June 18, 1957 J. T. PURVIS ET AL 2,795,930

JOINT CONSTRUCTION FOR COMBUSTION CHAMBER CASINGS

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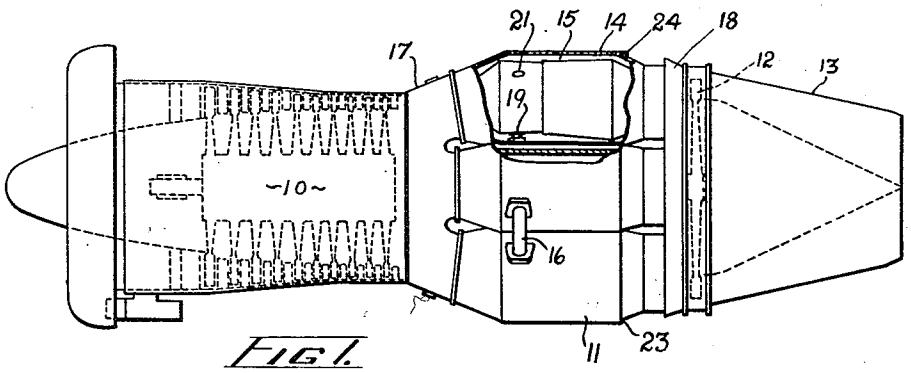

FIG 1.

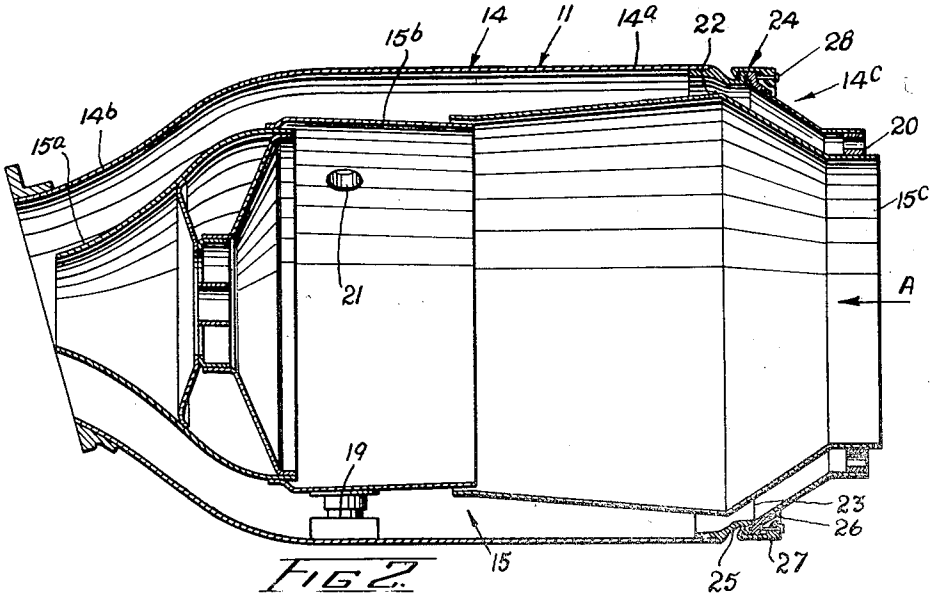

FIG 2.

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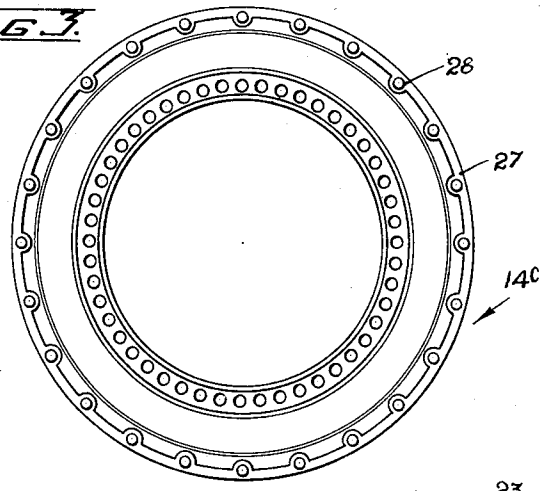
FIG 3.



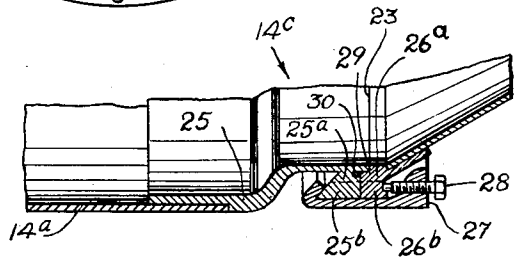
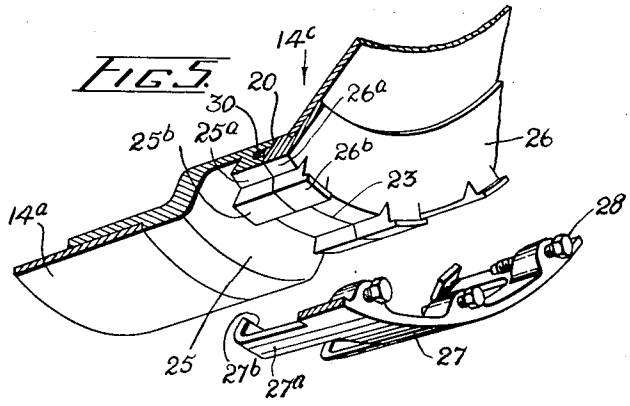


FIG 4.

FIG 5.



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JOINT CONSTRUCTION FOR COMBUSTION CHAMBER CASINGS

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4 Claims. (Cl. 60—39.31)

This invention relates to the combustion chambers of gas turbine engines and particularly to the construction of the casings thereof.

A common form of combustion system of a gas turbine engine comprises a group of tubular combustion chambers arranged annularly around and parallel to the longitudinal axis of the engine. Each combustion chamber contains a flame tube situated coaxially and in spaced relationship to the casing of the chamber, the purpose of the flame tube being to contain the burning gases while a layer of insulating and cooling air flows in the annular space between the flame tube and the casing. A combustion chamber casing commonly has a substantially cylindrical central portion and terminal portions tapering at the forward end to the attachment of the chamber to the diffuser casing of the engine, and at the rearward end to the attachment of the casing to the turbine nozzle box. Since the diameters of the combustion chamber at its attachment to the diffuser casing and at its attachment to the nozzle box are each materially less than the maximum diameter of the flame tube, it is necessary to incorporate a joint in the combustion chamber casing so that the flame tube may be inserted therein.

The overall diameter of the engine is usually determined by the overall diameter of the combustion system and it is desirable that adjacent combustion chambers should be mounted as closely to each other as possible, particularly in the application of the engine to aircraft. For this reason any avoidable excrescences on the perimeters of the combustion chambers should be eliminated so that for a given diameter of each combustion chamber, the overall diameter of the combustion system may be held to a minimum.

It is the object of this invention to provide a combustion chamber casing incorporating a joint which will furnish an opening sufficiently large to enable the flame tube to be inserted, and characterized by the absence of undesirable excrescences on the outside of the casing. Other objects and advantages will be apparent from the following description.

In the attached drawings forming a part of this application and in which like reference characters designate like parts throughout the same,

Fig. 1 is a side elevation of a gas turbine engine partially cut away to show a combustion chamber casing and a flame tube installation;

Fig. 2 is a longitudinal section of a combustion chamber taken on an axial plane of the engine;

Fig. 3 is an end elevation of a combustion chamber viewed in the direction of the arrow A in Fig. 2;

Fig. 4 is a fragmentary cross-sectional view of the joint in the combustion chamber which is the subject of this invention; and

Fig. 5 is a fragmentary perspective view of the joint, showing the clamp ring immediately prior to interdigitation with the castellations on the flange rings of the joint.

The engine shown in Fig. 1 includes a compressor **10** and a combustion system comprising six annularly arranged combustion chambers **11** which discharge into a turbine **12**; the exhaust gases from the turbine issue as a propulsive jet from a tail cone **13**. Each combustion chamber has a casing **14** and a flame tube **15** situated within the casing in spaced relationship thereto. The flame tubes are interconnected by interconnector tubes **16**.

The casing **14** comprises a cylindrical central portion **14a**, an integral upstream terminal portion **14b** providing an inlet end and tapering to the attachment of the casing **14** to a diffuser **17**, and a downstream terminal portion **14c** and providing an outlet end and tapering to the attachment of the casing **14** to a nozzle box **18**. The flame tube **15** is mounted within the casing **14**, in spaced relationship thereto, by three supports **19** (of which only one is shown in Fig. 2) adjacent the upstream end of the flame tube and by a spigot mounting **20** at the downstream end where the chamber is attached to the nozzle box. Two of the supports **19** are superimposed upon the ports **21** and provide the attachments of the interconnector tubes **16**, whereby the flame tubes of adjacent chambers are interconnected through their respective ports **21**.

The flame tube is composed of a series of overlapping sections of progressively increasing diameter, including a substantially conical inlet section **15a**, a cylindrical intermediate section **15b**, and an outlet section **15c**. The diameter of the outlet section **15c** increases immediately downstream of the joint between this section and the preceding sections **15b**, attaining a maximum at the station indicated by reference numeral **22**, and thereafter decreases towards the spigot mounting **20**. Other details of the construction of the flame tube are not of significance to this invention which is primarily concerned with the maximum diameter of the flame tube at the station **22** and the construction of the casing to provide a means for installing the flame tube within the casing.

According to the invention a joint **23** is provided in the downstream terminal portion **14c** near the central cylindrical portion **14a** of the casing **14**, with a coupling assembly, generally indicated by the numeral **24**, for securing the resulting fixed and removable parts of the terminal portion **14c** together. A cross-section of the coupling assembly **24** is shown in Fig. 4 from which it will be seen that it comprises a flange ring **25** attached to the casing **14a** and providing a fixed part of the terminal portion **14c** and another flange ring **26** attached to and providing a continuation of the removable part of the terminal portion **14c**, the two rings being held in abutment by the clamp ring **27** and providing abutting annular flanges **25a** and **26a**. The inside diameter of the flange ring **25** is just sufficient to enable the flame tube, at its station **22**, to pass through it and the outer configuration of the coupling assembly is such that its overall outside diameter is not materially greater than the outside diameter of the cylindrical central portion **14a** of the casing. Because the flange ring **25** is of relatively thin material, like the rest of the casing, the annular width of the flanges **25a** and **26a** will be materially greater than the maximum thickness of the wall of the fixed part.

The fixed part of the terminal portion **14c**, formed by the flange ring **25**, is tapered toward its downstream end, for instance by being joggled inwardly as shown in the drawings, and thus its cross-sectional outer dimensions diminish downstream toward the joint to accommodate the added wall thickness at the joint within the outside diameter of the central portion **14a** of the casing. At its downstream end a group of equally spaced castellations **25b** are disposed around the periphery of the flange **25a** on the flange ring **25**. A second group of castellations **26b** adapted to register with the first group are similarly provided on the flange **26a**. In the assembled position the castellations **25b** and **26b** are clamped together in registering abutment by a cylindrical assembly of an-

nularly spaced J-section clamps 27^a provided by the clamp ring **27**. The circumferential width of the clamps, being less than the spaces between the castellations, and their spacing on the clamp ring are such that, during assembly, the clamps are interdigitated with the castellations and then brought to bear on the mating castellations by a small angular rotation of the clamp ring. Each clamp 27^a is provided with a hook portion 27^b which engages a castellation 25^b, and with a screw **28**, which engages the corresponding castellation 26^b and which, when tightened, clamps the castellations in mutual abutment.

An annular spigot **29** is provided on the flange 25^a to engage a corresponding annular recess in the flange 26^a to centralize the downstream terminal portion 14^c of the casing with the cylindrical portion 14^a and the joint is rendered gastight by the gasket **30** housed in an annular groove between the abutting joint surfaces of the two flanges 25^a and 26^a.

It will be understood that the clamps need not necessarily be incorporated as integral parts of a clamp ring and that the construction of the coupling assembly is not substantially altered by the use of individual clamps, which can be applied independently of one another. The essential feature of the coupling assembly is the situation of the actual mating surfaces of the flange rings downstream of the greatest diameter of the combustion chamber casing so that the annular thickness of the coupling assembly, including the clamp, is accommodated on the taper of the downstream terminal portion and substantially within the annulus defined by the outer diameter of the casing and the maximum diameter of the flame tube at station **22**. In some instances it may be possible to use a conventional bolted flange joint, in place of the coupling arrangement described, but normally the annular space available will not provide sufficient edge distance between the bolt holes and the periphery of the flange rings.

The construction herein shown and described is therefore to be taken as a preferred example of the application of the invention and various changes in the shape, size and arrangement of the parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

What we claim as our invention is:

1. In a gas turbine engine having a flame tube disposed within a combustion chamber, an open-ended tubular casing for the combustion chamber spaced from the flame tube and comprising a central casing part, terminal casing parts tapering generally from the central part to the ends of the casing, the cross-sectional inner dimensions of the open ends of the terminal casing portions being less than the maximum corresponding dimensions of the flame tube whereby the latter is prevented from passing through the said end openings, one of the terminal parts having a joint longitudinally spaced from the central casing part and providing a fixed part secured to the central part and a removable part, the cross-sectional outer and inner dimensions of the fixed part diminishing toward the joint, coupling means for removably securing together the said fixed and removable parts and projecting outwardly from the outside of the fixed part, the annular width of the coupling means being materially greater than the thickness of the walls of the fixed part, the cross-sectional dimensions of the casing at the said joint being greater than the maximum corresponding dimensions of the flame tube whereby the latter may be inserted in the casing when the said removable part is removed, and the cross-sectional outer dimensions of the coupling means being not substantially greater than the corresponding outer dimensions of the central casing part whereby the coupling means may be accommodated within a hypothetical longitudinal extension of the periphery of the central casing part.

2. The combination claimed in claim 1 in which the coupling means include outwardly extending flanges on each of the said two parts at the said joint providing clamp-receiving surfaces, and also include clamp means external of the casing and flanges, the clamp means engaging the said surfaces and removably securing together the said two parts.

3. The construction claimed in claim 2 in which each of the flanges has an annular joint surface facing the other flange and an outwardly extending element registering with that on the other flange, one of the said flanges having a spigot extending from the joint surface thereof and the other of said flanges having a recess in its joint surface thereof, and the said clamp means include a clamp embracing the said element to secure the said two parts together with the joint surfaces in sealing contact and the spigot extending into the said recess, the taper of the said fixed part providing a reduction in diameter of the casing between the central casing part and the said joint to accommodate the annular thickness of the said flanges and clamp, the maximum cross-sectional dimensions of the said flanges and clamp being not substantially greater than the outer diameter of the central casing part.

4. A combination as claim in claim 2 in which each of the flanges has a series of outwardly extending spaced-apart castellations registering with those on the other flange, and in which the clamp means comprises a substantially cylindrical clamp ring having a series of spaced-apart clamps disposed around its circumference and encircling the casing adjacent the said joint, each of the clamps embracing a registering pair of the castellations to secure the said two parts together with the flanges in sealing contact.

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