PATENT SPECIFICATION (11) 1 589 481

(21) Application No. 23752/77 (22) Filed 3 June 1977 (19)

(23) Complete Specification filed 5 May 1978

(44) Complete Specification published 13 May 1981

(51) INT. CL.³ G21C 19/20

(52) Index at acceptance
G6C 224 22Y EB
F2B 13A1 13A4 13B2B 1X5

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(54) NUCLEAR REACTORS

(71) We, NUCLEAR POWER COMPANY LIMITED, 1 Stanhope Gate, London, W1A 1EH, a British Company, 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 nuclear reactors.

In one kind of nuclear reactor, namely, a liquid metal cooled fast breeder nuclear reactor, the nuclear fuel assembly submerged in a pool of liquid metal coolant is contained in a concrete vault and above the roof of the vault there is a chamber for receiving reactor components. Components such as heat exchangers, coolant circulation pumps and control rods may be transferred between the chamber and vault by way of penetration tubes of the vault roof structure. A handling machine housed within the chamber for transferring the components may carry a plurality of sealable flasks for receiving actively contaminated components, the flasks being of different proportions to accommodate components of varying sizes and there may be provided a range of adaptor tubes for sealably connecting the flasks to penetration tubes of varying diameters.

In the context of sealing expedients for the tubes hitherto employed and which involved fine tolerances and surface finishes, it will be appreciated that there is a practical problem where routine commercial power station operations are involved, in that the equipment must be robust and capable of withstanding careless handling and environmental corrosion.

It is an object of the invention to provide equipment which, in the light of the aforementioned circumstances, is more capable of providing long and efficient service under normal operating conditions.

According to the invention in a nuclear reactor construction comprising a nuclear fuel assembly and reactor components housed in a vault and chamber with reactor component handling means disposed above the vault, there being penetrations in the roof structure of the vault for passage of reactor components and the handling means being connectable to a penetration tube of the roof structure by means of an adaptor tube, there is sealing means for the tubes, the sealing means comprising at least one annular sealing member capable of being resiliently deformed radially inwardly and outwardly to effect a seal between the tubes, deformation being affected by telescopic contraction of an end of one of the tubes and recovery of the sealing member out of sealing contact with the tubes being affected by telescopic extension of said end of the one of the tubes.

In a nuclear reactor construction according to the invention the sealing member is contracted out of sealing contact when not in sealing use which means that the sealing members are less likely to become damaged and the sealing function impaired. This should result in longer seal life during which efficient sealing can be maintained.

A constructional example of a nuclear reactor embodying the invention will now be described with reference to the drawings accompanying the Provisional Specification wherein:

Figure 1 is a fragmentary side view in medial section and illustrates a sealing device with moving parts in one operating position, and

Figure 2 is a similar view to Figure 1 except that the movable parts are in another operating position.

Referring to the drawings, in which like reference numerals indicate like parts, firstly to Figure 1 thereof, we provide an adaptor tube 1 which is connected to a handling flask (not shown in the drawings) disposed above an operating floor of a nuclear reactor construction. The floor is constituted by the upper surface of the roof structure of a reactor vault and the adaptor tube 1 is intended to engage with the seal on a reactor vault penetration tube 4 which has a part 5 of in-

creased diameter on to which a removable bush 6 can be fitted from above, the bush 6 projecting radially beyond the part 5 and being supported thereby. The tube 4 also has a cylindrical surface 7 with a good surface finish, and a portion 8 of lesser diameter forming a lead-in when the adaptor tube 1 is fitted over the tube 4.

The lower end of the adaptor tube 1 has an inclined surface 9 and a seal mounting ring 10 has a complementary surface 11 inclined in the opposite sense to the surface 9 so that the surfaces 9, 11 co-operate to provide a mounting for a resiliently deformable sealing ring 12 which is made with a reducing cross-section outwardly, as can be seen from Figure 1. The seal mounting ring 10 also has an inclined surface 13, of similar inclination to that of surface 9, and an actuating ring 14 has a complementary surface 15, of similar inclination to that of surface 11, there being another resiliently deformable sealing ring 16 similar to the sealing ring 12 mounted between the surfaces 13, 15. The seal mounting ring 10 has a captive rim 17 accommodated in a elongated circumferential rebate 18 in a circumferentially recessed portion 20 of the outer end of the adaptor tube 1.

The actuating ring 14 is secured to the lower end of a sleeve 18 interposed between, on the one hand, the recessed portion 20 of the adaptor tube 1, the rim 17, the rings 12, 16 and the seal mounting ring 10, and, on the other hand, a depending skirt 21 welded at 22 to the adaptor tube 1. A plurlity of pins 23 (two only being shown in Figure 1) extend outwardly from the sleeve 19 and engage in slots 24 in the skirt 21, limiting the axial movement of sleeve 19 (and consequently actuating ring 14) and preventing relative rotation therebetween. A bellows 25 connects the upper end of sleeve 19 and the upper end of recessed portion 20, there being sufficient clearance between these two parts to allow the permitted axial movement of sleeve 19 relative to adaptor tube 1. In addition to the pin-slot expedients described, an outwardly projecting circumferential lug 26 near the lower end of sleeve 19 and in register with the lower end of skirt 21 limits the amount of axial movement of the sleeve 19.

Figure 2 illustrates the same structure as Figure 1, but with parts in an alternative operating position. The operation of sealing the adaptor tube 1 to the penetration tube 4 will be described with reference to the appropriate Figure. Figure 1 shows the relative positions as the adaptor tube 1 is being lowered over the penetration tube 4 preparatory to a seal being effected. The sleeve 19 is in its maximum extended position relative to adaptor tube 1, the bellows 25 being extended. In this position the sealing rings 12, 16 are a loose fit between the respective surfaces 9 and 11, 13 and 15, and their inside cylindrical surfaces are clear of the surface 8 of tube 4. As lowering proceeds, the ring 14 first contacts the bush 6, and thereafter continued lowering forces the ring 14 and sleeve 19 relatively upwardly, with the result that the surface 15 approaches the surface 13, and the ring 10 moves relatively upwardly in a floating manner thereby causing the surface 11 to move toward the surface 9, the latter being associated with and movable only with the adaptor tube 1 being lowered. The result is (Figure 2) to compress the rings 12, 16 and resiliently deform them radially inwardly and outwardly to effect sealing contact of the ring 12 with the rim 17 and surface 7 of the tube 4 and sealing contact of the ring 16 with the sleeve 19 and the surface 7 of the tube 4. The lowered position of adaptor tube 1 is determined when a good seal is made. This can be tested by the expedients shown in Figure 2 (which can be regarded as showing a different section than that of Figure 1) consisting of a flexible gas pipe 27, terminating in a union 28 on the tube 1, and an internal duct 29 from the union 28 to the rebate 18. The ring 10 also has a plurality of angularly spaced radial apertures 30 which communicate between the space 31 lying between the sealing rings 12, 16, and the space 32 which includes the rebate 18 and all the space between sleeve 19 and tube 1 and ring 10 defined by the bellows 20 at one end and the sealing ring 16 at the other end. These expedients give the ability to test the interspace 31 between the sealing rings 12, 16 for leakage, absence of which means that the lowered position of tube 1 is satisfactory, whilst any demonstrated leakage requires repositioning of tube 1 relative to tube 4.

It will be appreciated that the fact that the sealing rings are withdrawn during non-sealing means that they are less likely to be damaged and therefore will perform their function satisfactorily over longer periods before requiring replacement.

WHAT WE CLAIM IS:—

1. A nuclear reactor comprising a nuclear fuel assembly and reactor components housed in a vault and a chamber with reactor component handling means disposed above the vault, there being penetrations in the roof structure of the vault for passage of reactor components, the handling means being connectable to a penetration tube of the roof structure by means of an adaptor tube, and sealing means for the tubes, the sealing means comprising at least one annular sealing member capable of being resiliently deformed radially inwardly and outwardly to effect a seal between the tubes, deformation being effected by telescopic contraction of an end of one of the tubes and recovery of the sealing member out of sealing contact with the tubes

being effected by telescopic extension of said end of the one of the tubes.

2. A nuclear reactor according to claim 1 wherein the adaptor tube has a telescopic end which is capable of embracing the penetration tube and houses a pair of spaced sealing members, the members being arranged to be resiliently deformed into sealing contact with the tubes by telescopic contraction of the adaptor tube in end abutment with the penetration tube.

3. A nuclear reactor according to claim 2 having means for testing the effectiveness of the seal, the testing means comprising a gas duct extending from the interspace between the sealing members to gas detection means.

4. A nuclear reactor substantially as hereinbefore described with reference to the drawings accompanying the Provisional Specification.

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Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1981.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

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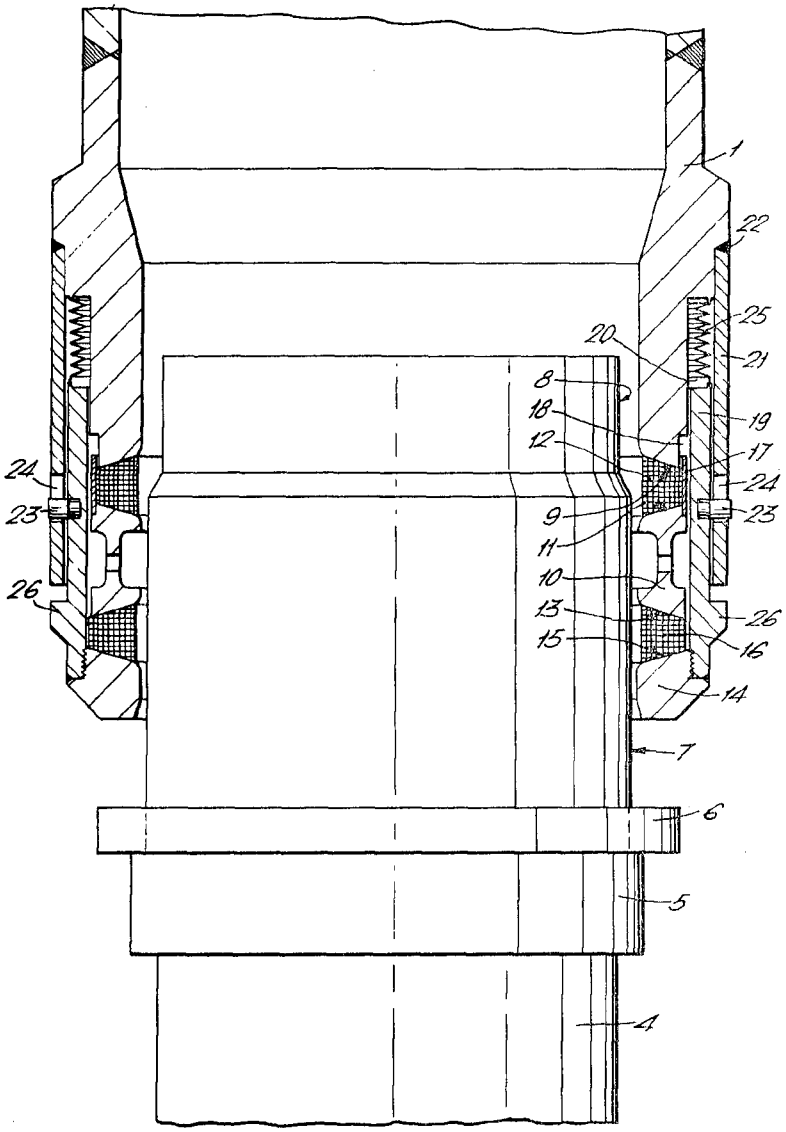
Sheet 1

FIG. 1.



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Sheet 2

FIG. 2.