July 14, 1953 W. M. McDONALD 2,645,081

SPACING MEANS FOR THE WALL SECTIONS OF FLAME TUBES

Filed Aug. 19, 1949 2 Sheets-Sheet 1

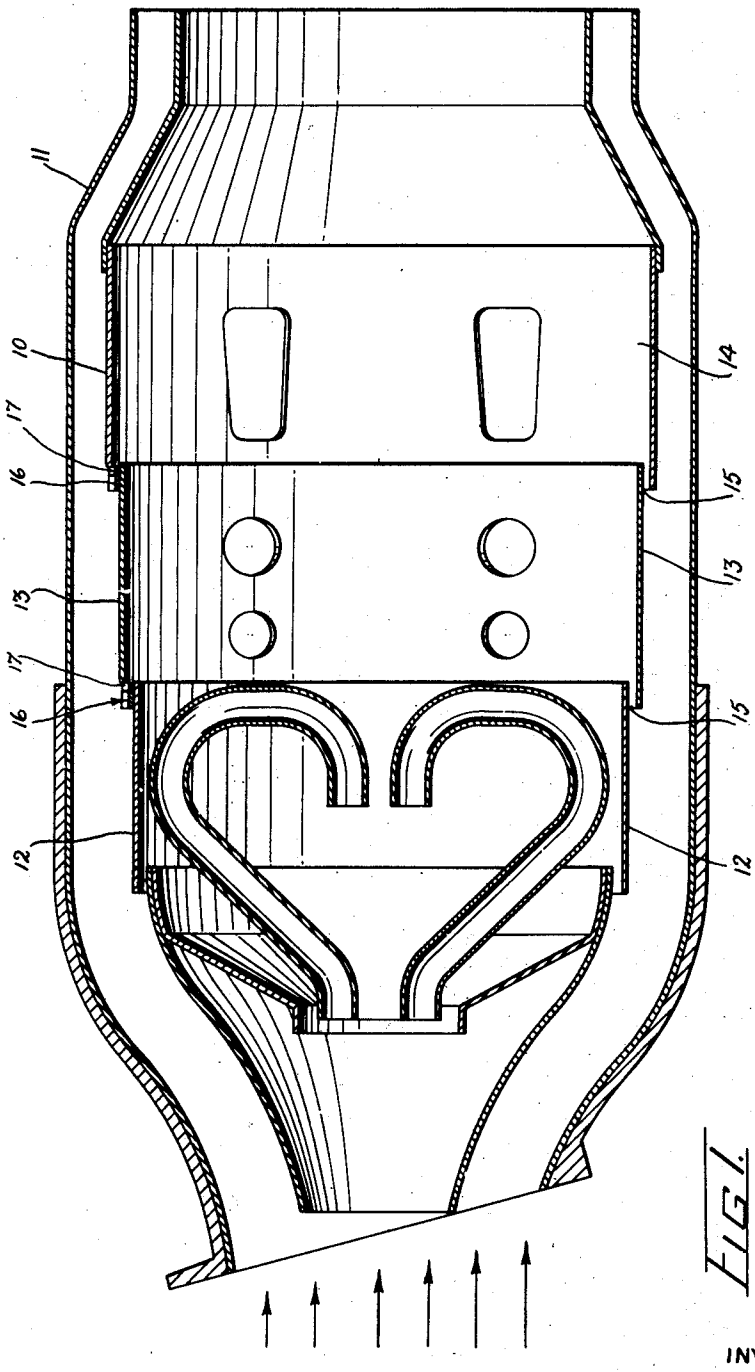


FIG. 1.

INVENTOR
WILLIAM M. McDONALD.
By
Granth E. Mayhew
ATTORNEY

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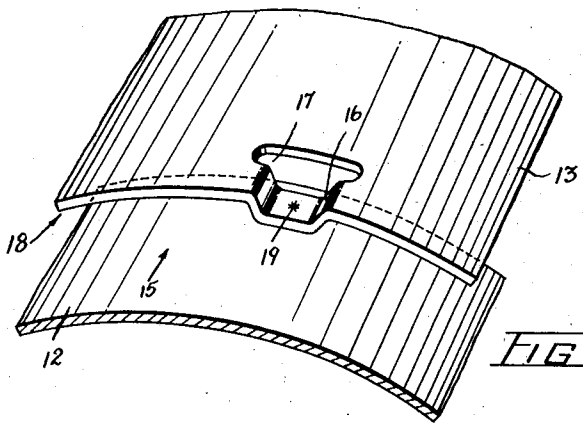


FIG 2.

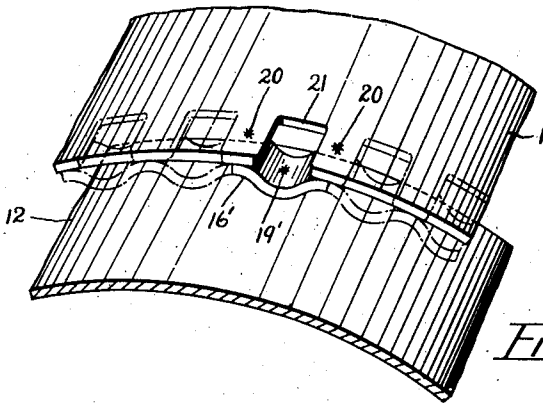


FIG 3.

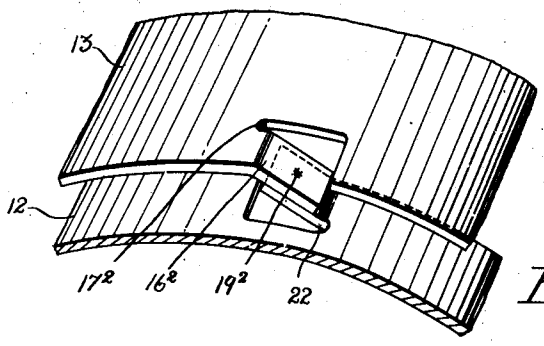


FIG 4.

INVENTOR
WILLIAM M. McDONALD.
By Gareth E. Myles
ATTORNEY.

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SPACING MEANS FOR THE WALL SECTIONS OF FLAME TUBES

William M. McDonald, Nobel, Ontario, Canada, assignor to A. V. Roe Canada Limited, Malton, Ontario, Canada, a corporation

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9 Claims. (Cl. 60—39.65)

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This invention relates to spacing means for the wall sections of flame tubes more particularly for use in gas turbine engines.

The development of gas turbines has necessitated the development of combustion chambers with means to cool the walls and thereby limit the distortion or damage that might result from the intense heat generated within the chambers. To this end it is customary to contain the combustion within a flame tube situated, in spaced relationship, inside the outer casing of the combustion chamber; and to cool the walls of the said flame tube by a stream of air through the annular space between the flame tube and the casing, and by a film of air, introduced to flow internally over the walls of the flame tube, thereby affording some degree of insulation from the heat of combustion.

A well known form of flame tube construction consists of a plurality of circular or annular sections arranged coaxially, the cross-sectional area of the upstream end of any section being substantially greater than the area of the downstream end of the section immediately preceding it. The ends of adjacent sections overlap and are held in correct radial relationship by spacing means in the annulus between the overlapping surfaces. Thus an annular film of air can be introduced, from the cooling air flowing outside the flame tube, to flow over the inner surface of each section.

One form of spacing means which has been employed consists of inwardly depressed portions of the edges of one of the sections where it overlaps the adjacent section, these inward depressions or dimples being of sufficient depth to bear upon the adjacent section. The disadvantage of this construction is that the depressions present obstructions to the flow of cooling air which, as described above, flows axially through the annular space between successive sections. Immediately downstream from each depression a small area of the wall is shielded from the stream of cooling air with the result that these areas overheat and may eventually fail.

Another form of spacing means consists of a circumferentially corrugated member which is interposed in the radial space between the ends of adjacent sections and, for purposes of attachment, overlapping each section by an amount greater than the overlap of the adjacent section. This construction has the advantage that it does not shield downstream portions of the annular surfaces from the effects of the cooling air, but it has the disadvantage that the spacing means

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introduces additional weight and increases the number of attachments necessary to complete the assembly.

The object of this invention is to provide a simplified form of construction of a spacing means for the wall sections of flame tubes which will not interfere with the effective cooling of the wall surfaces. Other objects and advantages of the invention will appear during the course of the following description.

In the accompanying drawings forming a part of this application and in which like numerals are employed to designate like parts throughout the same.

Fig. 1 represents a longitudinal section of a combustion chamber showing the overlapping relationship of adjacent wall sections of the flame tube;

Fig. 2 is a fragmentary perspective view of the spacing means shown in Fig. 1, on an enlarged scale;

Fig. 3 is a fragmentary section of an alternative form of spacing means; and

Fig. 4 is a fragmentary section of another alternative form of spacing means.

In the drawings a tube type combustion chamber is shown but it will be understood that this invention can be applied equally to the annular type of combustion chamber and that the general external shape of the chamber has no bearing upon use of the invention. Referring to Fig. 1 it will be seen that the flame tube 10 is mounted in the casing 11 and that the air, entering at the upstream end of the combustion chamber as illustrated by the arrows is free to flow through the annular space between these two components. The flame tube consists of a series of coaxial, substantially cylindrical sections, designated by the numerals 12, 13 and 14 and where adjacent sections overlap, the diameter of the upstream end of the downstream section is materially greater than the diameter of the downstream end of the upstream section, providing radial gaps 15 through which the cooling air is admitted to the inside surfaces of each section. The radial gaps are maintained by spacers 16 which hold the adjacent sections in spaced relationship to one another.

Fig. 2 shows a typical spacer, in this case between the sections 12 and 13. A circumferentially directed slot 17 with smooth rounded ends is cut through the wall of section 13 at a suitable distance from the circumferential edge 18 at the end of the section 13 which overlaps the wall of the smaller preceding section 12. The strip of

metal thus formed in the peripheral extent of the wall between the slot 17 and the circumferential edge 18 is inwardly depressed to form a substantially U-shaped spacer 16 making firm face to face contact with the wall of section 12. It will be observed that the spacer is continuous with the metal of the section from which it is formed only in a direction substantially perpendicular to the local air flow.

By means of a plurality of spacers in proximity to the circumferential edge 18 of the section 13, the end of the smaller section 12 is held in proper radial and axial relationship to the larger section 13. The area of metallic contact between the spacer 16 and the smaller section 12 may be joined by welding, riveting or other attaching means, indicated by the numeral 19.

From the foregoing description, the functioning of my improved construction will be readily apparent. The cooling air entering the radial gaps 15 is not impeded by the spacer because air flows freely around the spacer 16 and in doing so, it provides adequate cooling for the inner surface of the wall immediately downstream from the spacers. An important feature of the invention is that the spacer 16 is of the same thickness as the wall of the section from which it is formed and its major surfaces are substantially parallel to the longitudinal axis of the end portions of the wall sections and one of its edges faces the flow of air through the space between the sections. The spacer therefore offers little resistance to the flow of air around it. Another important feature of the invention is the accessibility of the spacer for its attachment to the smaller section and this accessibility is achieved by the opening in the overlapping end of the larger section 13 which is formed by depressing the wall or the section to form the spacer.

This point is emphasized by the type of spacer shown in Fig. 3. In this case the spacer 16' is a separate part (it may even take the form of a circumferentially corrugated annular member as indicated by the dotted lines on Fig. 3) which is attached to the section 13 by the attaching means 20, 20 before the sections 12 and 13 are assembled. The notches 21 in the section 13 form openings which give access to the attaching means 19' whereby the spacer is fastened to the section 12. The thickness of the spacer will be substantially the same as the thickness of the material of which the sections are made, and in any event materially less than the width of the space between the overlapping sections so as not to substantially impede the flow of air.

The arrangement described in the preceding paragraph is not very satisfactory since it introduces an additional part. However another form of spacer is shown in Fig. 4 in which the spacer 16^2 is made of two tongues, one formed by cutting an L-shaped slot 17^2 in the edge of section 13 and depressing the tongue so formed and the other by cutting an L-shaped slot 22 in the edge of section 12 and bending the tongue up to meet the tongue on section 13, and securing the tongues together at 19^2. The bending of the tongue in section 13 in effect provides the opening in the wall of the section necessary to give access to the attaching means 19^2.

Reference has been made to the openings formed about the periphery of the end portion of one of the wall sections by depressing the material in one of the sections, as illustrated in Figure 2, by cutting notches in one of the sections as illustrated in Figure 3, or by partly cutting and partly depressing the material as illustrated in Figure 4. It will be noted that in each case the spacers are secured (by being made integral or otherwise) to one or both of the sides of the openings which extend substantially longitudinally of the flame tube.

It will be further understood that whereas in the cases I have described as shown in Figs. 2 and 3, the spacers have been assumed as an integral part of, or as initially attached to the wall of the larger section 13, depressed inwardly towards the smaller section 12, they might be integral with or initially attached to the wall of the smaller section 12 and depressed outwardly towards the larger section 13. In fact in one installation it might be convenient to have spacers carried on both the inner and outer walls either spaced alternatively or coinciding with one another as they do in the case shown in Fig. 4.

It will also be observed that it is not necessary that the spacer be located at the extreme edge of the section. In Fig. 2 for instance the edge of section 13 forms one edge of the spacer 16 and the slot 17 the other edge. However, the spacer could be formed by cutting two slots and depressing the material between them.

Moreover, it is not intended that the application of this invention should be confined to flame tubes of circular cross-section and, although the slots 17 and 17^2 have been described herein as circumferentially directed and arranged, the use of such words as "circumferential" and "circumferentially" has been dictated by the fact that the flame tubes described are substantially circular and have circumferences. More broadly, to include the application of the invention to flame tubes of both circular and non-circular cross-section, it might be said that the slots are directed or arranged "perimetrically," since a circumference is a particular form of perimeter, and this broader term has been used in the subjoined claims.

It will be understood that various changes in the shape, size and arrangement of the parts, and the application of the invention to either tubular or annular combustion chambers, may be resorted to without departing from the scope of the claims.

What I claim as my invention is:

1. A flame tube, having in combination a first wall section, a second wall section having an end portion overlapping and spaced from an end portion of the first wall section to provide a space between the said end portions through which air can flow, said end portions having a common longitudinal axis, at least one of the said end portions having a plurality of laterally spaced-apart openings formed about its periphery, and having sides extending substantially longitudinally of the flame tube, and spacers formed of sheet material of a thickness substantially less than the width of the space between the overlapping sections and extending between the said end portions with their major surfaces substantially parallel to the longitudinal axis of said end portions and with one edge of each spacer facing the flow of air through said space whereby the flow of air is substantially unimpeded; a spacer being secured to one of the wall sections having such openings, at one longitudinally extending side at least of each of the openings in that wall section and to the other wall section in face to face contact at a location lying adjacent said opening, the openings being of such substantial area that access to a spacer may be

gained through each opening to secure the spacer to the said other wall section.

2. A flame tube, having in combination a first wall section, a second wall section having an end portion overlapping and spaced from an end portion of the first wall section to provide a space between the said end portions through which air can flow, said end portions having a common longitudinal axis, at least one of the said end portions having a plurality of laterally spaced-apart and substantially rectangular openings formed about its periphery and having sides extending substantially longitudinally of the flame tube, and spacers formed of sheet material of a thickness substantially less than the width of the space between the overlapping sections and extending between the said end portions with their major surfaces substantially parallel to the longitudinal axis of said end portions and with one edge of each facing the flow of air through the said space whereby the flow of air is substantially unimpeded; a spacer being secured to one of the wall sections having such openings at one at least of the longitudinally extending sides of each of the openings in that wall section and to the other wall section in face to face contact at a location lying adjacent said openings, the openings being of such substantial area that access to a spacer may be gained through each opening to so secure the spacer to the said other wall section.

3. Spacing means for wall section of flame tubes as claimed in claim 1 in which the spacer is an integral depressed portion of one of the wall sections having such openings.

4. Spacing means for wall sections of flame tubes as claimed in claim 1 in which each spacer is a separate member secured to one of the wall sections having such opening respectively at both of the opposite sides of each opening.

5. Spacing means for wall section of flame tubes as claimed in claim 1 in which each spacer is a tongue integral with one of the wall sections having such opening and extending respectively from one side of each opening.

6. Spacer means for wall sections of flame tubes as claimed in claim 1 in which each spacer is a substantially U-shaped member secured to a wall section which has such openings, at opposite sides of the opening.

7. A flame tube, having in combination a first wall section, and a second wall section having an end portion overlapping and spaced from an end portion of the first wall section to provide a space between the said end portions through which air can flow, said end portions having a common longitudinal axis and, at least one of the said end portions having a plurality of laterally spaced-apart and laterally elongated slots formed therein at locations spaced from but adjacent to the edge of the said one of the said end portions, the peripheral extent of the said one of the said end portions lying between a slot and the edge being bent toward and secured to the other of the said end portions in face to face contact, to provide spacers, the major surfaces of which are substantially parallel to the longitudinal axis of said end portions.

8. A flame tube, having in combination a first wall section, and a second wall section having an end portion overlapping and spaced from an end portion of the first wall section to provide a space between the said end portions through which air can flow, said end portions having a common longitudinal axis and, the overlapping end portion having a plurality of laterally spaced-apart and laterally elongated slots formed therein at locations spaced from but adjacent to the edge of the said overlapping end portion, the peripheral extent of the said overlapping end portion lying between a slot and the edge being bent toward and secured to the overlapped end portion in face to face contact, to provide spacers, the major surfaces of which are substantially parallel to the longitudinal axis of said end portions.

9. A flame tube, having in combination a first wall section, a second wall section having an end portion overlapping and spaced from an end portion of the first wall section to provide a space between the end portion through which air can flow, at least one of the said end portions having a plurality of laterally spaced-apart notches cut inwardly from the edges of the said one of the said end portions and having two longitudinally extending sides; and a spacer secured to one of the wall sections having such notches, at at least one longitudinally extending side of each of the notches in that wall section and to the other wall section at a location lying within one of the notches in the said one of the wall sections, the notches being of such substantial area that access to the spacer may be gained through the notches to secure the spacer to the said other wall section.

WILLIAM M. McDONALD.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,996,977	Scheu	Apr. 9, 1935
2,446,059	Peterson et al.	July 27, 1948
2,448,561	Way	Sept. 7, 1948
2,537,033	Christensen	Jan. 9, 1951
2,555,965	Garber	June 5, 1951
2,581,999	Blatz	Jan. 8, 1952