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(71) Applicant
National Nuclear Corporation Limited,
(Great Britain),
1 Stanhope Gate,
London,
W1A 1EH
(72) Inventors
Eric Pendleton,
Alan Murray
(74) Agents
United Kingdom Atomic Energy Authority,
Patents Branch,
L. A. Dunnill,
11 Charles II Street,
London,
SW1Y 4QP

(54) Cable support arrangements

(57) A cable support arrangement extending from a refuelling level floor (12) of a nuclear reactor to the inner shield (10) of a double rotatable shield comprises a linearly extensible cable support and disciplining boom (B), reaching from the floor to the main shield, and a circumferentially extensible cable support and disciplining means running from the end of the boom to a fixed end on the inner shield.

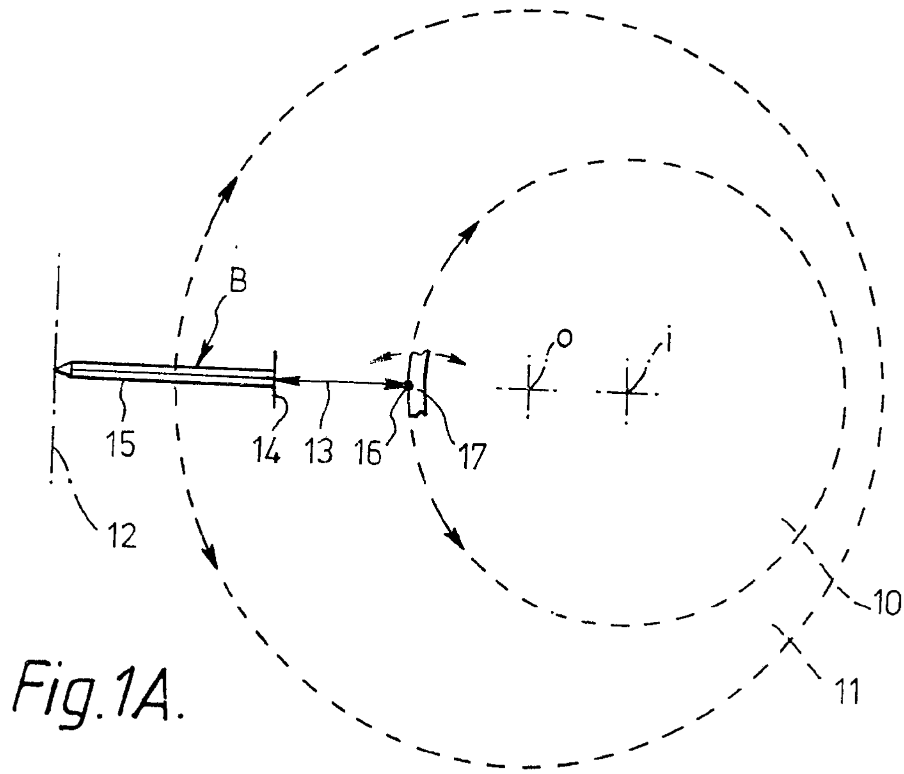


Fig.1A.

GB 2 104 861 A

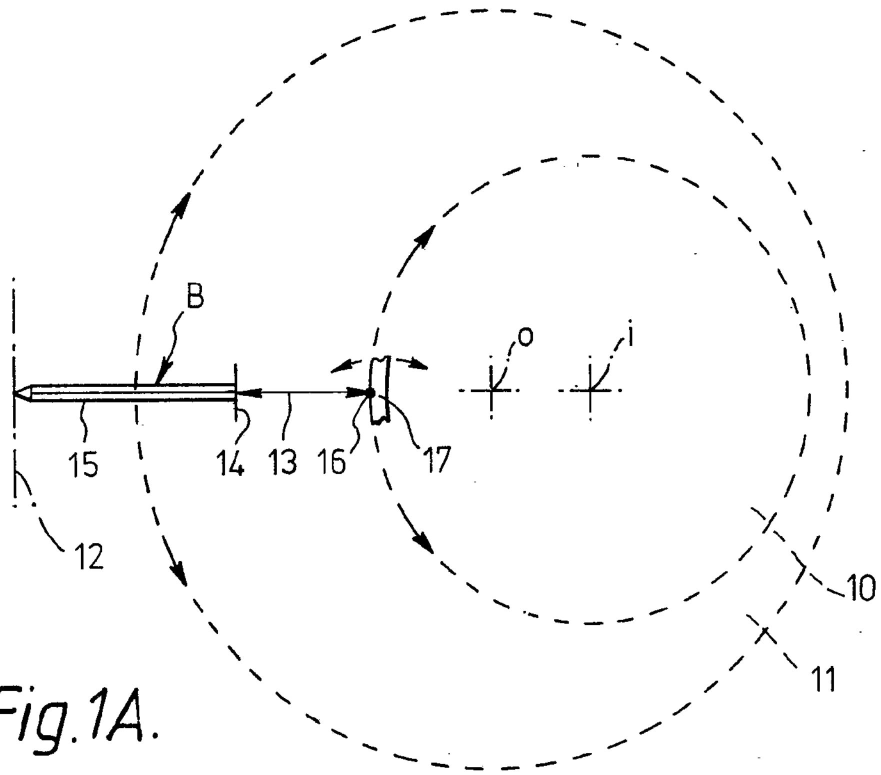


Fig.1A.

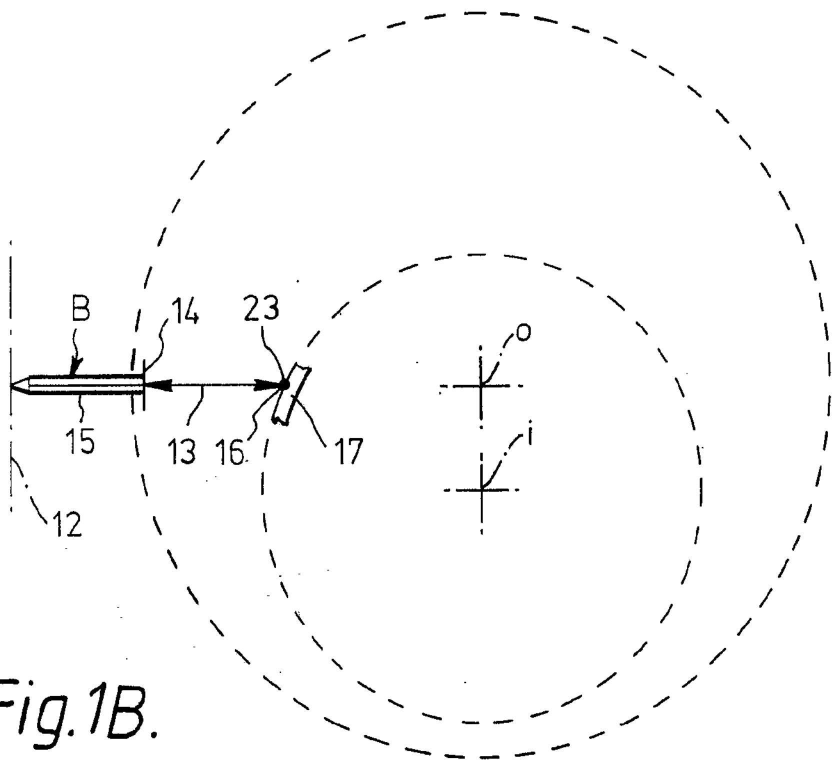


Fig.1B.

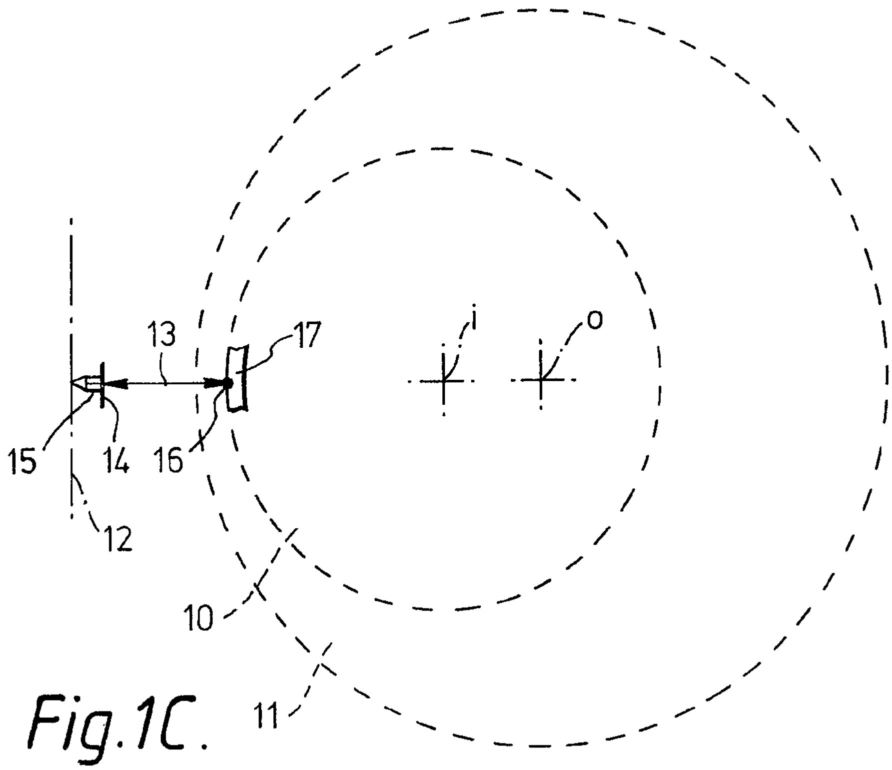


Fig.1C.

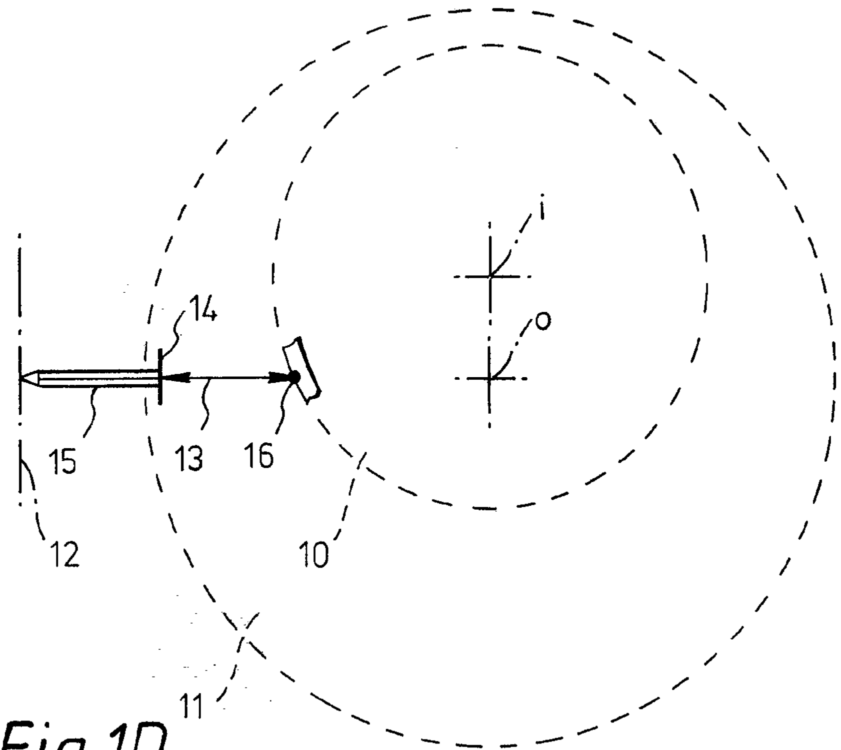
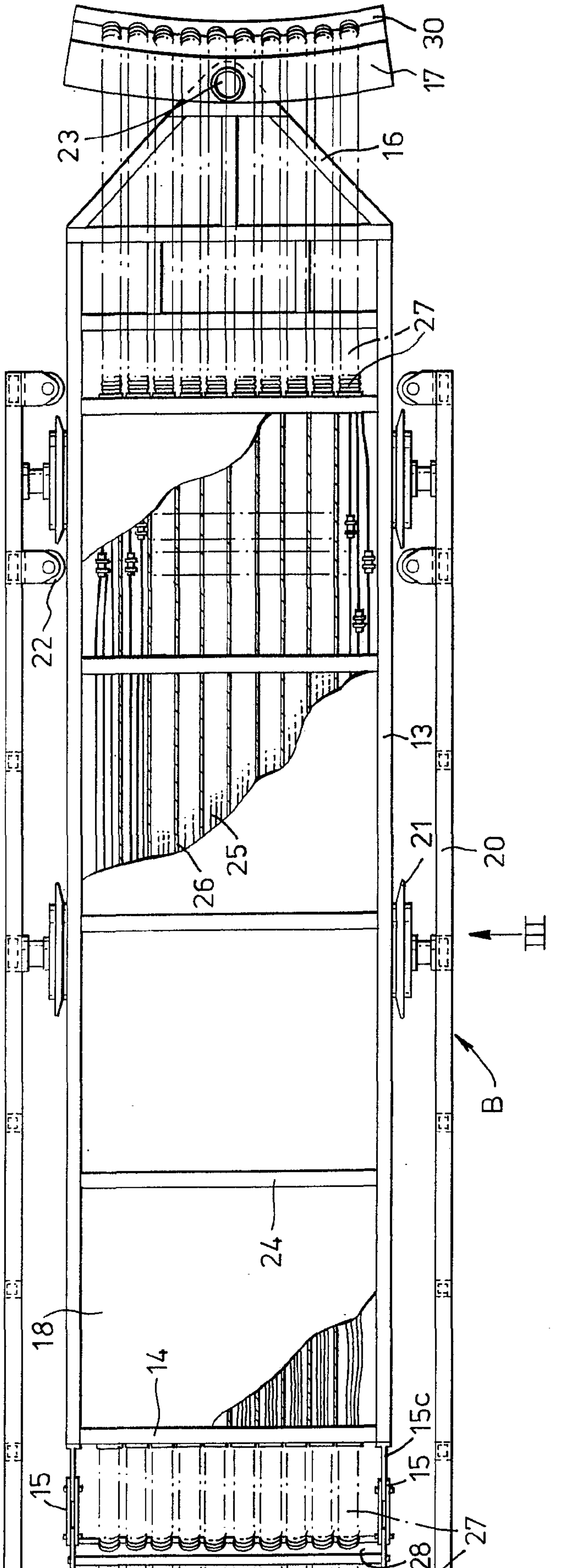


Fig.1D.

Fig. 2.



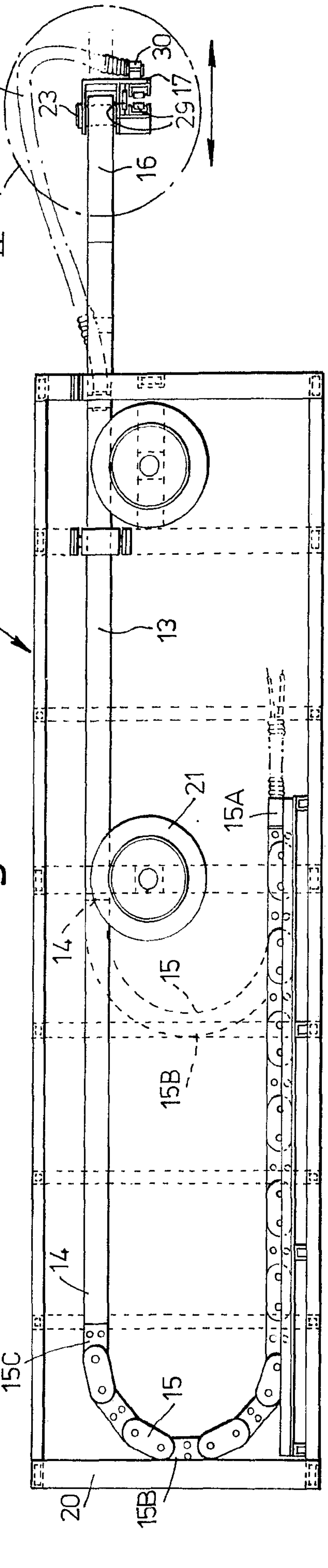

27
30
23
17
29
16
IV
B
13
21
15A
14
15
15B
14
15C
15
20
15B

Fig. 3.

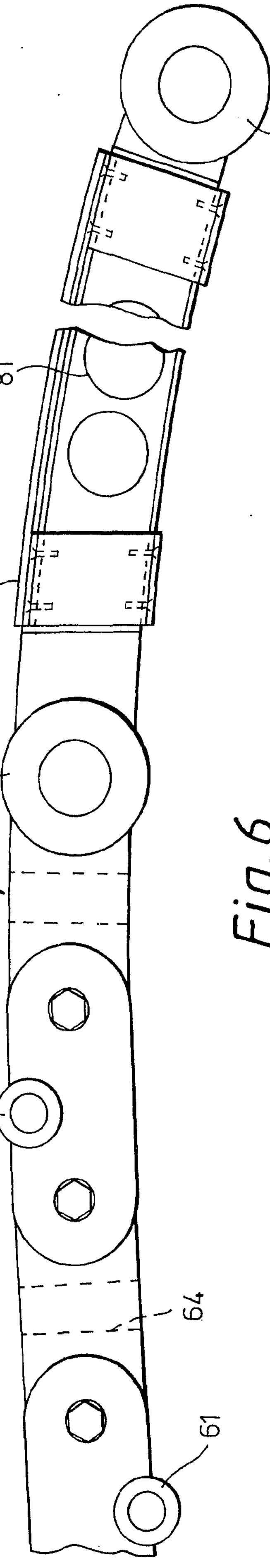

82
81
80
82
49
54
64
61

Fig. 6.

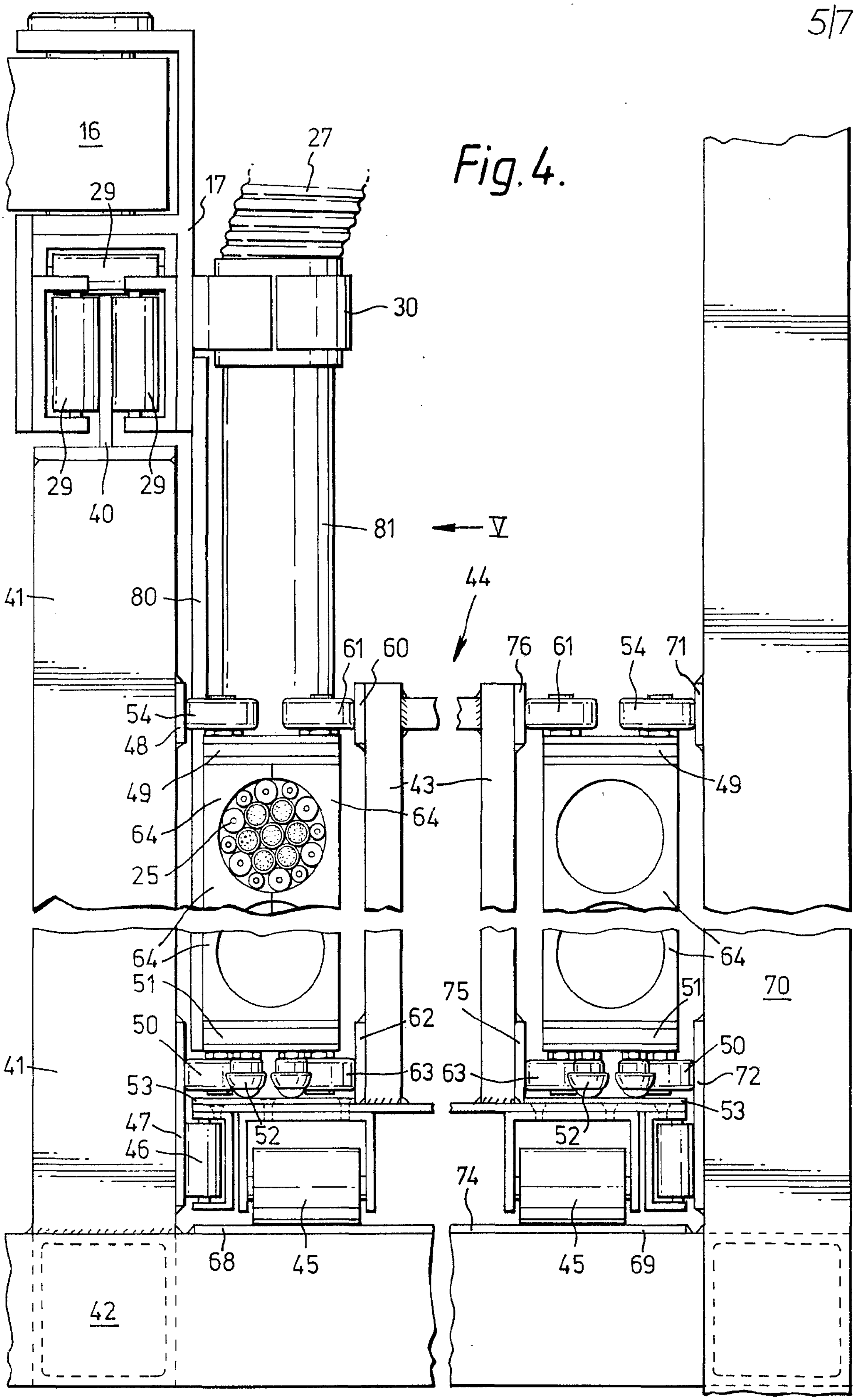


Fig. 4.
16
27
17
29
30
29
29
40
81
V
44
41
80
61
60
76
61
54
71
54
48
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49
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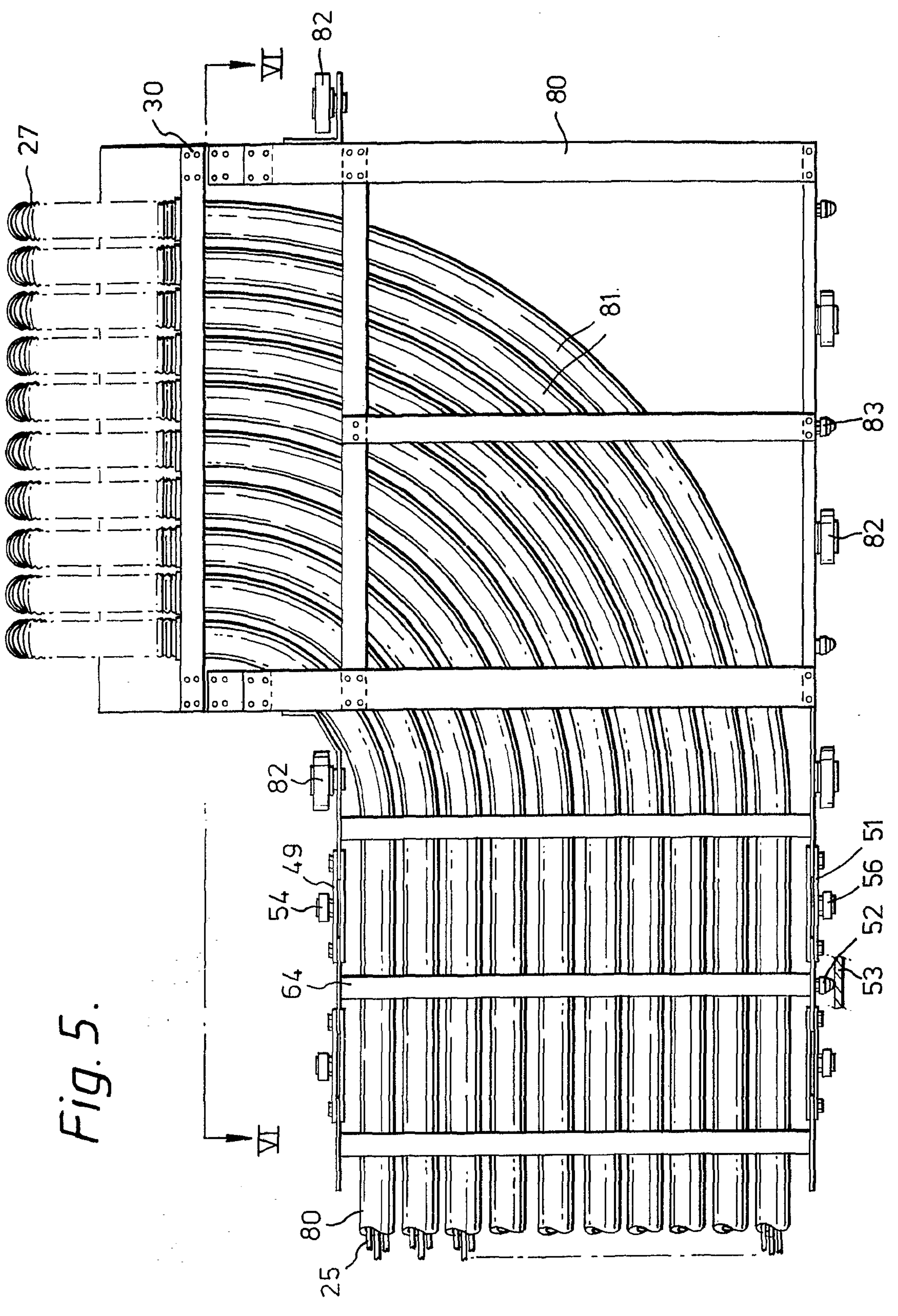

Fig. 5.

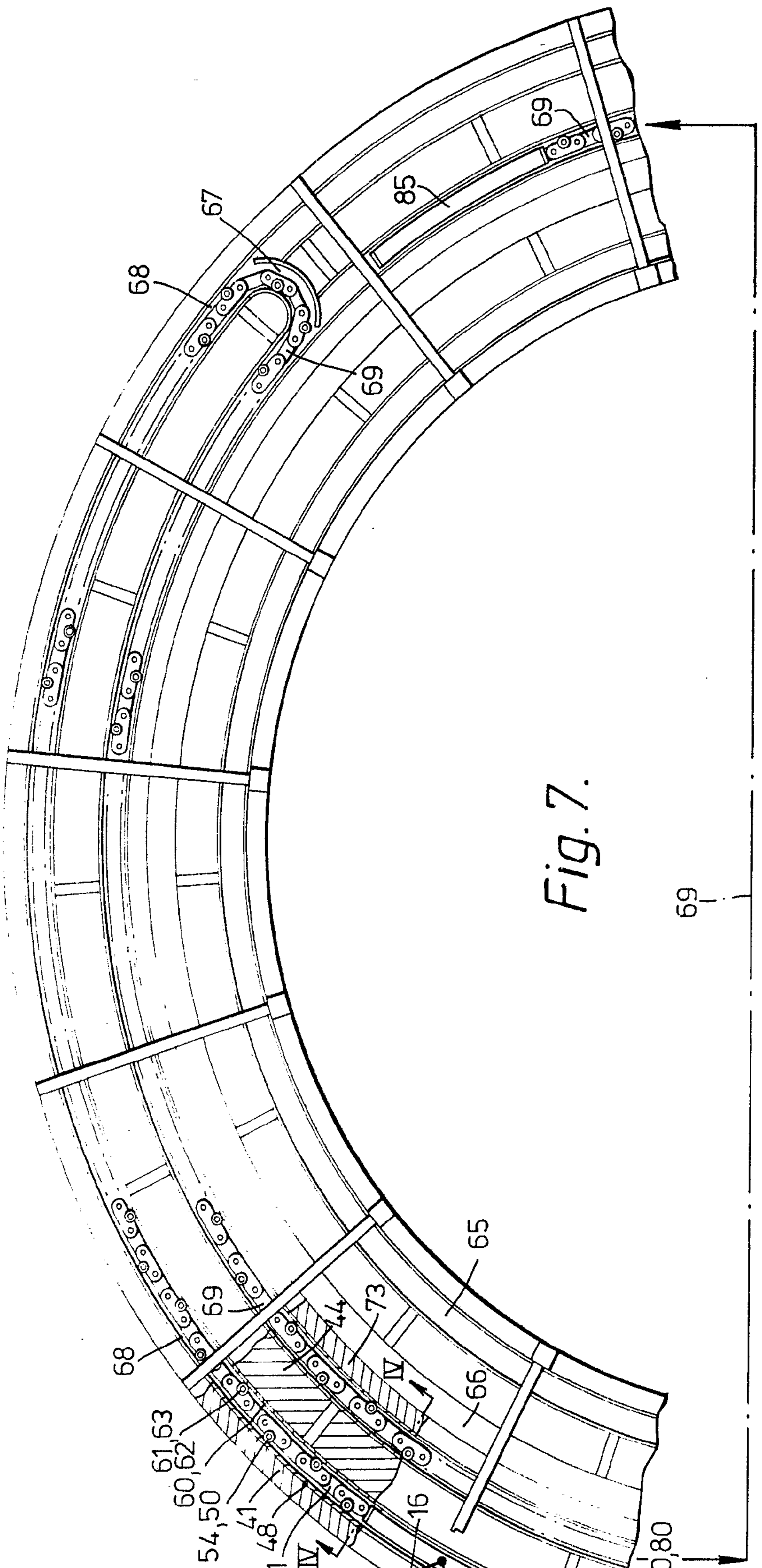
69
85
67
68
69
69
65
73
44
59
68
IV
66
61,63
60,62
54,50
41
48
49,51
IV
16
B
17,30,80

Fig. 7.

SPECIFICATION
Cable support arrangements

This invention relates to cable (which term includes conduit and hoses) support arrangements that allow such cable to have one end (the static end) fixed to a static element and the other end (the movable end) fixed to a movable element.

The invention is particularly concerned with the problem of the routing and support arrangements for cables which have a static end on a refuelling level floor of a nuclear reactor and a movable end on a rotatable inner shield of a refuelling shield arrangement having said inner shield rotatable in an outer rotatable shield. Such "double rotatable shields" are well known in the reactor art.

The prior art supplies a number of solutions to this problem. For example, the cables can be festooned from booms but this has no cable discipline, tends to stress the cables, and provides an untidy and access-inhibiting system. In an alternative arrangement (see for example GB 1,588,758) the cables can be supported in a tidy and relatively stress-free manner in loops in a horizontal plane on annular trays which are circumferentially split, so that the split parts can rotate relative to each other. In this arrangement the cables may not always conform to the discipline expected of them and the two degrees of relative movement which arise between static floor and outer shield on the one hand, and between outer shield and inner shield on the other hand have to be accommodated with respective sets of split annular trays and cable loops.

A more advantageous solution is now proposed. This solution, which follows the teaching of having looped cable in defined planes is based on the combined elements of:

a. linearly extensible cable support and disciplining boom having a fixed end on the refuelling level floor, bridging the outer shield and having a linearly movable end termination and pivot at a point of fixed radius on the inner shield; and

b. circumferentially extensible cable support and disciplining means having an end fixed on the inner shield and an end secured at said pivot.

In a preferred form of the invention, the means for imposing discipline on the cables is based on a device already known in the content of handling cables on oil rigs, machine tools, cranes etc. This device comprises a guided chain system folded to have a movable turning point. Clamping bars, plates or other supports are then provided on the chain system which hold the cables firmly on the chain system.

One form of the invention will now be described with reference to the accompanying drawings in which;

Figs. 1A—D are diagrams illustrating operation of the invention in a double rotating shield arrangement, the diagrams showing respectively the four cardinal points of rotation of the inner shield;

Fig. 2 is a plan view of a linearly extensible cable support and disciplining boom having a pivot at its movable end;

Fig. 3 is an elevation in the direction of arrow III of Fig. 2;

Fig. 4 is an enlarged view of that part of Fig. 3 represented by the circle marked "IV" and additionally includes a section on the line IV—IV of Fig. 7 to show the co-operation between the boom of Fig. 2 and 3 and the peripheral region of the inner shield of the double rotating shield arrangement.

Fig. 5 is an elevation in the direction of the arrow V of the upper region of Fig. 4;

Fig. 6 is a fragmentary plan view on the line VI—VI of Fig. 5; and

Fig. 7 is a plan view of approximately one half of the inner shield.

In Figs. 1A—D there is shown a double rotating shield comprising an inner shield 10 rotatable in outer rotatable shield 11. The axis of rotation of the shield 10 is marked "I" and the axis of rotation of the shield 11 is marked "0". A refuelling level floor is indicated by a datum dot-dash line 12. A movable part 13 of a horizontally orientated expansible boom B has one extremity 14 attached to chains 15 of a first guided chain system and the part 13 moves radially over shield 11 and nominally radially to the shield 10 (truly radial in Figs. 1A and 1C but chordal in Figs. 1B and 1D). The other extremity 16 of the part 13 carries a pivot member 17 which supports cable conduits 27 (see Figs. 2 and 3) prior to their location on chains 49/51 (see Fig. 4) of a second guided chain system. The member 17 is supported at extremity 16 on a pivot 23 (see Fig. 1B).

Fig. 1A shows the inner shield 10 at the "easterly" cardinal point, Fig. 1B shows the inner shield 10 at the "southerly" cardinal point, Fig. 1C shows the inner shield 10 at the "Westerly" cardinal point, and Fig. 1D shows the inner shield 10 at the "Northerly" cardinal point. All intermediate positions are possible simply by rotating the outer shield 11, with or without compensatory movement of the inner shield 10.

From Figs. 1A—D, two styles of movement are to be noted. In the first place the extremity 14 moves in an East-West direction radially to the shield 11 as the shield 11 rotates and the member 17 pivots in an oscillatory manner about the extremity 16 at pivot 23.

A preferred form of construction will now be described in more detail with reference to the remaining figures of the drawings starting with Figs. 2 and 3 which deal with the horizontally orientated expansible boom which includes the movable part 13 above referred to.

The boom B can be regarded fundamentally as a fixed elongate framework 20 having runners 21 and centralising rollers 22 for the movable part 13. The part 13 has the left-hand extremity 14 secured to chain 15 and the right-hand extremity

16 carries the member 17 at the pivot 23. The framework 20 is secured indirectly to the refuelling floor 12 of a reactor.

The part 13 has cable disciplining supports in the form of cross ties 24 above and below cables 25, and dividers 26 alongside the cables. The cables 25 are grouped into conduits 27. The part 13 has fire-preventing panels 18.

The chain 15 has regular cross bars clamps 28 which discipline the conduits 27 when they pass along to chain 15. The conduits and cables leave the chain 15 at its static end 15A (Fig. 3). The chain 15 can be regarded as having a self supporting movable turning point 15B and movable end 15C (Fig. 3).

The member 17 carries rollers 29 so that it can be guided on a peripheral track 40 (see Fig. 4) on the inner shield 10. The member 17 also has a split conduit clamping bar 30.

In Fig. 4 the rollers 29 are shown engaging the peripheral flange on track 40 mounted on uprights 41 of a structure 42 secured to the inner rotating shield 10. Uprights 43 are also provided on a tracked mobile carriage 44. This carriage runs on rollers 45 contacting a track 74 defining an outer track 68 and an inner track 69 on structure 42 and has lateral centralising rollers 46 engaging a track 47 on the uprights 41 and engaging a track 72 on uprights 70. The uprights 41 also have a track 48 for the outer upper guide wheels 54 of an upper chain 49 and the uprights 70 have a corresponding track 71. The track 47 is wide enough to provide a track for the outer lower guide wheels 50 of a lower chain 51. The chain 51 has castors (sealed ball units) 52 running on a track 53.

The uprights 43 provide upper tracks 60, 76 for inner upper guide wheels 61 of the chain 49 and lower track 62, 75 for inner lower guide wheels 63 of the chain 51. At intervals along the lengths of the chains 49, 51 split cable-clamping bars 64 are provided to apply a discipline to the cables.

Also shown in Fig. 4 there is a frame 80 secured to member 17 which supports armoured hoses 81 to give support for the cables 25 on leaving the conduits 27.

In Fig. 5 the frame 80 is shown in more detail and is seen to have guide wheels 82 aligned with the wheels 54, 61 etc on the chains 49/51. The frame also has castors 83 which run on the track 53. It may help, for an understanding of the device being described, to appreciate that Fig. 5 is nominally fixed in space and the structure 42 secured to the inner shield 10 moves past it.

Fig. 5 also shows the ends of the chains 49, 51 and how these chains join on to the frame 80.

A plan view of the fixed end of the chain 49 is given in Fig. 6. It is to be noted that the guide wheels 54, 61 appear on alternative sides of alternate chain links respectively.

In Fig. 7 the member 17, clamping bar 30, and frame 80 are shown with the combined reference 17/30/80. The extremity 16 of the movable part 13 of the boom B also is shown. These items accept cables 25 from the refuelling floor 12 via the chain 15 and leads then on to the clamping bars 64 of the chains 49/51. The chains 49/51 (hence the cables 25) are confined to follow outer and inner peripheral paths 68, 69 by virtue of guide wheels 50, 54, 61 and 63 on the chains contacting tracks 47, 48, 60, 62 on the outer path 68 and tracks 72, 71, 76, 75 on the inner path 69. (See Fig. 4).

The uprights 41, 73 are fixed relative to the inner rotating shield 10 (which of course can itself rotate) and the carriage 44 is free to run within structure 42 which is secured to the shield 10, (the uprights and carriage being highlighted by a region of hatching) under restraint applied by the chains 49/51 now to be described.

The chains 49/51, (and hence the cables 25) can be regarded as "starting" at the frame 80 (which corresponds to the position of member 17 and cable clamp 30) and then proceeding clockwise along the defined outer track 68 to a turning point 67 on the carriage 44 where they proceed anticlockwise along the inner track 69 which extends for nearly a complete 360° path to a frame 85 which is fixed on the inner shield 10. This frame 85 represents the "stopping" point of the chains 49/51 (and hence the cables 25). Thus the length of chains 49/51 between the points 80 and 85 will determine the degree of rotation that can be achieved by shield 10 to give a maximum circular movement of 3.5 π Radians (630° approx) shared directionally between clockwise and anit-clockwise rotation as required. (In conjunction with the rotation of the outer shield 11).

If we consider the outer rotating shield 11 fixed and the inner rotating shield 10 rotating clockwise at a speed of W radians per minute then we have this series of events:

a. The termination 17/30/80 is not moving in space neither are the chains 49/51 between that termination and the turning point 67.

b. The hatched parts 41/48 and 73 (being in effect the structure 42 secured to shield 10) are moving clockwise at W radians per minute.

c. The carriage 44 and the turning point 67 at moving clockwise at W/2 radians per minute.

d. The chains 49/51, from the turning point 67 to the frame 85 are moving clockwise at a speed of W radians per minute. The chains 49/51 are thus being transferred from the inner wall to the outer wall of structure 42 and the turning point 67 in changing its angular position relative to the Axis "O" and "i" of shields 10 and 11.

The cables 25 thereby accommodate to the movement of the shield 10 whilst being strictly disciplined at all points. If the outer rotating shield is rotated whilst the inner shield is not rotated relative to the outer shield then this series of events ensues:

a. As the outer shield 11 rotates the inner shield 10 rotates in space (essentially as shield 11 unless counter-rotation is applied) and the series of events are as described above with the following additions:—

b. The member 17 pivots and moves along the line of movable part 13 as shown in Figs. 1A—D.

c. the chain 15 moves at its movable end 15C to accord with the linear movement of part 13 and the turning point 15B moves between the point shown in full outline in Fig. 3 and the point shown in dash outline.

The description made above could be regarded as covering a basic system. It is possible to "multiply" the system described above so that at least two links 13/14 are provided to give two peripheral points of cable access. In Fig. 7 this could be accommodated by the use of a third and fourth peripheral path (numbered 65 and 66 in Fig. 7).

Two links 13/14 could also be provided at one peripheral point of access with one banked above the other.

Other applications

The method used for disciplining the cables on the inner shield 15 also applicable to a single shield operation and would allow a maximum circular rotation of such a single shield of 3.5 π radians 630° Approx) either clockwise or anti-clockwise or directionally shared as required by pre-positioning points 80 and 85 to suit the particular requirement.

Claims (Filed 10th August 1982)

1. A cable support arrangement to allow cables to have one end fixed on the refuelling level floor of a nuclear reactor and the other end fixed on a rotable inner shield of a refuelling shield arrangement having said inner shield rotatable in an outer rotatable shield, the cables being looped in a defined plane, in which there is:

a. A linearly extensible cable support and disciplining boom (B) having a fixed end on the refuelling level floor (R), bridging the outer shield (11) and having a linearly movable end termination (16) and pivot (23) at a point of fixed radius on the inner shield (10); and

b. circumferentially extensible cable support and disciplining means (49, 51, 64) having an end (85) fixed on the inner shield and an end secured at said pivot (23).

2. A cable support arrangement substantially as herein before described with reference to the drawings.

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