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COMBUSTION CHAMBER FLAME TUBE CONSTRUCTION

Filed Aug. 2, 1968

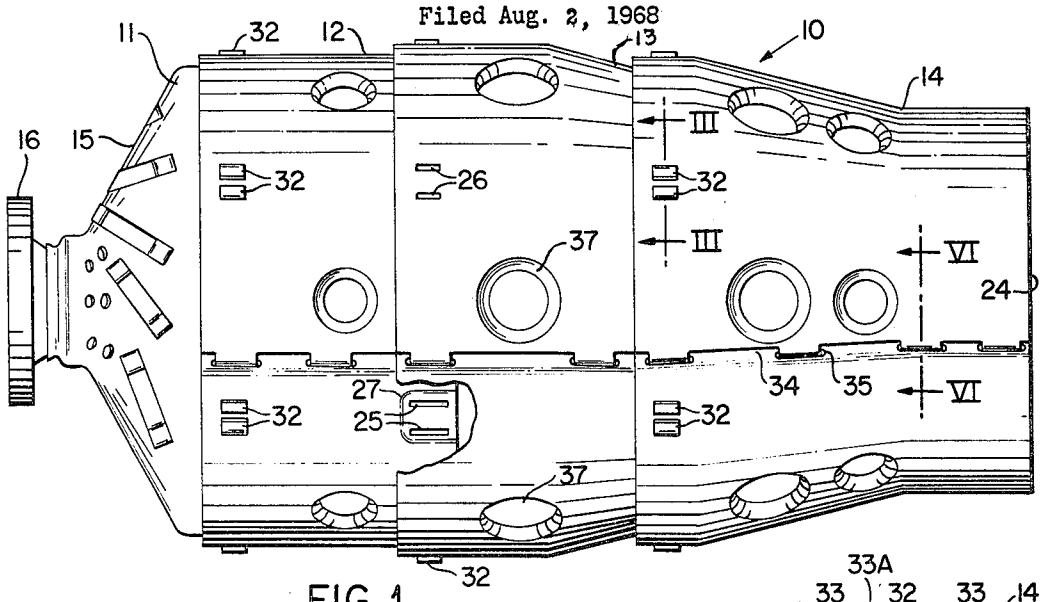


FIG. 1

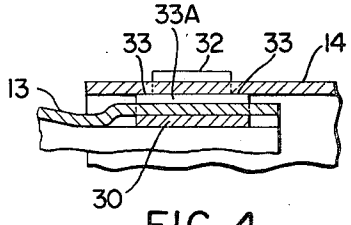


FIG. 4

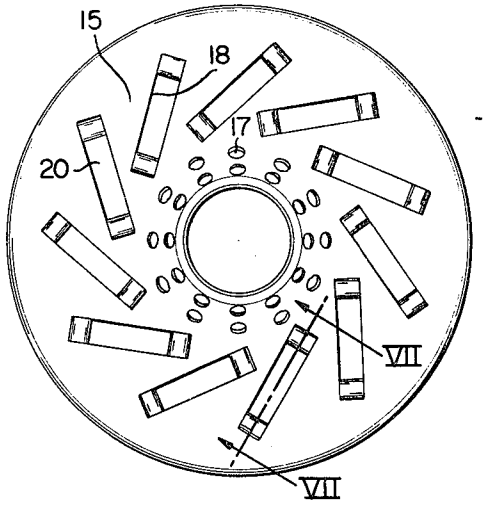


FIG. 2

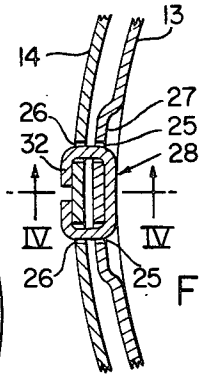


FIG. 3

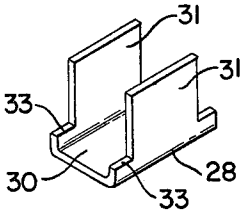


FIG. 5

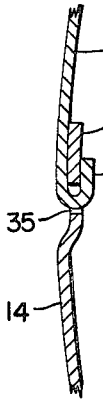


FIG. 6

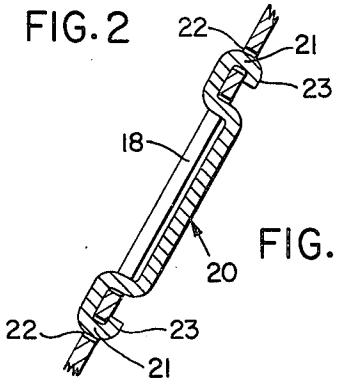


FIG. 7

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COMBUSTION CHAMBER FLAME TUBE CONSTRUCTION

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ABSTRACT OF THE DISCLOSURE

The subject flame tube has a plurality of tubular or sleeve sections fabricated from sheet stock stamped and rolled into tubular form, one longitudinal edge being offset and formed with slots and the other longitudinal edge being provided with tabs so that these edges can be smoothly overlapped with the tabs inserted into the slots and bent to lock the section in tubular form. Each section is shaped to permit nesting with the adjacent complemental section, the co-operating edge portions of the sections being provided with openings which register when the sections are nested and receive clips to lock the sections in assembled relationship. The clips are bent to lock the same in place. Certain sections are formed with localized recesses for receiving portions of the clip and providing unobstructed interior surfaces. The openings and clips are sized and shaped to provide and maintain circumferential air inlet spaces between the sections and to maintain predetermined spaced relation between air inlet orifices formed in the side walls of the sections.

SUMMARY

This invention relates generally to gas turbine engines, and more particularly to the combustor components of such engines. Still more particularly, the invention is directed to the construction of the liner or flame tube of a gas turbine engine combustor. Heretofore, such elements have been made in many ways; for example, they have been cast, turned, or fabricated from sheet and assembled by welding or other techniques which resulted in unitary construction and required the removal, discard and replacement of flame tubes which may have been subjected to only localized wear or deterioration. If the tubes or liners were repaired, costly and time consuming methods only could be employed.

An object of this invention is the provision of a liner or flame tube construction which will avoid the above-enumerated and other obvious objections.

Also, an object of this invention is to provide a flame tube construction embodying the concept of a plurality of segments so shaped and sized that they can be combined to form a flame tube unit, simple securing means being employed to retain the segments in assembled relationship and yet permit ready separation of the parts for repair or replacement.

A further object of the invention is to provide a flame tube construction in which a plurality of tubular or sleeve sections are employed, the tubes being formed with mating, complemental ends to permit nesting or stacking to make a unit, such complemental ends having registering openings to receive clips employed to lock the sections together, the clips and openings being constructed to hold the sections in relative positions to form circumferential air inlets therebetween, the clips also having deformable portions which permit the operation of assembling the tube to be performed by relatively unskilled labor without special tools.

A still further object of the invention is to provide the

flame tube construction of the preceding paragraph with pairs of registering openings to receive clips of a particular construction which serves to locate the sections relative to one another so that air inlet orifices will be disposed in predetermined relation to secure the most effective results, all the clips being of one form so designed that the sections can be dismantled and reassembled with new clips and still have the original required relationship of the parts and orifice patterns.

An object also is to provide a flame tube constructed of a plurality of parts manufactured and assembled without welding or similar steps.

Other objects and advantages will be obvious from the following description of the embodiment of the invention selected for illustration in the accompanying drawings.

IN THE DRAWINGS

FIG. 1 is a side elevational view of a flame tube formed in accordance with the invention;

FIG. 2 is an elevational view of the inlet end of the flame tube of FIG. 1;

FIG. 3 is an enlarged detail sectional view taken through the flame tube on the plane indicated by the line III—III of FIG. 1;

FIG. 4 is a similar view taken on the plane indicated by the line IV—IV of FIG. 3;

FIG. 5 is a perspective view of one of the clips used in securing the sections of the flame tube in assembled relationship;

FIG. 6 is an enlarged sectional view taken on the plane indicated by the line VI—VI of FIG. 1; and

FIG. 7 is a similar view taken on the plane indicated by the line VII—VII of FIG. 2.

Particular reference to FIG. 1 of the drawing will show that the flame tube **10** formed in accordance with the invention selected for illustration is composed of four tubular sections **11–14**, inclusive, Section **11** is designated hereinafter as the inlet end section. This section has an end wall **15** at one end of the tubular portion, this end having a central opening in which a fitting **16** is secured. In the present instance, this fitting is held by a portion of the end wall being rolled into a groove in the fitting. The fitting forms a suitable connection for a fuel injector (not shown). The end wall **15** is provided, as shown in FIG. 2, with a plurality of openings **17** and **18**, the former being perforations providing for entrance of air under pressure to be mixed with fuel supplied through the fuel injector.

The openings **18** are slots elongated to receive cap clips **20** which are shaped, as shown in FIG. 7, to project through the openings **18** and have ends **21** received by openings **22** at the ends of the slots **18**. The ends **21** are then bent over, as at **23**, to secure the cap clips in inserted positions. The body portions of the cap clips are disposed at the inner side of the end wall **15** at such a distance that air entrance slots are formed between the inner side edges of the slots **18** and the side edges of the clips. This arrangement provides for the entrance of air under pressure and directs the air generally along the inner surface of the end wall. This air also combines with the fuel to provide a combustible mixture. The air also flows along the wall **15** to provide a cooling effect.

Sections **12**, **13** and **14** are truly tubular sections, section **12** being of a diameter to permit the tubular end of section **11** to be nested therein. Section **13** has its upstream end of a size sufficient to similarly receive the downstream end of section **12**. Section **13** is reduced at its downstream end to be nested in the upstream end of section **14**. This section is also reduced to form the flame tube outlet **24**. To retain the sections in assembled relationship, the complemental nested ends of the sections

are provided with openings **25** and **26**, these openings being arranged in pairs and constituting slots which extend, in the present embodiment, longitudinally of the flame tube. The slots **25** are arranged in the downstream ends of sections **11–13**. The other slots are in the upstream ends. The localized portions of the sections around slots **25** are depressed, as at **27**, to receive the body portions of clips **28** used to hold the sections together.

As shown in FIG. 5, clips **28** have body portions **30** and tang portions **31**, the latter portions being inserted in registering sets of openings **25** and **26** of the complemental nested section ends. It will be noted from FIG. 3 that a pair of slots **25** registers with a pair of slots **26** in the complemental end and the tangs **31** extend through the registering pairs of slots. After the ends are inserted, they are bent over, as at **32**, to secure the clips in position. As shown in FIG. 5, the body **30** of the clip provides a surface for engagement with the depressed area of the section around the set of slots **25**. This arrangement locates the body portions in such a manner that no interference to fluid flow through the tube will result. Shoulders **33**, formed by reductions in the width of the tangs, provide surfaces for engagement with the inner side of the outer tubular section. The space between the body **30** and the shoulders **33** has been selected to maintain a peripheral opening **33A** between nested complemental ends resulting from making the relative diameters of the nesting portions of the sections such that this construction will result. Such openings **33A** are provided to permit air under pressure to flow into the flame tube and along the inner walls of the downstream sections. In other words, these peripheral openings **33A** have inlets on the outer side of the flame tube facing upstream and outlets on the inside of the flame tube facing downstream. Air flowing through these peripheral openings will move along the side walls a distance sufficient to cool these walls before mixing with the air to complete combustion.

All of the sections **11–14**, inclusive, are made from sheet metal. End section **11** is a stamping, while sections **12**, **13** and **14** are made from sheet, cut, formed, and rolled into tubular shape. As pointed out in the objects, the flame tube is fabricated without requiring welding or similar steps. The sections **12–14**, inclusive, are maintained in tubular form by providing one longitudinal edge of each section with an offset portion, as at **34**, and a series of slots **35**, as shown particularly in FIGS. 1 and 6. The other longitudinal edge of each section has tabs **36** provided thereon which are inserted in the slots **35** and bent back to prevent separation.

As shown in FIG. 1, each of sections 12, 13 and 14 is provided with air inlet perforations **37** for the entrance of air under pressure to combine with the air and fuel mixture and complete combustion. The openings **37** are disposed at predetermined points in the length of the flame tube to secure the most efficient operation. The manner of securing the sections in assembled relationship insures the maintenance of the spacing of the air inlet orifices.

While a single embodiment of the invention has been illustrated, it will be obvious that many changes may be made in the construction and relation of the parts without departing from the spirit of the invention.

We claim:

1. A flame tube for gas turbine combustors, comprising:

(a) a plurality of sleeve sections with complemental ends sized to permit nesting, said ends being provided with openings registering with one another when said sections are nested; and

(b) clip means shaped and sized for insertion in said openings to retain the sections in the nested relationship, said clip means having deformable portions to retain the clip means in the inserted positions.

2. A flame tube for gas turbine combustors according to claim **1** in which the clip means has spaced surfaces for engaging the sleeve sections to maintain a predetermined circumferential air space therebetween.

3. A flame tube for gas turbine combustors according to claim **1** in which a certain section is provided with depressed areas around said openings to receive portions of said clip means and eliminate obstructions to gas flow through the section.

4. A flame tube for gas turbine combustors according to claim **1** in which the openings are arranged in pairs and each clip means has a body with spaced tanks for insertion in registering pairs of openings in nested sections.

5. A flame tube for gas turbine combustors according to claim **4** in which a certain section is provided with depressed areas around said pairs of openings to receive the bodies of the clip means and eliminate obstructions to gas flow.

6. A flame tube for gas turbine combustors according to claim **5** in which the inner section is provided on the inner side with depressed areas around the pairs of openings.

7. A flame tube for gas turbine combustors according to claim **1** in which the openings in one section are of a different size than the openings in the complemental section, and the clips are constructed with portions sized to fit the opening into which the respective portion of the clip is inserted, thereby preventing relative movement of the nested ends of the sections.

8. A flame tube for gas turbine combustors according to claim **7** in which the openings are formed in pairs with the openings in the inner section larger than the openings in the outer section, and the clips are constructed with a body and a pair of spaced tanks for insertion in registering pairs of openings in the complemental ends of nested sections, the tanks being larger adjacent the body and smaller at the outer end to fit the openings in the sections and prevent relative movement of the nested ends of the sections.

9. A flame tube for gas turbine combustors according to claim **1** in which the sleeve sections are provided with air inlet perforations, the clip means and openings therefor being disposed, shaped, and sized to maintain the sections in relative positions with the air inlet perforations in predetermined spaced order.

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U.S. Cl. X.R.

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