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Splicing box for submarine optical fibre

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(56) Related Art
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EP 356942
EP 434530

ABSTRACT

A device designed to organise optical fibre cables for splicing purposes, and optical fibre cable splicing box.

The device, designed to organise optical fibre cables for splicing purposes, comprises a support assembly fitted with side openings for the passage of cable fibres, some means of securing the splices between fibres, and some means of coiling the excess length of jointed fibres.

The device further includes two sets of magazines (30) designed to store the additional slack left on the fibres issued from both cables (1A, 1B).

Application: Splicing box for jointing underwater optical fibre cables.

P/00/011 28/5/91
Regulation 3.2

AUSTRALIA

Patents Act 1990

ORIGINAL
COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title:

"SPLICING BOX FOR SUBMARINE OPTICAL FIBRE"

The following statement is a full description of this invention, including the best method of performing it known to us:-

This present invention relates to the splicing of optical fibre cables, particularly underwater optical fibre cables. It deals more specifically on a device designed to organise optical fibre cable splicing, and an underwater optical fibre cable splicing box.

Optical fibre cables consist in general of a set of optical fibres, these fibres may be mounted on a grooved reed or in a protective tube filled with gel, or they may be embedded in an assembling polymer with one or several bearing components and/or reinforcement associated with the fibres. Underwater optical fibre cables also comprise at least one layer of peripheral sheathing and, if need be, some electrically conducting means for remote power supply. Land-based optical fibre cables often include wires for tensile strength that are integrated to, or surround, their optical components. Optical fibre cables are covered with a sheath for protection and, possibly, insulation against sea water.

During splicing of two optical fibre cables, the set of fibres or the optical components of each cable are eased out of the structure of the cable, over a certain length of the end section of the cable, in view of splicing the fibres of the two cables.

Application EP-A- 0 274 060 describes a splicing box designed for optical fibre cables, especially for underwater cables. This box comprises a container tube whose extremities are closed by two bored out covers, and an internal cylindrical dish for the storage of the spliced fibres. This dish is fixed between the covers. Cables are anchored in the covers, and their fibres pass through the dish via a narrow passage provided in each cover. The dish presents a large central opening used to pull out the fibres to be jointed and to reinsert them into the dish. Its internal wall, cylindrical in the median part of the dish, ends in the form of a tulip to house the fibres passing through each cover. It also contains two ring-shaped internal recesses at the junction of each end section and median part of the dish, in which the excess length of jointed fibres are housed in loops against the bottom of these recesses. This storage dish does not secure the splices which must have good mechanical strength without external protective reinforcement and which are unrestrained in the storage dish. The absence of splice restrain in the dish is incompatible with the mechanical strengthening of these splices because their weight becomes significant with regard to

the rigidity of the fibres. Nevertheless, for practical reasons, mechanically reinforced splices are often preferred to splices without reinforcement.

Document US-A-4 840 449 describes a device designed to organise the splicing of two optical fibre cables. This device comprises a rectangular support fitted on one of its sides with an edge along each of its small sides, two drums for fibre coiling are provided side by side along one of its larger sides, and some means of maintaining the splice between fibres are provided along the other larger side. The two drums are spaced away from each other and from the adjacent edge. The cables being fixed against the support, near the openings provided on the support to feed their fibres through, fibre splicing is carried out. These splices are placed in some securing devices, and the excess length of cable fibres is stored in loops around each of the drums. The space between each drum and the adjacent edge of the support allows for storage of the loops whose length varies depending on the excess length to be stored.

These loops allow for a slight play or displacement of fibres towards the cable, at least if the first loop made is longer than the periphery of the drum. This possible play is nevertheless very limited and may be insufficient, especially when fibres are somewhat unrestrained in the structure of the cable and the cable is pulled.

According to an aspect of the present invention, there is provided a device for organising the optical fibres at a join of two optical fibre cables, said device including:

a support member of generally rectilinear configuration having a pair of opposite ends and being provided with a respective cable opening in each of said opposite ends;

splicing means located on the support member between the two cable openings for splicing individual fibres;

coiling means located on the support member for containing one or more coils of excess optical fibre lengths; and

slack take-up means located on the support member at least partially surrounding the coiling means, the slack take-up means being configured to guide fibres in an unrestrained manner from at least one of the openings around the coiling means,

wherein in use, tension applied to optical fibres causes the fibres to be drawn out of the slack take-up means and gradually tighten around the coiling means without applying tension to the individual fibre splices.

Preferably the slack take-up means includes at least a first magazine located adjacent one said cable opening and having a magazine opening that faces the opposite cable opening for the storage of an unrestrained loop of fibres from said opposite cable opening.

Preferably the slack take-up means includes a second magazine associated with the first magazine, said second magazine being located adjacent the opposite cable opening.

Preferably the second magazine has a magazine opening positioned such that it faces said one cable.

Preferably the magazine openings are positioned generally offset from each other.

Preferably the support member includes a central drum located intermediate the magazine openings around which said optical fibres will tighten when a tensile force is applied to the optical fibres in use.

Preferably wherein the support member comprises a top plate and a bottom plate in generally parallel disposition to each other and which define a space therebetween, in which the splicing means, coiling means and slack take-up means are located.

Preferably the bottom plate has the cable openings located therein.

Preferably the bottom plate is further provided with grooves adapted to guide the fibres from each support member opening.

Preferably the bottom plate is provided with a recess in which the two magazines are housed and attached thereto.

Preferably the top plate is provided with a recess in which the splicing means and the coiling means are located.

Preferably the splicing means comprises a series of parallel rib formations mounted to or formed on the top plate.

Preferably the coiling means comprises a pair of side drums formed on the top plate, the rib formations being located between the side drums.

Preferably the rib formations are divided into two opposing sets of rib formations and are located on a rib housing.

Preferably the rib formation housing further includes a removable plate which holds the splices between the sets of rib formation.

According to another aspect of the present invention, there is provided a splicing box for joining two underwater optical fibre cables which incorporates a device as claimed in any one of the preceding claims, the splicing box including:

a container tube for mounting the device therein and having two end covers for anchoring the cables; and

bearing components attached to the interior side of the respective covers for providing seating and mounting means for the device, and for providing a guide arrangement for cable fibres which extend through the cable openings of the device.

In order that the invention may be readily carried into effect, embodiments thereof will now be described in relation to the accompanying drawings, in which:

- figure 1 represents a cross section with partial cut-out of an underwater cable splicing box, fitted with a fibre organiser device according to the invention,

- figure 2 is a top view of a bottom plate which is not fitted with this device,

- figures 3 and 4 are two cross sections of this plate, according to lines II - II and III - III of figure 2,

- figure 5 is a top view of this bottom plate fitted,

- figure 6 is a cross section according to line VI - VI of figure 5 showing this plate fitted,

- figure 7 is a top view of the top plate of the device,

- figures 8, 9 and 10 are cross sections of the top plate, according to lines VIII - VIII, IX - IX and X - X of figure 7.

The splicing box represented in figure 1 is designed to splice two underwater optical fibre cables 1A and 1B. It comprises a device 2 designed to organise optical fibre cables for splicing purposes, which is secured inside a container tube 3 ensuring mechanical continuity of the jointed cables. This container tube is closed by two covers 4A and 4B designed to anchor the cables and to hold the device 2 securely between them. The container tube and the covers are made of metal. They are covered with an external protection, extending slightly on either side over the cables. This protection is afforded in this instance by two sheaths 5A and 5B, that are nested one onto the other around the central part of the container tube, and is then associated with retractable sleeves 6, 6A and 6B which provide further protection, notably tightness, and which are mounted on the nested sheaths, on their end sections and on the cables. As an alternative, this protection may consist of a cast made over the container tube, and on either side over the cables. Covers 4A and B are threaded on their periphery, and the container tube is threaded internally on its two end sections in view of their assembly. Each of the covers is bored out to receive, and to ensure the anchorage of, the cable that it receives by being adapted as need be to the structure of the cable that it receives. Thus, referring to this figure 1, it can be seen that the cover 4A is in a single block presenting, especially on its innermost part within the container tube, a tapered bore in which reinforcement wires 7A of cable 1A are stopped and blocked with the help of a counter-thrust collar 8A. As for cover 4B, it is made of two parts abutted against each other thus being equivalent to a single part adapted to cable 1B. This cover 4B presents a tapered bore in its end section which is the furthest within the container tube, used to stop and block reinforcement wires 7B of cable 1B, with the help of a counter thrust collar 8B.

Several collars nested one in the other in the bore of the cover are adopted if the cable reinforcement wires are in several layers.

Collars 8A and 8B ensure the axial passage of the set of fibres of the corresponding cable, this set of fibres being totally or partially eased out of the cable

depending on the structure of the optical section of the cable.

Parts 9A and 9B are fixed to the end of the covers, against their front side which is the furthest inside the container tube. Overall, they are half ring-shaped and, together, define a seat support for device 1, between the two covers, such that it may be secured on these parts by means of screws such as 10A and 10B. They present a groove to guide the set of fibres in the device 2. These parts 9A and 9B are also provided to allow, if need be, the anchorage of reinforcement components associated with the fibres in the optical section of the cable. Anchorage is then ensured by a stud such as 11B which is set in the central section of the part 9B concerned , and is fixed by means of screws either side of the fibre guiding groove between part 9B and stud 11B, in device 2.

Two lock nuts 12A and 12B are set in and screwed on covers 4A and 4B, on their extremity external to the container tube. They are screwed until they butt against the ends of the container tube.

With regard to cables 1A and 1B jointing, lock nuts 12A and 12B are placed over the respective cables, and the container tube 3 over one of the cables. The cables are stripped, their reinforcements are anchored in the covers, and the excess length of their fibres pass through the covers.

Fibres are jointed and their excess length is coiled in the device 2 fixed between the covers. The container tube 3 is then brought beyond the first cover encountered, by screwing it along this cover in order to be freed from it; it is then screwed simultaneously onto the two covers. The two lock nuts 12A and 12B are brought against the covers and screwed onto them. Then, protective sheaths 5A and 5B followed by sleeves 6, 6A and 6B are installed, these having been already positioned and waiting on the cables.

By referring also to figure 1, in which the device 2 has been represented partially cut-away, it can be seen that this device 2 comprises a bottom plate 20 which receives the fibres and stores the slack on fibres issued from both cables in magazines globally referenced as item 30, and a top plate 40 for the storage of splices and excess length remaining from the fibres jointed. Storage magazines 30 are located between plates 20 and 40. They are secured to the bottom plate 20 by means of

screws 13 and covered by the top plate. As an alternative, they can be fixed under the top plate. The top plate 40 is fixed on the bottom plate 20 by means of screws 14 .

The fibre splicing organiser device 2 is first detailed in reference to figures 2 to 4 showing the bottom plate 20 not fitted, and to figures 5 and 6 showing this same bottom plate fitted with magazines 30.

The bottom plate 20 is rectangular and presents a large rectangular notch 21 in its top side. This notch is delimited by a peripheral edge 22 and leaves a central drum 23, protruding from the bottom of this notch. This drum is provided slightly higher than the peripheral edge 22, and its diameter is smaller than that of the width of the plate. This plate 20 is preferably made of aluminium or aluminium alloy.

Two side openings 24A and 24B are provided through the small sides of the peripheral edge 22, in their median part, for the set of fibres of the two cables. They are slightly deeper than the notch 21. Two grooves 25A and 25B are provided in the bottom of the notch to guide the two sets of fibres. They are curved and open via a slight bend into side openings 24A and 24B, respectively, and are interconnected by bypassing the drum 23 at a tangent, along one of the large sides of edge 22. As an alternative, the two guiding grooves are not interconnected, but bypass the drum along both of the two large sides of edge 22. Sets of clips 26A and 26B are provided along the longitudinal groove opening, to hold the set of fibres in each of them. These clips correspond with an opening 27A and 27B provided under each of them, passing through the thickness of the bottom of each groove, for easier implementation of plate 20.

Two pairs of anchoring clips 28A and 28B are provided at the extremities of plate 20. Clips 28A, at one of the two extremities of the plate, are not very thick and are located at the level of the bottom of grooves 25A. They are pierced with an oblong hole 29A, whose large axis is parallel to the longitudinal axis of the plate. Clips 28B are thicker and are pierced with a circular hole 29B, whose top opening has a larger diameter in order to house the screw head.

By referring also to the figure 1, where parts 9A and 9B fixed to the covers of the container tube of the splicing box define the seat support of device 2, it can be understood that holes 29B receiving screws 10B do not allow for any play in plate 20

on parts 9B, while holes 29A receiving screws 10A allow a slight play in the plate on part 9A, along the large axis of holes 29A.

The plate 20 also presents an axial groove 24, directly connecting the side openings, and cutting the central drum 23. It also presents some holes 22' at the extremities of the small sides of edge 22 , and some holes 21' at the four corners of the bottom of its notch 21, the former for top plate mounting and the latter for fixing the magazines onto the bottom plate.

The axial groove 24 allows the passage of a possible central carrier associated with the set of fibres of the optical section of either of the cables. Such a central carrier is stopped and anchored in the central drum 23, by ancillary add-on parts, not illustrated. Storage magazines 30 used to store the slack on the set of fibres coming from each cable are assembled into two identical magazine sets. Each set of magazines is an add-on lodged in the notch 21, between one of the side openings 24A, 24B and the central drum 23. It is mounted on the bottom of the notch against the corresponding peripheral edge and is secured in position by means of the two corresponding screws 13 (figures 1 and 6) housed in holes 21' of plate 20 and in threaded holes 31 of the set of magazines.

The magazines of each set are defined by plates 32 and 33 which are parallel and slightly spaced from each other and assembled on a side retaining part 34. This retaining part 34 has an overall U shape, flat in the notch of the plate 20, whose branch and base width corresponds to the depth of notch 21. The internal sides of the branches and base of this part 34 define a semi-elliptic surface, in which are secured plates 32 and 33. The external sides of the branches and base are flat and applied against edge 22 of plate 20.

Plate 32 is referred to as the bottom plate in the set of magazines. It is solid and is semi-elliptical in shape. Each of plates 33 have an axial notch 35, also U-shaped with rounded bottom and extremities, which gives them the shape of an elliptic crown. The internal surface of the branches and base of the retaining part 34 has some grooves 36, that are stacked on top of each other while being continuous from the extremity of one of the branches to that of the other branch of this part. These grooves ensure correct positioning of plates 32 and 33 , and their mounting in each of them,

by means of gluing for instance.

These magazines 30 are opened opposite drum 23. They have an inlet 37, on their extremity above the median part of the guiding groove connections 25A and 25B, located between drum 23 and the corresponding large side of the edge. They also have an outlet 38 on their extremity on the other side of drum 23.

Individual magazines in each set are defined between two plates 32 and 33. They are alternately allocated to the storage of an unrestrained loop of variable length in each of them, to allow a significant slack on the set of fibres coming from both cables. This is shown in figure 6 by the letters A and B allocated to the magazines, to correspond with side opening 24A or 24B and in accordance with their rank in the set of magazines. The allocation of magazines from either one of the two sets is detailed taking into account their rank in each set, starting from the bottom magazine. In general, odd rank magazines in the set of magazines that is located on plate 20 opposite the relevant side opening, as well as even rank magazines in the other set of magazines, are allocated to the storage of slack on the set of fibres entering via this opening. Thus, magazines itemised 30A are allocated to fibres entering via opening 24A, and magazines itemised 30B to fibres entering via opening 24B. The first magazine (such as 30A) used for the storage of the set of fibres passing through opening 24A is the bottom magazine of the set opposite this opening, the second used is the second magazine of the other set, and the third used is the third magazine of the first set. The same principle applies to magazines 20B allocated to the set of fibres passing through opening 24B. The number of magazines in each set is selected to provide storage for a maximum slack length, the number being three in this implementation but may be greater.

This slack provided on the set of fibres coming from each cable allows the fibres to slip towards the cable when the cable is pulled and the set of fibres unrestrained in the cable structure. Under these conditions, the loops stored in the magazines successively tighten around the central drum 23 and as a result the set of fibres is not subject to any constraint in the pulled cable. Of course the diameter of drum 23 is selected such that the radius of the fibre curvature around this drum remained within the fibre tolerances.

Top plate 40 of the device designed to organise two optical fibre cables for splicing purposes is detailed in reference to figures 7 to 10 more specifically. Its assembly onto the bottom plate is detailed by referring also to figures 1, 5 and 6 in particular.

This plate 40 is rectangular and covers the bottom plate. It has two notches 41A and 41B on either side of a median section of one of its two large edges, to allow for the passage of fibres coming from the top magazines used, 30A and 30B. Its top side is notched and has a peripheral edge 42 interrupted by notches 41A, 41B. It is secured to the bottom plate 20 fitted with its two sets of magazines 30, by means of the four screws 14 housed in holes 22' of the bottom plate and the corresponding threaded holes 42' provided through the top plate in its edge 42. Positioning of plate 40 onto plate 20 is facilitated by a circular imprint 43 provided on its bottom side for the extremity of the bottom plate central drum 23.

Plate 40 has some ribs 44 protruding on the median portion of its notched top side, and two side drums 45A and 45B protruding either side of the ribs.

Ribs 44 are parallel to the large sides of the plate, and together with the large sides of edge 42, make up some grooves 46 retaining the splices between fibres. On the ribs, end bosses 47 correspond to the large sides of the edge, and protrude in the grooves for suitable splice clamping. These grooves are discontinuous and are split into two sets to define a central housing between these two sets of grooves. This housing is achieved with the installation of a removable plate 50 used to maintain the splices at the bottom of the grooves. As an advantage, plate 50 is fitted with a foam pad 51 on its side applied against the splices. It locks into two slots 52 provided opposite the large sides of edge 42. These slots 52 are advantageously duplicated on each edge, in order to define two levels for maintaining plate 50 onto the splices located in the grooves, especially for a single splice or for two splices stacked in each groove.

Fibres and their connecting splices have not been illustrated such that the drawings may be clearer. It should only be mentioned that the splices are protected for improved resistance.

The two drums 45A, 45B are allocated to the coiling of excess lengths on the two

sets of jointed fibres, irrespective of the slack allowed on each set of fibres coming from the cables, and already stored in the magazines. They correspond to and are surrounded by a peripheral gap 49A or 49B which is limited by the contiguous part of edge 42, whose small side is inwardly semi-circular, and by the ribs. Each gap is opened by one of notches 42A and 42B in order to communicate with the bottom plate fitted. Foam pads, such as 55, shown in a dotted line, are wedged by resilience between edge 42 and each side of drum 45A or 45B to secure the fibre loops stored in the gap around each of these drums.

Furthermore, it should be noted that, the large sides of edge 42 are chamfered externally such that they do not prevent the container tube from sliding over the fibre organiser device 2 (figure 1).

In the underwater optical fibre cable splicing box, such as in figure 1, the container tube ensures protection of the organiser device 2. For land optical fibre cables, the organiser device 2 is protected by a cover covering the top plate, or as an alternative, this top plate can act as a cover which, under these conditions, is preferably fitted on its face with some grooves for splice retention, and some side drums used for coiling the excess length of jointed fibres, which becomes the internal face for assembly onto the bottom plate, and in this case is no longer fitted with notches for communication with the bottom plate fitted.

This device designed to organise optical fibre cables for splicing purposes is suitable for cables of different structures which, according to their structure, can generate movements of their set of fibres during mechanical pull. It allows the storage of a significant slack in the set of fibres coming from the cables, irrespective of the excess length provided for fibre splicing of fibres and stored separately from the slack. It prevents the unrestrained loops of slack stored from getting entangled with the loops of excess length for fibre splicing. As an advantage, the splices between fibres use an external reinforcement protection and are thus held secure in the device.

Claims

1. A device for organising the optical fibres at a join of two optical fibre cables, said device including:

a support member of generally rectilinear configuration having a pair of opposite ends and being provided with a respective cable opening in each of said opposite ends;

splicing means located on the support member between the two cable openings for splicing individual fibres;

coiling means located on the support member for containing one or more coils of excess optical fibre lengths; and

slack take-up means located on the support member at least partially surrounding the coiling means, the slack take-up means being configured to guide fibres in an unrestrained manner from at least one of the openings around the coiling means,

wherein in use, tension applied to optical fibres causes the fibres to be drawn out of the slack take-up means and gradually tighten around the coiling means without applying tension to the individual fibre splices.

2. A device according to 1, wherein the slack take-up means includes at least a first magazine located adjacent one said cable opening and having a magazine opening that faces the opposite cable opening for the storage of an unrestrained loop of fibres from said opposite cable opening.

3. A device according to 2, wherein the slack take-up means includes a second magazine associated with the first magazine, said second magazine being located adjacent the opposite cable opening.

4. A device according to claim 3, wherein the second magazine has a magazine opening positioned such that it faces said one cable opening.

5. A device according to claim 4, wherein the magazine openings are positioned generally offset from each other.

6. A device according to either one of claims 4 or 5, wherein the support member includes a central drum located intermediate the magazine openings and around which said optical fibres will tighten when a tensile force is applied to the optical fibres in use.

7. A device according to any one claims 3 to 6, wherein the support member comprises a top plate and a bottom plate in generally parallel disposition to each other and

which define a space therebetween in which the splicing means, coiling means and slack take-up means are located.

8. A device according to claim 7, wherein the bottom plate has the cable openings located therein.

9. A device according to claim 7 or claim 8, wherein the bottom plate is further provided with grooves adapted to guide the fibres from each support member opening.

10. A device according to any one of claims 7 to 9, wherein the bottom plate is provided with a recess in which the two magazines are housed.

11. A device according to any one of claims 7 to 10, wherein the top plate is provided with a recess in which the splicing means and the coiling means are located.

12. A device according to any one of claims 7 to 11, wherein the splicing means comprises a series of parallel rib formations mounted to or formed on the top plate.

13. A device according to claim 12, wherein the coiling means comprises a pair of side drums formed on the top plate, the rib formations being located between the side drums.

14. A device according to claim 12 or claim 13, wherein the rib formations are divided into two opposing sets of rib formations and are located on a rib housing.

15. A device according to claim 14, wherein the rib formation housing further includes a removable plate which holds the splices between the sets of rib formations.

16. A splicing box for joining two underwater optical fibre cables which incorporates a device as claimed in any one of the preceding claims, the splicing box including:

a container tube for mounting the device therein and having two end covers for anchoring the cables; and

bearing components attached to the interior side of the respective covers for providing seating and mounting means for the device, and for providing a guide arrangement for cable fibres which extend through the cable openings of the device.

17. A device for organising the optical fibres at a join of two optical fibre cables substantially as hereinbefore described with reference to the accompanying drawings.

18. A splicing box for joining two underwater optical fibre cables substantially as hereinbefore described with reference to the accompanying drawings.

FIG.1

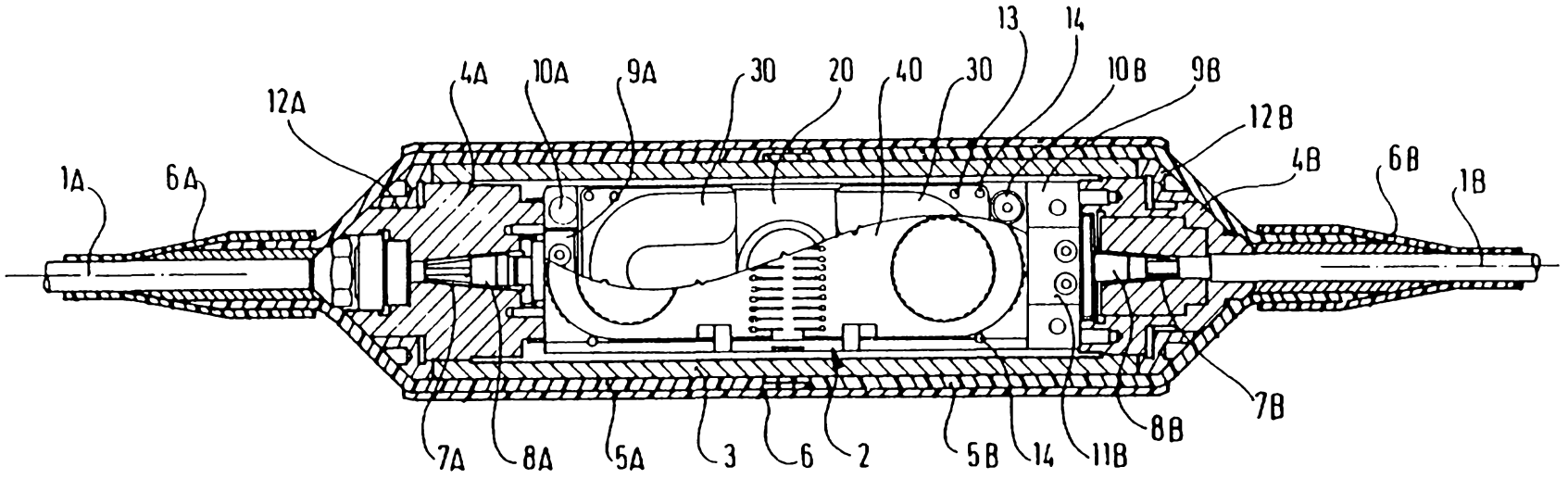

FIG.2

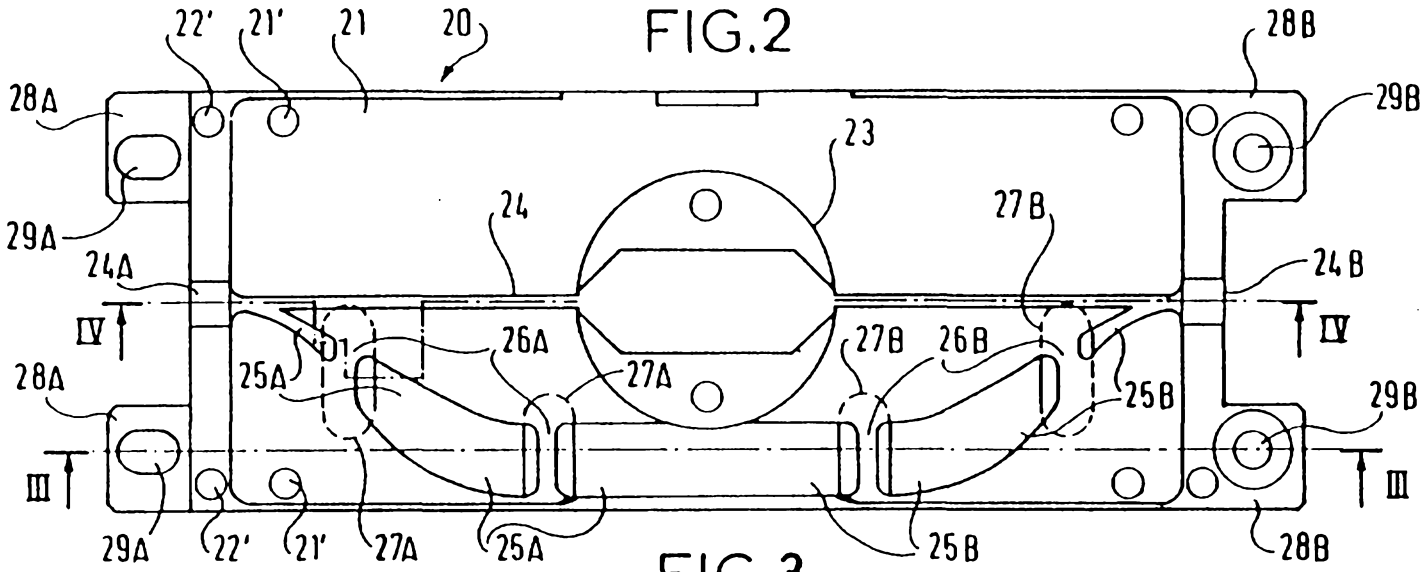

FIG.3

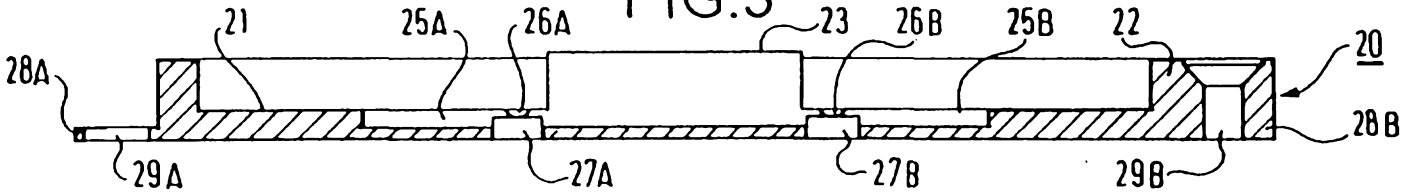

FIG.4

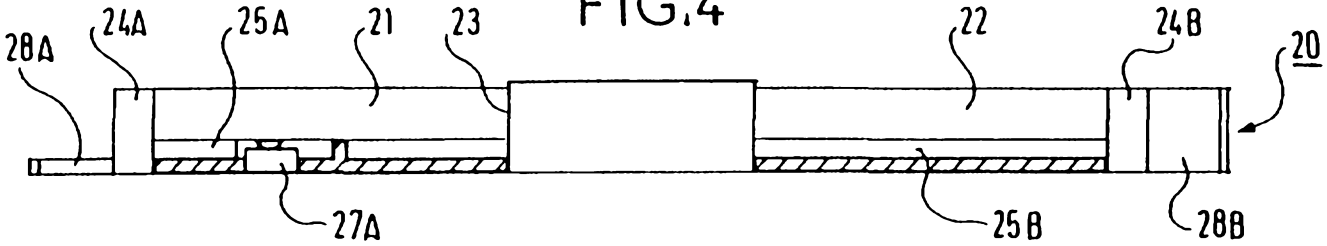

FIG.5

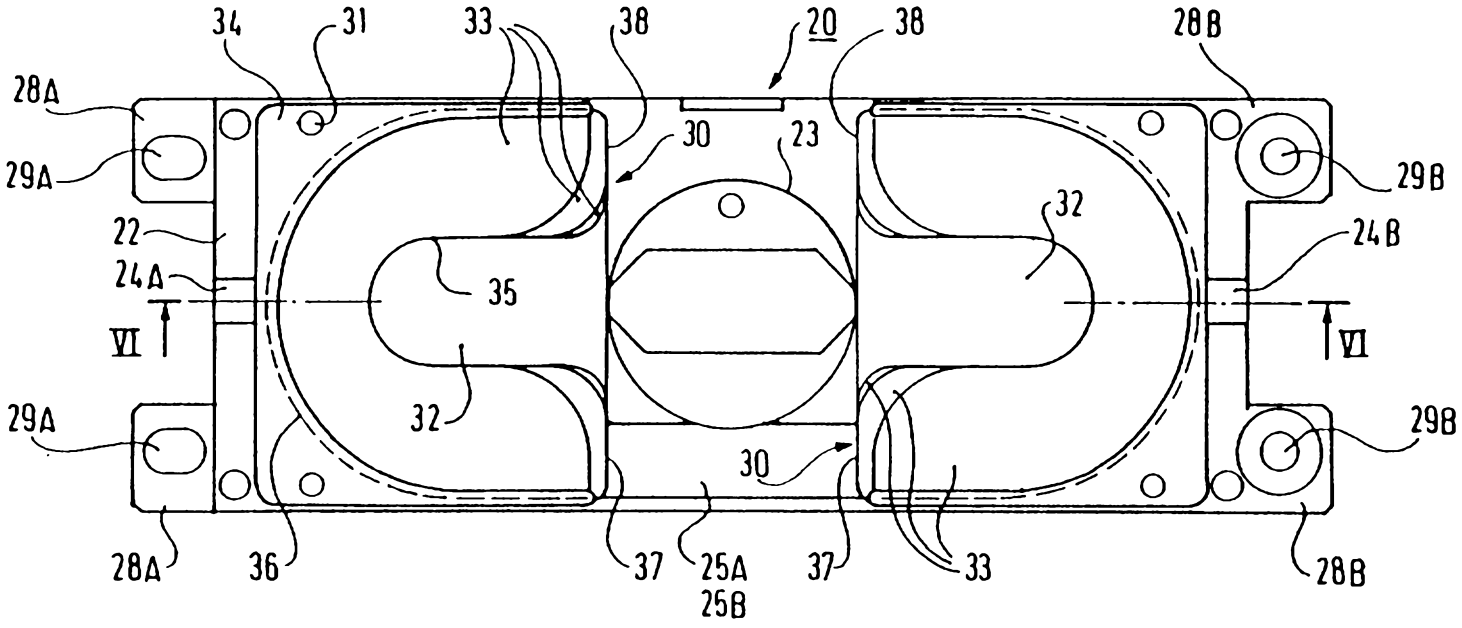
34
31
33
38
20
38
28B
28A
29A
30
23
29B
22
32
24B
24A
35
VI
VI
29A
32
29B
30
28A
36
37
25A
25B
37
33
28B

FIG.6

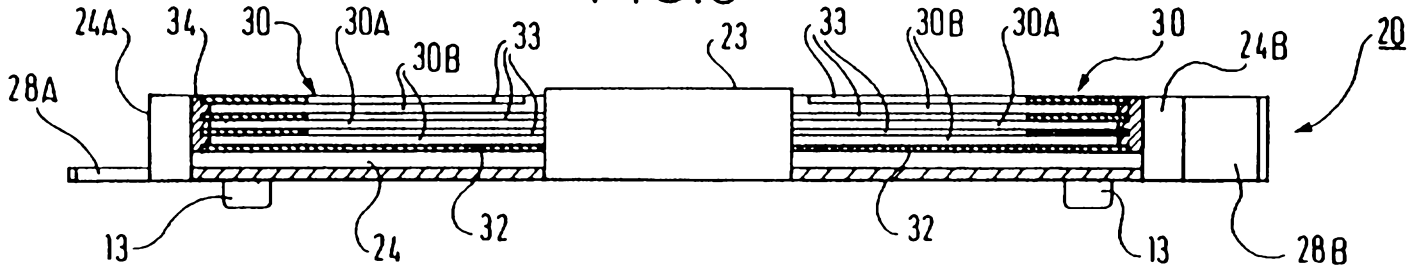
24A
34
30
30A
30B
33
23
33
30B
30A
30
24B
20
28A
13
24
32
32
13
28B

FIG.7

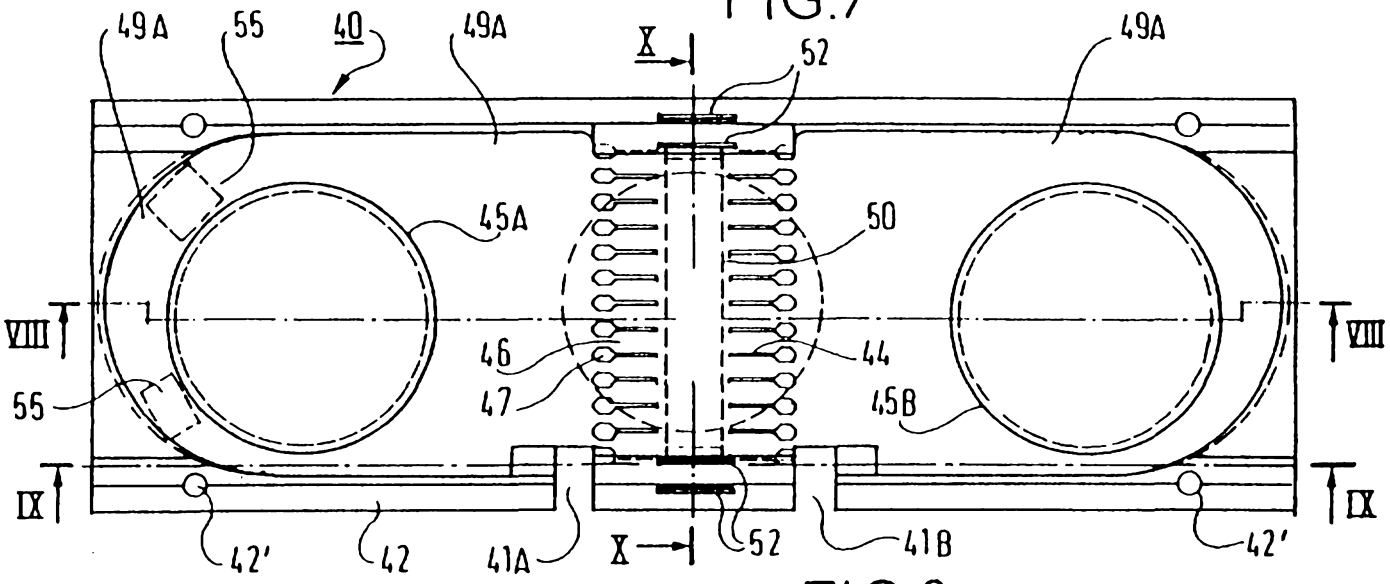

FIG.10

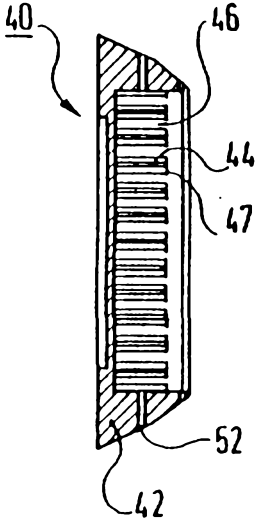

FIG.8

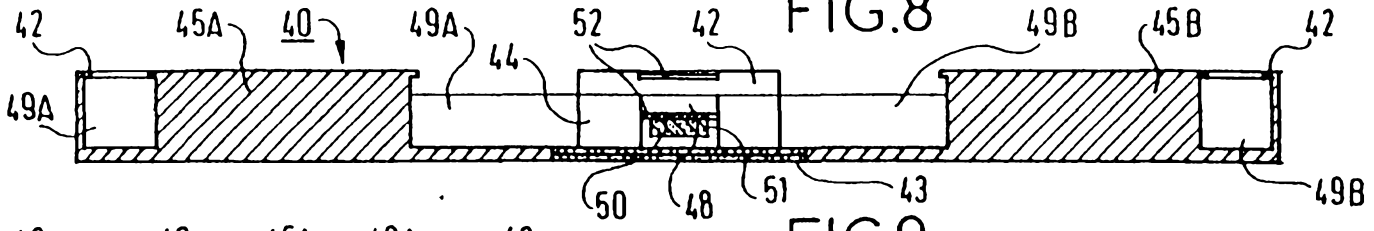

FIG.9