March 24, 1953 B. E. BAILEY 2,632,503

TUBULAR RADIANT GAS BURNER

Filed April 27, 1948 2 SHEETS—SHEET 1

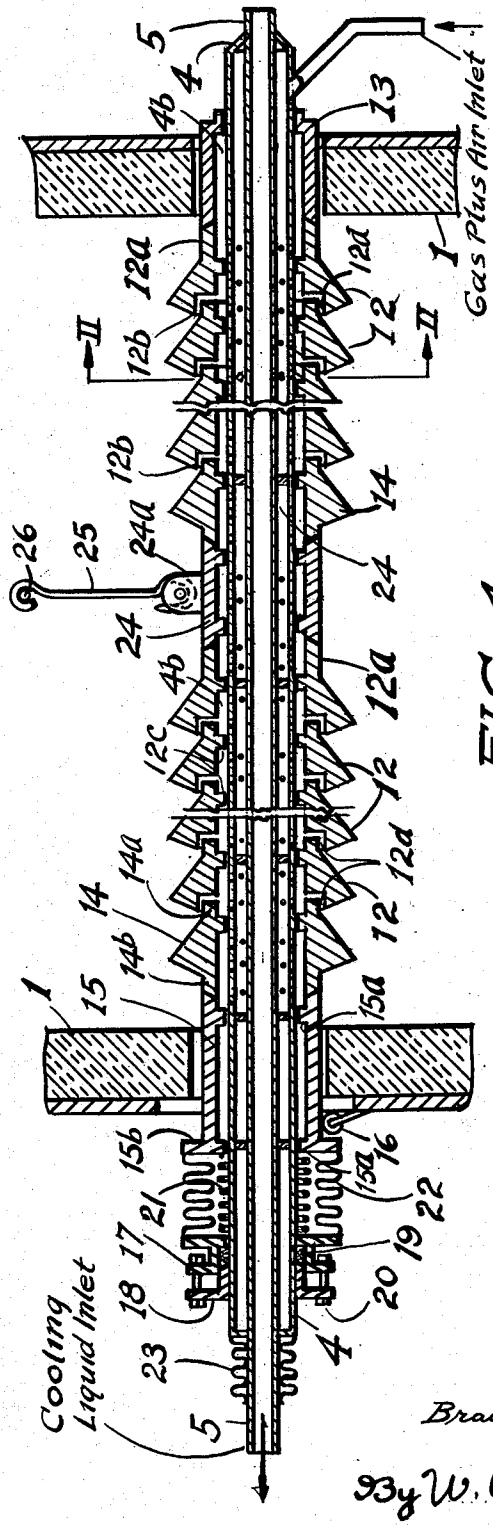


FIG.-1

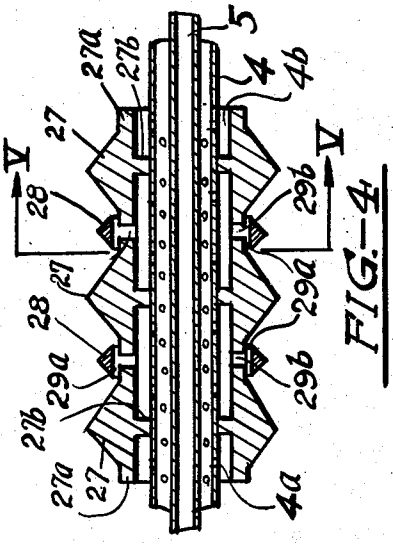


FIG.-4

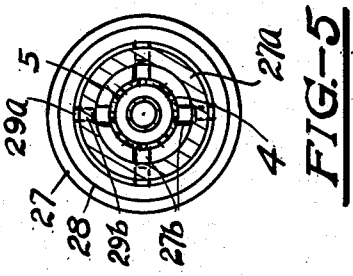


FIG.-5

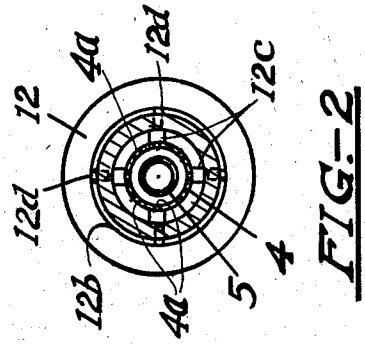


FIG.-2

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TUBULAR RADIANT GAS BURNER

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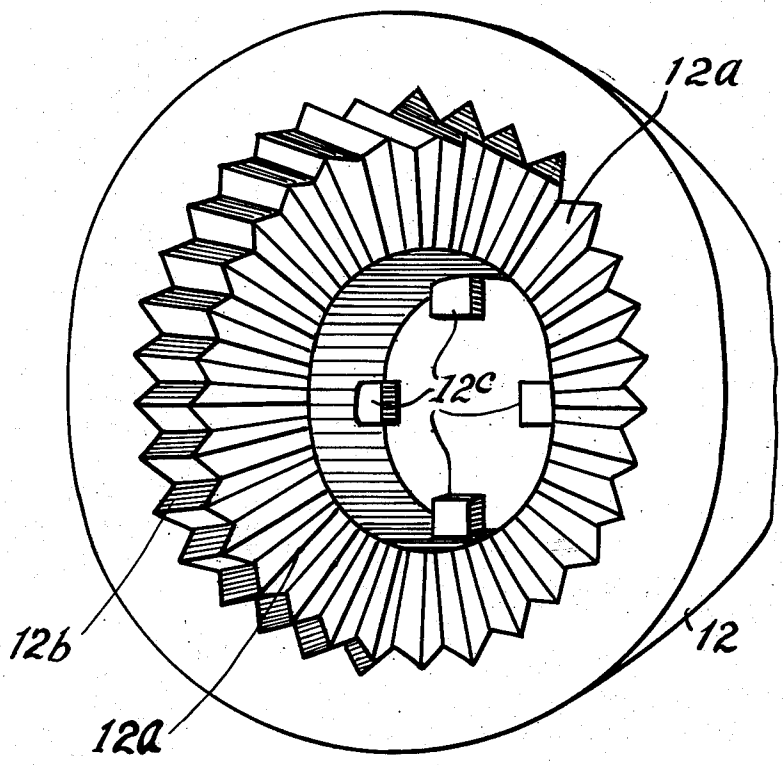


FIG.—3

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TUBULAR RADIANT GAS BURNER

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6 Claims. (Cl. 158—113)

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The present invention relates to an improvement in furnace burner structures, in which substantially tubular surface combustion burners are assembled from a plurality of annular burner elements.

It is the main object of the invention to provide a burner structure of substantially tubular form which may be assembled from a plurality of comparatively small and simple elements to produce a burner unit of any desired or required dimensions and capacity.

The invention and its objects may be more fully understood from the following description when read in conjunction with the accompanying drawings, in which

Fig. 1 is a view in vertical section longitudinally through a burner element and portions of a furnace.

Fig. 2 is a sectional view of the burner element along the line II—II of Fig. 1.

Fig. 3 is a perspective view of an alternate form of burner unit shown in Figs. 1 and 2.

Fig. 4 is a longitudinal section through a portion of a burner element, showing another form of burner unit, and

Fig. 5 is a sectional view of the burner element of Fig. 4, along the line V—V thereof.

Referring more particularly to the drawings, the burner elements of this invention are composed of a fuel supply conduit 4, of which that portion disposed within the furnace 1 is perforated to form passageways 4a, a plurality of annular burner units 12 fitted over the conduit 4 to provide a substantially continuous circular combustion surface, and a pipe member 5, disposed concentrically of the conduit 4, for circulation of a coolant material. The conduit 4 is sealed at one end in fluid and gas tight relationship to the pipe 5, and at the other end communicates with a fuel supply manifold 9.

As illustrated by Fig. 1, the annular burner units 12 have a form which is substantially that of a hollow frustum of a cone, with a cylindrical collar portion 12a at the apex end, and at the other end, a shouldered enlargement 12b of the central passage through the unit. The central passage through the element 12 is of greater diameter than that of the conduit 4, and radial lug type spacer elements 12c are provided to maintain substantially uniform annular spacing of the units 12 from conduit 4, and to form an annular passageway 4b therebetween. The respective burner units 12 may be maintained in spaced relation, one from another, by means of angular spacer elements 12d formed in the shoulder 12b

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and the adjoining side wall portion, against which abut the cylindrical collar portion 12a of the next adjoining unit. By this means, a substantially annular jet passageway is provided which communicates with the passageway between the units and the conduit 4, and which opens toward the conical surface of the adjoining element. Where desired, the shouldered portion 12b and the adjoining side wall portion may be serrated, as shown by Fig. 3 to provide a plurality of triangular jet passages between the collar portion 12a of one element and the shouldered portion 12b of an adjoining element.

The assembled burner units may be held in their designed relationship in any suitable manner. As illustrated in Fig. 1, a metallic sleeve member 13 is secured in fixed, fluid-tight relation to one end of the conduit 4. This sleeve 13 extends through the furnace wall, terminating immediately beyond the wall lining. The inner end of the sleeve is formed to provide a closely fitted joint with the collar portion 12a of the first burner element. The joint may be of any suitable type, but preferably should provide a substantial seal against leakage of fuel therethrough. The collar may be of any heat resistant metal or alloy.

At the other end of the unit, a burner unit 14 is provided which differs from the elements 12, of which the unit is principally formed, in that the shouldered portion 12b of the regular unit is omitted, the unit 14 being formed with a base collar portion 14b to make up a substantially fluid-tight joint with a sleeve 15 encircling the conduit 4 and extending outwardly through the furnace wall. Spacer lugs 15a support the tube 4 for longitudinal movement of expansion or contraction through the sleeve 15. The sleeve itself may be supported for movement under impulse of the burner elements as by rollers 16. The outer end of the sleeve 15 is provided with an annular flange 15b extending inwardly to slidably engage the conduit 4. In spaced relation to the outer end of sleeve 15, a packing gland assembly, including a gland member 17 and packing ring 18, is held in rigid, fluid-tight relation to the conduit 4 by pressure of the ring 18 against the packing 19. Such pressure is applied to the ring 18 by means of bolts 20. Between the gland 17 and the sleeve flange 15b a coil spring member 21 is held under compression to force the sleeve members 13 and 15 and burner units 12 and 14 into pressure contact, and to maintain such contact in spite of differential expansion or contraction of the related parts. A cylindrical bellows element 22 se-

cured at each end to the gland 17 and sleeve 15 respectively provides a flexible, fluid-tight seal between the gland and sleeve. A similar bellows member 23 secured in fluid-tight relation to the conduit 4 provides a seal between this element which is extensible and contractable with differential movement of the respectively connected parts.

Where by reason of exceptional length, the burner units require supplementary support, a hanger assembly may be provided as shown in Fig. 1. As illustrated, a sleeve 24 of a heat resistant metal or alloy is inserted in the sequence of burner elements between an element 14 on one side and an element 12 on the other. The sleeve 24 is provided with an upstanding ear or lug 24*a* adapted to be engaged by the lower hooked end of hanger rod 25, the upper hooked end of which is held by a bar support member 26.

In the form illustrated by Figs. 4 and 5, the burner units 27 have a body portion of substantially triangular longitudinal section, with a cylindrical collar portion 27*a* at each end, and a concentric passageway through the unit. The units 27 are disposed concentrically over the fuel mixture conduit 4 in the same fashion as units 12 and 14 being maintained in radially spaced relation thereto by means of the internal radial lugs or spacer elements 27*b*. In the assembled element, the units are held in spaced relation to one another in one of at least two ways. As shown, a deflector ring element 28 of substantially triangular longitudinal section is provided over adjoining collar portions 27*a*. This element 28 is formed with a plurality of T-shaped inner projections of which the horizontal portion 29*a* extends longitudinally of the element inner wall, and the vertical portion 29*b* extends radially inward and is of lesser width than the length of the element 28. The portions 29*b* thus serve to space the collar portions of the units 27, and the portions 29*a* serve to space the ring 28 from the collar portions and provide fuel jet passageways discharging toward the sloped surface of the triangular body portions of the units 27.

If desired, the units may be spaced by providing a castellated collar at one end of each unit in which the space between castellations will permit egress of the fuel mixture from the annular space between the fuel conduit 4 and the units. In such event, it is preferred that the deflector ring be provided with a serrated inner wall, much the same as the wall portion adjoining shoulder 12*b* of the unit 12 illustrated by Fig. 3, thereby providing a plurality of triangular shaped jet passages communicating with the space between the collars 27*a*. In the assembly utilizing the structural form of elements 27, the sleeves 13 and 15 and support hanger sleeves 24 may be employed without change merely by forming the edge portions of the collar portions 27*a* to fit the conformation of the several sleeve members which are to be engaged thereby.

Preferably, the units forming the combustion surface of the burner elements are formed of cast ceramic refractory materials such as compounds of silica, magnesite, dolomite, forsterite, chrome, mullite, alumina, silicon, carbide et cetera. Such refractory materials may be with or without the addition of super refractories including spinels, beryllium, thorium and zirconium compounds.

In operation, a fuel mixture of primary air and a gaseous or liquid fuel is supplied through manifold 9 and conduit 4. This mixture is discharged through passageways 4*a*, into the annular space between the conduit and the assembled unit, flowing therethrough to be discharged by way of the fuel jets opening from the space between units. By suitable restriction of flow through such passageways and spaces the velocity is maintained high enough to substantially overcome any tendency for the burning fuel to flash back into the conduit 4 or other fuel mixture passages. The protection of high velocity flow is supplemented by continuously flowing a coolant material such as water through the pipes 5. Where desired, the pipes 5 may be utilized as a heat exchange means to partially preheat the fluid being heated in the furnace.

Although the invention has been described with reference to specific embodiments thereof, various changes and modifications are possible, and it is not intended that the invention be limited by any such specific illustrations, but only by the appended claims.

What is claimed is:

1. A tubular burner assembly comprising an elongated fuel mixture supply conduit, a cylindrical sleeve element secured in fixed, fluid-tight relation adjacent one end of said conduit in radially spaced, coaxial relation thereto, a second cylindrical sleeve element slidably mounted on said conduit in coaxial, radially spaced relation thereto for limited reciprocal movement thereon, and in spaced relation to said fixed sleeve element longitudinally of the conduit, a plurality of annular burner units freely and coaxially supported on said conduit, between the sleeve elements, in radially spaced relation to said conduit to form an intermediate, substantially continuous, co-extensive, annular passageway between said conduit and burner units, and in spaced relation to each other longitudinally of the conduit to form discharge passageways, communicating at one end with said annular passageway and opening outwardly between adjacent units, means for diverting flow from each of said discharge passageways toward the outer surface of an adjoining burner unit, a plurality of passageways opening through the conduit wall circumferentially and longitudinally thereof between said sleeve elements, communicating between said conduit and the annular passageway, a pipe, for circulating a heat exchange fluid, extended through said conduit in substantially concentric, radially spaced relation thereto, secured to said conduit at one end in fixed, fluid-tight relation, and at the other end disposed for limited reciprocal movement longitudinally with reference to said conduit, a fluid-tight seal between the conduit and pipe at said other end, a fluid-tight seal between said conduit and second sleeve element, means for resiliently maintaining said burner units as a continuous assembly on said conduit between said sleeve elements, and means for introducing a fluid fuel mixture into said conduit.

2. A tubular burner assembly according to claim 1, in which said means for resiliently maintaining said burner units as a continuous assembly on said conduit between sleeve elements, comprises an annular gland-type seal member secured in fixed relation to said conduit beyond said second sleeve element, and a helical spring member encircling said conduit, disposed under compression between said seal member and sleeve element.

3. A tubular burner assembly according to

claim 1, in which each burner unit is a substantially frusto-conical member having an apex end and a base end, and a concentric passageway therethrough, an enlarged radially shouldered portion in said passageway at the base end, a cylindrical collar portion at the apex end adapted for insertion into the enlarged passageway portion of the next adjoining unit, a circumferential combustion surface on said unit flared outwardly from said collar toward the base end of the unit, said collar portion disposed in spaced relation to the wall and shouldered portion of said concentric passageway to form said discharge passageways, said discharge passageways being disposed so as to discharge against an outwardly flared combustion surface.

4. In a tubular burner assembly according to claim 1, an assembly of said burner units including at least two adjoining burner units, each of which comprises a body consisting of two substantially congruent conical frustum portions integrally joined at their larger base ends, with their smaller bases forming opposite ends of said body, a concentric passageway through said body, a cylindrical collar extension portion at each end of said body, radial spacer elements extending inwardly from the wall of said passageway, and said means for directing flow from said discharge passageways, comprising an annular deflector ring member encircling said collar portions of adjoining units and supported thereon in radially spaced relation thereto.

5. A burner unit assembly according to claim 4 in which said deflector ring comprises an annular member of substantially triangular longitudinal

section, said section having a base width substantially equal to that of two spaced unit collar portions, and a plurality of T-shaped spacer elements extending radially inward from the inner surface of said member, each element disposed with the horizontal portion of the T parallel with the axis of the member and the vertical portion perpendicular thereto, said latter portion extending inward to a depth equivalent to the thickness of the collar portions of said adjoining burner units.

6. A burner unit assembly according to claim 4, in which one collar portion of each unit is castellated to space said portions in the assembly and the deflector ring is an annular member of substantially triangular longitudinal section spaced from said collar portions by means of serrations on its inner wall portion.

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