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(71) Applicant *(for all designated States except US)*: VIKING MJØNDALEN A/S [NO/NO]; P.O. Box 55, N-3051 Mjøndalen (NO).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : SJØTUN, Kyrre [NO/NO]; Veungdalsvn. 15, N-3600 Kongsberg (NO).

(74) Agent: FRIBERG, Arild; Bryn & Aarflot A/S, P.O. Box 449 Sentrum, N-0104 Oslo 1 (NO).

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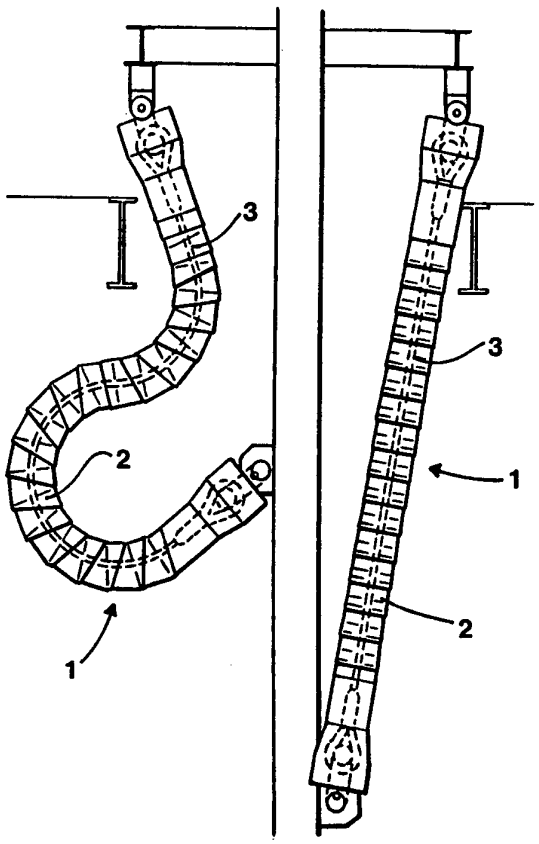
(54) Title: MOVABLE PROTECTION STRUCTURE FOR HAWSERS, HOSES, CABLES, PIPES AND SIMILAR

(57) Abstract

A protecting structure (2) for explosion vulnerable or combustible, elongated members (1) like hawsers, hoses, cables, pipes and similar comprises a movable system of successive, articulately connected and substantially cylindrical sections (3) of a fire protecting material, with a substantially axial through bore (4) for accommodating the member (1) to be protected.



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MOVABLE PROTECTION STRUCTURE FOR HAWSERS, HOSES, CABLES, PIPES AND SIMILAR

The present application relates to a protection structure for explosion vulnerable and combustible, elongated members like hawsers, hoses, cables, pipes and similar.

Particularly in the offshore industry, but also in other surroundings where there is a need of strong and flexible anchoring methods, it may turn out that fibre hawsers constitute a much better solution than e.g. steel chains. One obvious reason is the specific weight of steel chains as compared to the specific weight of a correspondingly strong fibre hawser. Studies have been made to the effect that steel chains give problems concerning dimensions, effect, costs, wear problems, wind problems (due to the large mass), torsion problems etc. Often a total construction may quite simply become instable when using such heavy steel products. In addition it is a well known fact that steel in maritime surroundings is rather heavily exposed to corrosion. Thus, fibre hawsers may often be a favourable replacement.

However, a need exists to protect such a hawser against fire, and in this connection the present invention has its relevance. The invention is constituted by an articulated structure surrounding and protecting the hawser, while still providing full hawser movability.

The invention is defined precisely in the enclosed patent claims.

The protecting structure in accordance with the invention may, depending on dimensions, provide protection against a hydrocarbon fire for two or four hours, and will thus fulfil the normally set requirements for safety regarding this type of fire in oil platforms and similar. In a system where a fibre hawser of the type "Twaron" is used, a fire protected system is achieved which is equally strong as steel, but which weighs only one fifth of a steel system. The hawser together with its fire protection structure can be moved in all directions, and also a rotating movement can be imparted

thereto. The protecting structure resists fire, does not corrode, is shock resistant, resistant to sea water and oil, is a low weight structure, is non-magnetic, electrically non-conducting and cannot cause sparking. The system is simply handled due to its flexibility and its small weight, and in many cases regarding handling, a full crew may be reduced to only one man. It should be noted that the protecting structure can be used not only for fibre hawsers, but as indicated in the introduction, also as a protection around cables, pipes and hoses.

The invention shall be described more closely in the following, while referring to the exemplary embodiment and also referring to the enclosed drawings.

In figs. 1a and 1b are shown complete hawsers in tightened and slack conditions, with the protecting structure in place. The protecting structure consists of successive sections connected to each other by joints in such a manner that the sections together form a movable, flexible and stretchable tube around the hawser to be protected. The material from which said sections are manufactured, is in reality the so-called "Viking Fire Stop" material, i.e. a special rubber compound with excellent fire preventing and heat insulating characteristics. However, the material itself is not of paramount importance, since it is the section-wise construction which primarily constitutes the present invention.

The single sections may display a substantially cylindrical exterior, but the expression "substantially cylindrical" shall in this context also comprise a conical shape or for instance an undulated outer contour. The assembly of many sections each of which deviating to a certain degree from a cylindrical shape, will nevertheless result in a substantially cylindrical shape when the hawser including its envelope is stretched out in a straight line.

In figs. 2a and 2b is shown the internal structure of a first embodiment of the protection system. The hawser to be protected will be located in a central bore passing through

all sections. In the embodiment shown, the sections are connected by means of ball-and-socket joint connections, where the balls themselves also have the same bore, and with a conical opening in the end of each ball to provide a smooth transition to the bore of the next section. It is to be noted that when a joint is e.g. bent all the way to the outer mechanical touch position for the joint movement, the use of an elastic material (rubber in particular) entails that further deflection is possible, by elastically deforming the material itself.

In figs. 3a and b is shown a variant which is quite similar to the preceding one, but in this case more importance is attached to providing good tightening from the outer milieu toward the inner bore. This is achieved by having O-ring packings as seals in the ball joints, in fig. 3a this seal is situated in the outer joint, while in fig. 3b it is located in the inner joint. Furthermore, the outer envelope of each section is extended somewhat in relation to that which is shown in the first drawing, in order to improve the tightening.

In figs. 4a and 4b is shown a double system, i.e. the hawser to be protected runs in an inner bore and is surrounded by a first protecting structure, which itself is located in a bore in a second protecting structure. Both protecting structures utilize ball-and-socket joints, where the geometrical relations are adapted. Such a double protection system may prove very favourable.

Fig. 5 shows the end pieces of the system, where the hawser is suspended in/strapped to outside constructions, and the end sections of the system are adapted around the suspension points.

Fig. 6 shows typical dimensions of the system in connection with a parameter table, and fig. 7 shows how the tensile strength of a fibre hawser changes with temperature and time.

In addition to the fire protection, the protecting structure in question will be efficient also regarding

explosion protection. The effect of an explosion pressure wave will be subdued strongly for the hawser or hose itself, and similarly other types of external stresses and shocks will be subdued.

The protecting structure consists of a number of joints, preferentially but not necessarily of the ball-and-socket type. However, a ball-and-socket connection provides very good possibilities for the joint to follow the hawser in all directions, and very small bend radii can be achieved. In addition, the ball-and-socket joint provides the axial movement necessary in order to follow the longitudinal extension of the hawser when it is exposed to a strain. When a tensile load is created in the system, the force is accomodated by the blocking action of the smallest diameter of the outer joint against the ball. See fig. 8, Ø 196H8, which diameter is smaller than the top diameter of the ball-and-socket joint, Ø 198H8, same figure. When this tensile load is removed, the ball joints slide into each other again, and a neutral position is established.

The ball-and-socket joints are particular in that the inner joint has a smaller radius shape R=99, see fig. 8, than the outer joint, R=100. Consequently, the joints may, when they are pressed weakly against each other, move freely and with a very small friction in relation to each other. This is an important factor when it comes to accomodating rapid movements created e.g. by arriving pressure waves from explosions and similar.

By constructing the joints connections as approximate spheres or balls, and snapping these into each other, the protecting system will maintain its radial strength at all times, and thereby render the system shock and explosion safe in all joint deflection positions.

The joint deflection is adapted in such a manner that the system simultaneously works as a bend safety means for cables, pipes, hoses, wires, chains and similar. This is a substantial advantage, safeguarding against a bend overload for the object to be protected, which object always has a

smallest allowed bend radius. This feature also increases the general system safety, and reduces the need for inspection.

It should also be noted that joint connections of the type mentioned, provide a spring-like tensile connection, i.e. the articulate protection sleeve will pull itself together after a situation with a tensile load.

Another important point is that this system has a great radial strength.

There is no doubt that joint connections are previsously known, also ball-and-socket connections, however an articulate protection system of the type mentioned above, is supposedly novel. The ability to achieve free movability, torsion, bending and extension and at the same time maintaining the radial stiffness and position (impact resistance), imply sufficient advantages to support a presumption that the system is a substantial improvement in relation to previously known products for fire and explosion protection.

For time reasons, a copy of an English language offer to a customer of the Applicant, is enclosed, and parts of this text will be merged into a more formally correct application text.

RISER CATCHER PROTECTION

3.1 System description

3.1.1 Contents

The Catcher system consists of 2 flexible layers of Viking Firestop, which cover a webbed Twaron fibre rope, which has two slings for connection to both riser and the frame. See drawing no. 26-372-303. On the end of the flexible layer there is a split end cover which fits into the flexible other layer of the Viking Firestop protection, and to the Chartec III fire protection cover which is specified used on the riser.

3.1.2 Function

The Viking Firestop layer consists of a number of joints, which are fitted together with a ball-and-socket joint connection, which gives sufficient movement for the joints to follow the rope/catcher in all directions and specified bending radiuses (min. 1 m).

The ball and socket joint also gives the necessary axial movement to follow the elongation on the rope which takes place. The whole catcher cover is locked between the two connection slings on both sides of the rope (see drawing), and will therefore always be kept together and in a right and safe position.

The end protection consists of a split cover which is kept together with clamping rings, and has to be adapted to the Chartec III configuration. The dimension of the Chartec III protection cover is not shown in the drawing, therefore this end cover has to be adapted directly on the Chartec III body.

We suggest that we deliver two separate catcher sets, one for workover (3,989 m and one 4,006 m) and one for drilling (7,654 m and 7, 662 m). That will give the lightest, lean form, the easiest to handle, and the cheapest catcher altogether.

3.1.3 Dimensions

To meet your requirements of 4 hours hydrocarbon fire, we have to build up the Viking Firestop protection based on our earlier test results. From our tests with covering steel pipe (30-50 mm fire protection) and covering steel panels, with tongue and grooves, (35 mm fire protection), see enclosed test report. Our system is generally designed for 2 hours. We have two such layers in this case.

We also think that two separate layers have a better insulation effect than the same dimension in one layer. This because of the fact that big destructions might occur after 2 hours around the catcher, with very big vibration and mechanical breakdowns.

Then we believe that parts of the outer layer can fall off, and we still have our inner layer left with full strength for the next two hours.

3.1.4 Alternative solutions

Important reasons for this solution:
Viking Mjøndalen has made a wide study on different steel chains and wire solutions used together with our Firestop material, and found that because of the dimensions, weight, cost, wear problems, wind problems (because of the heavy masses), twist problems etc. the total construction will be unstable with this steel product. If you compare

steel chain with webbed Twaron fibre rope regarding weight, the relation is 395 kg/m (100 tons) for steel chain and 8,6 kg/m (150 tons) for webbed Twaron fibre rope. The dimension proportion is for the same 481 x 288 mm for steel chain and ø 100 for Twaron fibre rope. Totally Saga will save many tons of weight with our solution.

In addition comes the increase in weight and dimension of our Firestop material which makes the total cost very high.
Another important reason for using rope, is the fact that the steel beam on the upper deck EL 515000 comes very close to the catcher protection. Wear and damages may occur on the protection over a long time, using a steel solution.

3.1.5 Rope

The Twaron webbed fibre rope is a well tested rope offshore, and gives many advantages compared to steel products. The rope is delivered with Lloyds or Veritas certificate and with all relevant data sheets. See enclosed data sheet and pamphlet. In addition to the already mentioned advantages (in item 3.1.4) for the use of rope, there are other features:

- With use of Twaron fibre rope we are avoiding all corrosion problems and all workover cost with regard to that.
- A Twaron webbed fibre rope has a relatively slow percentage loss of strength with influence of high termperature, ses enclosed diagram for 340° from 4 to 5 hours.
- A Twaron webbed fibre rope will also, because of its elastical property, have a suitable and important ability to withstand impact forces, for pulse

lengths (see enclosed diagram) which are most common for mechanical forces in an offshore environment.

3.1.6 Maintenance work

There is no need for extra maintenance work on the catcher rope or on the Viking Firestop material itself. It is however, important to check if e.g. the fire shield "skirt" (see drawing) is in the right position, and has no damages before mounting. This can be taken care of by ordinary routine control, which has to be worked out in relation to how often the catcher is mounted on and off. That figure is not mentioned in your specification.

If there is any need of repair work, this can be done with your people, but always controlled by Viking Mjøndalen or by representatives approved by Viking Mjøndalen.

Due to your requirement of service life of 15 years it is necessary with a maintenance routine worked out together with Saga. There is no need for special tools for mounting or for maintenance work on the platform.

3.1.7 Fire protection

Consists of 2 layers with Viking Fireprotection, dimensions and configuration are described in drawing P26-373-302, 303 and 304.

From our earlier tests we have only tested our Firestop material for 2 hours against a hydrocarbon fire of 1100^{o}C.

We cannot be sure of how our Firestop material

behaves with an increase in the thickness only, and there is also a limitation in the production regarding thickness.

There is a need for fire testing of this dimension and configuration before we put too much cost into this solution. Only a prototype test can give a safe answer to this. We will however, also give reference to the flench protector test at SINTEF 14.9.90 (see enclosure) which gives us a belief that this is the right way to go.

In addition to these enclosed data, we will mention that our Firestop material has been jet fire tested at The British Gas Test Site in Spadeadam, UK.

PATENT CLAIMS

1. A protecting structure for explosion vulnerable or combustible elongated members like hawsers, hoses, cables, pipes and similar,
characterized in that it comprises a movable system of successive, articulately connected and substantially cylindrical sections of a fire protecting material, with a substantially axial through bore for accomodating the member to be fire and explosion protected.

2. Structure in accordance with claim 1,
characterized in that the articulations are of the ball-and-socket type, the ball member thereof having substantially the same bore as each section, however with a conical enlargement of the bore in the end of the ball.

3. A structure in accordance with claim 1 or 2,
characterized in that the fire protecting material is a material exhibiting a certain elasticity, so that further bending and extension of the system can be achieved also beyond the full mechanical joint deflection.

4. A structure in accordance with one of the preceding claims,
characterized in that the fire protecting material comprises a neoprene rubber.

5. A structure in accordance with one of claims 2-4,
characterized in that each ball joint is equipped with a seal ring in the actual joint surface, either in the inner joint or in the outer joint.

6. A structure in accordance with one of the preceding claims,
characterized in that a radially outer part of each section is extended to overlap the adjacent part of the

preceding section for protecting and completing each articulation also at full joint bend deflection.

7. A structure in accordance with one of the preceding claims,

c h a r a c t e r i z e d i n that it is a double structure, i.e. a corresponding second and outer structure surrounds a first such structure in such a manner that said inner, first structure is accomodated in the substantially axial bore of said second structure and is protected by said second structure.

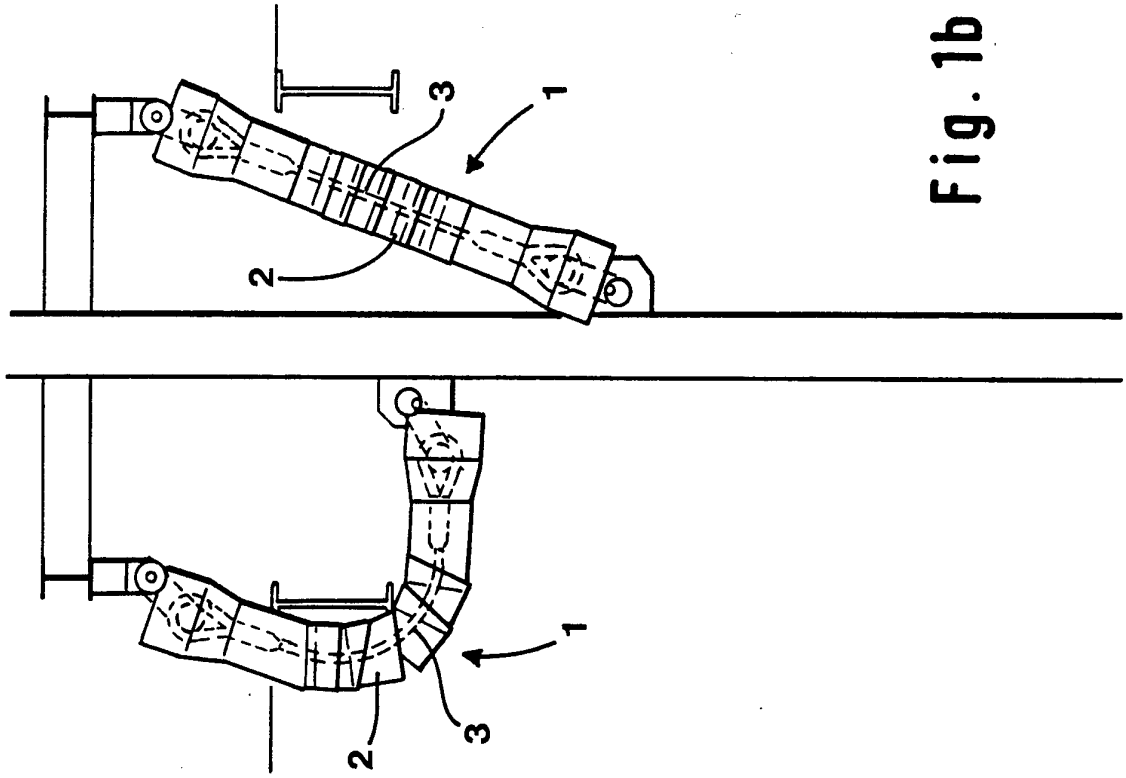

Fig. 1b

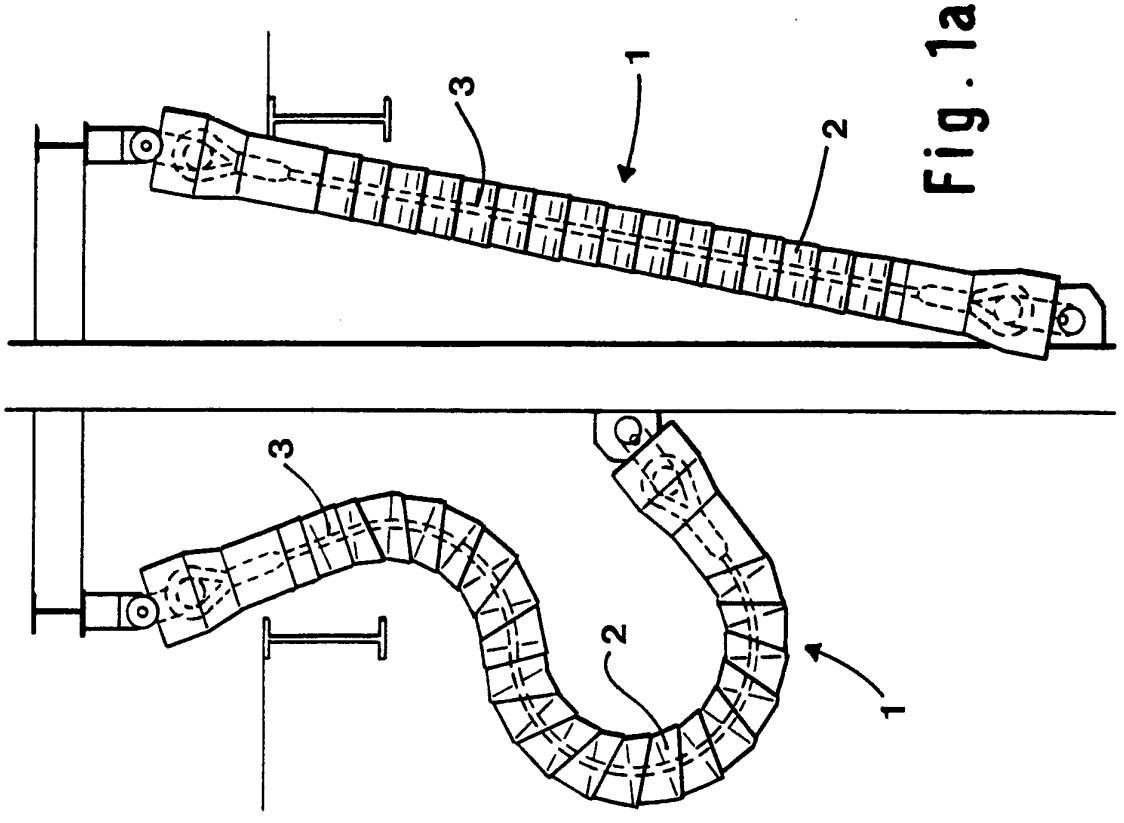

Fig. 1a

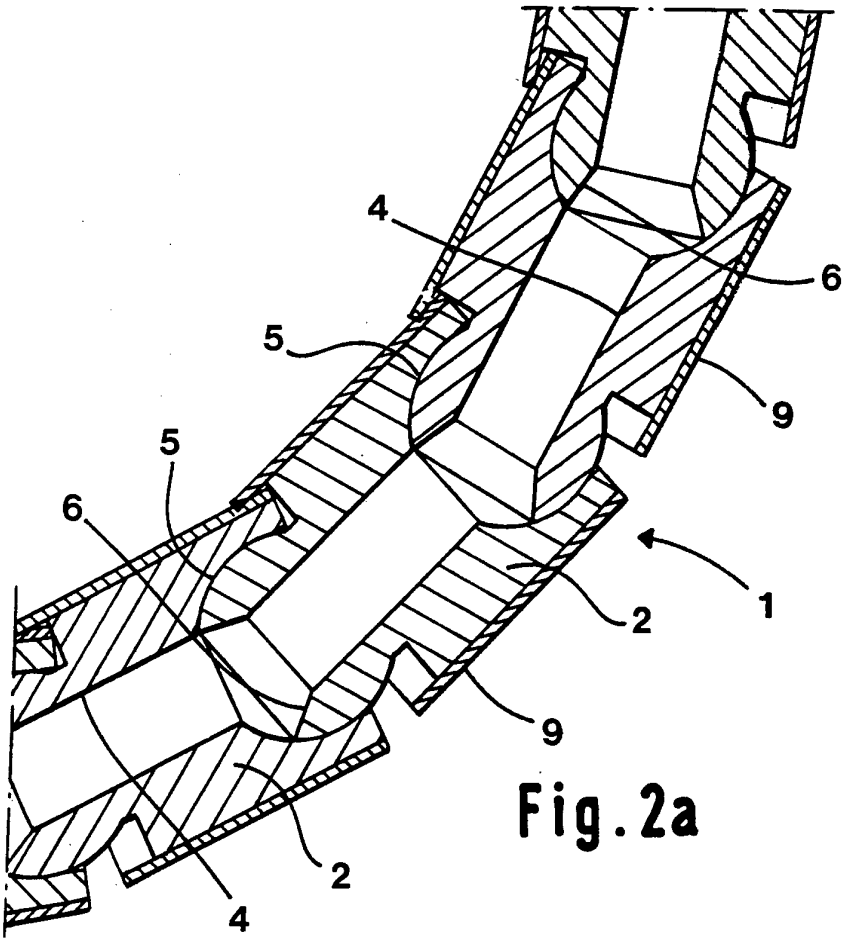

Fig. 2a

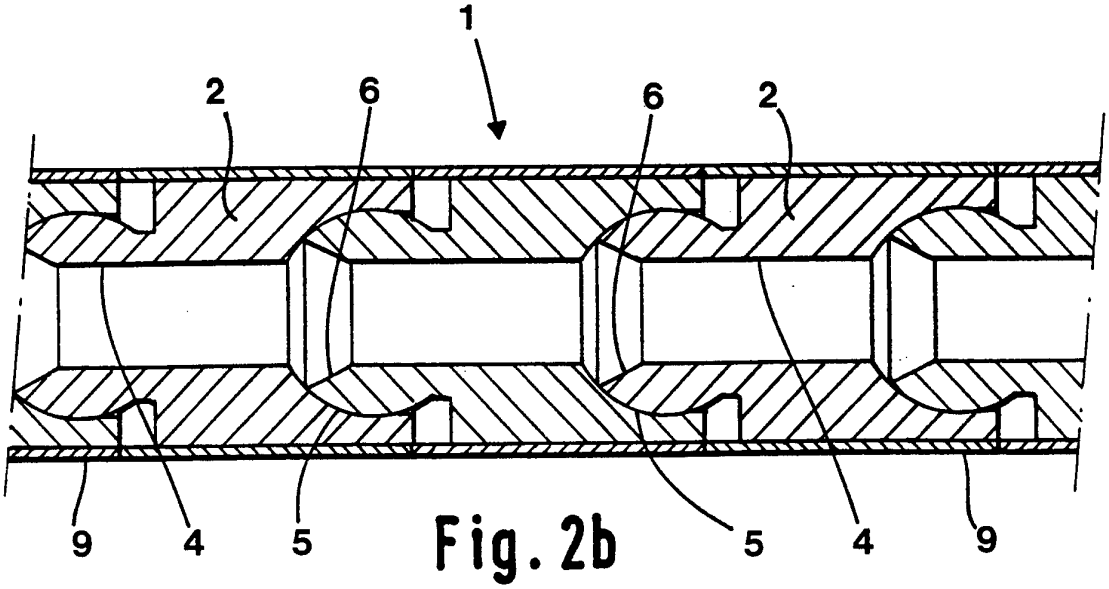

Fig. 2b

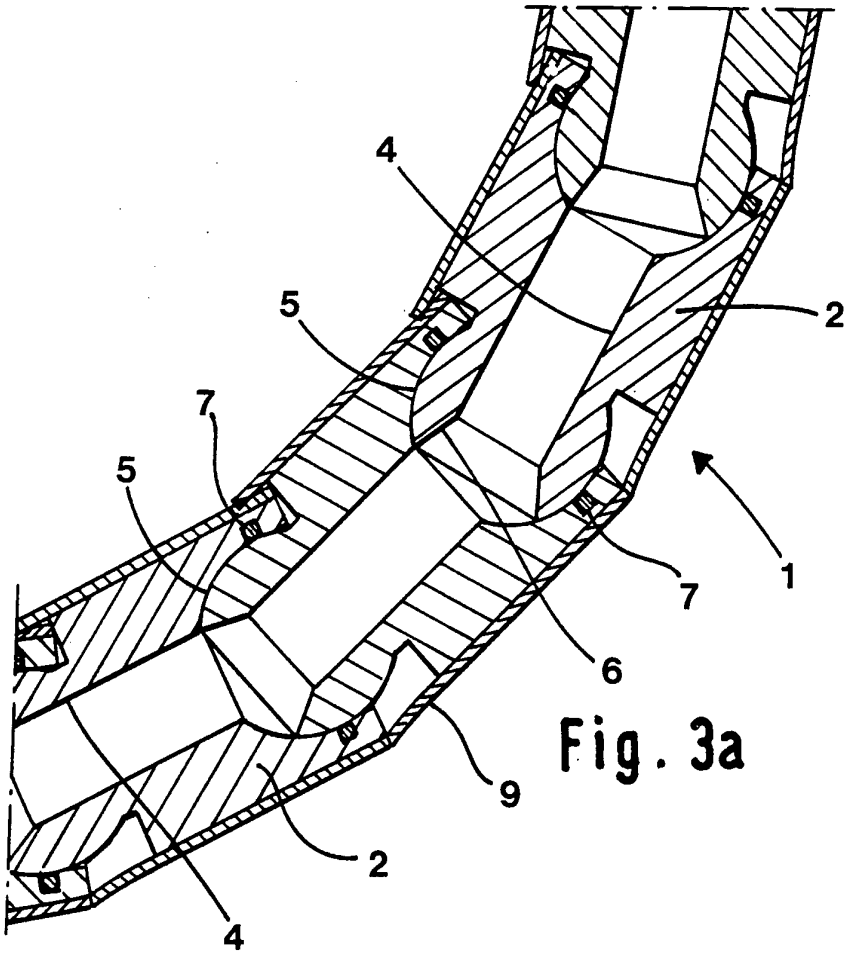

Fig. 3a

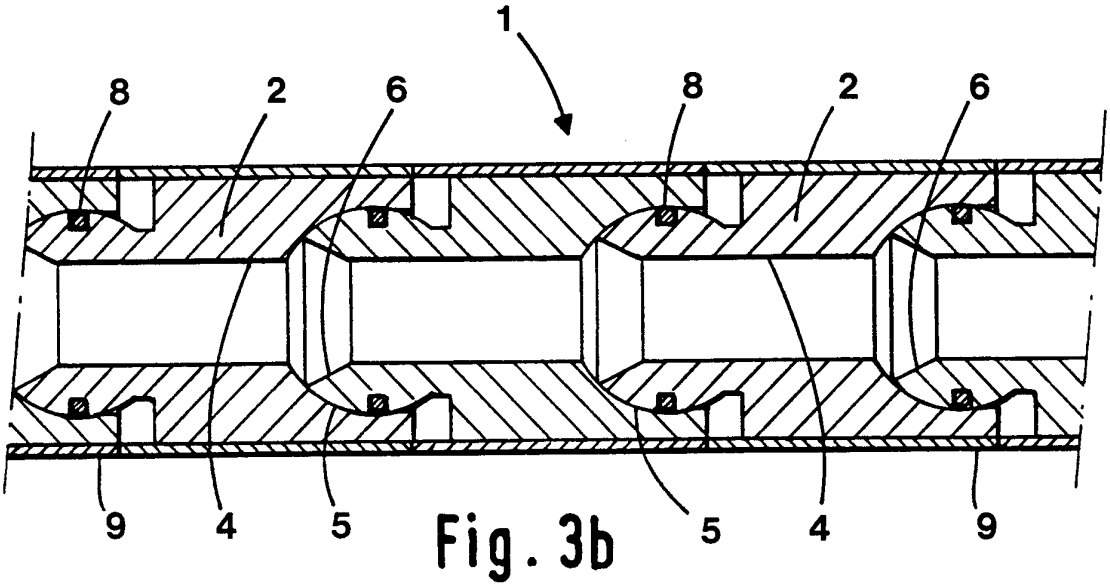

Fig. 3b

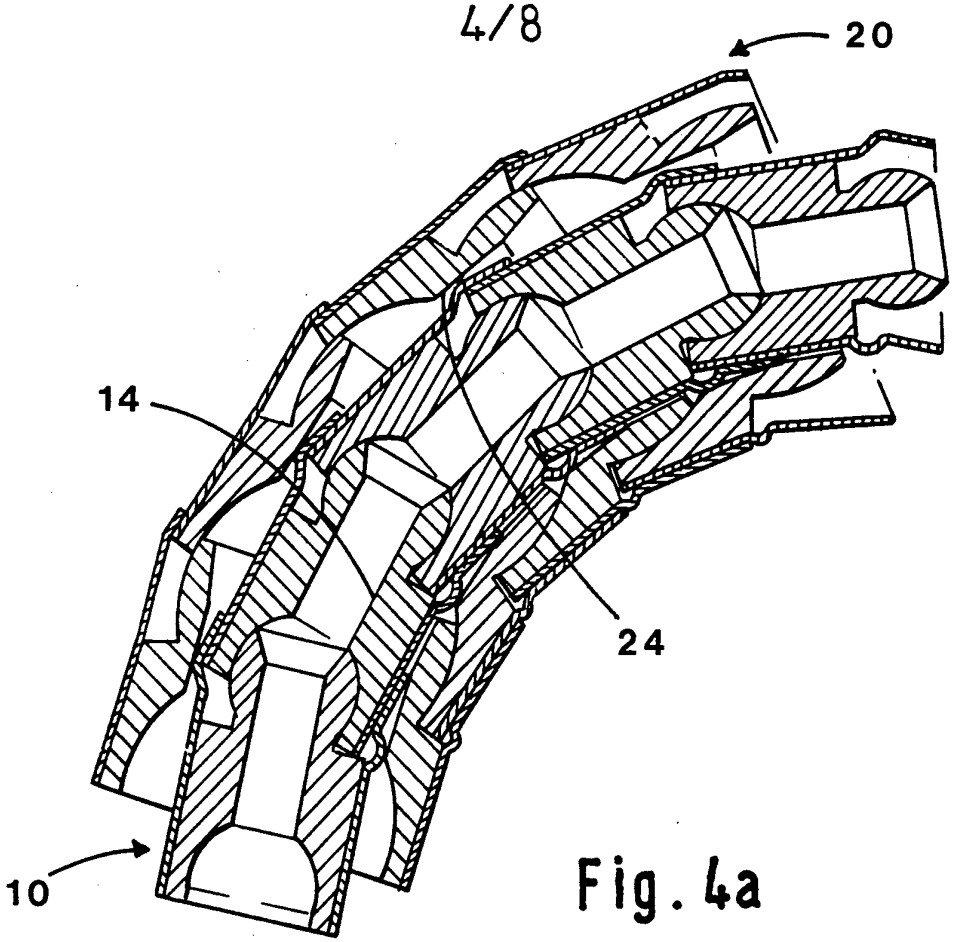

Fig. 4a

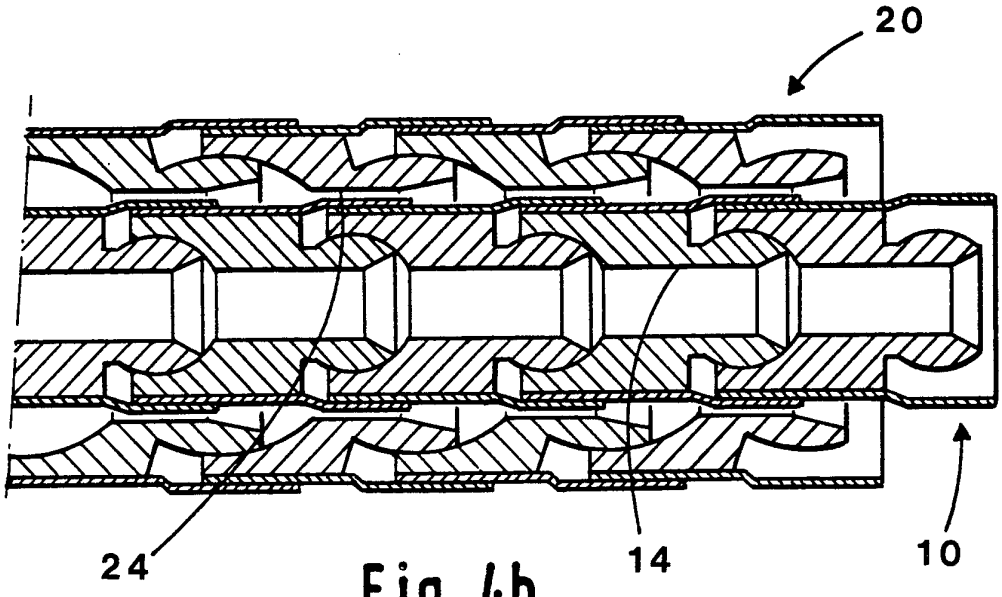

Fig. 4b

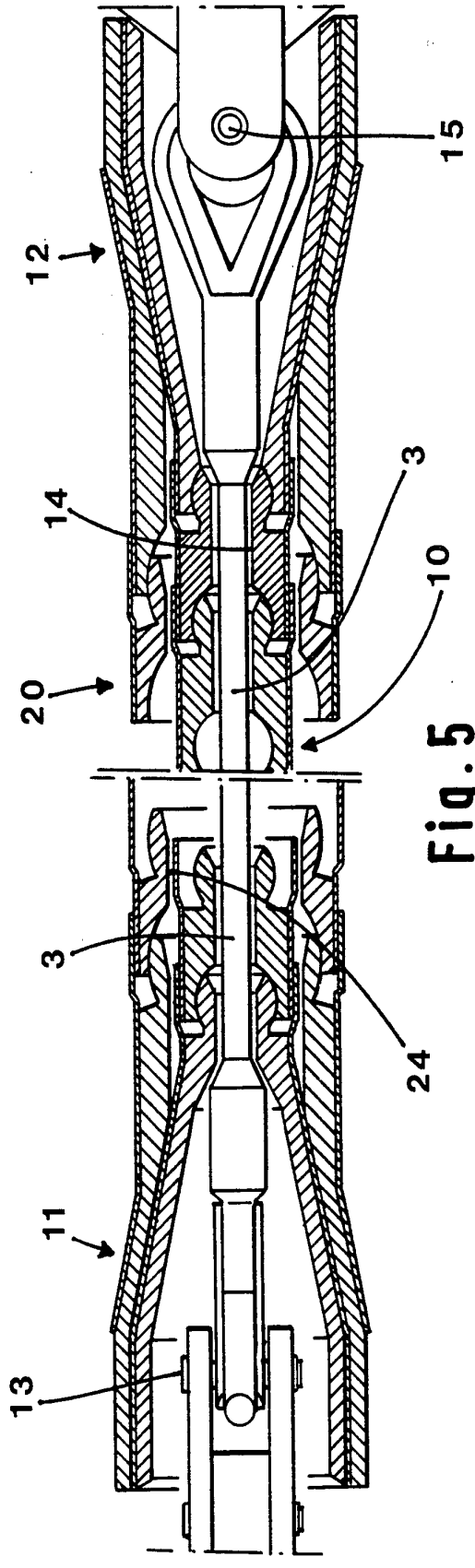

Fig. 5

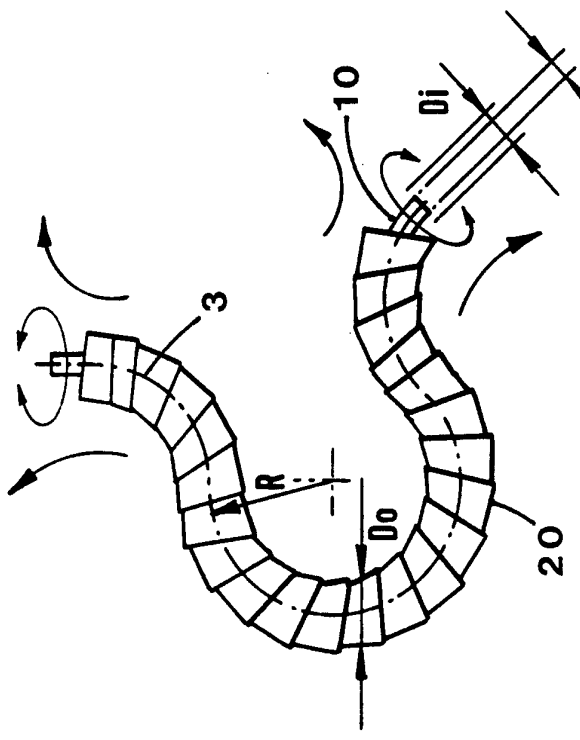

Fig. 6

TYPICAL DIMENSIONS

MBL	Designed to last 2 hours Hydrocarbon Fire						4 hours					
	Approx. Do	Approx. Di	drope	Approx. Weight	R		Approx. Do	Approx. Di	drope	Approx. Weight	R	
tons	mm	mm	mm	kg/m	mm		mm	mm	mm	kg/m	mm	
300	305	100	75.2	54	1000		530	100	75.2	175	1000	

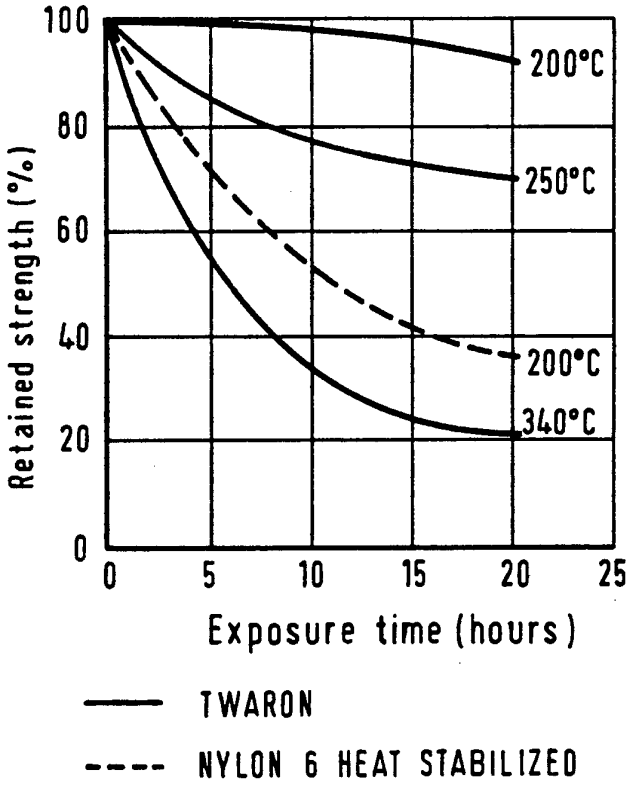
100
80
60
40
20
0
Retained strength (%)
0
5
10
15
20
25
Exposure time (hours)
200°C
250°C
200°C
340°C
TWARON
NYLON 6 HEAT STABILIZED

Fig. 7

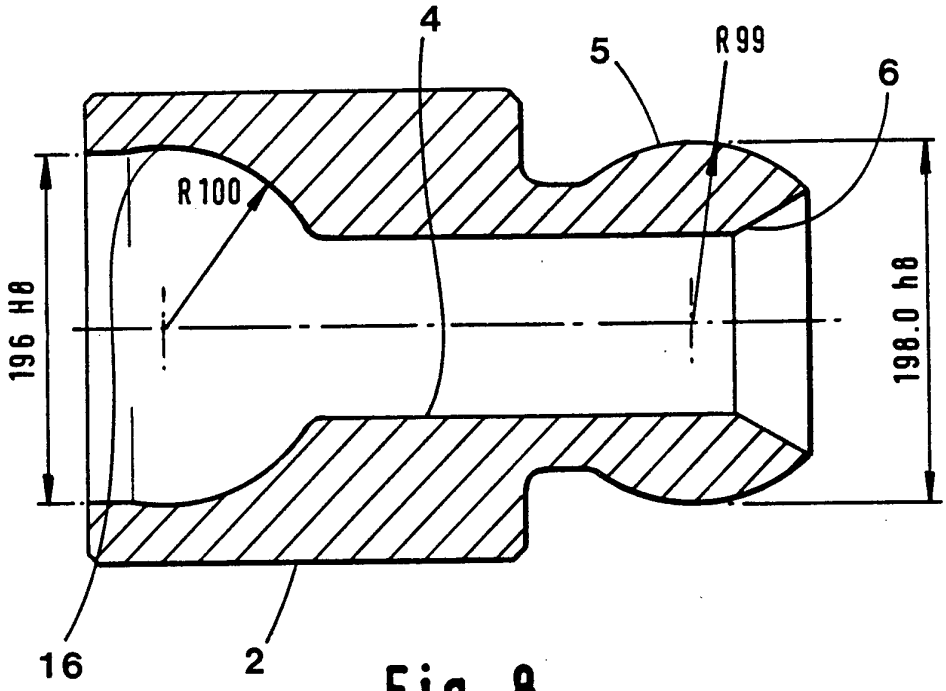

Fig. 8

INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 92/00110

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: F 16 L 57/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	F 16 L

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	DE, C2, 3107045 (MOSKOVSKIJ STANKOSTROITEL'NYJ ZAVOD "KRASNYJ PROLETARIJ" IMENI A.I. EFREMOVA) 9 September 1982, see the whole document --	1-7

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"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
8th January 1993	25 -01- 1993
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Anita Skeppstedt

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/NO 92/00110

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 02/12/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-C2- 3107045	82-09-09	NONE	