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BURNER APPARATUS

Filed Sept. 21, 1964

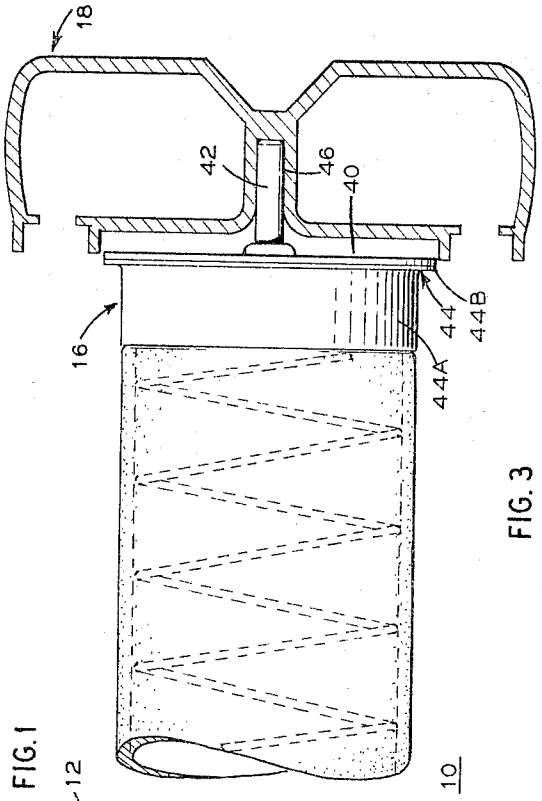


FIG. 1

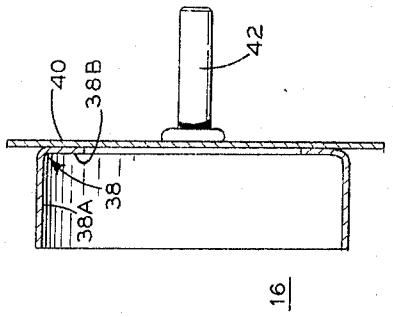
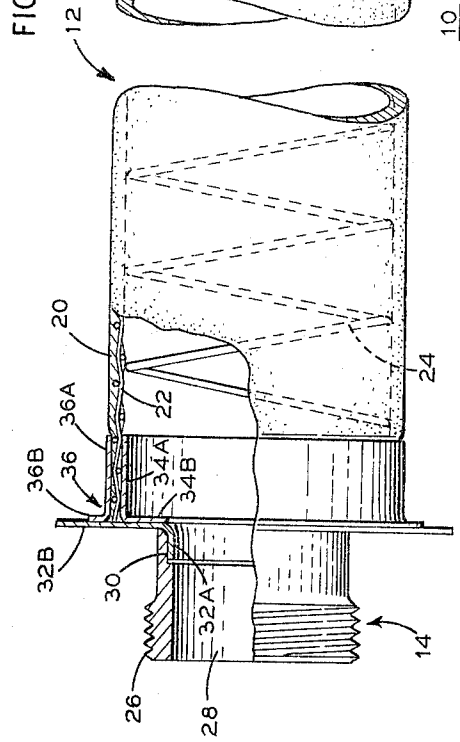


FIG. 3



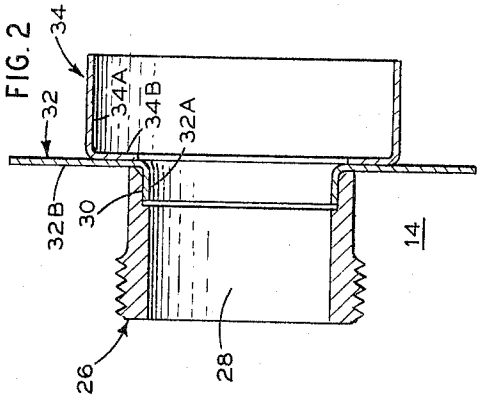


FIG. 2

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BURNER APPARATUS

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This invention pertains to fuel burners and more particularly to surface combustion burner apparatus.

Many gaseous hydrocarbon fuel burners employing arrays of jets or gas ports operate with limited efficiency, generate limited quantities of heat, and produce heat at restricted rates. Lately, there has become available heat resistant porous fabrics through which a combustible gaseous mixture can readily flow and which can provide considerable continuous area combustion sites. Because of the large combustion sites and the smooth flow of combustible gaseous mixtures to the combustion sites, burners employing such fabrics more closely approach an optimum distribution of combustion area (and volume) in relation to the heat transfer surface which will absorb the generated heat.

However, when such fabrics are used in large burners, mechanical support problems arise. The fabrics are woven from short brittle fibres having a minimum of structural strength. Accordingly, heretofore, burner sizes have been restricted to the self supporting ability of the fabrics. Furthermore, since it is necessary to connect the fabrics to coupling means which feed the combustible gaseous mixture to the combustion sites provided by the fabrics and because of the fragile nature of the fabrics it has been difficult to provide long lasting reliable leak-free joints.

It is, accordingly, an object of the invention to provide an improved fuel burner.

It is another object of the invention to provide an improved surface combustion burner element.

It is a further object of the invention to provide an improved surface combustion burner element employing a fragile heat resistant fabric.

It is yet another object of the invention to provide an improved surface combustion burner element employing fragile heat resistant fabric as the combustion site which is reliably supported without undue stress on the fabric.

It is yet a further object of the invention to provide an improved means for connecting in a leak-free manner a fragile heat resistant fabric combustion site to a support.

Briefly, the invention contemplates surface combustion burner apparatus which includes a hollow cylinder of fabric woven of heat resistant fibres and a member of rigid material within the cylinder to prevent its collapse. There is provided an inlet coupling means including a hollow coupling member for receiving a combustible mixture of gas. An inlet flange means has a sleeve portion fixed to the hollow coupling member, and a flange portion extending radially outward from the sleeve portion. An inner retaining ring includes a sleeve positioned within one end of the hollow cylinder, and a radially inward extending flange fixed to the flange portion of the inlet flange means. Means are provided for closing off and supporting the other end of the hollow cylinder. There are also other means fitted about the hollow cylinder for urging a portion thereof in tight fitting relationship with the sleeve of the inner retaining ring.

Features of the invention are concerned with the rigid member within the hollow cylinder, the inlet coupling means, and the end closure means.

Other features, objects and advantages of the invention will be apparent from the following detailed description of the invention when read with the accompanying drawings,

which show by way of example and not limitation, the now preferred embodiment of the invention.

In the drawings:

FIGURE 1 is a plan view, partially in section, showing surface combustion burner apparatus including a surface combustion burner element, an inlet coupling means, and an end closure and support means in accordance with the invention;

FIGURE 2 is a sectional view of the inlet coupling means of FIGURE 1; and

FIGURE 3 is a sectional view of the end closure and support means of FIGURE 1.

Referring to FIGURE 1 the surface combustion burner apparatus **10** is shown comprising: a burner element **12**; an inlet coupling means **14** connecting to one end of burner element **12** to support the latter and to connect a source of a combustible gaseous mixture (not shown) thereto; and an end closure **16** connected to the other end of burner element **12** for supporting the latter by engaging heat exchanger **18**, only a portion of which is shown.

Burner element **12** comprises a hollow cylinder **20** of a heat resistant porously woven fabric of heat resistant fibres of alumina ceramic and Nichrome wire. The fabric is about one-eighth inch thick and has a weave density so that there is a pressure drop of about one-half inch of water for a gas flow of 20 cubic feet per minute per square foot of burner surface. The fabric can withstand a continuous temperature of a least 2000 degrees Fahrenheit. The Carborundum Co. makes a suitable fabric under the trademark Fiber-Frax. Fitted within hollow cylinder **20** is a hollow cylinder **22** of wire mesh. The wire mesh may be hardware cloth (4 x 4 mesh, 23 gauge wire of galvanized steel). The wire mesh is rigid enough to provide a tubular shape to hollow cylinder **20** of fabric. In order to prevent accidental collapse of hollow cylinders **20** and **22** during shipping and installation there is positioned a helix **24** of rigid material such as steel wire within hollow cylinder **22** of wire mesh and abutting the inner wall thereof. Although helix **24** is shown extending within most of the cylinder **20** it may also be only several turns in the center of the cylinder. It should be noted that the ends of the hollow cylinder **20** and **22** are adjacent each other.

Because of the brittleness and fragility of the fabric of burner element **12** special couplings must be employed. Accordingly, inlet coupling means **14** (see also FIG. 2) includes a hollow coupling member **26** of bronze whose inlet is coupled to a source of a combustible gaseous mixture such as air and a hydrocarbon (not shown). The inner wall at the end remote from inlet **28** has a setback portion **30**. Fixed to coupling member **26** is an inlet flange means **32** of heat and corrosion resistant steel such as stainless steel type 446 which includes a sleeve portion **32A** and a flange portion **32B** radially outwardly extending from sleeve portion **32A**. Sleeve portion **32A** is brazed to setback portion **30** with there being a smooth transition from the inner wall of coupling member **26** to the inner surface of sleeve portion **32A**. An inner retaining ring **34** of heat and corrosion resistant steel has a sleeve **34A** which abuts one end of the inner surface of hollow cylinder **22** of wire mesh. Extending radially inward from sleeve **34A** is a flange **34B** which is spot welded to flange portion **32B**. In order to securely fix burner element **12** to inlet coupling means **14**, there is provided an outer retaining ring **36** of heat and corrosion resistant steel which includes a sleeve **36A** and a radially outwardly extending flange **36B**. Outer retaining ring **36** is slidably fitted on burner element **12**, and, when slid to encompass the end of burner element **12** with flange **36B** abutting the flange portion **32B**, sleeve **36A** presses the ends of hollow cylinder **20** and **22** against sleeve **34A**. Because of the resiliency of the woven fabric in hollow

cylinder **20**, a leak-free joint is obtained. It should be noted that because of the smooth expanses of the surfaces of sleeves **34A** and **36A** an even pressure is applied to the sandwiched fabric, minimizing the possibility of fibre breakage.

End closure **16** seals off the other end of burner element **12** and provides mechanical support thereto. End closure **16** (FIG. 3) includes an inner retaining ring **38** of heat and corrosion resistant steel having a sleeve **38A** fitted within the other end of hollow cylinder **22** of wire mesh, and a flange **38B** extending radially inward from sleeve **38A**. Spot welded to flange **38B** is an end plate **40**. Extending from plate **40** is a support pin **42**. In order to securely fix burner element **12** to end closure **16**, outer retaining ring **44** of heat and corrosion resistant steel is provided. Outer retaining ring **44** includes a sleeve **44A** and radially outwardly extending therefrom is a flange **44B**. Outer retaining ring **44**, like outer retaining ring **36** is slidable on hollow cylinder **20**. When outer retaining ring **44** is positioned so that flange **44B** abuts end plate **40**, the pressure exerted by sleeve **44A** on the ends of the hollow cylinders **20** and **22** against sleeve **38A** provides a leak-free joint as hereinbefore described with respect to retaining rings **34** and **36**.

As was heretofore stated, burner element **12** is supported by inlet coupling means **14** and end closure **16**. Inlet coupling means **14** is fixed to a support (not shown) while end closure **16** is supported by heat exchanger **18**. Since there may be a differential expansion of burner apparatus **10** with respect to its supports, heat exchanger **18** is provided with recess **46** to slidingly accommodate pin **42** to prevent any possible buckling of burner element **12**.

In operation, a combustible gaseous mixture is fed via inlet coupling means **14** to the interior of hollow cylinders **20** and **22**. The mixture diffuses through the fabric of hollow cylinder **20** to the outer surface thereof where it is ignited by a sparkplug (not shown). The mixture burns on the outer surface of hollow cylinder **20** in the form of a glow and at a temperature of about 1450 degrees Fahrenheit to heat the surrounding region which preferably contains a heat exchanger. It should be noted that the temperature on the inner surface of hollow cylinder **22** at this time is only about 140 degrees Fahrenheit. Accordingly, there is not the slightest chance of damage to the wire mesh.

While only one embodiment of the invention has been shown and described in detail, there will now be obvious to those skilled in the art many modifications and variations which satisfy many or all of the objects of the invention. However, these modifications and variations will not depart from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A surface combustion burner apparatus comprising: a hollow cylinder of fabric porously woven of heat resistant fibres, said hollow cylinder of fabric including inner and outer surface portions and first and second end portions; a member of rigid material within said hollow cylinder of fabric to prevent the collapse of said hollow cylinder; inlet coupling means including a hollow coupling member for receiving a combustible mixture of gas, said hollow coupling member including inner and outer wall portions and first and second end portions, and a setback portion in the inner wall portion adjacent the first end portion of said coupling member, an inlet flange means including a sleeve portion and a flange portion extending radially outward from said sleeve portion, said sleeve portion being fixedly fitted in the setback portion of said coupling member, an inner retaining ring including a sleeve and a radially inwardly extending flange, the flange of said inner retaining ring being fixed to the flange portion of said inlet flange means, the sleeve of said inner retaining ring being positioned within the first end portion of said hollow cylinder of fabric; and end closure means for closing off the second end portion of said hollow cylinder, and means for urging the first end portion of said hollow cylinders in tight fitting relationship with the sleeve of said inner retaining ring.

2. A surface combustion burner apparatus comprising: a hollow cylinder of fabric porously woven of heat resistant fibres, said hollow cylinder of fabric including inner and outer surface portions and first and second end portions; a hollow cylinder of wire mesh disposed within said hollow cylinder of fabric and coextensive therewith, said hollow cylinder of wire mesh including inner and outer surface portions and first and second end portions, the outer surface portion of said hollow cylinder of wire mesh abutting the inner surface portion of said hollow cylinder of fabric to provide mechanical support thereto; the first and second end portions of said hollow cylinder of fabric being opposite respectively the first and second end portions of said hollow cylinder of wire mesh; inlet coupling means including a hollow coupling member for receiving a combustible mixture of gas, said hollow coupling member including inner and outer wall portions and first and second end portions, and a setback portion in the inner wall portion adjacent the first end portion of said coupling member, an inlet flange means including a sleeve portion and a flange portion extending radially outward from said sleeve portion, said sleeve portion being fixedly fitted in the setback portion of said coupling member, an inner retaining ring including a sleeve and a radially inwardly extending flange, the flange of said inner retaining ring being fixed to the flange portion of said inlet flange means, the sleeve of said inner retaining ring being positioned within the first end portion of said hollow cylinder of wire mesh; and end closure means for closing off the second end portions of said hollow cylinders, and means for urging the first end portions of said hollow cylinders in tight fitting relationship with the sleeve of said inner retaining ring.

3. The apparatus of claim **2** wherein said fibres are of alumina ceramic and Nichrome wire.

4. The apparatus of claim **2** further comprising a helix of rigid material within said hollow cylinder of wire mesh for preventing the collapse of said hollow cylinders.

5. A surface combustion burner apparatus comprising: a hollow cylinder of fabric porously woven of heat resistant fibres including inner and outer surface portions, and first and second end portions; a hollow cylinder of wire mesh disposed within said hollow cylinder of fabric and coextensive therewith, said hollow cylinder of wire mesh including inner and outer surface portions and first and second end portions, the outer surface portion of said hollow cylinder of wire mesh abutting the inner surface portion of said hollow cylinder of fabric to provide mechanical support thereto; the first and second end portions of said hollow cylinder of fabric being opposite respectively the first and second end portions of said hollow cylinder of wire mesh; inlet coupling means including a hollow coupling member for receiving a combustible mixture of gas, said hollow coupling member including inner and outer wall portions and first and second end portions, and a setback portion in the inner wall portion adjacent the first end portion of said coupling member, an inlet flange means including a sleeve portion and a flange portion extending radially outward from said sleeve portion, said sleeve portion being fixedly fitted in the setback portion of said coupling member, an inner retaining ring including a sleeve and a radially inwardly extending flange, the flange of said inner retaining ring being fixed to the flange portion of said inlet flange means, the sleeve of said inner retaining ring being positioned within the first end portion of said hollow cylinder of wire mesh; an end closure means for closing off the second end portions of said hollow cylinders, and an outer retaining ring including a sleeve portion for abutting the outer surface portion at the first end portion of said hollow cylinder of fabric and a radially outwardly extend-

ing flange portion for abutting the flange portion of said inlet flange means, for urging the first end portions of said hollow cylinders in tight fitting relationship with the sleeve of said inner retaining ring.

6. The apparatus of claim 5 wherein said fibres are of alumina ceramic and Nichrome wire.

7. A surface combustion burner apparatus comprising: a hollow cylinder of fabric porously woven of heat resistant fibres of alumina ceramic and Nichrome wire, said hollow cylinder of fabric including inner and outer surface portions, and first and second end portions; a hollow cylinder of wire mesh disposed within said hollow cylinder of fabric and coextensive therewith, said hollow cylinder of wire mesh including inner and outer surface portions and first and second end portions, the outer surface portion of said hollow cylinder of wire mesh abutting the inner surface portion of said hollow cylinder of fabric to provide mechanical support thereto; the first and second end portions of said hollow cylinder of fabric being opposite respectively the first and second end portions of said hollow cylinder of wire mesh; a helix of rigid material within said hollow cylinder of wire mesh and abutting the inner surface portion thereof to prevent the collapse of said hollow cylinders; inlet coupling means including a hollow coupling member for receiving a combustible mixture of gas, said hollow coupling member for receiving a combustible mixture of gas, said hollow coupling member including inner and outer wall portions and first and second end portions, and a setback portion in the inner wall portion adjacent the first end portion of said coupling member, an inlet flange means including a sleeve portion and a flange portion extending radially outward from said sleeve portion, said sleeve portion being fixedly fitted in the setback portion of said coupling member, an inner retaining ring including a sleeve and a radially inwardly extending flange, the flange of said inner retaining ring being fixed to the flange portion of said inlet flange means, the sleeve of said inner retaining ring being positioned within the first end portion of said hollow cylinder of wire mesh; an end closure means for closing off the second end portions of said hollow cylinder, and an outer retaining ring including a sleeve portion for abutting the outer surface portion at the first end portion of said hollow cylinder of fabric and a radially outwardly extending flange portion for abutting the flange portion of said inlet of flange means, for urging the first end portions of said hollow cylinders in tight fitting relationship with the sleeve of said inner retaining ring.

8. A surface combustion burner apparatus comprising: a hollow cylinder of fabric porously woven of heat resistant fibres of alumina ceramic and Nichrome wire, said hollow cylinder of fabric including inner and outer surface portions, and first and second end portions; a hollow cylinder of wire mesh disposed within said hollow cylinder of fabric and coextensive therewith, said hollow cylinder of wire mesh including inner and outer surface portions and first and second end portions, the outer surface portion of said hollow cylinder of wire mesh abutting the inner surface portion of said hollow cylinder of fabric to provide mechanical support thereto; the first and second end portions of said hollow cylinder of fabric being opposite respectively the first and second end portions of said hollow cylinder of wire mesh; a helix of rigid material within said hollow cylinder of wire mesh and abutting the inner surface portion thereof to prevent the collapse of said hollow cylinders; inlet coupling means including a hollow coupling member for receiving a combustive mixture of gas, said hollow coupling member including inner and outer wall portions and first and second end portions, and a setback portion in the inner wall portion adjacent the first end portion of said coupling member, an inlet flange means including a sleeve portion and a flange portion extending radially outward from said sleeve portion, said sleeve portion being fixedly fitted in the setback portion of said coupling member, an inner

retaining ring including a sleeve and a radially inwardly extending flange, the flange of said inner retaining ring being fixed to the flange portion of said inlet flange means, the sleeve of said inner retaining ring being positioned within the first end portion of said hollow cylinder of wire mesh; an end closure, said end closure including an inner retaining ring including a sleeve and a radially inwardly extending flange, the sleeve of said inner retaining ring being positioned within the second end portion of said hollow cylinder of wire mesh, an end plate fixed to said flange, and a pin extending from said end plate in a direction opposite to said hollow cylinders and adapted to be slidably supported; a first outer retaining ring slidably fitted on the first end portion of said hollow cylinder of fabric, said first outer retaining ring including a sleeve for abutting the outer surface portion at the first end portion of said hollow cylinder of fabric and a radially outwardly extending flange for abutting the flange portion of said inlet flange means for urging the first end portions of said hollow cylinders in a tight fitting relationship with the sleeve of the inner retaining ring of said inlet coupling means; and a second outer retaining ring including a sleeve for abutting the outer surface portion at the second end portion of said hollow cylinder of fabric and a radially outwardly extending flange for abutting the end plate of said end closure, for urging the second end portions of said hollow cylinders in tight fitting relationship with the sleeve of said second inner retaining ring.

9. A surface burner element comprising a hollow open-ended cylinder of fabric of porously woven heat resistant fibres of alumina ceramic and Nichrome wire, said hollow cylinder of fabric including inner and outer surface portions and a hollow cylinder of bendable wire mesh within said hollow cylinder of fabric, said hollow cylinder of bendable wire mesh including inner and outer surface portions, the outer surface portion of said hollow cylinder of bendable wire mesh abutting the inner surface portion of said hollow cylinder of fabric.

10. A surface burner element comprising a hollow cylinder of fabric of porously woven heat resistant fibres of alumina ceramic and Nichrome wire, said hollow cylinder of fabric including inner and outer surface portions, a hollow cylinder of bendable wire mesh within said hollow cylinder of fabric, said hollow cylinder of bendable wire mesh including inner and outer surface portions, the outer surface portion of said hollow cylinder of bendable wire mesh abutting the inner surface portion of said hollow cylinder of fabric, and a helix of rigid material within said hollow cylinder of bendable wire mesh and abutting the inner surface portion thereof.

11. A surface burner element comprising a hollow open-ended cylinder of fabric of porously woven heat resistant fibres of alumina ceramic and Nichrome wire, said hollow cylinder of fabric including inner and outer surface portions and first and second end portions and a hollow cylinder of bendable wire mesh within said hollow cylinder of fabric, said hollow cylinder of bendable wire mesh including inner and outer surface portions and first and second end portions, the outer surface portion of said hollow cylinder of bendable wire mesh abutting the inner surface portion of said hollow cylinder of fabric, the first and second end portions of said hollow cylinder of bendable wire mesh being opposite the first and second end portions respectively of said hollow cylinder of fabric.

12. A surface burner element comprising a hollow cylinder of fabric of porously woven heat resistant fibres of alumina ceramic and Nichrome wire, said hollow cylinder of fabric including inner and outer surface portions and first and second end portions, a hollow cylinder of bendable wire mesh within said hollow cylinder of fabric, said hollow cylinder of bendable wire mesh including inner and outer surface portions and first and second end portions, the outer surface portion of said hollow cylinder of bendable wire mesh abutting the inner surface portion of said hollow cylinder of fabric, the first and second end portions

of said hollow cylinder of bendable wire mesh being opposite the first and second end portions respectively of said hollow cylinder of fabric, and a helix of rigid material within said hollow cylinder of bendable wire mesh and abutting the inner surface portion thereof.

13. The combination comprising a tubular burner member of heat resistant fragile material, a coupling member including an inner wall portion, an outer wall portion, and first and second end portions, an inlet flange means including a sleeve portion and a flange portion extending radially outwardly from said sleeve portion, said sleeve portion being fixed to the inner surface portion of said coupling member, an inner retaining ring including a sleeve and a radially inwardly extending flange, the flange of said inner retaining ring being fixed to the flange portion of said inlet flange means, the sleeve of said inner retaining ring being positioned within said tubular member, and an outer retaining means slidably fitted over and peripherally surrounding said tubular member for urging said tubular member in tight fitting relationship with the sleeve of said inner retaining ring.

14. The combination comprising a tubular burner member of heat resistant fragile material, a coupling member including an inner wall portion, an outer wall portion, and first and second end portions, a set back portion in the inner wall portion adjacent the second end portion of said coupling member, an inlet flange means including a sleeve portion and a flange portion extending radially outwardly from said sleeve portion, said sleeve portion being fixed to the set back portion of said coupling member, an inner retaining ring including a sleeve and a radially inwardly extending flange, the flange of said inner retaining ring being fixed to the flange portion of said inlet flange means, the sleeve of said inner retaining ring being positioned within said tubular member, and an outer retaining means slidably fitted over and peripherally surrounding said tubular member for urging said tubular member in tight fitting relationship with the sleeve of said inner retaining ring.

15. The combination comprising a tubular burner member of heat resistant fragile material, a coupling member including an inner wall portion, an outer wall portion, and first and second end portions, a set back portion in the inner wall portion adjacent the second end portion of said coupling member, an inlet flange means including a sleeve portion and a flange portion extending radially outwardly from said sleeve portion, said sleeve portion being fixed to the set back portion of said coupling member, an inner retaining ring including a sleeve and a radially inwardly extending flange, the flange of said inner retaining ring being fixed to the flange portion of said inlet flange means, the sleeve of said inner retaining ring being positioned within said tubular member, and an outer retaining ring including a sleeve peripherally surrounding said tubular member and a radially outwardly extending flange abutting the flange portion of said inlet flange means, for urging said tubular member in tight fitting relationship with the sleeve of said inner retaining ring.

16. The combination comprising a tubular burner member of heat resistant fragile material, a plate member including first and second surface portions, a pin extending from said first surface portion and adapted to be slidably supported, an inner retaining ring including a sleeve and a radially inwardly extending flange, a flange of said inner retaining ring being fixed to the second surface portion of said plate member, the sleeve of said inner retaining ring being positioned within said tubular member, and an outer retaining means slidably fitted over and peripherally surrounding said tubular member for urging said tubular member in tight fitting relationship with the sleeve of said inner retaining ring.

17. The combination comprising a tubular burner member of heat resistant fragile material, a plate member including first and second surface portions, a pin extending from said first surface portion and adapted to be slidably supported, an inner retaining ring including a sleeve and a radially inwardly extending flange, the flange of said inner retaining ring being fixed to the second surface portion of said plate member, the sleeve of said inner retaining ring being positioned within said tubular member, and an outer retaining ring slidably fitted over said tubular member, said outer retaining ring including a sleeve peripherally surrounding said tubular member and a radially outwardly extending flange abutting the flange portion of said inlet flange means, for urging said tubular member in tight fitting relationship with the sleeve of said inner retaining ring.

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