April 21, 1970 K. BUTTER 3,507,449

ROCKET ENGINE COMBUSTION CHAMBER WALL CONSTRUCTION

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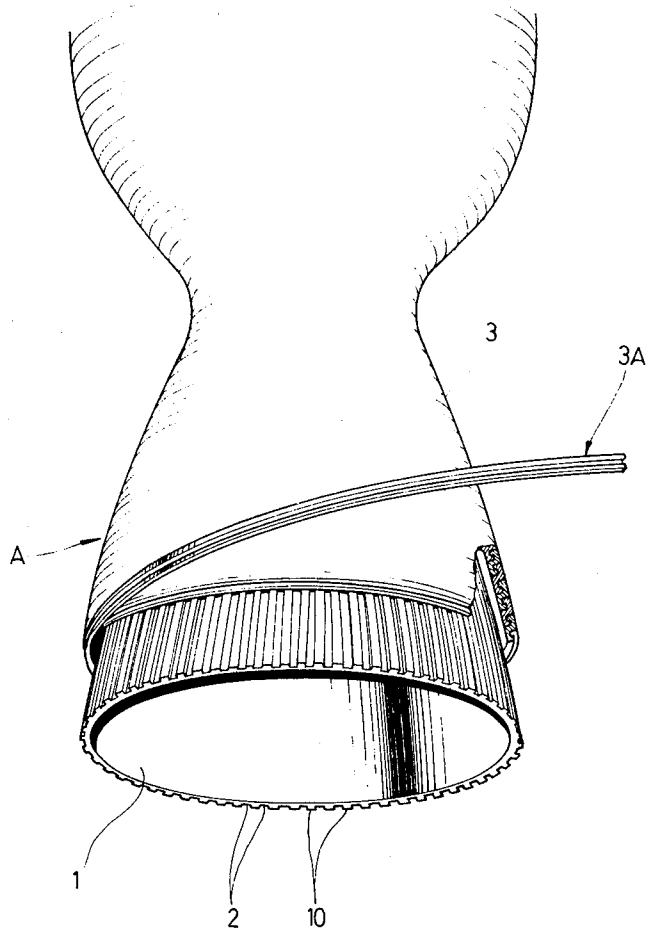
Fig.1



Inventor
KARL BUTTER
by McGlew and Toren
Attorneys

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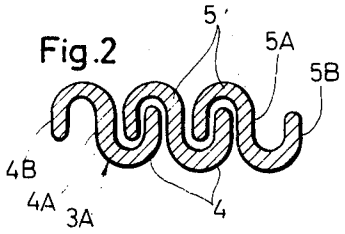
Fig.2



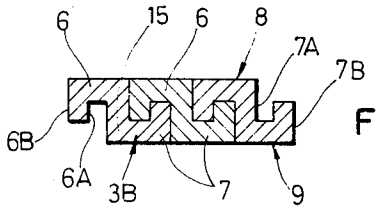


Fig.3

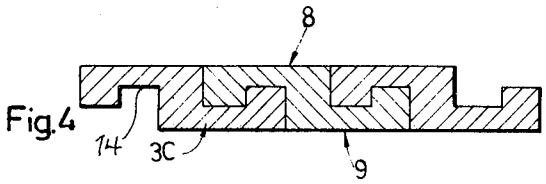


Fig.4

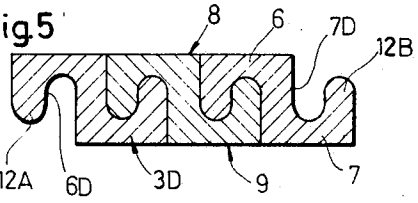


Fig.5

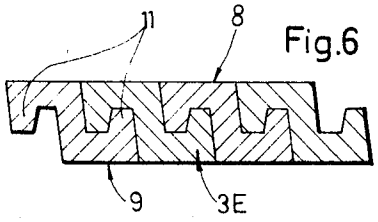


Fig.6

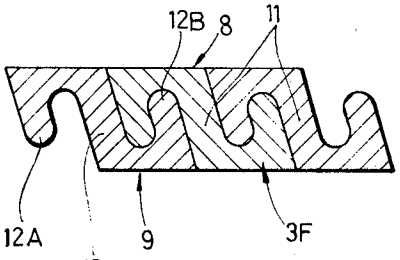


Fig.7

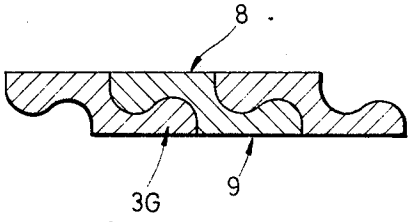


Fig.8

Inventor
KARL BUTTER

by McGlew and Toren
Attorneys

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ROCKET ENGINE COMBUSTION CHAMBER WALL CONSTRUCTION

Karl Butter, Munich, Germany, assignor to Bolkow Gesellschaft mit beschrankter Haftung, Ottobrunn, near Munich, Germany

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Int. Cl. B64d 33/04
U.S. Cl. 239—127.1 4 Claims

ABSTRACT OF THE DISCLOSURE

A casing for a rocket engine combustion chamber formed by an axially elongated tubular inner wall enclosed by and in surface contact with an outer wall. The inner wall has a number of channels in its outer surface which in combination with the inner surface of the outer wall form a plurality of cooling channels. The outer wall is formed by a strip of wire found continuously in a transverse direction around the inner wall with the longitudinal edges of the wire arranged in overlapping, interlocking relationship. In transverse cross section, the wire has U-shaped grooves into which the edge portions of the wire fit in interlocking engagement.

SUMMARY OF THE INVENTION

The present invention is directed to a wall construction for the casing of a rocket engine combustion chamber and, more particularly, it is concerned with a double walled casing. The inner wall of the casing has a plurality of cooling channels extending in the axial direction and the outer wall is formed by a wire continuously wound about the inner wall in surface contact with it and having the edges of adjacent coils of the wire arranged in overlapping interlocking engagement. The inner and outer walls of the casing and the adjacent coils of the wire forming the outer wall are integrally secured together.

Rocket engine combustion chambers have been known which employ a double wall casing with the outer surface of the inner wall of the casing furnished with longitudinally extending cooling channels. In such casings the outer surfaces of the channels have been closed by continuously winding a wire about the inner wall with the adjacent coils of the wire soldered together. In the past the wires used for this purpose have been strip or band-shaped with a rectangular or square cross section, for a typical arrangement see U.S. Patents 2,943,442 and 3,120,101. In these known embodiments the outer wall, formed by continuous coils of wire, is capable of withstanding high radial forces resulting from the thermal differences between the inner and outer walls and the high coolant pressures, however, it provides a problem in that it can only withstand low axial stresses across the soldered joints securing adjacent coils.

Accordingly, the present invention is directed to an arrangement of the outer wall of a combustion chamber casing capable of absorbing the high radial and axial stresses which develop in the operation of the rocket engine due to the substantially higher temperatures and greater elongation of the inner wall as compared to the outer wall. To withstand the high axial stresses the present invention utilizes a continuous strip of wire coiled transversely about the inner wall of the casing. The wire is formed with grooves and edge members extending along its length with the grooves and edge members of adjacent coils interlocking and positively securing the wire in the longitudinal direction of the casing.

In addition to providing a positive interlocking engagement between adjacent coils of the wire the additional surfaces formed by the cross sectional configuration of the wire afford increased strength in the integral attachment of adjacent coils of the wire.

Accordingly, the primary object of the present invention is to utilize a continuous strip of wire wound in overlapping interlocking relationship about the inner wall of a rocket engine combustion chamber to form an outer wall of increased strength in the axial direction.

Another object of the invention is to increase the area of surface contact between adjacent coils of wire and thereby augment the strength of the integral attachment between the coils.

Moreover, another object of the invention is to afford an improved cross sectional configuration of the wire forming the outer wall of the casing.

Therefore, the preseint invention is directed to a casing for a rocket engine combustion chamber comprising an axially elongated tubular inner wall and an outer wall having at least a portion of its surface in contact with the inner wall. The outer surface of the inner wall has a plurality of longitudinally extending grooves, which combine with the inner surface of the outer wall to form a plurality of axially extending cooling channels. The outer wall is composed of a continuous strip of wire wound transversely around the inner wall and adjacent coils of the wire are disposed in overlapping interlocking engagement to afford increased strength in the axial direction of the casing. Further, the adjacent coils are integrally secured together affording additional strength in the axial direction.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view, partly in section, of the casing for a rocket engine combustion chamber showing the formation of the outer wall of the casing, and

FIGS. 2 to 8 illustrate a plurality of configurations of wire utilized in forming the outer wall of the casing shown in FIG. 1.

DESCRIPTION OF THE INVENTION

In FIG. 1 a casing A for a rocket engine combustion chamber is shown formed by a tubular shaped axially elongated inner wall enclosed by and in surface contact with an outer wall 3. Axially extending grooves 2 are disposed along the outer surface of the inner wall 1. The outer wall 3 of the casing A is formed by continuously winding a strip of wire 3A about and in contact with the outer surface of the inner wall 1. The strip of wire has a configuration whereby the edges of adjacent coils of the wire are arranged in overlapping interlocking relationship so that the outer wall is provided with increased strength in the axial direction of the casing. It is possible to shape the wire forming the outer wall 3 in a number of different forms to achieve the interlocking relationship shown in FIG. 1.

In FIG. 2 the wire 3A has a reverse curve configuration, that is, it has an S-shaped form. The downwardly facing surface 4 of the wire has a groove 4A and its upwardly facing surface 5 has an oppositely disposed groove

5A. The left-hand edge 4B of the strip faces downwardly and the right-hand edge 5B faces upwardly. As the strip 3A is wound the edge 4B fits in interlocking overlapping engagement into the upwardly facing groove 5A of the adjacent coil and its other edge 5B fits into the downwardly directed groove 4A on the opposite adjacent coil of wire.

In the various wire shapes shown in FIGS. 3 to 8 the upper surface 8 and the lower surface 9 is smooth or as can be seen if FIG. 1 lies in a continuous curved plane.

The wire 3B shown in FIG. 3 is a rectilinear version of the S-shaped arrangement illustrated in FIG. 2. The wire 3B comprises a pair of right angled U-shaped members 6 and 7 joined by a common leg 15. The left hand member 6 has a groove 6A facing downwardly and a downwardly directed edge member 6B, similarly the right-hand member 7 has an upwardly directed groove 7A and an upwardly extending edge member 7B. When wound in overlapping engagement the member 6B fits into the groove 7A along the edge of the adjacent coil and the upwardly directed member 7B fits into the downwardly directed groove 6A of the coil along the other edge of the wire 3B.

In FIG. 4 the arrangement of the wire 3C is similar to that shown in FIG. 3, however, the width of the wire and the corresponding widths of the grooves and the edge members is increased. As the width of the wire strip is increased the number of turns or coils required to enclose the inner wall is reduced.

In the arrangements shown in FIG. 5 the wire 3D has a shape which combines features of both of the wires 3A and 3B. The end members 12A, 12B of the strip 3D have round surfaces as do the downwardly and upwardly directed grooves 6D, 7D. Because the rounded surfaces of adjacent coils of the wire 3D engage one another in overlapping relationship a slight sliding or a low-resistance slipping will develop between adacent coils. The surface of the end members which fit into the grooves can be "oblong" or, as is shown in the wire 3G of FIG. 8, it may be given a larger radius to improve the winding conditions and, in addition, to reduce the winding time by reducing the number of turns required.

Another arrangement is shown in FIG. 6 wherein the end members 11 of the wire strip 3E and their corresponding grooves have a trapezoidal shape.

To increase the strength of the interlocking engagement between adjacent coils of wire 3F, in FIG. 7, the edge members 12A and 12B and the common intermediate member 13 are angularly disposed with regard to the inner and outer surfaces 8, 9. This shape provides an improved hooking of the interlocking portions of the wire so that a joint of increased strength is attained.

The individual coils of wire forming the outer wall 3 can be integrally attached to each other in any of a number of known ways, such as, by cementing, soldering or welding. The joining of the individual coils of wire can be achieved by applying solder or some other binding material to the contacting surfaces of the wire strip before it is wound about the inner wall casing. After the casing A is completed it can be inserted into a furnace for soldering the contacting surfaces of the wire strip together. Further it is also possible to insert solder or other binding material between the contacting faces of the wire strip, for example a joining material could be inserted between the individual contact faces of the S-shaped wire strip 3A shown in FIG. 2. It will be appreciated that in the other wire strip configurations shown in FIGS. 3 to 8 the soldering material could be placed between the contacting surfaces of adjacent coils of the wire strip.

While the outer wall of the casing A forming the combustion chamber is illustrated as a single wall it should be understood that several layers of wire could be used if necessary and different materials could be employed for the various layers.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A casing for a rocket engine combustion chamber comprising an axially elongated tubular shaped inner wall and an outer wall having a portion of its inner surface in contact with said inner wall, said outer wall formed of a continuous strip of wire wound transversely around said inner wall and having adjacent coils thereof disposed in overlapping interlocking engagement, said wire having an inner surface, an outer surface and a pair of edge surfaces disposed angularly to the inner and outer surfaces, a longitudinally extending inwardly facing groove is formed in the inner surface of said wire, a longitudinally extending outwardly facing groove is formed in the outer surface of said wire and is spaced laterally from said inwardly facing groove, said wire comprises an inwardly projecting member an outwardly projecting member and a common intermediate member positioned between said inwardly projecting member and said outwardly projecting member, said inwardly projecting member extends longitudinally along one side of said wire adjacent said inwardly facing groove, said inwardly projecting member having a pair of parallel longitudinally extending side surfaces with one of said side surfaces forming one said edge surface of said wire and the other said side surface forming the laterally outer side surface of said inwardly facing groove, said outwardly projecting member extends longitudinally along the other side of said wire adjacent said outwardly facing groove, said outwardly projecting member having a pair of parallel longitudinally extending side surfaces with one of said side surfaces forming the other said edge surface of said wire and the other said side surface thereof forming the laterally outer side surface of said outwardly facing groove, said common intermediate member extends longitudinally of said wire and connects said inner surface and said outer surface of said wire, said intermediate member is disposed between and spaces said inwardly facing groove and said outwardly facing groove apart, one side surface of said intermediate member forming the laterally inner side surface of said inwardly facing groove and the other side surface of said intermediate member forming the laterally inner side surface of said outwardly facing groove, said inner and outer surfaces of said wire in the direction perpendicular to the longitudinal axis of said wire being rectilinear, and in a plane arranged perpendicularly to the longitudinal axis of said wire the side surfaces of said inwardly projecting member said outwardly projecting member and said intermediate member being arranged in parallel relationship and being disposed at an oblique angle to said inner and outer surfaces of said wire, the base of each of said inwardly and outwardly facing grooves and the end of each of said inwardly and outwardly projecting members interconnecting the longitudinally extending side surfaces thereof being rounded and being of substantially the same radius so that the ends of said inwardly and outwardly projecting members fit closely into said outwardly facing groove and said inwardly facing groove, respectively, of adjoining coils of said wire as said wire is wound about said inner wall.

2. A casing, as set forth in claim 1 wherein the outer surface of said inner wall has a plurality of axially extending grooves therein which in combination with the inner surface of the said outer wall provide a plurality of axially extending coolant channels about the combustion chamber.

3. A casing as set forth in claim 1 wherein adjoining coils of said wire are integrally secured together.

4. A casing as set forth in claim 3 wherein soldering material is disposed between the contacting surfaces of

said adjacent coils of said wire for integrally securing the coils together.

References Cited

UNITED STATES PATENTS

2,288,094	6/1942	Karmazin.	
3,035,333	5/1962	Baehr	165—169 X
3,044,257	7/1962	Shesta	165—154 X
3,162,012	12/1964	Blaze et al.	60—267 X
3,254,487	6/1966	Baehr	60—271
3,289,843	12/1966	Tomas et al.	239—127.1

FOREIGN PATENTS

526,049	5/1931	Germany.
538,923	5/1955	Belgium.

EVERETT W. KIRBY, Primary Examiner

U.S. Cl. X.R.

165—134; 60—271; 52—592