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(72) Inventors WILLIAM BIRCH
ROBIN PEARSON

(19)

(54) IMPROVEMENTS IN OR RELATING TO THERMAL BARRIER SYSTEMS

(71) We, THE NUCLEAR POWER GROUP LIMITED, a British Company, of Radbroke Hall, Knutsford, Cheshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to attachment means between a fixed structure and a thermal barrier structure and is particularly, although not exclusively, applicable to a thermal barrier system in a nuclear reactor.

It is known, in gas cooled reactors, to provide a thermal barrier system on the internal surface of a prestressed concrete pressure containment vessel which houses the reactor core and contains the primary coolant system. Provision has to be made to anchor the thermal barrier system to a metal liner within the pressure vessel. The thermal barrier system may consist of a plurality of module plate members arranged in overlapped fashion or having flexible joint portions between adjoining plates. One of the problems in this type of thermal barrier system concerns the means of anchoring each module plate of the hot face structure to the cold pressure vessel by a rigid central attachment. The design of such an attachment system is influenced by having to ensure that provision is made for adequate bending and axial strength compatible with a minimal heat conduction area and allowable thermal stress. The arrangement must also be designed for ease of installation.

The object of this invention is to provide an attachment means which may be used between the fixed pressure vessel wall and the thermal barrier such that thermal stresses induced in the attachment means by temperature differences between the thermal barrier and the pressure vessel are minimised and also to provide for a 'fail-safe' structure.

According to the present invention, fixing means attachable to a fixed structure and a relatively movable thermal barrier shell member spaced from the fixed structure comprises a metal stud having a hollow body portion and having two or more helical channels through the longitudinal side walls of the hollow body portion, such that the hollow body portion of the stud will expand or contract to accommodate axial temperature gradient stress set up by the temperature difference between the fixed structure and the shell member.

The shell member may comprise a plurality of overlapping plate or foil members arranged on substantially the whole of the surface of the fixed structure. Alternatively, the plate or foil members may be joined to adjacent members by flexible margin portions.

In a preferred embodiment the fixed structure is a concrete pressure containment vessel for a nuclear reactor and the heat shell member forms a thermal barrier containing the primary coolant.

The space between the shell member and the fixed structure may contain solid insulation material.

Alternative embodiments in accordance with the invention, by way of example, will now be described with reference to the accompanying drawings in which:—

Figure 1 shows a fixing stud for the attachment of a thermal barrier to the metal liner within a concrete pressure vessel, and

Figure 2 shows an alternative embodiment to the arrangement shown in Figure 1.

As shown in Figure 1, a metal plate 10 forming part of a thermal barrier for the containment of the primary coolant gas in a nuclear reactor, is attached to the inner wall of a metal liner 11 in a con-

crete pressure vessel, not shown, by means of a metal stud 12. The stud has an end portion 12*a* having a through bore 12*d* and a hollow body portion 12*b* opening out to a mouth portion 12*c*. The body portion 12*b* contains three parallel, helical slots 13 arranged to follow the same helical form. The stud 12 is fixed at end 12*a* by means of a stud 14, welded to liner 11, which projects through the bore 12*d* and is secured by a circular nut 15. The mouth 12*c* of stud 12 projects through a hole in plate 10 and is surrounded by a circular collar 16, which also passes through plate 10, having a conical bore 16*a*.

The plate 10, collar 16 and stud 12 are secured together by means of an explosive charge placed in the mouth 12*c* to weld the stud 12 to the conical bore 16*a* of collar 16, thus belling out mouth 12*c* to the same conical shape as bore 16*a*. This technique is described, for example, in UK Patent No. 1 149 317.

In the embodiment shown in Figure 2, the stud 17 is completely hollow, having the same helical slots 13 as described in relation to Figure 1, but is provided with upturned foot portions 18 which are secured to the metal liner 11 *via* a ring member 19 and four studs 20 welded to the liner 11 and retained by nut 21. The end 17*a* of the stud is surrounded by a collar portion 23 formed on plate 22 and is welded by conventional means.

In both of the embodiments described the helical slots increase the effective length of attachment in terms of heat conduction, and the cross sectional area of the fixing stud may be increased to provide a greater heat conduction path. In addition, since each helical strip effectively forms a single attachment, failure of one or more strips does not result in overall failure of the fixing stud.

It will be appreciated that the invention is not limited to the embodiments described and that alernative means may be used to secure the studs to the metal liner and to the thermal barrier. It will also be appreciated that the invention is not limited to use in nuclear reactor structures and may be used wherever there is a large temperature gradient between the thermal barrier and the containment vessel.

Furthermore the space between the thermal barrier and the containment vessel may include solid insulation material, such as mineral wool or ceramic fibre, and means may be provided to prevent the egress of the insulating material through the bore of the stud.

WHAT WE CLAIM IS:—

1. Fixing means attachable to a fixed structure and a relatively movable thermal barrier shell member spaced from the fixed structure, comprising a metal stud having a hollow body portion and having two or more helical channels through the longitudinal side walls of the hollow body portion, such that the hollow body portion of the stud will expand or contract to accommodate axial temperature gradient stress set up by the temperature difference between the fixed structure and the shell member.

2. Apparatus as claimed in claim 1, wherein the shell member comprises a plurality of overlapping plate or foil members arranged on substantially the whole of the surface of the fixed structure.

3. Apparatus as claimed in claim 1, wherein the shell member comprises a plurality of plate or foil members arranged on substantially the whole of the surface of the fixed structure, the members being joined to adjacent members by flexible margin portions.

4. Apparatus as claimed in claim 1, 2 or 3, wherein the fixed structure is a concrete pressure containment vessel for a nuclear reactor and the shell member forms a thermal barrier containing the primary coolant.

5. Apparatus as claimed in any one of claims 1 to 4, wherein the space between the shell member and the fixed structure contains solid insulation material.

6. Fixing means attachable to a fixed structure and a relatively movable thermal barrier shell member substantially as described with reference to the accompanying drawings.

MARKS & CLERK,
Chartered Patent Agents,
57 & 58, Lincoln's Inn Fields,
London, WC2A 3LS.
Agents for the applicants.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

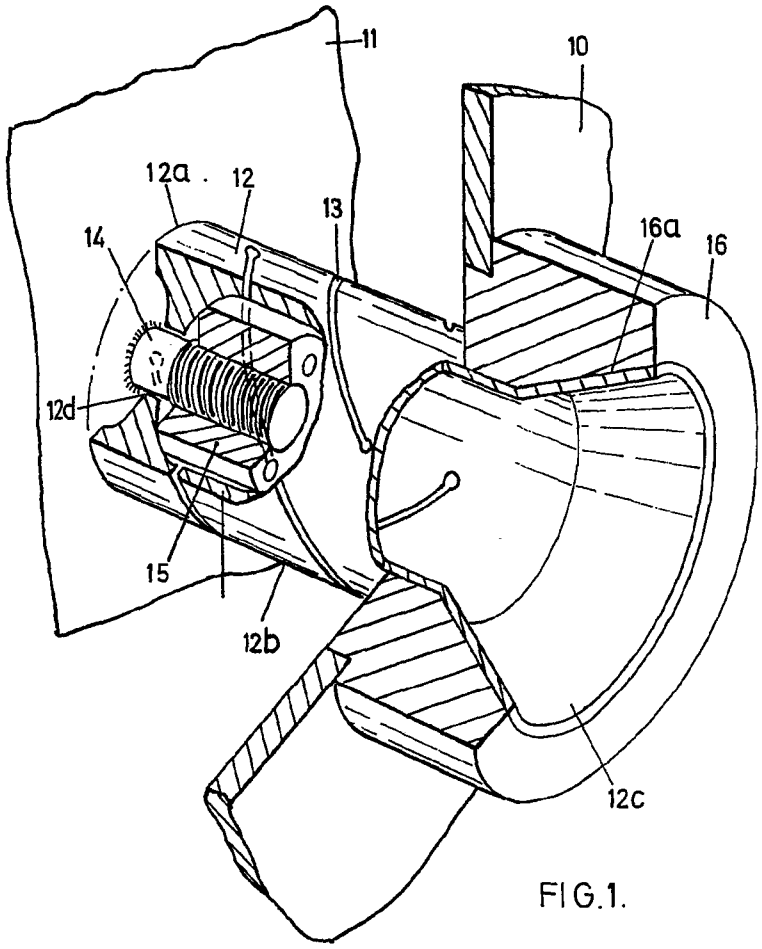

FIG.1.

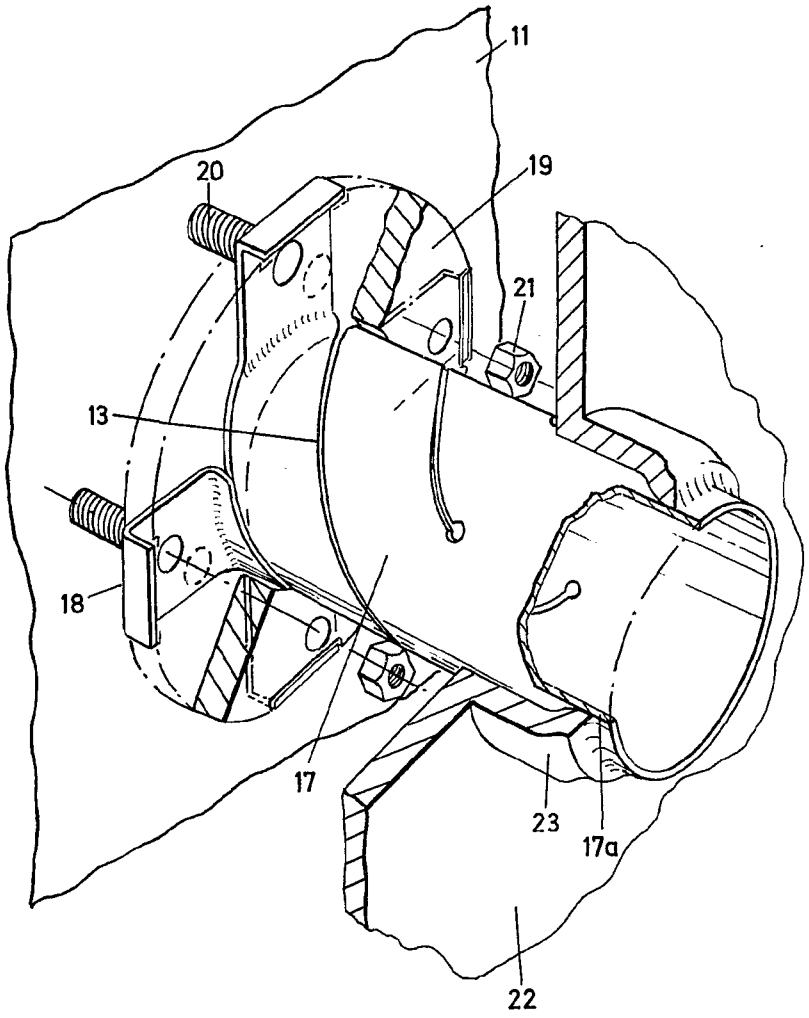

FIG. 2.