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COMBUSTION APPARATUS FOR GAS TURBINE ENGINES

Filed Dec. 28, 1967 4 Sheets-Sheet 1

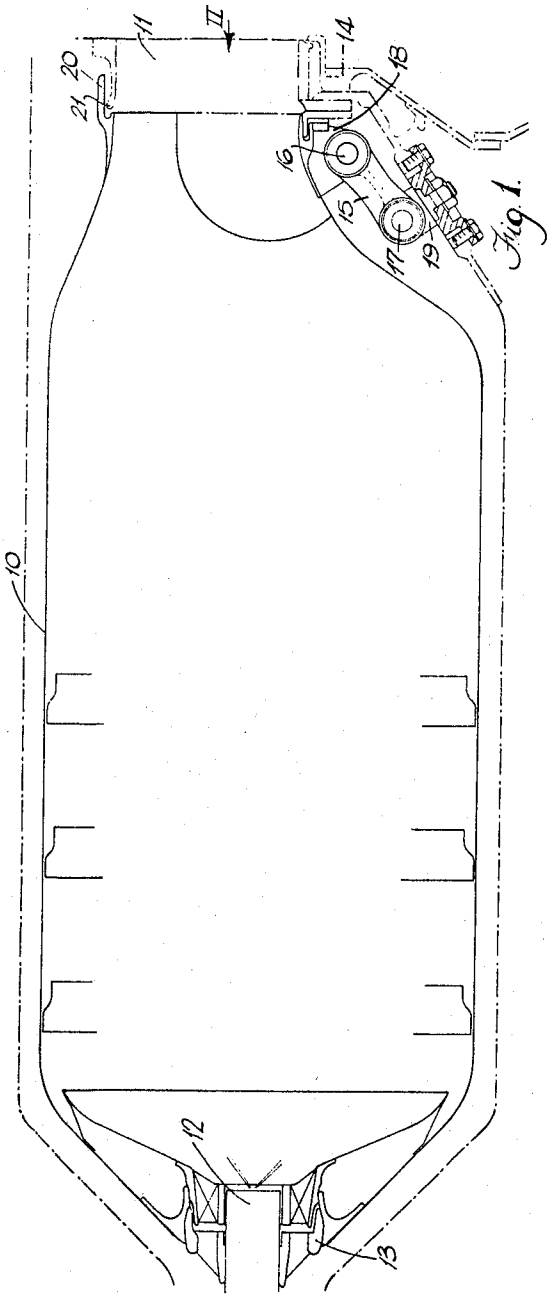


Fig. 1.

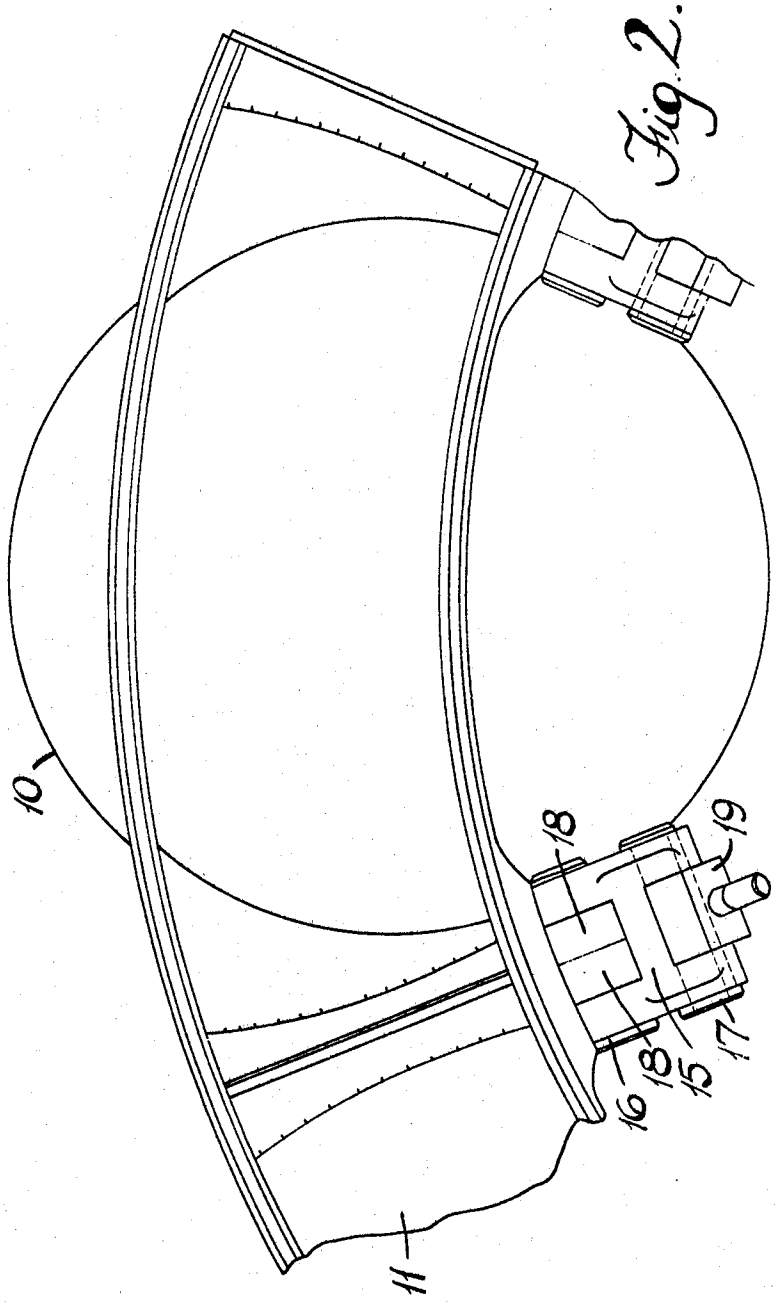
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Fig. 2.



COMBUSTION APPARATUS FOR GAS TURBINE ENGINES

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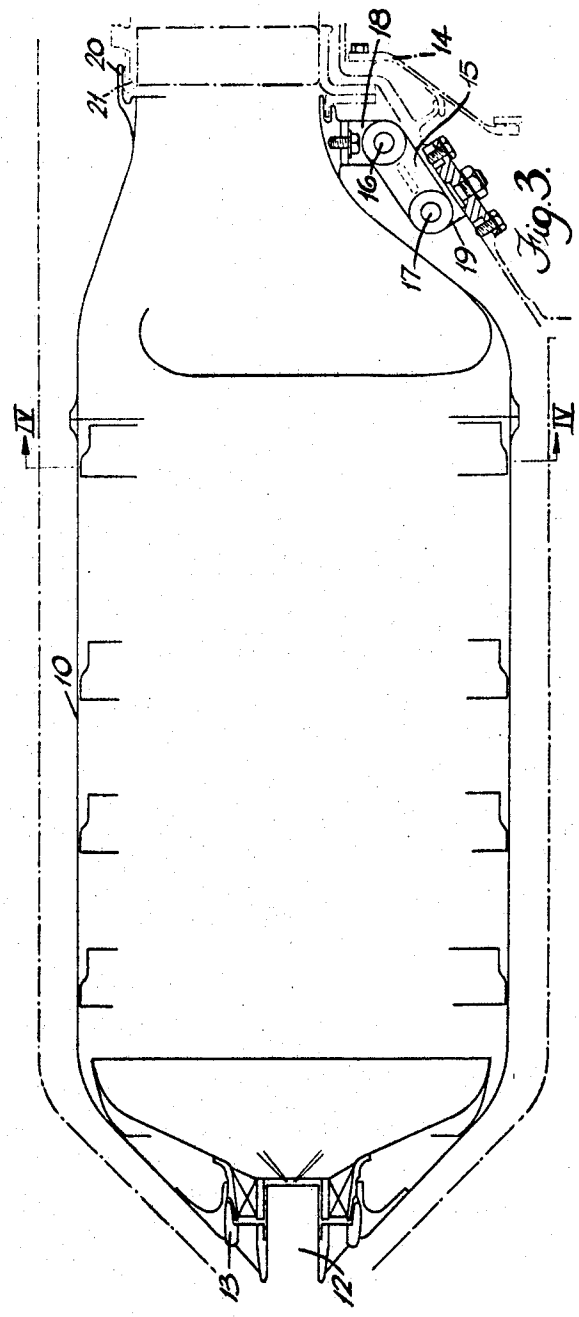


Fig. 3.

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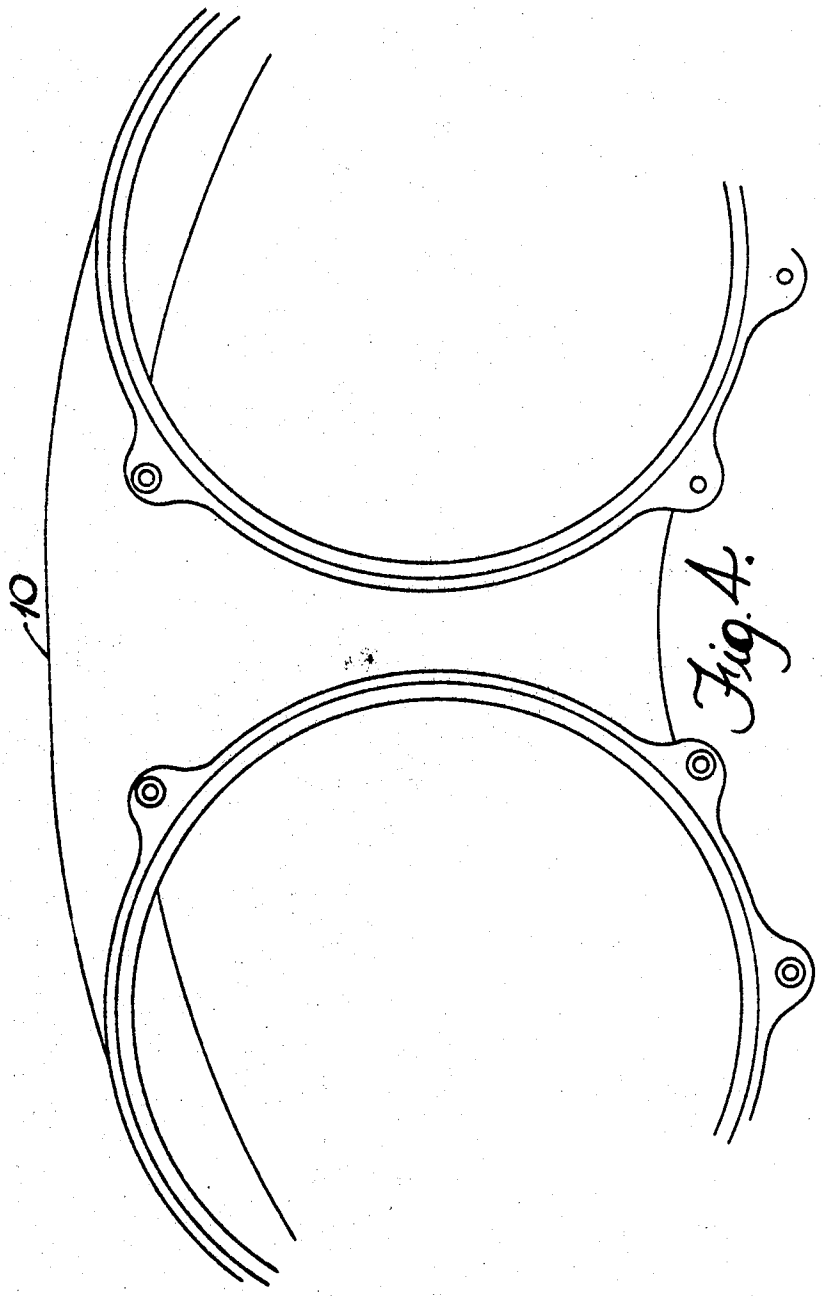


Fig. 4.

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3,481,146

COMBUSTION APPARATUS FOR GAS TURBINE ENGINES

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U.S. Cl. 60—39.32 1 Claim

ABSTRACT OF THE DISCLOSURE

Combustion apparatus for gas turbine engines comprises a plurality of flame tubes spaced angularly about the engine axis, each flame tube, at its upstream end being mounted for sliding and pivotal movement, the downstream end being connected to supporting structure through a link connected with its axes generally tangential with respect to a circle the centre of which lies on the engine axis, the link being on the inner side of the flame tube and overlapping flanges on the flame tube and supporting structure.

This invention relates to combustion apparatus for gas turbine engines and of the kind comprising a plurality of flame tubes spaced angularly about the longitudinal centre line of the engine, to a first or upstream end of each of which air can be supplied from a compressor, means being provided for supplying liquid fuel to the flame tubes, and from the opposite or downstream end of the flame tubes the products of combustion can be discharged through a turbine.

The parts of the combustion apparatus are subjected, in use, to considerable temperature changes, and it has therefor been proposed to mount the flame tubes on supporting structures of the engine in such a way that stressing due to differentialy thermal expansion and contraction is minimised.

The object of this invention is to provide combustion apparatus, in a convenient form, which permits of some relative movement between the flame tubes and the supporting structure, to minimise stressing.

According to the present invention, in combustion apparatus of the kind specified, each flame tube is mounted on supporting structure of the engine, at its upstream end for sliding movement longitudinally of the flame tube as connected at one end of the flame tube, and its other end well as for limited pivotal movement of the flame tube about its upstream end, the downstream end being connected to the suporting structure through a link pivotally connected at one end to the flame tube, and its other end connected to the supporting structure, the axes of the pivotal connections being generally tangential with respect to a circle, the centre of which coincides with the engine centre line, said link being disposed at the inner side of the flame tube with respect to the engine centre line. and overlaping flanges on the flame tube and on the supporting structure respectively, at the downstream end, permitting relative movement of the flame tube and the supporting structure.

The invention will now be illustrated by way of example with reference to the accompaning drawings in which:

FIGURE 1 is a diagrammatic cross-sectional side elevation view taken on a radial plane of a gas turbine engine,

FIGURE 2 is a view on arrow II in FIGURE 1,

FIGURE 3 is a similar view to FIGURE 1 showing an alternative arrangement, and

FIGURE 4 is a cross-sectional view on the line IV—IV in FIGURE 3.

In the example shown in FIGURE 1 and 2, there is provided a gas turbine engine having a plurality of flame tubes disposed equi-angularly about the engine centre line, each flame tube, one of which is shown in FIGURE 1 and indicated by numeral **10**, is arranged to receive air at its upstream end, from a compressor (not shown) and arranged to discharge the products of combustion from its downstream end, through an annular discharge duct **11**, to a turbine (not shown).

Each flame tube is mounted on the engine, at its upstream end, by means of a liquid fuel burner nozzle **12** incorporating a part-spherical bearing **13** to permit of limited pivotal movement of the flame tube about its upstream end. The flame tube **10** is also slidable longitudinally relative to the burner nozzle **12**.

The downstream end of each flame tube is connected, at its inner side, with respect to the engine centre line, to supporting structure **14** of the engine, by a link **15** pivotally connected at one end to the flame tube **10** and at the other to the supporting structure **14**, the axes of the pins **16**, **17** forming the pivotal connections being generally tangentially with respect to a circle, the centre of which coincides with the engine centre line. Each link **15** is forked at both ends. One pair of forks receives a pair of lugs **18** fixed respectively to a pair of adjacent flame tubes, these parts being connected thereto by the pin **16**. The other pair of forks of the link **15** receives a lug **19** fixed to the supporting structure **14**. These are connected by the pin **17**. With this arrangement the link serves to secure together a pair of adjacent flame tubes **10**.

The flame tubes which are of circular cross-section are arranged to be connected to the annular discharge duct **11** and the downstream end of each flame tube **10** merges into the annular form at or near the junction with the discharge duct **11**. The adjacent flame tube wall portions join to form a portion which is concave as viewed in a radial plane with respect to the centre line of the engine and convex as viewed in a plane perpendicular to said radial plane. The junctions between the adjacent flame tubes, as well as the junctions between the flame tubes and the discharge duct, include overlapping flanges **20**, **21** which permit of relative movements, in response to differential expansion and contractions of the parts.

In a modified form of the invention shown in FIGURES 3 and 4, the downstream end portions of the flame tubes **10** are separate from the upstream end portions, these portions being bolted together, as shown in FIGURE 4. The downstream end portions serve as transitional portions from circular cross-section to segmental cross-section, merging into the annular shape of the discharge duct **11** in this downstream end portion.

With the arrangement of this invention, the flame tube downstream ends can move radially of the engine under the control of the links **15** and also to a limited extent, longitudinally, as radial movement occurs. The provision of the links afford hinge connections at the downstream ends of the flame tubes respectively. There is described and claimed in the complete specification of our co-pending British patent application No. 23,560/64, a further form of such a hinge connection.

Having thus described our invention what we claim as new and desire to secure by Letter Patent is:

1. Combination apparatus for a gas turbine engine comprising supporting structure for a plurality of flame tubes spaced angularly about a longitudinal center line of the engine, an inlet at the upstream end, and an outlet at the downstream end of each of the flame tubes respectively, liquid fuel delivery means to the upstream ends of the flame tubes respectively, each flame tube being

mounted on the supporting structure, at its upstream end to permit longitudinal sliding movement of the flame tube, as well as limited pivotal movement of the flame tube about its upstream end, the downstream end being connected to the supporting structure through a link pivotally connected at one end to the flame tube and at its other end to the supporting structure, the axes of the pivotal connection being generally tangential with respect to a circle, the center of which coincides with the engine center line, said link being disposed at the inner side of the flame tube with respect to the engine center line, and overlapping flanges on the flame tube and on the supporting structure respectively, at the downstream end, permitting relative movement of the flame tube and the supporting structure.

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