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(54) **Nuclear reactor constructions**

(57) A nuclear reactor construction of the kind comprising a containment vault with a rotatable shield plug in an opening in the roof for gaining access to the reactor core. Service cables and pipes extend between the roof and the rotatable plug by way of a cable transfer system comprising a stack of annular trays disposed about the opening, the trays being divided into outer and inner sections 19a 19b attached to the roof and shield plug respectively. The cables have loops 18 which are laid in the trays with opposed legs in opposed trays so that as the shield plug is rotated cable is peeled from the one tray and laid in the other.

Fig. 2.

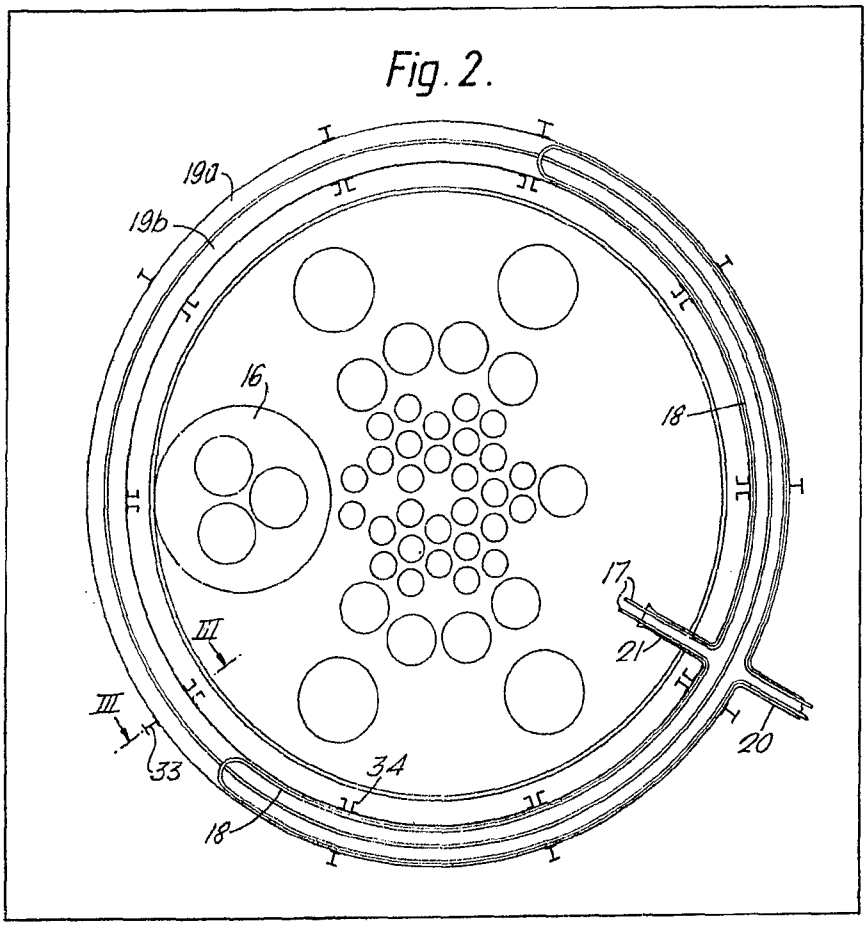

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Fig. 1.

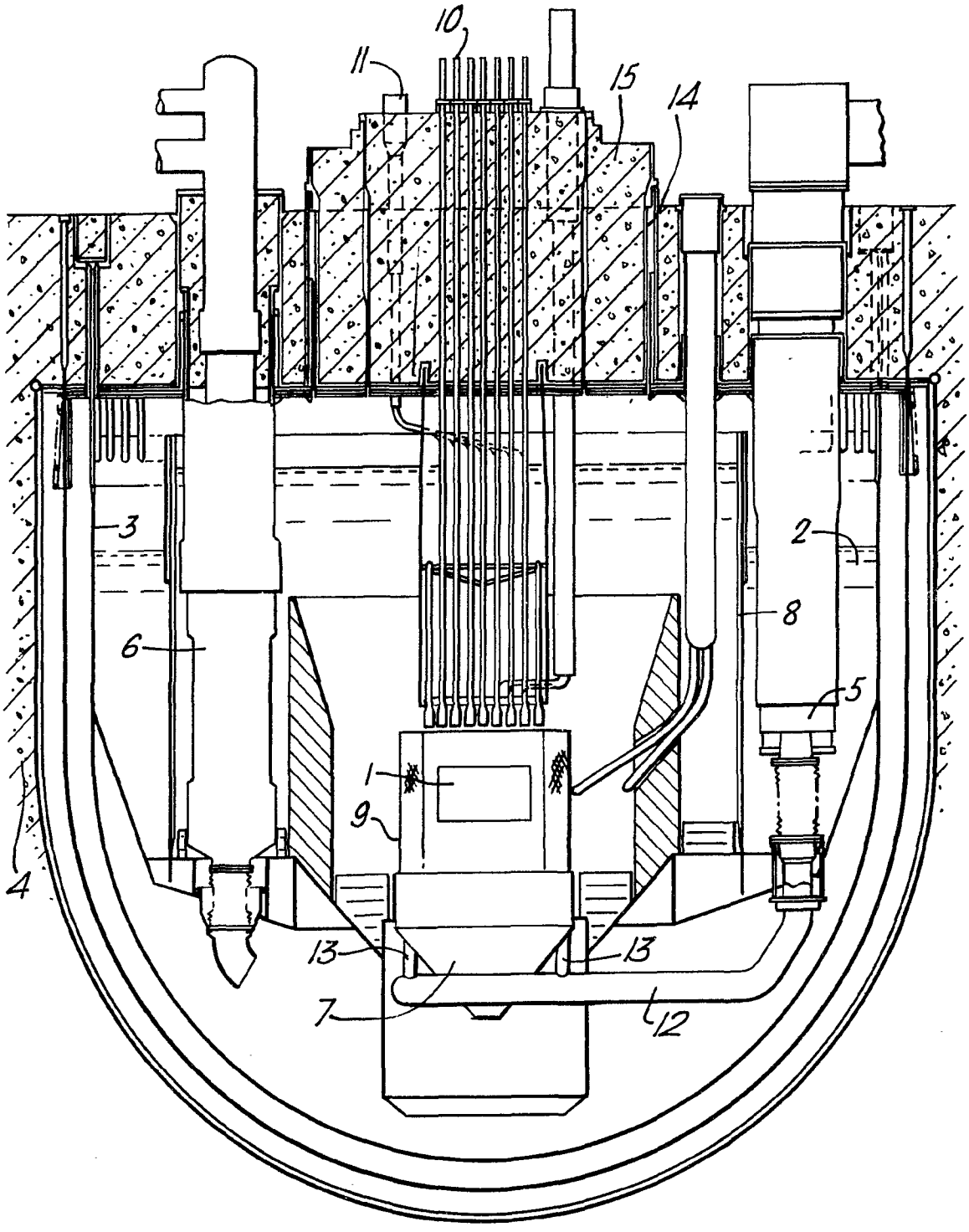


Fig. 2.

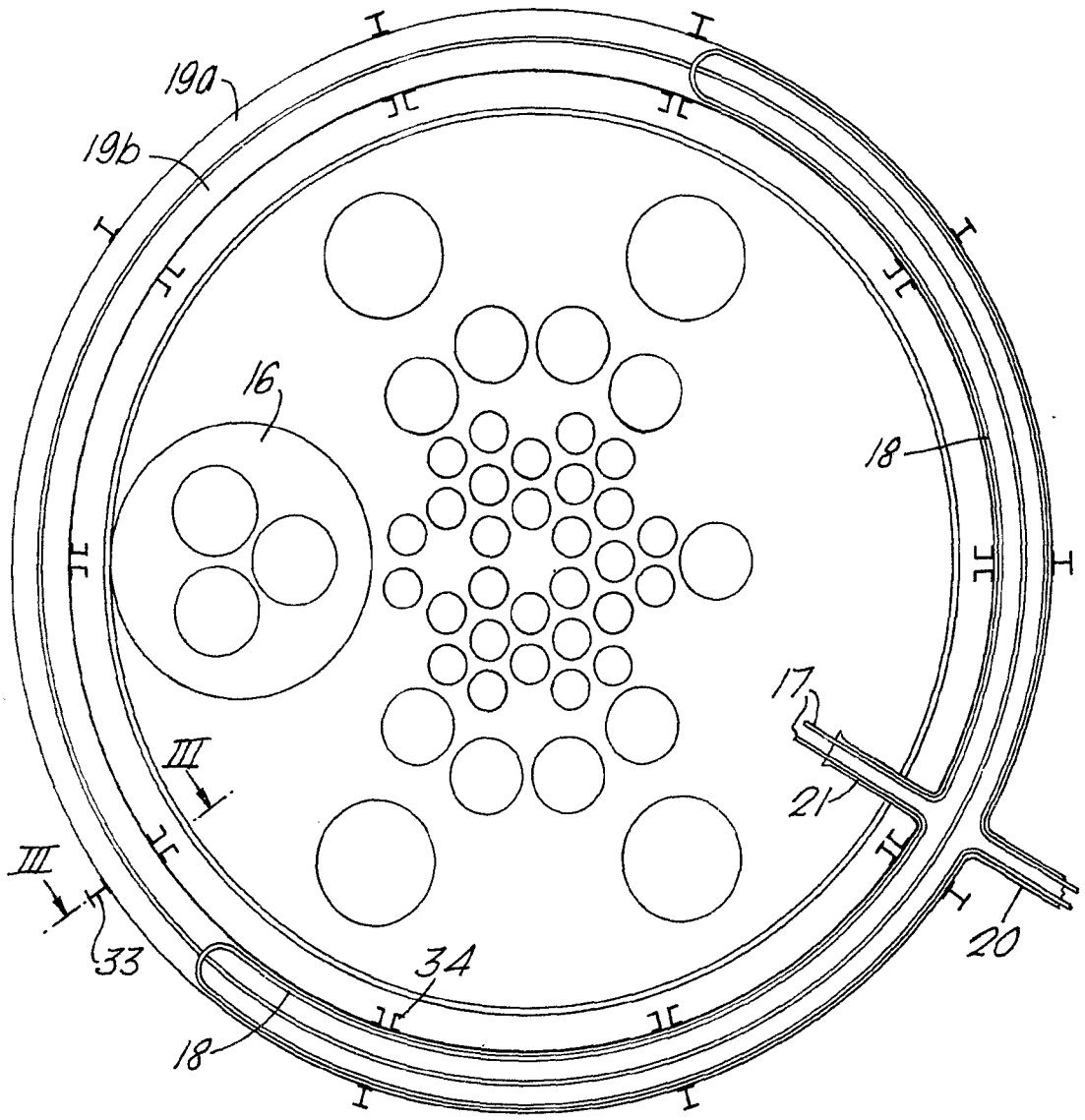
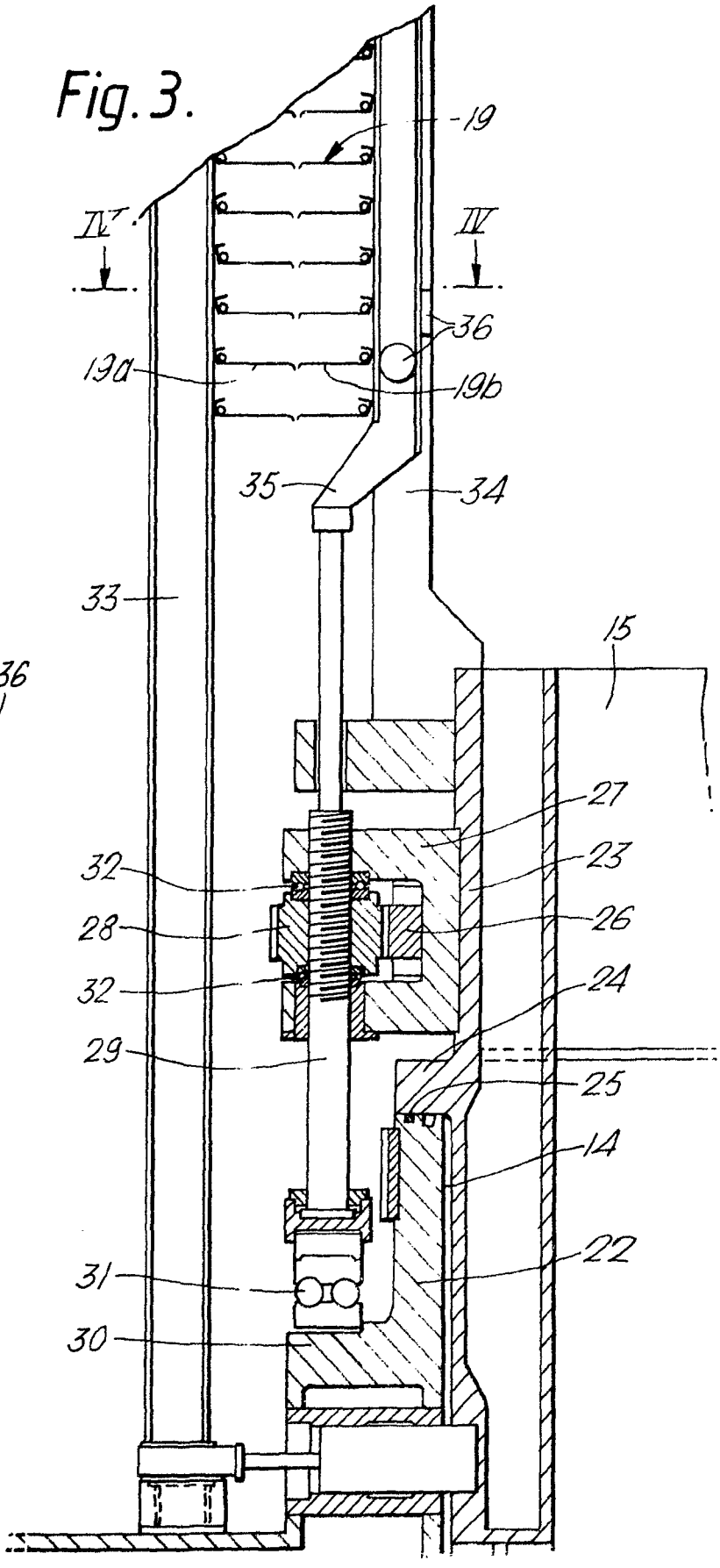


Fig. 3.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IV
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19a
19b
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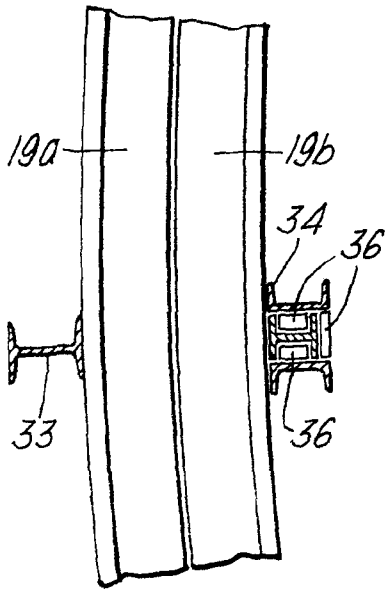
Fig. 4.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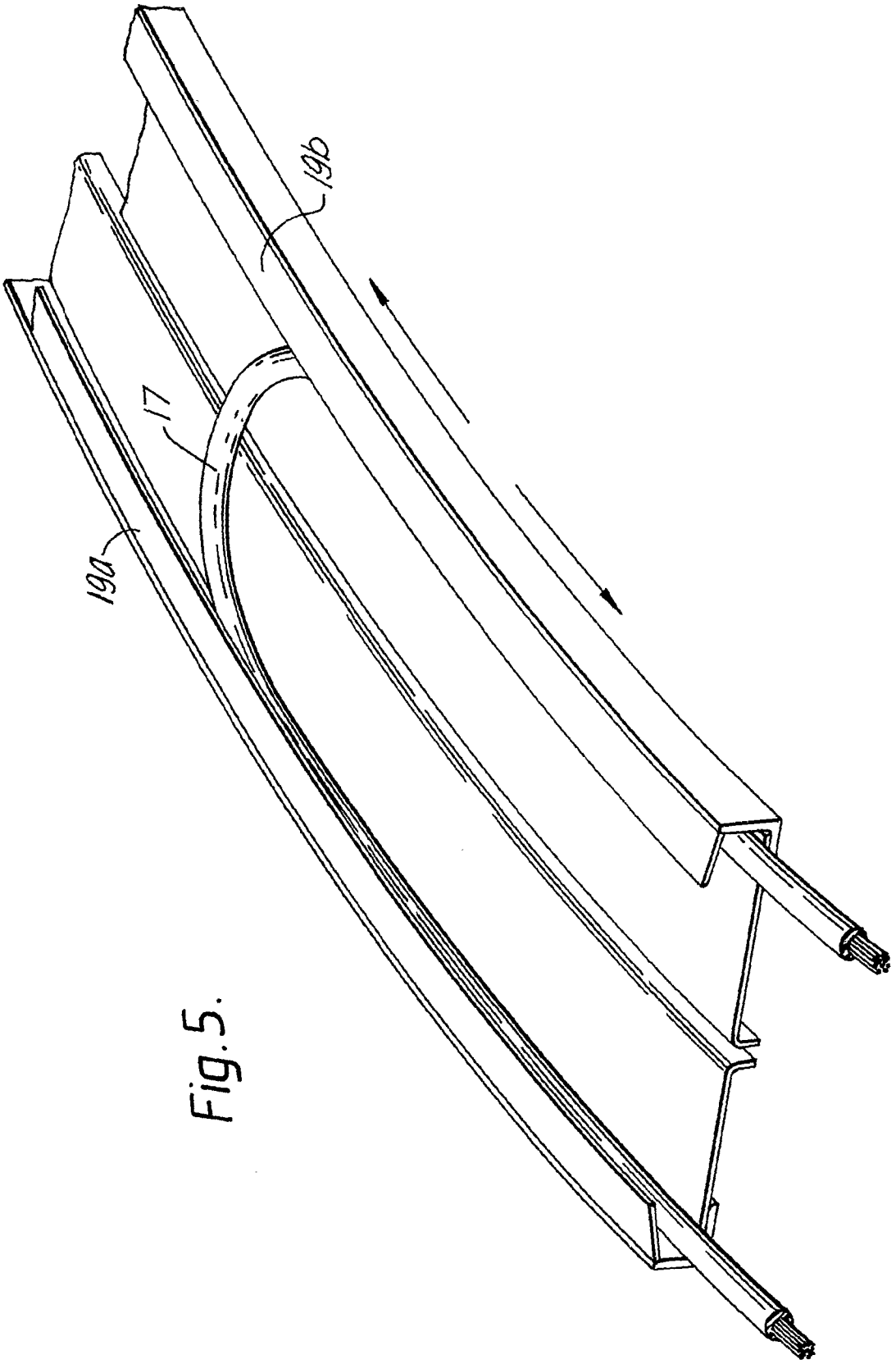

Fig.5.

SPECIFICATION

Nuclear reactor constructions

This invention relates to nuclear reactor constructions.

In one kind of nuclear reactor construction, namely that kind generally known as a liquid metal cooled fast breeder nuclear reactor of the pool kind, the nuclear fuel assembly is submerged in a pool of liquid metal coolant contained by a primary vessel housed within a concrete containment vault. The primary vessel depends from the roof of the vault and an opening is provided in the roof to give access to the fuel assembly for replacement of spent fuel. The opening in the roof of the vault is normally closed by a rotatable radiation shielding plug which carries a fuelling facility and there are cables and pipes extending from the fixed part of the roof to the rotatable plug for carrying services such as gas, water, electricity and instrumentation leads. It is an object of the invention to provide for relative movement between that part of each cable which is carried by the fixed roof and that part which is carried by the rotatable plug and according to the invention in a nuclear reactor construction having a containment vault with a rotatable plug in an opening in the roof thereof and service cables and pipes extending between the roof and the rotatable plug, each cable and pipe is formed with a loop of hairpin form, the legs of the loop being laid in a horizontal plane and parallel to the perimeter of the opening and arranged so that cable or pipe is transferred from one leg of the loop to the other leg by partial rotation of the plug in the opening.

The invention finds application in a liquid metal cooled fast breeder nuclear reactor construction of the pool kind having a containment vault with a rotatable plug for an opening in the roof thereof, and service cables and pipes extending between the roof and the rotatable plug, the construction including a cable transfer system comprising a vertical series of annular cable carrying trays disposed co-axially with the opening in the roof of the vault, each tray comprising outer and inner annular sections, the outer sections being secured to the roof and the inner sections being attached to the rotatable plug, the cables and pipes extending from the roof to the rotatable plug each including a loop of hairpin form laid in a tray, opposed legs of each loop being laid in opposed sections of the tray and arranged so that on rotation of the plug cable or pipe is transferred between the legs of the loop by peeling cable or pipe from one of the tray sections and laying it on the other.

In a preferred construction of nuclear reactor wherein the rotatable plug is vertically displaceable relative to the roof, there is means for vertically displacing the inner sections of the trays relative to the rotatable plug arranged so that complementary inner and outer sections of the trays are maintained co-planar during vertical displacement of the plug.

A nuclear reactor construction embodying the invention is described, by way of example only, with reference to the accompanying drawings wherein:

Figure 1 is a diagrammatic side view, in section, of a liquid metal cooled fast breeder nuclear reactor construction having a containment vault,

Figure 2 is a plan view of the roof of the vault including a cable transfer system and drawn to a larger scale,

Figure 3 is a fragmentary side view in section on line III—III of Figure 2,

Figure 4 is a fragmentary plan view on line IV—IV of Figure 3, and

Figure 5 is a fragmentary perspective view of the cable transfer system.

Figure 1 illustrates a liquid metal cooled fast breeder nuclear reactor having a fuel assembly 1 submerged in a pool 2 of liquid sodium coolant in a primary vessel 3. The primary vessel is suspended from the roof of a containment vault 4 and there is provided a plurality of coolant pumps 5 and heat exchangers 6 only one of each of pumps and heat exchangers being shown. The fuel assembly 1 supported on a diagrid 7, is housed with the heat exchangers in a core tank 8 whilst the pumps 5, which deliver coolant to the diagrid, are disposed outside of the core tank. The core or fuel assembly 1 comprises a plurality of sub-assemblies which upstand from the diagrid in closely spaced side-by-side array and the fuel assembly is embraced by a core restraining barrel 9 to provide peripheral restraint. Control rods 10 and instrumentation 11 penetrate the roof of the vault and a ring main 12 having six vertical risers 13, delivers coolant from the pumps 5 to the diagrid 7. The roof of the vault has an opening 14 disposed directly above the fuel assembly and closed by a rotatable plug 15. The plug 15 is mainly of concrete providing biological shielding and carries a fuelling facility, not shown in Figure 1 but designated 16 in Figure 2, whereby fuel can be transferred to and from the fuel assembly. In operation coolant drawn from the pool is pumped by way of the risers 15 to the diagrid 7 thence in heat exchange upwardly through the fuel assembly 1. The hot coolant leaving the fuel assembly is passed through the heat exchangers in heat exchange with a secondary coolant in a system (not shown) incorporating a steam generator, thence back to the pool.

Service cables 17 carrying water, gas, electricity and instrumentation leads, extend from the fixed part of the roof of the vault to the rotatable plug as shown in Figure 2. The relative movement between the fixed roof and the rotatable plug is accommodated in the cables by horizontally disposed loops 18 of hairpin form arranged so that cable is transferred from one leg of each of the loops to the other leg by rotation of the plug.

Figures 2, 3, 4 and 5 show the cable transfer system in more detail. There is a vertical series of sixteen annular cable carrying trays 19 disposed co-axially with the opening in the roof of the vault.

Each tray 19 comprises outer and inner annular sections designated 19a, 19b, the outer section 19a being fixedly secured to the roof and the inner section 19b displaceably attached to the rotatable plug 15. The cables extend in pairs from the roof to the rotatable plug, each cable 17 including a loop 18 of hairpin form, each pair of loops being laid in a tray 19. Each pair of cables enters its tray by way of a fixed bridge 20 and the loops, opposed legs of which are laid in opposed sections of the tray, extend in opposite directions about the rotatable plug. The cables 17 leave the trays 19 to extend to the rotatable plug 15 by way of a pivotable bridge 21. When the plug 15 is rotated cable is transferred between the legs of the loops by peeling cable from one of the tray sections and laying it on the other.

Referring now to Figure 3, the periphery of the opening 14 is shown bounded by steel structure 22 whilst the periphery of the rotatable plug 15 is shown bounded by steel structure 23. The structure 23 has a flange 24 which normally rests on a sealing face 25 of the structure 22 and carries a gear ring 26 which can be rotatably driven by way of electric motors not shown in any of the figures. Disposed about the rotatable plug there is a plurality of spaced brackets 27 which each carry a pinion 28 complementary to the driving ring 26 and the pinions have screw-thread engagements with complementary vertically disposed jacking shafts 29. The feed of the jacking shafts are reacted by a flange 30 of the structure 22 through a thrust bearing 31 and there are thrust bearings 32 intermediate the pinion 28 and the brackets 27. Thus, when the ring 26 is rotated relative to the plug 15 the pinions 28 are run up the threads of the jacking shafts to lift the rotatable plug clear of the sealing face.

The outer sections 19a of the trays are fixedly secured to the roof of the vault by way of a series of stanchions 33, whilst the inner sections 19b are displaceably secured to the rotatable plug 15 by way of stanchions 34. The inner sections 19b of the trays are mounted on brackets 35 which are guided for vertical movement on the stanchions 34 by rollers 36. The lower ends of the brackets 35 are secured to the upper ends of the jacking shafts 29 so that the inner sections of the trays remain stationary and in register with the outer sections of the trays when the rotatable plug 15 and stanchions 34 are lifted. The pivotal bridge 21 accommodates the vertical movement of the rotatable plug.

Although reference throughout has been directed to cables it should be understood that also included are flexible pipes and in fact the cables or pipes may be housed within flexible metal conduits.

In an alternative construction of liquid metal cooled fast breeder nuclear reactor the brackets 35 supporting the inner sections 19b are extended to sit directly on the bearing 31 thereby making the system independent of a jacking system.

In a second alternative liquid metal cooled fast breeder nuclear reactor construction the rotatable plug comprises inner and outer sections rotatable on parallel axes and there is a second cable transfer system comprising a vertical series of annular cable carrying trays disposed co-axially with the perimeter of the inner section of the rotatable plug. Each tray comprises inner and outer annular sections, the outer sections being secured to the outer section of the rotatable plug and the inner sections being secured to the inner section of the rotatable plug. The cables and pipes extend from the outer section of the rotatable plug to the inner section of the rotatable plug and each includes a loop of hairpin form laid in a tray. Opposed legs of each loop are laid in opposed sections of the tray and arranged so that on rotation of the inner section of the plug relative to the outer section, cable is transferred between the legs of the loop by peeling cable from one of the tray sections and laying it on the other.

CLAIMS

1. A nuclear reactor construction having a containment vault with a rotatable plug in an opening in the roof thereof and service cables and pipes extending between the roof and the rotatable plug, wherein each cable and pipe is formed with a loop of hairpin form, the legs of the loop being laid in a horizontal plane and parallel to the perimeter of the opening and arranged so that cable or pipe is transferred from one leg of the loop to the other leg by partial rotation of the plug in the opening.

2. A liquid metal cooled fast breeder nuclear reactor construction of the pool kind having a containment vault with a rotatable plug in an opening in the roof thereof, and service cables and pipes extending between the roof and the rotatable plug, the construction including a cable transfer system comprising a vertical series of annular cable carrying trays disposed co-axially with the opening in the roof of the vault, each tray comprising outer and inner annular sections, the outer sections being secured to the roof and the inner sections being attached to the rotatable plug, the cables and pipes extending from the roof to the rotatable plug each including a loop of hairpin form laid in a tray, opposed legs of each loop being laid in opposed sections of the tray and arranged so that on rotation of the plug cable is transferred between the legs of the loop by peeling cable from one of the tray sections and laying it on the other.

3. A nuclear reactor construction according to claim 2 wherein the rotatable plug is vertically displaceable relative to the roof and there is means for vertically displacing the inner sections of the trays relative to the rotatable plug arranged so that complementary inner and outer sections of the trays are maintained co-planar during vertical displacement of the plug.

4. A nuclear reactor construction according to any one of the preceding claims wherein the rotatable plug comprises inner and outer sections rotatable on parallel axes and there is a second cable transfer system comprising a vertical series

of annular cable carrying trays disposed co-axially with the perimeter of the inner section of the rotatable plug, each tray comprising inner and outer annular sections, the outer sections being secured to the outer section of the rotatable plug and the inner sections being secured to the inner sections of the rotatable plug, the cables and pipes extending from the outer section of the rotatable plug to the inner section of the rotatable plug each including a loop of hairpin form laid on a tray, opposed legs of each loop being laid in opposed sections of the tray and arranged so that on rotation of the inner section of the plug relative to the outer section, cable is transferred between the legs of the loop by peeling cable from one of the tray sections and laying it on the other.

5. A liquid metal cooled fast breeder nuclear reactor construction substantially as hereinbefore described with reference to the accompanying drawings.

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