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(54) **Protected cable device for the safe lifting and handling of materials**

Vorrichtung mit geschütztem Kabel zum sicheren Heben und Transportieren von Material

Dispositif à câble protégé pour le levage et le transport fiable de matériaux

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Description

[0001] The present invention relates to a novel design of a protected cable device for safely lifting and moving materials. The cable is provided with eyelets at its ends and used for lifting and moving loads of all types. The cable which forms the body of the protected cable device may be made equally well of metallic, textile, synthetic or mixed materials depending on the various materials with which the device itself is to be used and, in accordance with the invention, the external surface of this cable is provided with a protective layer.

[0002] For a long time it has been known, in the art, to use bare loop-shaped cables provided with eyelets at their ends, commonly called slings, for lifting and moving materials and loads in general. After arranging one or more slings around and underneath the material to be moved, the end eyelets of the slings are attached to a lifting and moving means which, depending on the circumstances, may be a crane, a bridge crane, a derrick, the tooth of a mechanical shovel and the like, such that the load may be lifted and moved in the desired manner.

[0003] The abovementioned loading slings are at present very commonly used - both individually and, more frequently, in pairs - in all those cases where heavy materials must be moved and, owing to the great degree of versatility of application, they are used practically in every type of industry and goods handling station. They are therefore widely used, for example, in ports, for loading and unloading ships, in mechanical and iron-and-steel processing workshops, in stone material quarries and in sawing mills and workshops for processing said stone materials in the form of both blocks and slabs.

[0004] The protected cable device according to the present invention is in particular intended to be used in all those cases - i.e. typical of the stone material excavation and processing industry - where at present slings of the known type are used in direct contact with the material to be moved.

[0005] In these cases, in fact, the sling is subject to particularly intense wear due to rubbing against the material to be moved. Moreover, since, during lifting, the weight of the material is concentrated only at the points where the material to be moved makes contact with the sling, the section of the sling at said contact points is stressed in an anomalous manner, often beyond the yield limit of the material from which it is made. This gives rise to numerous drawbacks which have particularly adverse consequences for slings formed by cables which are at least partially metallic, said slings forming moreover the vast majority of the slings used for heavy work.

[0006] A first drawback is associated with the fact that the high flexing to which the sling is subject at the points of contact, together with the abrasive action exerted thereon by the material which is moved, results in rapid and frequent breakage of the individual elemental wires which form the strands of the cable. Since the overall number of these breakages may be perceived in an approximate manner only from an external examination of the cable, in order to eliminate any possibility of breakage of the sling and therefore serious danger for the safety of the operators involved, the sling must be periodically replaced at fairly frequent intervals. In the case where the sling is subject to intense and continuous use, replacement of the sling must be performed very frequently, i.e. about once a week or once every few weeks, therefore resulting in not insignificant costs.

[0007] A second drawback arises from the fact that very frequently - as, for example, in the case of blocks or slabs of stone materials - the point of contact between the material to be moved and the cable of the sling is a sharp edge. In these cases, at the point of contact, the cable undergo ovalisation and deformation of its cross-section, and this condition, in addition to leading to the already mentioned breakage of the individual wires, results in a reduction in the maximum hanging load of the sling. In the vicinity of the edge, in fact, some of the cable fibres are subject to compressive stresses and the working cross-section of the cable which is able to withstand the tensile stresses imparted by the load is therefore correspondingly reduced.

[0008] A third problem, which operators using sling known devices often complain of, is associated with the fact that, due to repeated local stresses following the lifting operations, the cable of the sling undergoes permanent deformation which causes the formation of coiled and/or angularly deformed zones along the length of the sling. This deformation result not only in greater difficulty of use and correct positioning of the sling around the material to be moved, but also in inevitable longitudinal dragging of the sling over the material to be lifted before it assumes an extended configuration, with consequent greater wear of the sling.

[0009] A further drawback, which also poses a considerable risk for the safety of the operators, is associated with the damage which may be caused by the elemental wires of the cable following their breakage. These wires, in fact, owing to their elasticity, when loose and detached from the strands which form the cable are always directed towards the outside of cable surface and therefore may easily cause injury to the hands of the operators or to other unprotected parts of the body which may - also accidentally - come into contact with the cable.

[0010] A further drawback finally arises from the rapid corrosion of the sling which may be caused by the environmental and climatic conditions, said corrosion being accelerated by the abovementioned breakage of the elemental wires of the cable and also leading to more rapid deterioration in the mechanical features of the sling and, eventually, to a further reduction in the duration of its working life.

[0011] The object of the present invention is therefore that of overcoming all the drawbacks examined above by proposing an improved protected cable device which allows materials of any type to be lifted and moved with-

out this resulting in permanent damage or deformation of the load-bearing cable and consequently increasing considerably the working life of the protected cable device and decreasing significantly the risks of injury for the operators involved in the material moving operations.

[0012] GB-A-1 102 672 discloses a rope slings for use in lifting loads, particularly hot loads, comprising a resiliently flexible helical member mounted on a rope stretch to protect the same from abrasion, cutting, heat and pressure, while permitting flexing thereof. The helical member is fixed to the rope at its opposed ends only.

[0013] This object is achieved, according to the present invention, by means of a protected cable device comprising a stranded metallic cable provided with eyelets at its ends, at least one portion of said cable being covered by at least one cylindrical spiral spring element concentric with said cable portion, characterized in that it further comprises a continuous layer of plastic or elastomeric material adhering to the cable and including said spiral spring element.

[0014] Further features and advantages of the present invention will emerge, however, more clearly from the following detailed description of a few preferred embodiments thereof, with reference to the accompanying drawings in which:

Figs. 1 and 2 are schematic perspective views which illustrate possible uses of a pair of slings and a single sling of the known type, respectively;

Fig. 3 is a schematic front view of a portion of a bare cable which is used for slings of the known type and which forms the load-bearing element of the protected cable device according to the present invention;

Fig. 4 is a schematic front view of a section of a protected cable device of the known type ;

Fig. 5 is a longisection view along the line V-V of Fig. 4;

Fig. 6 is a front schematic view of a section of the protected cable device according to the invention; and

Fig. 7 is a longisection view along the line VII-VII in Fig. 6.

[0015] Figs. 1 and 2 illustrate a typical use of the slings of the known type for lifting stone materials, such as marble and granite, in the form of blocks M (Fig. 1) or slabs L (Fig. 2), respectively.

[0016] In the first case a pair of slings B of the known type is used, said slings being arranged, in the manner shown, around the block M and then being attached at their eyelet ends (not shown in the drawing) to a hook G of a lifting and moving means T of the type described above. In the second case a single sling B of the known type is used, said sling being arranged around a set of slabs L in the vicinity of the middle thereof, such that the load is all the same batanced.

[0017] From the abovementioned figures it can be clearly seen that the slings of the known type are subject, at the edges of the block M or the slabs L, to angular deformations of up to 90° of curvature over a very short portion, said deformations being precisely one of the main causes of the drawbacks described further above, considering that the cable F currently used for making the known type of slings - shown in Fig. 3 - is a bare cable and therefore a cable which exposes directly to the load the external surface consisting of the individual strands from which it is formed.

[0018] According to the main feature of the present invention, the protected cable device according to the invention uses said cable F as a load-bearing element, with the formation, however, around the same, of a substantially continuous, thick, flexible reinforcement sheathing fixed to the cable and made of a suitable resilient material. Thanks to said reinforcement sheathing, it is possible to obtain some essential functions for the protection of the cable.

[0019] The reinforcement sheathing of the cable F prevents direct contact between the cable F and the load to be moved and thus eliminates any wear of said cable due to the load, this wear instead occurring on the reinforcement sheathing and therefore without any negative consequence since the reinforcement sheathing does not have any load-bearing function, In order to achieve this result, the reinforcement sheathing must be preferably fixed in a longitudinal direction with respect to the cable F so as to prevent any relative slipping between cable and reinforcement sheathing; said slipping could in fact give rise to undesirable wear of the same reinforcement sheathing and/or the load-bearing cable.

[0020] According to a second equally important function, the reinforcement sheathing of the cable F has the function of "moving away" the section of the cable F from the point of contact with the material to be moved and thus allows the cable to operate in a statically more correct manner in the edges zones, i.e. with a radius of curvature which is markedly greater than that actually present in the current bare slings. In this way it is possible to avoid, in particular, those anomalous stresses of the cable which are responsible for yielding thereof and the consequent permanent deformation induced in the cable as well as breakage of the elemental wires forming the same. In order to achieve this result, it is important for the reinforcement sheathing to have a sufficiently high overall thickness, for example in a range comprised between 15 and 30% of the total diameter of the protected cable device according to the invention.

[0021] Finally, the abovementioned reinforcement sheathing has a third important function, namely that of providing a "hooping" effect on the cable, thus preventing or significantly reducing the ovalisation or deformation in the zones in contact with the load and in particular in the

edges zones. It is thus possible to ensure that there are no substantial reductions in the maximum hanging load of the protected cable device according to the invention, even when the latter is used for directly lifting and moving materials with sharp edges.

[0022] The reinforcement sheathing of the cable F suitable for forming the protected cable device according to the invention may be made of different materials, i.e. both homogeneous and composite materials, and have different forms - also depending on the use for which the protected cable device is intended - so as to be able to provide all the abovementioned functions in the best way. Thus it is important that said material have a sufficiently high degree of elasticity so as to be able to withstand the stresses imparted to the same during use of the protected cable device, without undergoing permanent deformation except after a very long period of use compared to the average working life of slings of the known type. It is also important that at least the external part of the reinforcement sheathing be made of a material which is wear-resistant and, finally, that the reinforcement sheathing have an adequate shape rigidity in the transverse direction to ensure a good hooping effect, and an optimum shape flexibility in the longitudinal direction such that the protected cable device may fit without any problem to the various shapes of the materials to be moved, with a flexibility similar to that of slings of the known type.

[0023] According to an embodiment, illustrated in Figs. 4 and 5, said reinforcement sheathing consists of a spring element 1, of example a cylindrical spiral spring. From the studies and practical tests carried out by the inventors, it has in fact been possible to ascertain that a reinforcement sheathing of this type is one which, while having a very low cost, is able to provide the abovementioned performance in the best way. The spring element 1 is arranged, coaxially, around the cable F and has an internal diameter slightly greater than the external diameter of the cable F such that it may be easily mounted thereon. Relative fixing of the cable F and the spring element 1 is achieved by means of fixing sleeves located at the ends of the spring element 1 and, if necessary, also in one or more intermediate positions thereof, or using other suitable fixing systems of a type per se known. The coils of the spring element 1 are arranged very close to each other, i.e. practically nearly adjacent, so as to provide a substantially continuous external surface 1c contacting the material to be moved. The cross-sectional shape of each individual coil is generally of the circular type, although other shapes are possible, for example in order to ensure a more continuous external surface of the spring.

[0024] According to a variation of the embodiment described above, two spring elements, one of which is screwed inside the other, are used so as to form a substantially continuous external surface. It is possible, however, to use any other type of protective reinforcement sheathing, both of a metallic and non-metallic nature, provided that this reinforcement sheathing - formed by a single element or also by several elements joined or hinged together - is able to ensure the necessary already mentioned longitudinal flexibility and transverse rigidity of the protected cable device and, at the same time, provide the latter with a substantially continuous external surface.

[0025] The reinforcement sheathing consisting of the spring element 1 may extend over the whole length of the protected cable device, i.e. from eyelet to eyelet, or cover only the section of the protected cable device which comes into contact with the material to be moved.

[0026] According to the embodiment of the invention, which is illustrated in Figs. 6 and 7 and is particularly suitable for more demanding applications of the protected cable device, the reinforcement sheathing consisting of the spring element 1 is supplemented by a layer 2 of plastic or elastomeric material. In making this composite reinforcement sheathing, the metallic reinforcement sheathing consisting of the spring element 1 is first mounted on the cable F and the layer of plastic or elastomeric material 2 is then formed thereon and on the cable F by means of a process involving injection moulding or immersion in a molten-material bath or also using other known coating methods, provided that they are suitable for the formation of a coating 2 having a high thickness and a good adhesion to the cable F, as required in accordance with the invention.

[0027] The thickness of the layer 2 must in particular be such as to cover completely the spring element 1 which is thus completely included therein and the method used for making this layer must be such as to allow penetration of the plastic or elastomeric material also between the individual wires which form the strands of the cable F. In this way the adhesion of the layer 2 - and consequently of the spring element 1 - to the cable F is considerably increased and moreover the frictional forces between the individual metal strands of said cable are significantly reduced, since the plastic or elastomeric material acts as an "internal lubricant" for the cable, thus also increasing for this reason the durability of the protected cable device according to the invention.

[0028] A protected cable device provided with this latter type of reinforcement sheathing is apt to ensure maximum strength for any type of use, also in the case of materials which are particularly hard and have cutting or sharp edges, as in the case of blocks and slabs of stone materials and/or ferrous materials. The reinforced sheathing formed by the two above said materials show, in fact, thanks to a synergic mutual interaction between said materials an overall high resistance and stability both with respect to mechanical stresses and with respect to wear due to friction and the corrosive action of the environment. Furthermore, the presence of the external layer of plastic or elastomeric material increases the frictional force between the protected cable device and the material to be lifted or moved, thus preventing any slipping which is very dangerous in particular when operating with a single device (Fig. 2). Finally, it is pos-

sible advantageously to use food grade polymers for the material forming the layer 2, thus making the reinforcement sheathing of the cable F completely non-toxic and safeguarding the health of the operators who come in contact with the protected cable device according to the invention, during manufacturing or use thereof.

[0029] From the above description it must be clear how the present invention has fully achieved the preset object, eliminating all the drawbacks associated with slings of the known type. The reinforcement sheathing formed on the cable F, which constitutes the load-bearing element of the protected cable device, in fact prevents any possible contact between said cable and the material to be moved and also ensures that the maximum curvature to which the elemental wires of the cable F are subject remains within the elasticity limits. In this way the possible breakage of said elemental wires is completely prevented and therefore the working life of the protected cable device is increased enormously compared to the working life of slings of the known type. Owing to this and also owing to the hooping effect of the reinforcement sheathing around the cable F, which prevents ovalisation or deformation of the said cable, the maximum hanging load of the cable F also remaining substantially unchanged over time and equal to its nominal value.

[0030] Further, the limitation of the maximum deformation of the cable F, on the one hand, and the transverse reinforcing effect of the reinforcement sheathing, on the other hand, eliminate entirely the typical coil formation to which slings of the known type are subject, thus ensuring safe and easy use of the protected cable device according to the invention during the whole of its working life.

[0031] Finally, the presence of the reinforcement sheathing radically prevents the elemental wires of the cable F from breaking and therefore from coming into contact with the operators using the protected cable device, thus avoiding any risk of harm or injury thereto.

[0032] It will be noted, finally, that the construction of the protected cable device according to the present invention may be obtained using methods and materials which are easily and widely available and have a low cost. It is therefore possible to manufacture said protected cable device at a very low cost such that the use thereof is much more advantageous compared to the use of slings of the known type in view of the extraordinary increase in its working life compared to the slings which are currently used.

[0033] The present invention has been described with particular reference to preferred embodiments thereof, but it must be clear that many possible variations are in the obvious reach of a person skilled in the art in order to adapt it to specific applications, for example modifying the type or form of the material used for the reinforcement sheathing or the method of application of the reinforcement sheathing to the load-bearing cable. All said variations are to be considered as comprised in the scope of the invention, whenever they fall within the definitions of the invention given in the appended claims.

Claims

1. Protected cable device comprising a stranded metallic cable (F) provided with eyelets at its ends, at least one portion of said cable (F) being covered by at least one cylindrical spiral spring element (1) of metallic material concentric with said cable portion, **characterized in that** it further comprises a continuous layer (2) of plastic or elastomeric material adhering to and including said portion of the cable (F) and the spiral spring element (1), to form therewith a composite reinforcement sheathing of the cable (F).

2. Protected cable device as in Claim 1, wherein said plastic or elastomeric material layer also extends between the individual wires which form the strand of said cable (F), adhering therewith.

3. Protected cable device as in any one of the Claims 1 to 2, wherein said reinforcement sheathing has a substantially continuous external surface.

4. Protected cable device as in any one of the Claims 1 to 3, wherein said reinforcement sheathing comprises one cylindrical spiral spring element (1) having coils arranged adjacent to each other.

5. Protected cable device as in any one of the Claims 1 to 4, wherein said reinforcement sheathing comprises two cylindrical spiral spring elements (1) which are screwed together one onto the other.

6. Protected cable device as in any one of Claims 5, wherein said cylindrical spiral spring elements has only a fitting slack with respect to said cable (F).

7. Protected cable device as in any one of the preceding Claims, wherein said layer (2) of plastic or elastomeric material is formed by means of a process involving injection-moulding or immersion in a bath of said material, in a molten state, of the cable (F) already covered by said spiral spring element(s) (1).

8. Protected cable device as in any one of the preceding Claims, wherein the overall thickness of said reinforcement sheathing is in the range comprised between 15% and 30% of the diameter of the protected cable device.

9. Protected cable device as in any one of the preceding Claims, wherein said stranded metallic cable (F) also comprises textile, synthetic or mixed materials.

Patentansprüche

1. Vorrichtung mit geschütztem Kabel, die ein verseil-

tes metallisches Kabel (F) umfaßt, das an seinen Enden mit Ösen versehen ist, wobei wenigstens ein Abschnitt besagten Kabels (F) von wenigstens einem zylindrischen Spiralfederelement (1) aus metallischem Material überdeckt ist, das konzentrisch mit besagtem Kabelabschnitt ist, **dadurch gekennzeichnet, daß** es weiter eine kontinuierliche Schicht (2) aus Kunststoffmaterial oder elastomerem Material umfaßt, das an besagtem Abschnitt des Kabels (F) und dem Spiralfederelement (1) anhaftet und diese einschließt, um damit eine Verbundverstärkungsummantelung des Kabels (F) zu bilden.

2. Vorrichtung mit geschütztem Kabel nach Anspruch 1, **dadurch gekennzeichnet, daß** besagte Kunststoffmaterialschicht oder elastomere Materialschicht sich auch zwischen den einzelnen Drähten erstreckt, die den Strang besagten Kabels (F) bilden, an dem sie anhaftet.

3. Vorrichtung mit geschütztem Kabel nach einem der Ansprüche 1 bis 2, **dadurch gekennzeichnet, daß** besagte Verstärkungsummantelung eine im wesentlichen kontinuierliche Außenfläche besitzt.

4. Vorrichtung mit geschütztem Kabel nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, daß** besagte Verstärkungsummantelung ein zylindrisches Spiralfederelement (1) mit Wicklungen umfaßt, die benachbart zueinander angeordnet sind.

5. Vorrichtung mit geschütztem Kabel nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, daß** besagte Verstärkungsummantelung zwei zylindrische Spiralfederelemente (1) umfaßt, die eine auf die andere miteinander verschraubt sind.

6. Vorrichtung mit geschütztem Kabel nach Anspruch 5, **dadurch gekennzeichnet, daß** besagte zylindrische Spiralfederelemente nur einen Paßschlupf im Hinblick auf besagtes Kabel (F) aufweisen.

7. Vorrichtung mit geschütztem Kabel nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, daß** besagte Schicht (2) aus Kunststoffmaterial oder elastomerem Material mittels eines Verfahrens hergestellt ist, das Spritzguß oder Eintauchen in ein Bad besagten Materials, in einem geschmolzenem Zustand, des bereits mit besagtem(n) Spiralfederelement(en) (1) überdeckten Kabels (F) umfaßt.

8. Vorrichtung mit geschütztem Kabel nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, daß** die Gesamtdicke besagter Verstärkungsummatelung im Bereich liegt, der zwischen 15% und 30% des Durchmessers der Vorrichtung mit geschütztem Kabel liegt.

9. Vorrichtung mit geschütztem Kabel nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, daß** das verseilte metallische Kabel (F) auch Textilmaterialien, synthetische Materialien oder gemischte Materialien umfaßt.

Revendications

1. Dispositif à câble protégé comportant un câble métallique toronné (F) pourvu d' oeillets à ses extrémités, au moins un tronçon dudit câble (F) étant recouvert d'au moins un élément à ressort hélicoïdal cylindrique (1) en matière métallique concentrique avec ledit tronçon de câble, **caractérisé en ce qu'**il comporte en outre une couche continue (2) de matière plastique ou élastomérique adhérant audit tronçon de câble (F) et à l'élément à ressort hélicoïdal (1) et les incluant afin de former avec eux une gaine de renfort composite du câble (F).

2. Dispositif à câble protégé selon la revendication 1, dans lequel ladite couche de matière plastique ou élastomérique s'étend aussi entre les fils individuels qui forment le toron dudit câble (F) y adhérant.

3. Dispositif à câble protégé selon l'une des revendications 1 ou 2, dans lequel ladite gaine de renfort a une surface extérieure sensiblement continue.

4. Dispositif à câble protégé selon l'une quelconque des revendications 1 à 3, dans lequel ladite gaine de renfort comporte un élément à ressort hélicoïdal cylindrique (1) ayant des spires agencées de façon à être adjacentes les unes aux autres.

5. Dispositif à câble protégé selon l'une quelconque des revendications 1 à 4, dans lequel ladite gaine de renfort comporte deux éléments à ressorts hélicoïdaux cylindriques (1) qui sont vissés ensemble l'un sur l'autre.

6. Dispositif à câble protégé selon la revendication 5, dans lequel lesdits éléments à ressorts hélicoïdaux cylindriques ne présentent qu'un jeu de montage par rapport audit câble (F).

7. Dispositif à câble protégé selon l'une quelconque des revendications précédentes, dans lequel ladite couche (2) de matière plastique ou élastomérique est formée au moyen d'un procédé impliquant un moulage par injection ou une immersion dans un bain de ladite matière, dans un état fondu, du câble (F) déjà recouvert dudit élément ou desdits éléments à ressorts hélicoïdaux (1).

8. Dispositif à câble protégé selon l'une quelconque des revendications précédentes, dans lequel l'épais-

seur globale de ladite gaine de renfort se situe dans la plage comprise entre 15 et 30 % du diamètre du dispositif à câble protégé.

9. Dispositif à câble protégé selon l'une quelconque des revendications précédentes, dans lequel ledit câble métallique toronné (F) comprend aussi des matières textiles, synthétiques ou mélangées.

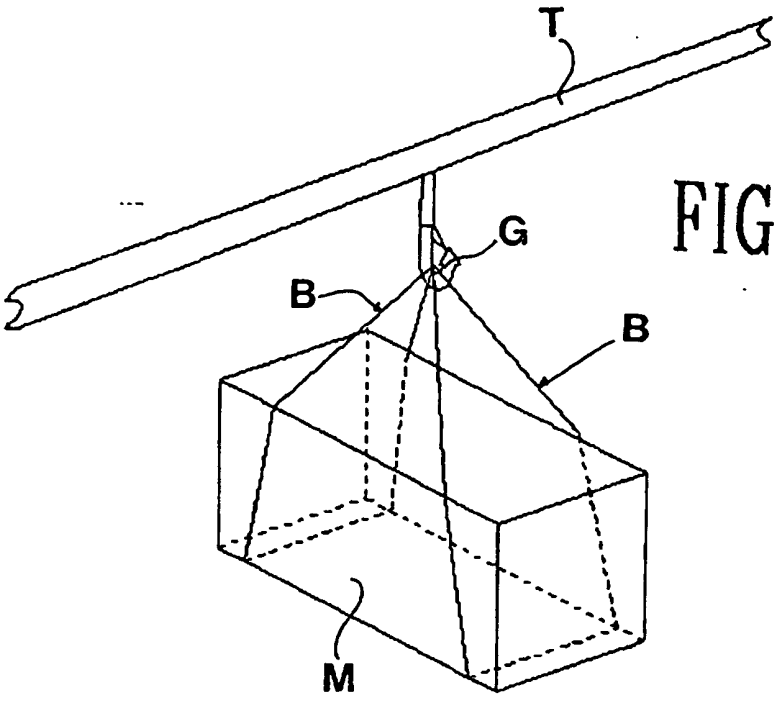

FIG.1

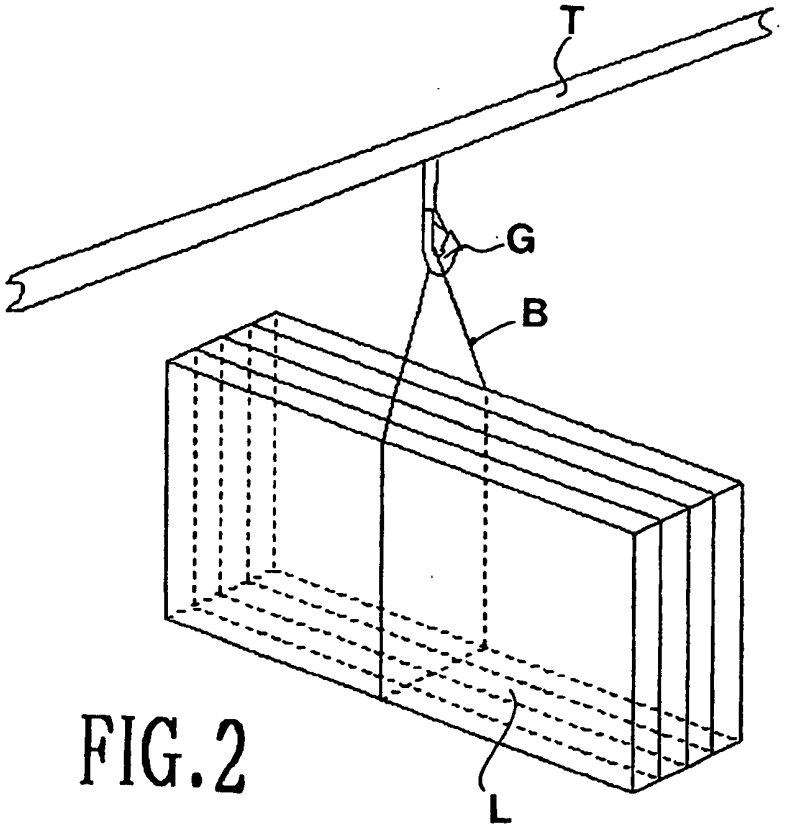

FIG.2

FIG.3

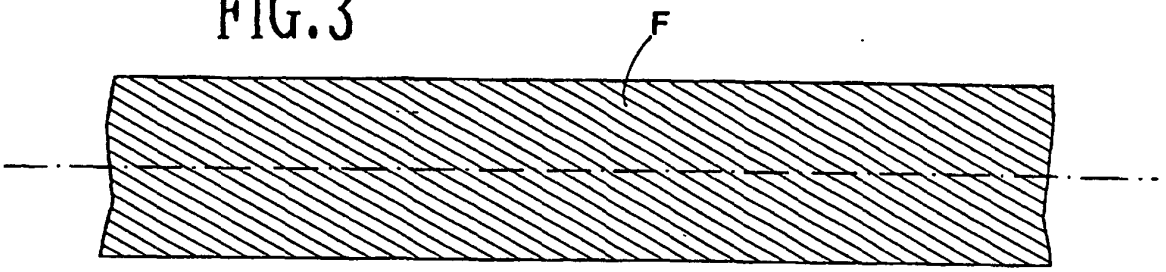

FIG.4

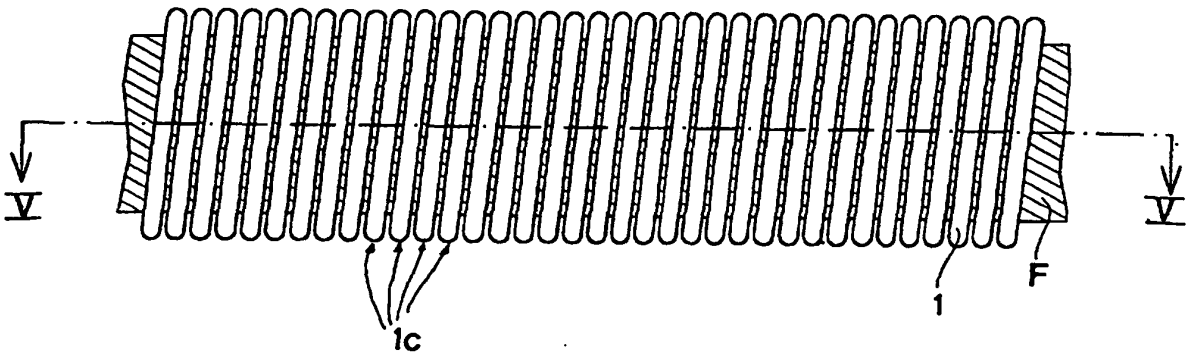

FIG.5

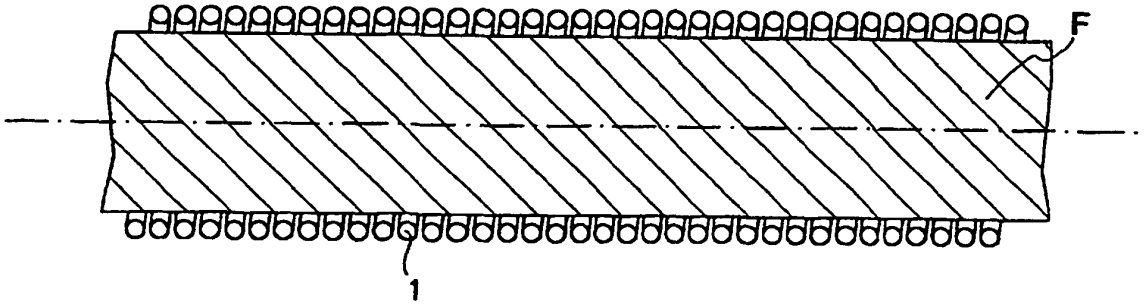

FIG.6

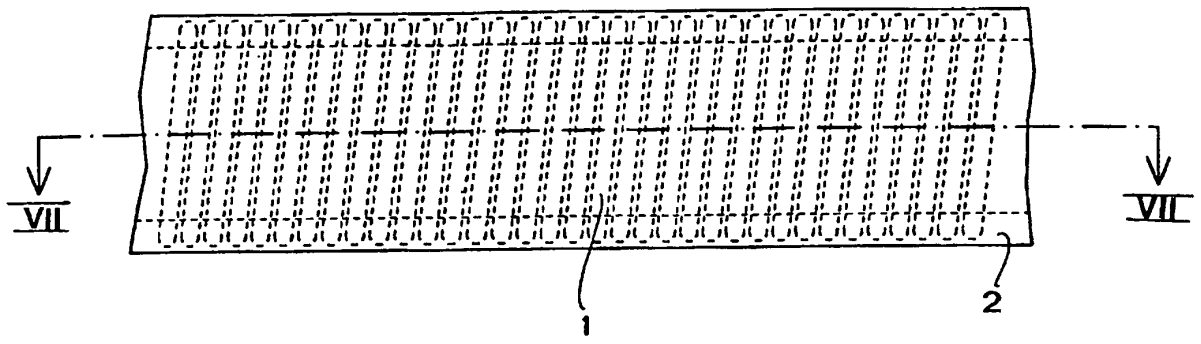

FIG.7