annular collar **28** has a cut-out portion **31** that is closed by a washer **32** so that when the burner tip, the washer, and the annular collar are in assembled relation with respect to the outer shell **19** a small annular space is provided. This space is used for circulating cooling water so that the burner tip **26** and collar **28** will not become overheated. To this end an inlet **33** and an outlet **34** (Figure 3) are provided through which the cooling water may be passed. These parts, as well as the ceramic parts which were described above, are all cemented together with a suitable high temperature cement so that when they are in assembled relation, as shown in the drawing, they will form a rigid unitary member with gas tight joints between each part.

The burner tip or nozzle **26** has in it a port **35** which is substantially U-shaped. This port is provided with a horizontal portion **36** and two upwardly extending portions **37** and **38** that converge toward their outer ends. As shown best in Figures 3 and 4 the upwardly extending portions of the slot are cut at an angle to the face of the burner tip so that the hot gases of combustion from the combustion chamber **22** passing through the port **35** in the tip will take the form of a U, the angle of the legs causing the gases to converge. The pattern of the gases is substantially that of a hollow truncated pyramid with a small triangular opening in the top through which the thread **4** passes. This is best shown in dash lines in Figure 6.

There is shown in Figure 5 another shape for the burner port. In this case the port **35***a* is circular in shape except for a short portion of the arc across the top thereof. This leaves a space through which the thread may fall to be enveloped by the hot gases. As in the previously described embodiments, port **35***a* is larger on the inner face of nozzle or tip **26** than it is on the outer face thereof. This gives a converging pattern to the port and to the gases passing therethrough so that they form, in effect, a hollow truncated cone with an opening in the top thereof. Whether the port is shaped as shown in Figure 3 or Figure 5, the pattern of the gases, looking from above, will be substantially the same and similar to that shown in Figure 6. In both cases the port may be said to be substantially U-shaped with the vertical legs converging. The port may take other shapes as long as the gases passing through it form a closed pattern with an opening in the top through which the thread **4** of material may fall.

In the operation of the burner **6** to produce a high velocity stream of the heated products of combustion, a fuel mixture comprising gas and combustion supporting air is supplied through the inlet pipe **11** from a suitable source. When the burner is relatively cool and at a low temperature the mixture supplied thereto passes through the inlet chamber **8**, burner screen **14** and the combustion space **22**, from which it is discharged through the port **35** or **35***a* in the burner tip **26**. The combustible mixture is initially supplied to the burner at a relatively low pressure so that the gaseous mixture discharged from this space can be ignited to produce and maintain a flame at the outlet.

When a flame is being maintained at the outlet, the pressure of the gaseous mixture supplied to the burner may be momentarily reduced sufficiently to cause the flame to backfire through the outlet in the burner tip and into the combustion space **22**. When this occurs a plurality of flames are produced and maintained at the upper ends of the small apertures **15** in the burner screen **14**.

When the flames are being maintained at the top of the burner screen, the pressure of the gaseous mixture supplied to the burner may then be increased. After a short interval of time the flames maintained at the top surface of the burner screen effect such heating of the inner refractory lining **24** that its surface is heated to a high incandescent temperature. The heating of the inner refractory lining to a highly incandescent condition and radiant heat therefrom promotes substantially complete combustion of the mixture, before the mixture reaches the port in the burner tip. From this port in the tip is discharged a high velocity stream of heated gases at a temperature nearly equal to the temperature of the combustion space, and constituting substantially entirely heated products of combustion.

In a burner of the type described, the heated products of combustion are discharged from the combustion space through the port in the tip at an elevated temperature of approximately 3000° F. and at a velocity of from 800 to 1000 feet per second.

The molten material from the forehearth **1** falls in a vertical thread **4** to a point closely adjacent the front of the burner nozzle and between the converging portions of the blast which are ejected from the upstanding portions of the nozzle openings as shown in Figure 6. This thread of material will fall until it reaches the lower horizontal section of the blast where it will be blown to the left in Figure 1. As the thread moves away from the front of the burner, it will be completely enveloped in the high temperature gases of combustion that are being discharged through the port **35** or **35***a*.

Because of the pattern in which the gases are formed as they leave the burner tip, the thread **4** is completely enclosed by these gases. Therefore, there is no possibility of the thread bouncing off or away from the gases and consequently not being reduced sufficiently in size. Since the thread **4** is completely enclosed by the gases which are above the temperature at which the material melts, the material while being carried

with the blast will be remelted to an extremely fluent state and blown in a fine spray in the direction of the gas flow. This fine spray of material forms a high grade of fibers.

While in accordance with the provisions of the statutes I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention, as set forth in the appended claims, and that in some cases certain features of my invention can be used to advantage without a corresponding use of other features.

What is claimed is:

1. A gas burner comprising a body having a combustion chamber formed therein, said chamber having an inlet opening at one end and an outlet opening at the other end, means to supply fuel to be burned to the inlet opening of said chamber, a tip to close the outlet of said chamber, means to fasten said tip to said body, said tip being provided with an opening through which the hot products of combustion produced in said chamber may be exhausted, the opening in said tip being substantially U-shaped with the legs of the U being closer together at their unjoined ends than at their joined ends.

2. A gas burner comprising a metallic shell, a ceramic lining in said shell to form a combustion chamber having an inlet for fuel and combustion air and an outlet for the products of combustion, a water cooled annulus attached to said shell surrounding said outlet, a tip member held in position over said outlet by said annulus, said tip member being provided with an outlet port therein through which the products of combustion pass, said port being substantially U-shaped, the portions of the port forming the legs of the U converging from the side of the tip in the combustion chamber to the other side thereof whereby the gases leaving said port will flow in a converging pattern.

3. A gas burner comprising a hollow body forming a combustion chamber having an inlet opening and an outlet opening through which a combustible mixture and products of combustion may pass respectively, a tip member, means to attach said tip member to said body to close the said outlet opening, said tip member being provided with a port through which the products of combustion flow said port being substantially U-shaped and of substantially uniform cross section, the portions of the port forming the legs of the U converging from the side of the tip in the combustion chamber to the other side thereof whereby the gases leaving said port will flow in a converging pattern.

4. A tip for a gas burner comprising a flat piece of material having two faces, said material being formed with a substantially U-shaped opening therein, the legs of said U-shaped opening being further apart on one face of said member than on the other face thereof, whereby gas forced through said opening from said one face will converge.

5. A tip for a gas burner comprising a flat piece of material having a flat inside surface and a flat outside surface, said material being provided with an opening extending between said surfaces, said opening comprising a straight portion and a separate inclined portion connecting at an acute angle with each end of said straight portion.

6. A burner tip of claim 5 in which the inclined portions are closer together on the outside surface than they are on the inside surface of said material.

7. A gas burner comprising a body having a combustion chamber formed therein, the chamber having an inlet opening at one end and an outlet opening at the other end, means to supply fuel to be burned in said chamber, a tip to cover the outlet end of said chamber, means to attach said tip to said body in a position to close the outlet opening of said chamber, said tip being provided with a substantially flat surface being formed with a slot through which products of combustion may be discharged, said slot having a straight portion and two converging portions communicating at an acute angle with said straight portion at the ends thereof, each of said converging portions being so formed that the openings on the side of said tip toward said chamber are further apart than the openings on the opposite side of said tip.

8. A gas burner comprising a body having a combustion chamber formed therein, said chamber having an inlet at one end and an outlet opening at the other end, a tip for said burner attached to said body to close the outlet opening of said chamber, said tip being provided with a substantially flat surface having an opening therein comprising a straight portion and a pair of converging portions each communicating with an end of said straight portion at an acute angle thereto.

9. A tip for a burner comprising a body of material provided with a port therein, said port being substantially U-shaped and of substantially uniform cross section, the portions of the port forming the legs of the U converging from one side of the body of the material toward the other side thereof whereby gases passing through said port from said one side will flow in a converging pattern.

10. A tip for a gas burner and through which hot products of combustion are to be discharged comprising a body of material having opposed faces, said body having an opening, said opening being in the shape of an arc and extending through more than 180°, the opening being of substantially uniform cross section and larger on one face of said body than on the other face thereof whereby gases flowing through said opening from said one face will flow in a converging pattern.

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