

March 29, 1966

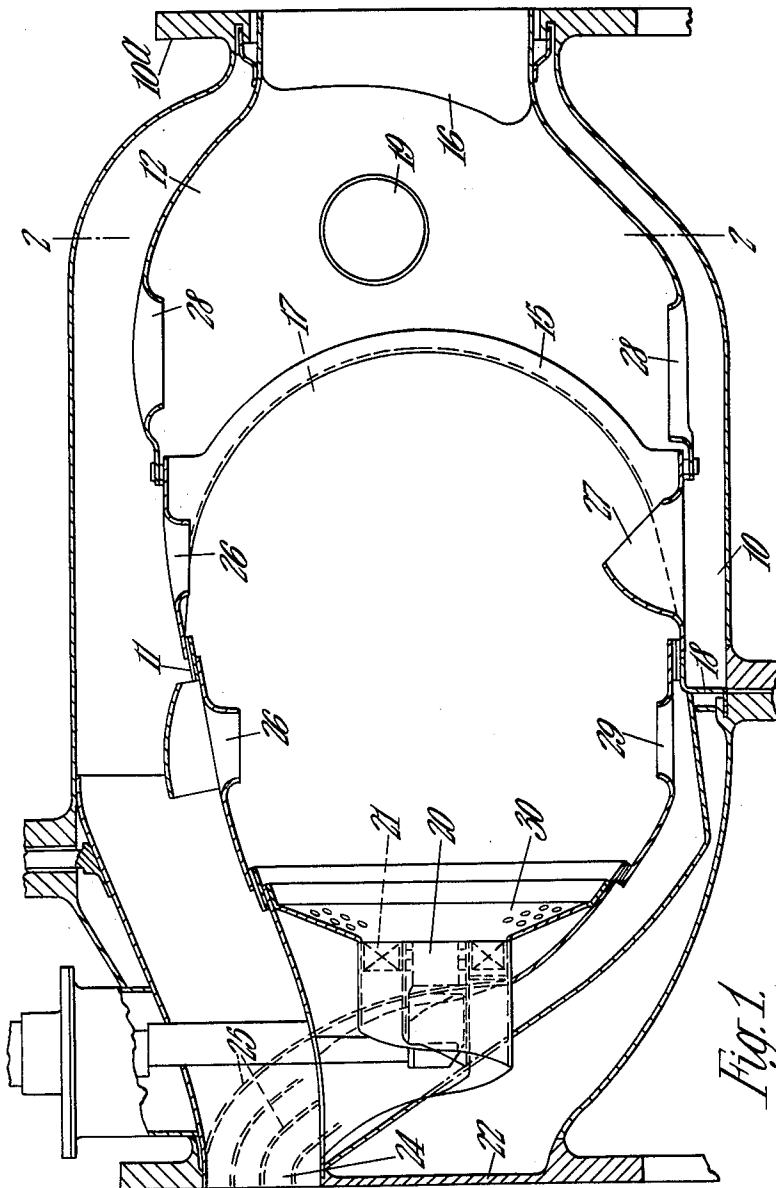
A. E. CLARKE ET AL

3,242,674

LIQUID FUEL COMBUSTION APPARATUS

Filed July 8, 1964

3 Sheets-Sheet 1



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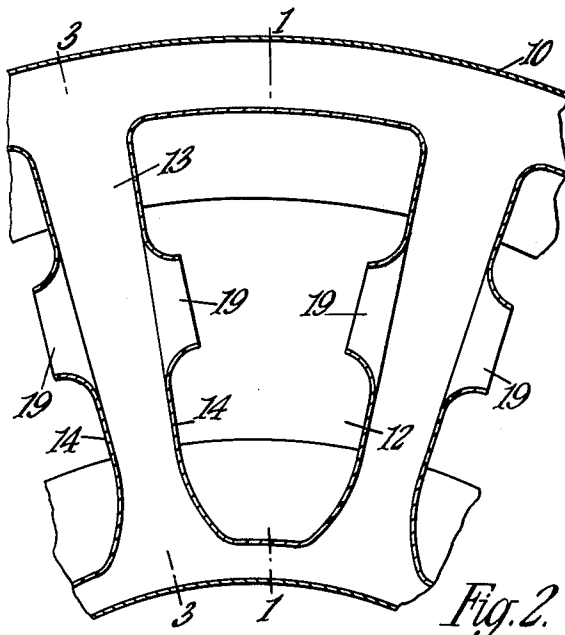
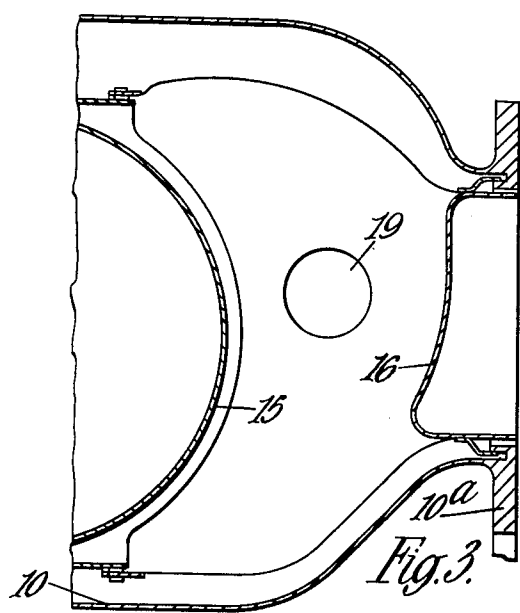
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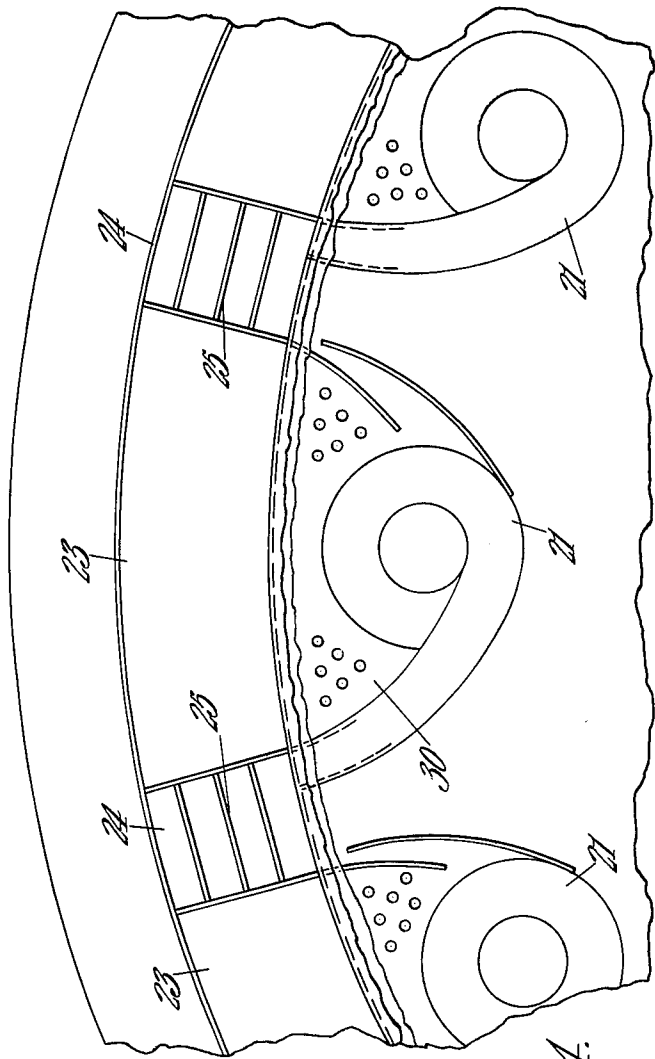


Fig. 4.

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LIQUID FUEL COMBUSTION APPARATUS
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ing, Clitheroe, England, assignors to Joseph Lucas
(Industries) Limited, Birmingham, England
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2 Claims. (Cl. 60—39.65)

This invention relates to liquid fuel combustion apparatus for gas turbines, and more particularly to the kind comprising an annular flame tube contained within an annular air jacket casing, with the upstream end of the air jacket being adapted to receive air from a compressor, and the downstream end of the flame tube being arranged to discharge the products of combustion to a turbine.

The object of the invention is to provide such apparatus in a convenient form.

According to the invention in apparatus of the kind specified a dilution zone in the downstream end portion of the flame tube is divided into a plurality of angularly spaced outlet ducts by a plurality of hollow partitions through which air can flow from the outer annular space within the air jacket to the annular space within the air jacket on the inner side of the flame tube, with the partitions having formed therein apertures through which dilution air can enter the flame tube in a substantially circumferential direction relative to the engine as a whole.

An example of the invention is illustrated in the accompanying drawings in which—

FIGURE 1 is a view in longitudinal section through part of the apparatus, the section being taken on the line 1—1 of FIGURE 2,

FIGURE 2 is a sectional view taken along the line 2—2 of FIGURE 1,

FIGURE 3 is a section on the line 3—3 of FIGURE 2 and

FIGURE 4 is an end view of FIGURE 1 with parts broken away.

In an example of the invention there is provided an annular air jacket casing 10 which at its upstream end is adapted to receive air from a compressor and at its downstream end is adapted for connection to a turbine housing. Within the air jacket is an annular flame tube 11 which is mounted in spaced relationship except at its downstream end where it has a slidable connection with a flanged part 10^a of the air jacket.

The dilution zone at the downstream end portion of the flame tube 11 is divided into a plurality of equi-angularly spaced outlet ducts 12 by a plurality of hollow partitions 13 the interiors of which are in communication with both inner and outer annular spaces defined within the air jacket 10. Each partition comprises a pair of side walls 14 which extend substantially radially relative to the axis of the engine, an upstream wall 15 of arcuate cross-section, which is concave as viewed in longitudinal cross-section of the engine, as in FIGURE 1, and which is convex as viewed in cross-section in a plane perpendicular to that of FIGURE 1, and a downstream wall 16 closing the downstream end of the partition. The combustion zone 17 of the flame tube when viewed in axial cross-section immediately upstream of a partition is of substantially circular form. Moreover, the annular space between the inner wall of the air jacket 10 and the flame tube 11 is closed by an annular baffle 18 at a point

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approximately half-way along the combustion zone 17 of the flame tube.

In the pair of side walls 14 of each partition are formed outwardly directed dilution air inlets 19 and dilution air is directed from the compressor by means to be referred to into the outer annular space within the air jacket from whence it can flow through the partitions to the downstream portion of the inner annular space within the air jacket. On its way some of the dilution air will enter the outlet ducts 12 through the dilution air inlets 19 in the side walls in a generally circumferential direction relative to the engine as a whole.

At the upstream end of the flame tube are a plurality of equi-angularly spaced liquid fuel burners 20 which are situated respectively at the center of an equal number of volute swirlers 21.

The upstream end of the air jacket is blanked off by a wall 22 except for an annular air inlet 23 disposed radially outside the circle on which the burner axes are disposed. In the air inlet are disposed a plurality of equi-angularly spaced air ducts 24 equal in number to the number of swirlers. Air entering the inlet 23 between the ducts 24 is directed into the outer annular space within the air jacket to serve as secondary and dilution air.

The secondary air from this annular space enters the flame tube through inlets 26, and a further inlet 27 after passing through the partitions. The dilution air in addition to flowing through inlets 19 flows through inlets 28 in the inner and outer walls of the ducts 12.

Air entering each duct 24 is directed radially inwards by vanes 25 and is divided into three streams. One stream is directed to the swirler 21 to serve as primary air, and the second stream is directed to an annular space in the air jacket at the upstream side of the baffle 18 from whence it can enter the combustion zone 17 of the flame tube through a plurality of inwardly directed secondary air inlets 29 in the inner wall of the flame tube. The third stream is directed through small holes in a flare 30 as additional primary air.

By a construction as above described, for a given power, the length of the flame tube 11 can be shorter than with normal engines thereby enabling the overall length of the engine to be reduced.

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

1. A liquid fuel combustion apparatus for gas turbines, comprising an air jacket casing having upstream and downstream ends with the upstream end being adapted to receive air from a compressor and the downstream end for connection to a turbine housing, an annular flame tube mounted within the air jacket casing in spaced relationship thereto for providing an annular space between the outside of the tube and the inside of the air jacket casing, said flame tube having upstream and downstream end portions with said downstream end portion being provided with a dilution zone, said dilution zone being constituted by a plurality of equi-angularly spaced hollow partitions dividing said downstream end portion between adjacent partitions into outlet ducts, each of said hollow partitions including a pair of side walls, a downstream wall and an upstream wall with air being capable of flow through the partitions from the outer annular space within the air jacket casing to the annular space within the air jacket casing on the inner side of the flame tube, each of said upstream walls being concave as viewed in

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longitudinal cross-section of the apparatus and convex as viewed in cross-section in a plane perpendicular to the longitudinal axis of the apparatus, and said partitions having apertures therein through which dilution air can enter the flame tube in a substantially circumferential direction relative to the apparatus as an entity.

2. The liquid fuel combustion apparatus as claimed in claim 1 in which the side walls of each partition extend approximately radially to the axis of the apparatus and the area of the flame tube immediately upstream of the upstream wall of each partition which constitutes the

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combustion zone of the tube is of substantially circular form when viewed in axial cross-section.

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