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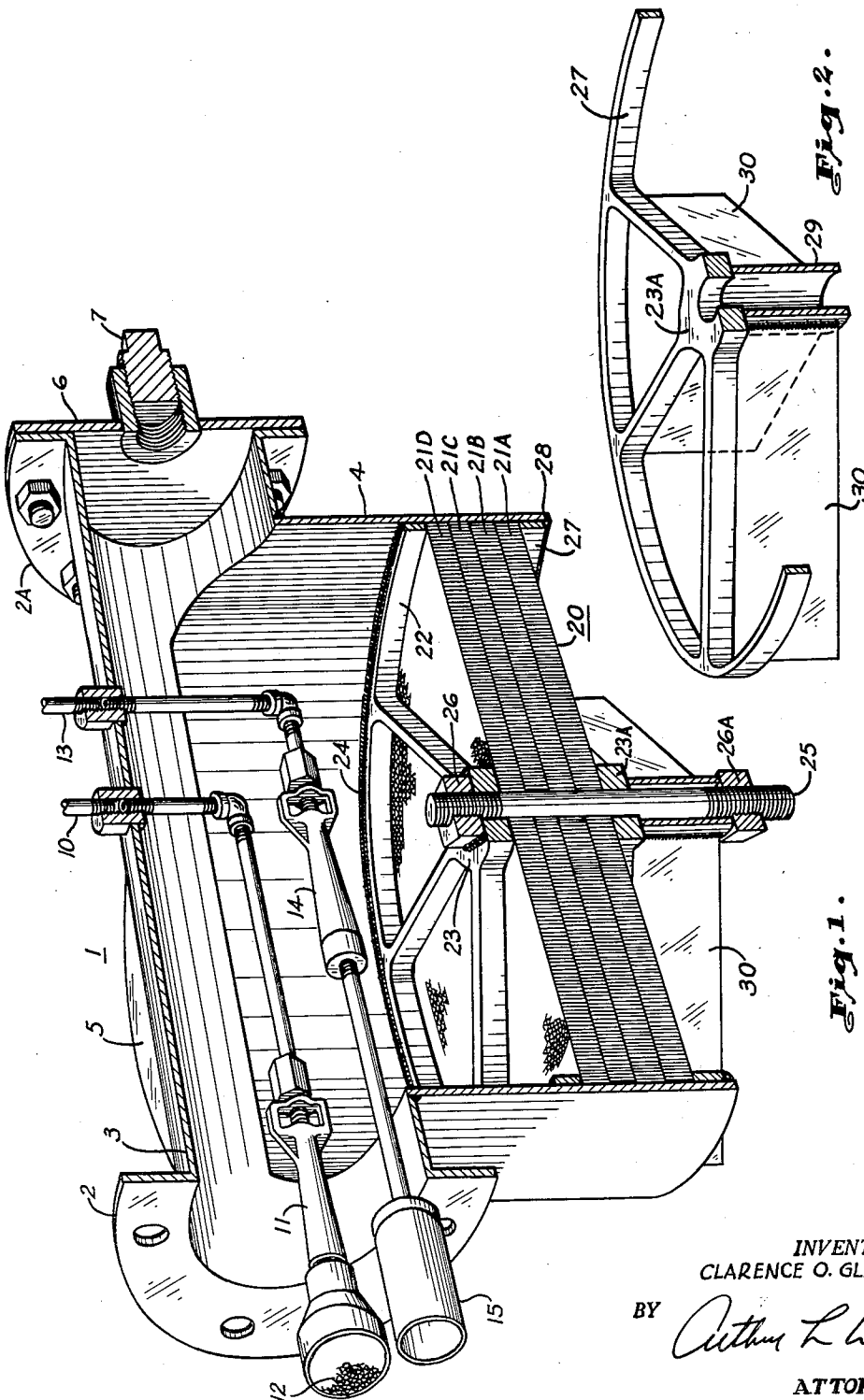
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FLAME ARRESTOR

Filed Dec. 31, 1959

2 Sheets-Sheet 1



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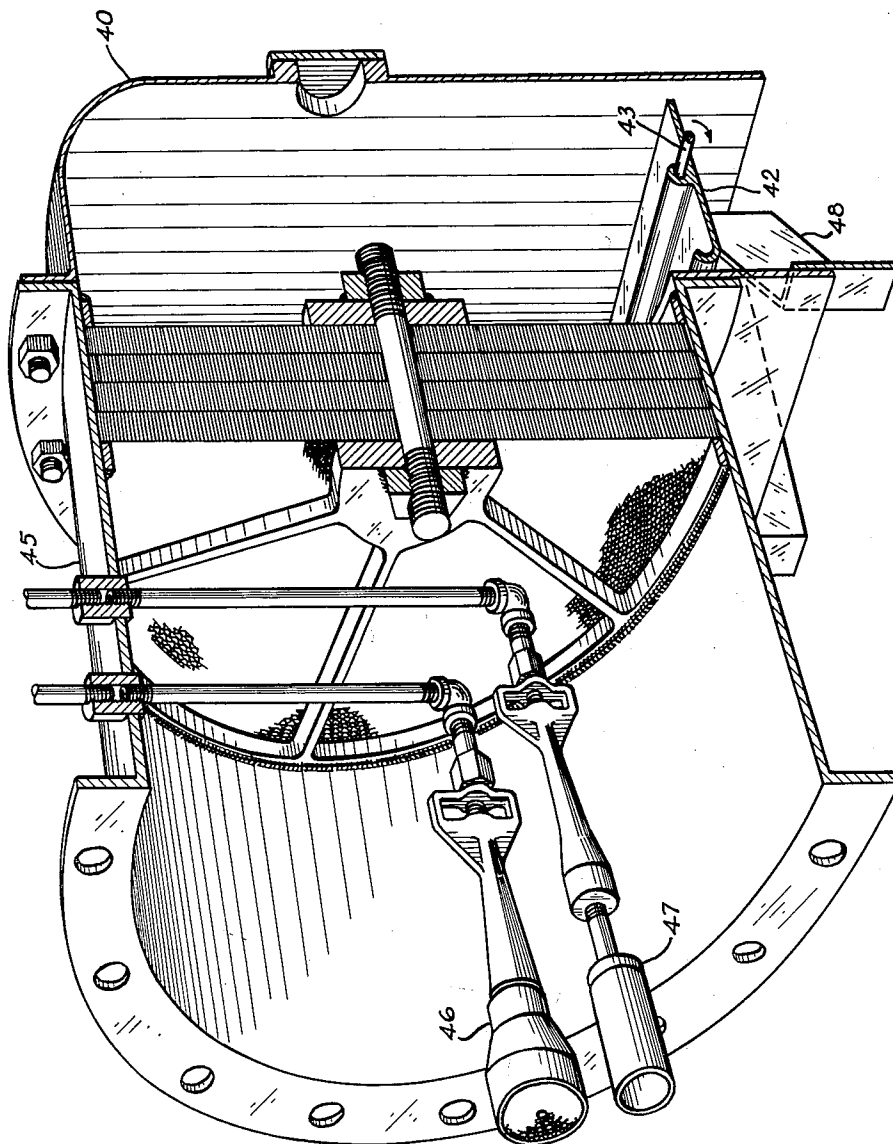


Fig. 3.

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## FLAME ARRESTOR

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The present invention relates to the control of the flame of burning fuel. More particularly, the invention relates to a device for confining the flame propagated, and the heat, of a burner to a restricted zone within an industrial heater.

In producing oil and gas wells, it has been conventional to install heaters which are not equipped with adequate flame arresting devices from one hundred to one hundred and fifty feet upwind of separation equipment. The advent of package production units has brought fired units and separation equipment side-by-side on the same skid. Additionally, fired units on off-shore installations must be mounted on the platforms very close to separation, dehydration, and oil well treating equipment. The resulting increase in the danger from fire has demanded a structure which will efficiently "cage" the combustion process of the fired equipment to prevent explosions and external fires when the equipment fails or is operated carelessly.

The enclosing structure required for any burner must provide an opening for bringing the air of combustion to the ignition zone of the process. If an inflammable mixture is brought to the burning process through this combustion air opening, there is danger that the flame of the process will be propagated back along the path of the air and combustible mixture, causing widespread damage.

Also, should the walls surrounding the combustion zone fail, and combustible material being heated flow out the combustion air opening, there is danger of the combustion flame being taken along with the escaping combustible material. Obviously, extensive damage could result from the fire released from the equipment.

Even when a fire is contained in the combustion zone, the heat on barrier structures provided over the combustion air opening may eventually raise the temperature on the external surface of the structure high enough to ignite combustible material in proximity to the enclosure. Heat transmitted by these sustained fires out of control in burner enclosures is a source of danger which must be neutralized.

Careless operation of burners may fill the combustion zone with explosive mixtures. When explosions result, the enclosure for the burner has often been damaged—fractured, broken—at some point.

Additionally, enclosing structure for combustion zones have the problem of bringing combustion air evenly over the surface of their openings to provide a high efficiency of combustion. Outdoor winds which pass across the openings tend to disrupt the flow, creating negative pressures which often quench the propagated flame.

An object of the present invention is to provide combustion air for a burner along a path which will not permit flame propagation along its length when a highly inflammable mixture is passed along the path.

Another object is to dissipate the heat of a flame within an enclosure zone so efficiently that the ignition temperature of inflammable mixtures in contact with the external surface of the enclosure will not be reached.

Another object is to provide an enclosure for a combustion process with strength sufficient to withstand the force of an explosion of a mixture within the zone of combustion.

Another object is to maintain a positive pressure on the supply of combustion air to the process as winds exter-

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nal of the structure defining the zone of the combustion process vary in direction and velocity.

The present invention contemplates a housing in which a combustion process is supported by burning fluid fuel.

5 The secondary air of combustion is brought into the housing through a screen type of structure having a plurality of paths, each of sufficiently small cross-sectional area that the flame of the combustion process will not be propagated through the screen regardless of which direction  
10 an inflammable mixture passes through the screen.

The invention further provides that the screen type of structure be composed of a series of similar elements abutting each other so the paths of each element will be misaligned at random with the paths of each abutting  
15 element to provide a tortuous path for fluid flowing through the plurality of the elements and a rate of heat dissipation by the screen and housing great enough to prevent reaching the ignition point of inflammable materials in contact with the external side of the screen.

20 The invention further provides the screen with a material and arrangement in the housing which will give an enclosure sufficiently sturdy to withstand the force of an explosion of a mixture within the housing.

25 The invention further provides for deflecting structure on the external side of the screen arranged to pass at least part of the air of winds passing parallel to the screen up into the combustion zone to keep a positive pressure for combustion air into the zone.

30 Other objects and advantages of the present invention will become readily apparent from the following detailed description of the invention with a specific reference to the accompanying drawings in which:

35 FIG. 1 is a partially sectioned isometric view of a screen structure for arresting the flame of a burner which embodies the present invention;

FIG. 2 is a partially sectioned isometric view of the lower retaining frame for the screen of FIG. 1 with wind deflecting fins depending therefrom; and

40 FIG. 3 is a partially sectioned isometric view of a screen structure positioned in combination with a conventional burner front.

Referring to FIG. 1 there is shown, in an isometric view, a housing portion 1 in which a combustion process is supported by burning liquid fuel. Housing portion 1  
45 is part of a complete enclosure for the combustion process. This portion illustrated in FIG. 1 is attached to the portion, not shown, by a flange 2. Housing portion 1 is shown supporting a burner and pilot light which propagate a flame to which secondary air of combustion is brought through a screen type of structure in which the present invention is embodied.

Housing 1 is formed of very simple parts, welded together. Flanged pipe 3 is extended horizontally and has a right-angle portion removed from its lower side, up to its center line. A vertically extended, larger pipe 4 is  
55 shaped on its top to match the cut out in pipe 3. Portions of the top of pipe 4, on either side of pipe 3 are covered by flat plate, one such plate being indicated at 5. Top plates 5 are preferably sloped slightly, away from pipe 3 so rain and snow will not collect thereon. All these parts may be welded together in a relatively inexpensive, sturdy, construction. Flange 2A is closed by bolting a plate 6 over it. An inspection plug 7 is threaded  
60 mounted in a fitting in plate 6.

65 A burner structure is mounted in housing 1. A fuel supply is available to the burner through conduit 10 which extends through the top of pipe 3. As is conventional, the fuel of conduit 10 is ejected from an orifice into venturi section 11. Secondary air of combustion, coming  
70 into housing 1 through the lower end of pipe 4, is drawn into the throat of venturi section 11, mixing with the fluid fuel. The combustible mixture then discharges from tip

12 and propagates a flame in the housing portion attached to flange 2.

These industrial burners are not always operated continuously. When they are intermittently shut-off, it is desirable to maintain a pilot light which will relight the mixture discharged from tip 12. Conduit 13 brings fluid fuel to the pilot light, ejecting it into venturi section 14 through an orifice. The air drawn into venturi section 14 and mixed with the fuel of conduit 13, is burned at tip 15. The specific control of the fluid fuel of conduits 10 and 13, and the general operation of the main burner and pilot burner, are of no concern in disclosing the present invention. The present invention is embodied in the structure which passes combustion air to these burners from pipe 4 in a satisfactory fashion while effectively isolating flames propagated within housing 1. The combustion air is brought to the burners evenly and with a positive, or atmospheric, pressure to give high efficiency in the combustion process and without danger of combustible materials external of housing 1 being ignited.

An important feature of this structure is the relatively large size and rugged construction of housing 1. Considering the size of the flame propagated by the main burner, housing 1 offers a mass to flame within housing 1 of a size sufficient to dissipate the heat of combustion over a large area. Therefore, should a failure, or improper operation, cause an explosion or unusual flame propagation to take place within housing 1 the construction is sufficiently rugged to withstand the strain of the explosion and is of a sufficiently large mass to dissipate the heat of the unusual flame propagation to prevent the external temperature of the housing from reaching the ignition temperature of explosive mixtures external of the housing.

Primary features of the invention are embodied in the screen type of structure mounted as a barrier across the opening into housing 1 through pipe 4. Screen structure 20 is composed of several similar elements. Taken together, the plurality of screen elements 21A, 21B, 21C and 21D, provide a complete path for the secondary air of combustion which is comprised of a myriad of paths, each path in substantially the form of a tube with sufficiently small cross-sectional area that the flame of a combustion process will not be propagated through the screen structure, regardless of which direction an inflammable material flows through the screen. Functioning with this form, screen structure 20 will supply combustion air evenly from the large surface of its plane to the main and pilot burners without allowing the flames propagated to travel in reverse direction through the screen structure regardless of the nature of combustible material which may flow through the screen structure in either direction.

Considering each of screen elements 21A-21D separately, they are made up of aluminum strips wound spirally about a center. One actual reduction to practice utilized a strip in the order of three-quarters of an inch wide, which was readily corrugated by passing it through the forming teeth of gear-like wheels. A strip of the same, but not corrugated, metal was then wound in lamination with the corrugated strip and about a center. The result is a plate-like form of element with holes, formed by the corrugations, extending in a direction transverse the plane of the body. Four such elements are sandwiched together in FIG. 1 and held by a framework in the opening of pipe 4.

Before considering the specific structure of each of the screen elements further, the framework holding them, as a group in position within pipe 4 will be considered. Basically, frame members within pipe 4 function to hold the abutting screen elements in parallel planes across the mouth of pipe 4. FIG. 1 shows the top frame member 22 is formed by removing segments from a circular plate in a regular pattern about a central hub portion 23. Removing these segments leaves an extensive surface through which air for supporting combustion will normally flow through the screen structure 20. At the same time, the frame 22 gives solid mechanical support to screen struc-

ture 20 on its upper end. As indicated at 24, a weld is formed around the periphery of the frame, joining it solidly with the inside wall of pipe 4.

The hub 23A of the lower frame member is shown vertically below hub 23, on the lower side of screen structure 20. Holes in each hub are aligned and a bolt 25 extended through the holes. A nut 26 is welded to the top of hub 23, its hole aligned with the hole through hub 23. Bolt 25 treads up through nut 26 and nut 26A threads on the lower end of bolt 25 to bring the frame members toward each other, on each side of screen structure 20.

FIG. 2 is established to show lower frame member 27 in greater detail. It is not normally expected that the screen structure 20, and its frame members, will be removed after they are mounted in pipe 4. Therefore, a weld 28 may be made around the lower edge of frame 27 to join it to pipe 4.

FIG. 2 specifically discloses a pipe 29 extending downward from hub 23A. This small pipe is journaled as in a sleeve over bolt 25 and froms the central support for a series of plate-like fins 30. Fins 30 radiate from pipe-sleeve 29, along the spoke-arms of lower frame member 27. These fins 30 are readily welded to the external wall of pipe-sleeve 29 and the lower surfaces of the spoke-arms of the lower frame member 27.

When positioned, as intended, fins 30 depend from frame member 27, below the lower end of pipe 4. These fins function as a simple deflector for winds which pass across opening of pipe 4. As air hits these fins, regardless of the direction the winds come from, at least a portion of their air will be deflected upwardly through screen structure 20. Thus, winds parallel to the opening to the screen will be at least partially deflected into the housing opening to maintain a positive pressure on the atmospheric air to the combustion process within the housing 1. As the fins radiate from pipe-sleeve 29 in various directions they catch winds from every direction and deflect a portion of them upwardly.

Returning to a consideration of the more specific structure of the screen elements, the section through them in FIG. 1 indicates the series of transverse passages through them approximate a cylinder in form. An actual reduction to practice has effectively utilized cylindrical holes which have a maximum diameter of .088 inch. This diameter was selected in view of the findings published in the Chemical Engineers Handbook, third edition, 1950, by McGraw-Hill Book Company, Incorporated. At page 1587 under the title "Gaseous Fuels," it is stated, "Methane and air mixtures will not propagate flame through tubes whose internal diameter is smaller than .142 inches or 3.6 millimeters." Therefore, the hole size selected for the screen elements, actually reduced to practice is below the size through which the flame of highly inflammable materials, such as methane and air mixtures, will be propagated. Further, prevention of flame propagation through the screen is augmented by the fact that the plurality of screen elements abutting each other in parallel planes have their holes misaligned. With this random misalignment, no hole through screen structure 20 has an effective cross-section equal to the cross-section of any hole through one of the screen elements. Thus, the .142 inch limitation of the Chemical Engineers Handbook is not approached by any aperture in the surface of the screen structure 20. In fact, as combustion air leaves the holes of screen element 21A, it is divided by the misaligned holes of element 21B. When the air finally leaves element 21D it has traversed a tortuous path through the holes of all the screen elements having a size far smaller than one which will propagate a flame of a combustible mixture.

In addition to the safety feature of the hole size through screen structure 20, the nature of the heat-transmission path provided by the element sandwich is an additional safeguard against reaching the ignition temperature of combustible material external of housing 1. With screen structure 20 actually consisting of elements in four layers,

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considered along a transverse line, heat applied to the top of element 21D will not pass downward, through the screen, as readily as it would if the screen structure was composed of a single element equal to the width of the combined elements.

In actual practice, three screens give adequate protection from flame propagation and heat transmission. Four screens are as readily employed, however. Therefore, the present disclosure indicates four as preferred.

The construction techniques employed in assembling this type of structure may be relatively crude, certainly not of machine shop quality. Welding torches are used to cut out the sections which are removed from pipes 3 and 4. The complete structure is then assembled by welding and bolting. However, it is necessary that screen structure 20 be positioned in pipe 4 with no peripheral leakage. A technique of assembly which does not adequately insure against peripheral gaps, between screen 20 and pipe 4, will defeat the purpose of the screen structure 20 in effectively containing combustion within housing 1. The present structure lends itself readily to eliminating leakage at this point.

As each screen element 21A—21D is formed, the strips held as a spool about a center in making up the body of plate-like form to have a circular shape, are wound tight enough about the center to give a diameter to the body slightly smaller than that of pipe 4. The elements are placed within pipe 4 and released from this tight winding. As the elements unwind, or expand, they fill the diameter of pipe 4 completely. Further, they are continuously urged to expand, sealing against the inside wall of pipe 4. With frame members 22 and 27 welded to the wall of pipe 4 they overlap the edges of screen structure 20 between them, efficiently sealing the screens to the walls of the pipe 4 opening so all combustion air through the opening will be forced to pass up through the screen.

FIG. 3 is established to illustrate a screen structure embodying the present invention mounted in a housing with a slightly different relation to the main and pilot burners and the entrance for air into the housing. The structural embodiment of FIG. 3 considers the present invention incorporated in a structure using a conventional burner front 40. Damper 42 is used to control the entrance of combustion air, pivoting through hinge 43. The screen structure of the present invention is mounted between burner front 40 and the firetube, or other structure defining the space in which the flame is propagated.

A tube 45 is flanged at either end for mounting between burner front 40 and the remainder of the combustion housing. The main burner 46 is mounted in tube 45, along with pilot burner 47. The screen structure is then mounted vertically in horizontal tube 45.

The structure of the screen is similar to that shown in connection with FIG. 1. The support structure for the screen is between the two frame spiders welded to the internal walls of tube 45. There is a difference between the two structures in that the deflecting fins 30 are eliminated from the frame in FIG. 3.

The equivalent of deflector fins 30 is provided by fin 48. Fin 48 is formed of a single strip of material. This strip of material is formed in a V-shape, its legs secured to one side of the burner front 40 opening and its apex secured to the opposite side of the burner front 40 opening. In this position, strip 48 not only functions to deflect winds, as do fins 30, but additionally gives structural support to the ends of burner front 40.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the apparatus.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

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As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A flame arresting and combustion air supply housing for a burner including,

an enclosure in which a combustion process is propagated,

a shell adapted to be mounted on the enclosure and having an opening in the wall of the shell through which all combustion air from the atmosphere reaches the combustion process in the enclosure,

a screen structure mounted in the opening in the wall of the shell and providing passages small enough to prevent the flame of mixtures at least as flammable as methane and air from being propagated through the passages,

and a fin in the form of a plate mounted at the opening of the shell wall in a plane aligned with the direction of air flow into the opening,

whereby wind traveling parallel to the opening will strike the fin and be at least partially deflected into the shell and through the screen and into the enclosure to maintain a positive supply pressure of atmosphere air to the combustion process.

2. A flame arresting and combustion air supply housing for a burner including,

an enclosure in which a combustion process is propagated,

a shell adapted to be mounted on the enclosure and having an opening in the wall of the shell through which all combustion air from the atmosphere reaches the combustion process in the enclosure,

a screen structure mounted in the opening in the wall of the shell and providing passages small enough to prevent the flame of mixtures at least as flammable as methane and air from being propagated through the passages,

a frame member mounted in the shell opening to support the screen structure on the side of the screen external the shell and to seal the edges of the screen structure to the shell opening to ensure all air flowing through the opening of the shell passes through the passages of the screen structure,

and a fin in the form of a plate mounted on the frame member in a plane aligned with the direction of air flow into the opening,

whereby wind traveling parallel to the opening will strike the fin and be at least partially deflected into the shell and through the screen and into the enclosure to maintain a positive supply pressure of atmosphere air to the combustion process.

3. A flame arresting and combustion air supply housing for a burner including,

an enclosure in which a combustion process is propagated,

a shell adapted to be mounted on the enclosure and having an opening in the wall of the shell through which all combustion air from the atmosphere reaches the combustion process in the enclosure,

a screen structure mounted in the opening in the wall of the shell and providing passages small enough to prevent the flame of mixtures at least as flammable as methane and air from being propagated through the passages,

and two fins in the form of plates mounted at an angle to each other and both mounted at the opening of the shell wall in separate planes with each plane aligned with the direction of air flow into the opening,

whereby wind traveling parallel to the opening will strike at least one of the fins and be at least partially deflected into the shell and through the screen

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and into the enclosure to maintain a positive supply pressure of atmosphere air to the combustion process.

4. A flame arresting and combustion air supply housing for a burner including,

an enclosure in which a combustion process is propagated,

a shell adapted to be mounted on the enclosure and having an opening in the wall of the shell through which all combustion air from the atmosphere reaches the combustion process in the enclosure,

a screen structure mounted in the opening in the wall of the shell and providing passages small enough to prevent the flame of mixture of least as flammable as methane and air from being propagated through the passages,

a frame member mounted in the shell opening to support the screen structure on the side of the screen external the shell and to seal the edges of the screen structure to the shell opening to ensure all air flowing through the opening of the shell passes through the passages of the screen structure,

and two fins in the form of plates mounted at an angle to each other and both mounted on the frame mem-

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ber sealed to the shell wall and each mounted in separate planes with each plane aligned with the direction of air flow into the opening, whereby wind traveling parallel the opening will strike at least one of the fins and be at least partially deflected into the shell and through the screen and into the enclosure to maintain a positive supply pressure of atmosphere air to the combustion process.

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