(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 186 565 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
10.12.2003 Bulletin 2003/50

(51) Int Cl.[7]: **B66B 7/12**

(21) Application number: **01830546.6**

(22) Date of filing: **21.08.2001**

(54) **Magnetic-inductive device for the control of multiple steel-wire ropes**

Gerät für magnetisch-induktive Kontrole von mehreren Stahlseilen

Dispositif de controle magnétique-inductif de plusieurs cables d'acier

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR

(30) Priority: **22.08.2000 IT TS000006**

(43) Date of publication of application:
13.03.2002 Bulletin 2002/11

(73) Proprietor: **Security Control S.r.l.**
34019 Sistiana (TS) (IT)

(72) Inventor: **Visintin, Roberto**
34129 Trieste (TS) (IT)

(56) References cited:
US-A- 4 427 940
US-A- 5 828 213

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 186 565 B1

Printed by Jouve, 75001 PARIS (FR)

Description

Technical Field

[0001] This invention consists in a device which allows a non-destructive testing of multiple steel wire ropes and is therefore suitable for the periodic inspection of elevator wire ropes, of goods lifts and of all the installations containing multiple steel wire ropes.

Background Art

[0002] The non-destructive testing of steel wire ropes is a procedure adopted to check the state of the wire ropes of the installations for the public transportation of people (wire ropeways, carways, chair lifts, ski lifts, etc.) or materials (goods lifts, cranes, hoists, tackles, etc.). These periodic inspections are aimed at preventing the deterioration of wire ropes, which may be caused by many factors: breaking of the wire ropes due to fatigue or anomalous scraping, corrosion, anomalous distribution of tensions due to manufacture or assembly defects, etc.

[0003] One of the non-destructive testing systems, known for many years, is based on magnetic induction. It consists in the introduction of a single wire rope in a device which exploits magnetic induction and in the sliding of this wire rope within the device itself. In case of fixed wire ropes, the device slides along the wire ropes.

[0004] Each device of this type consists essentially of an inductor with permanent magnets. They generate one o two circular magnetic fields which are generally tangent to the wire rope. Only the USA patent 4,495,465 describes the generation of two magnetic fields with the same axis of the wire rope to be tested. The wire rope is magnetized by the magnetic field generated by the inductor. Any discontinuity of the wire rope, both internal and external, provokes perturbations in one o more magnetic fields around the wire rope, which are sensed by special measure coils. These perturbations, as a consequence of the magnetic induction principle, create an inductive electromotive force that provokes an electric power which reaches the signal power point. From that point the electric power is taken through power cables to an analogical recorder, placed at some distance, which is able to amplify it and to print a diagram on continuous paper. The reading of this diagram allows to identify any anomaly of the wire rope, both external (breaking of the wires, flattenings, deformations) and internal (breaking of the wires, corrosions, deterioration of the core).

[0005] Present devices permit to verify only one wire rope at a time, because they generate a circular magnetic field. This is due to the disposition of the magnets within the device. If this kind of device were to be used to test more wire ropes, the reading, which is the sum of the perturbations within the magnetic field provoked by all the wire ropes at the same time, would be incorrect, because the coils are placed circularly around the sliding section. This lack of precision is due to the fact that anomalies of the wire ropes which are more distant from the coils provoke a weaker signal than the same anomalies of the wire ropes which are closer to the coils. The analysis of the diagram obtained under these circumstances may lead to wrong conclusions as regards the situation of the wire ropes.

[0006] As elevators use a multiple wire rope system in which wire ropes are parallel on the same plane, the use of magnetic-inductive devices with circular field does not give reliable results.

[0007] Consequently, the system currently used to control the wire ropes of these lifting facilities is visual, accompanied with empirical systems like the use of cotton wires or a small wooden bar exclusively to find out any breaking of the external wires.

[0008] Obviously, these empirical control systems have many disadvantages, mainly due to the limited field of vision of the human eye, to the contemporary movement of different wire ropes which need testing, and to the masking of these wire ropes by their lubricant. More importantly, the internal anomalies of the steel wire ropes go unnoticed.

Summary of the invention

[0009] The main purpose of this invention is to put at the user's disposal a device permitting a contemporary non-destructive testing of more steel wire ropes.

[0010] This and other aims are achieved by the device described in this patent, which is composed of two moduli, which internally are fundamentally specular. These moduli are fixed to each other through hinges or joint pins and clamping elements like lever locks.

[0011] Each modulus has at least one magnet, at least one coil, a signal power point, two rollers and a shell which supports and/or protects these elements. Each magnet develops along the wire ropes axis. When a modulus has more magnets, these are placed on one or more planes parallel to that of the wire ropes. Each coil may be wrapped around one or more magnets. These coils can be substituted, in each modulus, by one single coil placed between the magnets and the steel wire ropes.

[0012] The lateral supports of the shell consist of two plates having an axis parallel to that of the wire ropes. These supports are fixed to an upper plate and a lower plate, both plates having their axis orthogonal to that of the wire ropes. These plates create the pole pieces. Finally, the shell of each modulus contains two U-shaped plates, having their axis parallel to that of the wire ropes and constituting the fore frontal covering and the back frontal covering. The first covering delimits the sliding section of the wire ropes, the second protects the magnetic components.

[0013] The inductor is composed of the pole pieces and the permanent magnets. These are made of high-

stability materials. The inductor can be easily remagnetized.

[0014] The coil/coils can be replaced by one or more Hall sensors, placed between the magnets and the steel wire ropes.

[0015] The coil or the Hall sensor are connected to a signal power point, placed on the external part of the modulus. When more coils or Hall sensors are used, they are connected to each other in series and with the signal power point.

[0016] The magnets are fixed to the plates constituting the pole pieces. Specific guides and ties of these plates permit the correct positioning of the magnets.

[0017] On the upper and lower parts of each modulus (with reference to the direction of the wire ropes) there is a roller, orthogonal to the wire ropes axis. To each roller of a modulus corresponds a roller on the other modulus, thus creating two couples of rollers (the upper couple and the lower couple), which allows the sliding of multiple wire ropes and their positioning in the section between the two moduli, at the centre of the device.

[0018] The roller shafts are placed in holes made on the lateral supports. The holes can also be created in stirrups fixed to the supports or to the plates constituting the pole pieces.

[0019] The two moduli, though essentially identical, are different. The holes of one of them, defined as principal, have a diameter slightly bigger than that of the shafts and, consequently, no change of their position is possible. In this case, to wire ropes of a certain diameter will correspond a roller with a proportional diameter, in order to keep the wire ropes at the centre of the device, between the two moduli. Alternatively, the two shafts placed in the principal modulus can be inserted in bushings with eccentric hole, which permits the shifting of the shafts and, consequently, the shifting of the rollers along the wire ropes, so that rollers of the same diameter can be used for wire ropes of different diameters.

[0020] Internal devices in the principal modulus keep the multiple wire ropes at the centre of the device with reference to the plates constituting its lateral supports.

[0021] The two shafts of the secondary modulus are inserted in lengthened slits, which develop orthogonally to the multiple wire ropes axis. As these rollers do not have a fixed rotation centre, they can be drawn closer to the rollers of the principal modulus. The simultaneous contact of each couple of rollers with the wire ropes is obtained and maintained through elastic elements which are applied between the corresponding shafts, on both sides.

[0022] Holes or slits on lateral supports are used to insert handles or other instruments aimed at securing the device to the desired position.

[0023] The rollers preferably have a cylindrical shape, with a axis transversal to the wire ropes axis and can be smooth and/or grooved.

[0024] This device permits a correct reading, valid for all the wire ropes examined contemporarily, because it magnetizes the section of the wire ropes to be checked with a longitudinal magnetic field of such an intensity to bring steel to saturation point. As a consequence of the saturation, a magnetic flux parallel to the field of the wire ropes surrounds them.

A Brief Description of the Drawings

[0025] More characteristics and advantages of the invention will become clearer from a description of some forms of execution, preferred but not exclusive, of the device and of its parts, which are preferable but not compulsory and are given for illustration purposes only in the enclosed drawings, in which:

- figure 1 shows a frontal view of the device;
- figure 2 shows an upper view of the device;
- figure 3 shows a lateral view of the device;
- figure 4 shows a transversal section of the device along the plane A-A;
- figure 5 shows a longitudinal section of the principal modulus along the plane B-B;
- figure 6 shows a transversal section, along the plane A-A, of a device having a different structure and disposition of the coils;
- figure 7 shows a longitudinal section, along the plane B-B, of the principal modulus of the device shown in figure 6;
- figure 8 shows a longitudinal section, along the plane C-C, of the principal modulus. It shows a first device to hold multiple wire ropes on their direction and in the centre of the device with reference to its lateral supports;
- figure 9 shows a transversal section, along the plane D-D, of this last modulus;
- figure 10 shows a longitudinal section, along the plane C-C, of the principal modulus. It shows a second device holding multiple wire ropes on their direction and in the centre of the device with reference to its lateral supports;
- figure 11 shows two transversal sections, along planes E-E and F-F, of this last modulus;
- figure 12 shows a frontal view of a sliding block with a smooth surface and a grooved surface;
- figure 13 shows a lateral view of this sliding block;
- figure 14 shows a frontal view of a grooved roller;
- figure 15 shows a lateral view of a bushing with an eccentric hole of the principal modulus;
- figure 16 shows a transversal section, along the plane G-G, of this bushing;
- figure 17 shows a lateral view of two rollers and of the elastic ring placed between the respective shafts which holds the two rollers tight to the wire ropes;
- figure 18 shows a lateral view of two rollers and of the spring placed between the respective shafts which holds the two rollers tight to the wire ropes.

Mode for Carrying Out the Invention

[0026] More precisely, the device is composed of two specular moduli 1, 2, connected through a hinge 3 and two lever locks 4. Each modulus 1, 2 contains twelve permanent magnets 5 which are placed on two planes parallel to the axis of the wire ropes 6. Each modulus contains six coils 7, wrapped around an equal number of magnets 5. The coils 7 of each modulus 1, 2 are connected electrically between them and to a signal power point 8 fixed to the external part of the modulus 1, 2. There can also be a single coil 7.1 in each modulus and it can be placed between the magnets 5 and the steel wire ropes 6, as shown in figures 6 and 7.

[0027] The magnets 5 of each modulus 1, 2 are protected by a shell. The shell is composed of two plates 9 constituting its lateral supports, of an upper plate 10, of a lower plate 11, of a fore frontal covering 12 and of a back frontal covering 13.

[0028] The longitudinal axis of the lateral supports 9, of the fore frontal covering 12 and of the back frontal covering 13 is parallel to the longitudinal axis of the wire ropes 6. The axis of the upper plate 10 and of the lower plate 11 is orthogonal to that of the wire ropes 6. The fore frontal covering 12 and the back frontal covering 13 are U-shaped. The magnets 5 are inserted in the guides of the upper plate 10 and of the lower plate 11. The magnets 5 are fixed to plates 10, 11, which function as pole pieces, through draught screws 10.1.

[0029] The plates 10, 11, together with the permanent magnets 5, constitute the magnetic inductor. The two plates constituting the lateral supports 9 and the plates constituting the fore frontal covering 12 and back frontal covering 13 are also fixed to the plates 10, 11.

[0030] The plates constituting the fore frontal covering 12 delimit the section of the sliding wire ropes 6. The fore frontal covering 12 and the back frontal covering 13 prevent accidental contacts, respectively, of the wire ropes 6 or of the operator's hands with the magnets 5 and the coils 7, 7.1.

[0031] The upper part and the lower part of each modulus 1, 2 have a roller 14 orthogonal to the wire ropes axis 6. To each roller 14 of the modulus 1 corresponds a roller 14 of the other modulus 2, thus forming two couples of rollers 14 (an upper roller and a lower roller), which place the multiple wire ropes in the longitudinal section between the two moduli, at the centre of the device. The shaft 14.1 of the rollers 14 of the modulus 1 are places in holes made on the lateral supports 9. These holes have a diameter which permits the insertion of the shafts 14.1 of the rollers 14, but not a translation. Consequently, they cannot be moved.

[0032] The shifts 14.1 of the rollers 14 of the modulus 2 are placed in lengthened slits 9.1 of the supports 9, which are orthogonal to the multiple wire ropes axis 6. The rollers 14 of the modulus 2 can therefore be drawn nearer to the rollers 14 of the modulus 1 (and to the wire ropes 6) and can be held in the desired position using springs 15 or elastic rings 16 placed between the corresponding shafts 14.1.

[0033] This structure of the holes hosting the shafts 14.1 of the modulus 1 forces the user to substitute the rollers 14 of the modulus 1 every time the wire ropes diameter 6 changes, in order to keep the wire ropes 6 at the centre of the device, with reference to the two moduli 1, 2. In order to avoid this substitution, the holes can be replaced by bushings 17 with an eccentric hole, fixed to holes specifically made on the plates 9 of the principal modulus 1. Each bushing 17 is blocked with a screw. The rotating movement of these bushings permits the moving of the shafts 14.1 inserted in the bushings 17 and, consequently, the movement of the rollers 14, in order to use rollers 14 of the same diameter, even with wire ropes 6 having different diameters.

[0034] In the lateral supports 9 holes 9.2 are made to insert handles or to block the device in the desired position.

[0035] Rollers 14 may be smooth (figures 1, 2, 3 and 5) or grooved (figure 14). Each groove 14.2 contains a wire rope 6. Rollers 14 may be substituted by sliding blocks, as shown in figures 12 and 13.

[0036] Internal devices of the principal modulus 1 keep the multiple wire ropes at the centre of the device, with reference to the plates constituting its lateral supports 9, in order to allow an exact evaluation. A first device consists of two blades 18, an upper blade and a lower blade, which are orthogonal to the ropes 6 and are fixed to the lateral plates 9 of modulus 1. Each blade 18 has lengthened slits 18.1, which are orthogonal to the wire ropes 6. Two screws 19 of the slits 18.1 fix two rods 20 to the blades 18. The longitudinal axis of the rods 20, which are lateral to the wire ropes 6, is parallel to that of the wire ropes 6. The rods 20 can slide, orthogonally to the wire ropes 6, towards the internal part of the device or towards the opposite direction, by simply passing the screws 19 in the slits 18.1, until the distance between the two rods 20 is slightly superior to the sum of the diameter of the ropes 6, including the spaces between one rope and the other, thus allowing their correct positioning.

[0037] As an alternative to this device, another device has been invented, where small bars 21 are fixed to the plates 9 which constitute the sides of the modulus 1. These small bars 21 are connected to two rods 24 through two pins 22 and a regulation screw 23. The longitudinal axis of the rods 24, which are lateral to the wire ropes 6, is parallel to that of the wire ropes 6, whereas the pins 22 and the regulation screws are orthogonal to the ropes. By acting on the regulation screws 23, the distance between the two rods 24 can be regulated, until the distance between the two rods 24 is slightly superior to the sum of the diameter of the ropes 6, including the spaces between one wire rope 6 and the other.

[0038] While using the device, the rollers 14 of the principal modulus 1 are chosen according to the number and the diameter of the multiple wire ropes 6 to be

checked. Or, if the device has the above-mentioned bushings 17, the position of the rollers along the wire ropes can be regulated.

[0039] The internal devices of the principal modulus 1 are then regulated through the screws 19 or 23 until the distance of the rods 20, 24 is superior to the sum of the diameters of the wire ropes 6, including the spaces between one wire rope 6 and the other. The two moduli 1, 2 are then closed on the wire ropes 6, so that the wire ropes can slide through each couple of rollers 14. The two moduli 1, 2 are later fixed to each other through lever locks 4. The rollers 14 of the other modulus 2 are then drawn closer to the wire ropes 6, sliding their shafts 14.1 in the slits 9.1; the simultaneous contact between the rollers 14 of the modulus 1, the wire ropes 6 and the rollers 14 of the modulus 2 is assured through springs 15 or through the elastic springs 16 placed between the corresponding shafts 14.1, on both sides. The device is then fixed in a correct position through fixing elements acting on the holes 9.2.

[0040] Finally, the wire ropes 6 slide in the internal space of the device delimited by the plates 12 of the two moduli 1, 2. Any internal or external discontinuity of the moving wire ropes 6 provokes perturbations of the magnetic field generated by the inductor around the wire ropes 6. The longitudinal axis of the magnetic field is parallel to that of the wire ropes 6. These perturbations of the magnetic field are recorded by the coils 7, 7.1 connected to the signal power points 8. The perturbations create an inducted electromotive force generating an electric power which reaches the signal power points 8. The power is then transferred, through cables, to an analogic recorder, which is separated from the device and is able to amplify the electric power and to print on paper the state of the wire ropes 6. The reading of the diagram allows to identify any anomaly of the wire ropes 6, both internal and external.

Claims

1. Magnetic-inductive device for the control of multiple steel-wire ropes, composed of two substantially specular moduli (1, 2), a principal modulus (1) and a secondary modulus (2), connected each to the other by hinges (3) or joint pins and locking elements like lever locks (4); each modulus (1, 2) has at least one permanent magnet (5) made of high-stability material and easy to remagnetize, at least one coil (7, 7.1), one signal power point (8), two rollers (14) and a shell which supports and/or protects these elements; the perturbations of the magnetic field generate an inducted electromotive force which provokes an electric power which reaches first the signal power points (8) and then, through cables, an analogic recorder separated from the device, which is able to amplify the power and print a diagram on continuous paper; on the upper and lower parts of each modulus (1, 2) there is a roller (14) orthogonal to the wire ropes (6) axis; to each roller (14) of the principal modulus (1) corresponds a roller (14) of the other modulus (2), thus forming two couples of rollers (14), an upper couple and a lower couple, which place the multiple wire ropes (6) at the centre of the device, between the two moduli (1, 2); this device is **characterized by** the fact that the permanent magnets (5), fixed to an upper plate (10) and to a lower plate (11) constituting the pole pieces, form with these plates (10, 11) the magnetic inductor; the magnets (5) are placed on at least one plane parallel to the plane of the wire ropes (6) and generate a magnetic field having its longitudinal axis parallel to that of the wire ropes (6); the longitudinal axis of each magnet (5) is parallel to that of the wire ropes (6); the coils (7) are wrapped around one or more magnets (5) and lead to a signal power point (8) which is fixed on the external part of the modulus (1, 2); the coils (7) are electrically connected to each other in series and with the signal power point (8); internal devices of the principal modulus (1) keep the multiple wire ropes (6) at the centre of the device with reference to the lateral plates (9); specific elements of this device regulate the distance between the roller (14) of the principal modulus (1) and the corresponding roller (14) of the secondary modulus (2) and of differently shaped rollers (14); holes (9.2) or slits are made in the plates (9) to insert handles or other instruments aimed at securing the device in the desired position.

2. Magnetic-inductive device, according to claim 1, **characterized by** the fact that in each modulus (1, 2) a coil (7.1) is placed between the permanent magnets (5) and the wire ropes (6).

3. Magnetic-inductive device, according to claims 1 and 2, **characterized by** the fact that in each modulus (1, 2) the coil (7.1) is substituted by one or more Hall electronic sensors, placed between the permanent magnets (5) and the steel-wire ropes (6).

4. Magnetic-inductive device, according to claim 1, **characterized by** the fact that the shell is composed of an upper plate (10), of a lower plate (11), of two plates (9) constituting the lateral supports, of a plate (12) constituting the fore frontal covering and of one plate (13) constituting the back frontal covering, where the two plates (12) delimit the sliding section of the wire ropes (6); the longitudinal axis of the plates (9) constituting the lateral supports is parallel to that of the wire ropes (6); these plates are fixed to the upper plate (10) and to the lower plate (11); the axis of these two plates (10, 11) is orthogonal to that of the wire ropes (6); the plate (12) constituting the fore frontal covering and the plate (13)

constituting the back frontal covering are U-shaped and their axis is parallel to that of the wire ropes (6).

5. Magnetic-inductive device, according to claim 1, **characterized by** the fact that the principal modulus (1) has an internal device which keeps the multiple wire ropes (6) at the centre of the device with reference to the plates (9) constituting its lateral supports; this device consists of two blades (18), an upper blade an a lower blade, which are orthogonal to the wire ropes (6) and are fixed to the lateral plates (9) of the principal modulus (1); these blades (18) have lengthened slits (18.1) with an axis orthogonal to that of the wire ropes (6); screws (19) placed in these slits (18.1) fix the blades (18) to two rods (20); the longitudinal axis of the rods (20), which are lateral to the wire ropes (6), is parallel to that of the wire ropes (6); the rods (20) are translated, orthogonally to the wire ropes (6), towards the internal part of the device or in the opposite direction, by sliding the screws (19) in the slits (18.1), until the distance between the two rods (20) is slightly superior to the sum of the diameters of the wire ropes (6), including the spaces between one wire rope (6) and the other, thus allowing their correct positioning.

6. Magnetic-inductive device, according to claim 1, **characterized by** the fact that the internal device of the principal modulus (1) used to keep the multiple wire ropes (6) at the centre of the device with reference to the plates (9) constituting its lateral supports is made of small bars (21) fixed to the lateral plates (9), connected to two rods (24) through pins (22) and regulations screws (23); the longitudinal axis of these rods (24), which are lateral to the wire ropes (6), is parallel to the longitudinal axis of the wire ropes (6); the pins (22) and the regulations screws (23) are orthogonal to the wire ropes (6); the regulations screws (23) allow to push the rods (24) towards the wire ropes (6) or to pull them in the opposite direction until the distance between the two rods (24) is slightly superior to the sum of the diameters of the wire ropes (6), including the spaces between one wire rope (6) and the other.

7. Magnetic-inductive device, according to claim 1, **characterized by** the fact that the shafts (14.1) of the rollers (14) of the principal modulus (1) are placed in holes made in the lateral plates (9); the diameter of these holes is slightly superior to that of the shafts (14.1); the shafts (14.1) of the rollers (14) of the secondary modulus (2) are placed in lengthened slits (9.1) made in the lateral plates (9); the slits (9.1), being orthogonal to the axis of the multiple wire ropes (6), allow the translation of the rollers (14) of the secondary modulus (2) on the rollers (14) of the principal modulus (1) and on the wire ropes (6); the simultaneous contact of each couple of rollers (14) with the wire ropes (6) is obtained and maintained through elastic elements which are applied between the corresponding shafts (14.1), on both sides.

8. Magnetic-inductive device, according to claims 1 and 7, **characterized by** the fact that the shafts (14.1) of the rollers (14) of the principal modulus (1) are inserted in bushings (17) with an eccentric hole, which are blocked by screws and allow the moving of the shafts (14.1) with reference to the wire ropes (6).

9. Magnetic-inductive device, according to claims 1 and 7, **characterized by** the fact that the holes and the slits (9.1) housing the shafts (14.1) of the rollers (14) or the bushings (17) and the holes (9.2) or the slits for inserting handles or instruments to block the device are made of stirrups fixed to the lateral plates (9).

10. Magnetic-inductive device, according to claims 1, 7 and 9, **characterized by** the fact that the holes and the slits (9.1) housing the shafts (14.1) of the rollers (14) or the bushings (17) and the holes (9.2) or the slits for inserting handles or instruments to block the device are made of stirrups fixed to the plates (10, 11) constituting the pole pieces.

11. Magnetic-inductive device, according to claim 1, **characterized by** the fact that the rollers (14) are smooth and/or grooved;

12. Magnetic-inductive device, according to claims 1 and 11, **characterized by** the fact that the rollers (14) are substituted by sliding blocks.

Patentansprüche

1. Die induktivmagnetische Anlage für die Kontrolle der mehrfachen Stahlseile wird dadurch charakterisiert, dass sie aus zwei grundsätzlichen Spiegelmoduln (1, 2) besteht, wobei einer von denen ein Hauptmodul (1) und der andere ein Sekundärmodul ist (2); diese Moduln sind miteinander durch ein Scharnier (3) oder einen Steckzapfen und die Klemmelemente, welche die Hebelverschlüsse (4) sind, verbunden; jeder Modul (1, 2) besteht zumindest aus einem Dauernmagneten (5), der aus den hochstabilen und leicht aufmagnetisierten Materialien angefertigt ist, einer Spule (7, 7.1), einem Signalverbinder (8), zwei Walzen (14) und einer Hülle, die alle obengenannten Elementen bewahrt und/oder schützt; die Störungen des Magnetfeldes verursachen die elektromotorische Induktionskraft, die den elektrischen Strom auslöst, der seinerseits die Si-

gnalverbinder (8) erreicht; dabei wird der elektrische Strom durch die Kabel von den Signalverbinder zu einem analogischen Registriergerät gebracht; das Registriergerät ist in solcher Entfernung einzugesetzen, um den Spannungssignal gelegend verstärken und das entsprechende Diagramm ausdrucken zu können; jeder Modul (1, 2) präsentiert im oberen und unteren Teil eine Walze (14), die orthogonal zur Seilachse (6) aufgestellt ist; jeder Walze (14) des Hauptmoduls (1) entspricht eine Walze (14) des anderen Moduls (2) so, dass die zwei Walzenpaaren (14) formen (ein Ober- und ein Unterpaar), die die Mehrfachseilen (6) in der Mitte der Anlage zwischen zwei Moduln (1, 2) positionieren; für diese Anlage ist kennzeichnenc, dass die Dauernmagneten (5) an die Polarexpansionen bildenden Ober- (10) und Unterplatten (11) fixiert sind, und zusammen mit denen einen magnetischen Induktor formen; die Magneten (5) sind mindestens auf einer parallelen Ebenen zur Seilebene (6) angeordnet, und ein Magnetfeld erzeugen, dessen Longitudinalachse parallel zu der des Seils (6) ist; die Longitudinalachse jedes Magnets (5) liegt zu der des Seils (6) parallel; die Spulen (7) sind um einen oder mehreren Magneten (5) eingewickelt und stellen sich um einen außen vom Modul (1, 2) fixierten Signalverbinder (8) zusammen; die Spulen (7) sind miteinander serienmäßig mit dem obengenannten Signalverbinder (8) verknüpft; die Innenmechanismen des Hauptmoduls (1) halten die Mehrfachseile (6) in der Mitte der Anlage hinsichtlich der Seitenstützen (9); die Details der obengennanten Anlage regulieren den Abstand zwischen der Walze (14) des Hauptmoduls (1), der Walze (14) des Sekundärmoduls (2) und der anders verformten Walzen (14); in den Stützen (9) werden die Löcher (9.2) oder die Schlitze für das Einstecken der Griffe oder für die Verankerung der Anlage in der gewünschten Position ausgeführt.

2. Die induktivmagnetische Anlage (laut Forderung 1) wird dadurch charakterisiert, dass eine Spule (7.1) in jedem Modul (1, 2) zwischen den Dauernmagneten (5) und den Seilen (6) eingesetzt ist.

3. Die induktivmagnetische Anlage (laut Forderung 1 und 2) wird dadurch charakterisiert, dass die Spule (7.1) in jedem Modul (1, 2) von einem oder mehreren elektronischen Hall-Sensoren ersetzt werden kann, die zwischen den Dauernmagneten (5) und den Stahlseilen (6) eingesetzt werden können.

4. Die induktivmagnetische Anlage (laut Forderung 1) wird dadurch charakterisiert, dass die Hülle aus einer Oberplatte (10), einer Unterplatte (11), zwei Seitenstützenplatten (9), einer Vorderdeckungsplatte (12) und einer Hinterdeckungsplatte (13) besteht, wobei zwei Vorderdeckungsplatten (12) einen Raum abgrenzen, in dem die Seile (6) fließen; die Longitudinalachse der Seitenstützenplatten (9) liegt zu der der Seile (6) parallel; diese Platten sind auf die Ober- (10) und die Unterplatte (11) fixiert; die Achsen der obengenannten Platten (10, 11) sind zu der der Seile (6) orthodonal gestellt; die Vorderdeckungs- (12) und die Hinterdeckungsplatte (13) weisen eine U-Form auf, und haben eine parallele Achse zu der des Seils (6).

5. Die induktivmagnetische Anlage (laut Forderung 1) wird dadurch charakterisiert, dass der Hauptmodul (1) mit einem Innenmechanismus ausgestattet ist, der die Mehrfachseile (6) in der Mitte der Anlage in Bezug auf die Seitenstützenplatten (9) zu halten hat; der Mechanismus besteht aus zwei oben und unten eingesetzten Klingen (18), die orthogonal zu den Seilen (6) positioniert und auf den Seitenstützen (9) des Hauptmoduls (1) fixiert sind; die Klingen (18) sind mit den ausgestreckten Schlitzen (18.1) ausgestattet, die ebenfalls orthodonal zu den Seilen (6) eingesetzt sind; die in den Klingen hineingedrehten Schrauben (19) fixieren die Klingen (18) mit zwei Achsen (20); die Longitudinalachse der Achsen (20), die seitlich zu den Seilen (6) eingesetzt sind, liegt parallel zu der der Seilen (6); die Achsen (20) werden orthogonal zu den Seilen (6) nach innen der Anlage oder in eine Gegenrichtung geschoben, die Schrauben (19) werden in den oben genannten Schlitzen (18.1) bis zum Moment gleiten lassen, in dem die Distanz zwischen zwei Stangen (20) etwas größer als die Summe der Diameter von den Seilen (6) (umfassend die vorhandenen Abstände zwischen dem Seil (6) und dem Seil (6)) ist; demzufolge wird ihre richtige Positionierung erreicht.

6. Die induktivmagnetische Anlage (laut Forderung 1) wird dadurch charakterisiert, dass der Innenmechanismus des Hauptmoduls (1), der die Mehrfachseile (6) in der Mitte der Anlage hinsichtlich der die Seitenstützen (9) kostituierenden Klingen zu halten hat, aus den Stäben (21) besteht, die auf die Seitenstützen (9) fixiert und durch die Zapfen (22) und die Regelungsschrauben (23) mit zwei Achsen (24) verbunden sind; die Longitudinalachse der obenerwähnten Achsen (24), die seitlich zu den Seilen (6) platziert ist, ist parallel zu der den Seilen (6) eingesetzt; die Zapfen (22) und die Regelungsschrauben (23) sind zu denen orthogonal; durch die Wirkung auf die Regelungsschrauben (23) wird möglich, die Achsen (24) zu den Seile (6) zu schieben oder in eine Gegenrichtung bis zum Moment zu ziehen, in dem die Distanz zwischen zwei Achsen (24) etwas größer als die Summe der Diameter von den Seilen (6) (umfassend die vorhandenen Abstände zwischen dem Seil (6) und dem Seil (6)) ist.

7. Die induktivmagnetische Anlage (laut Forderung 1) wird dadurch charakterisiert, dass die Bolzen (14.1) der Walzen (14) vom Hauptmodul (1) in den Löchern eingesetzt sind, die in den Seitenstützenplatten (9) entstehen; der Diameter dieser Löcher ist etwas größer als der der Bolzen (14.1), die Bolzen (14.1) der Walzen (14) vom Sekundärmodul (2) werden dagegen in den ausgestreckten Schlitzen (9.1) gestellt, die in den Seitenstützenplatten (9) entstehen; die Schlitzen (9.1) liegen orthogonal zur Achse der Mehrfachenseile (6) und erlauben die Überführung der Walzen (14) des Sekundärmoduls (2) in Bezug auf die Walzen (14) des Hauptmoduls (1) und die Seile (6); der simultane Kontakt von jedem Walzenpaar (14) mit den Seilen (6) wird durch die elastischen Elemente erhalten, die zwischen den entsprechenden Bolzen (14.1) auf den beiden Seiten eingesetzt werden.

8. Die induktivmagnetische Anlage (laut Forderung 1 und 7) wird dadurch charakterisiert, dass die Bolzen (14.1) der im Hauptmodul (1) vorhandenen Walzen (14) in die Buchsen (17) mit einem Exzenterloch eingefügt und in der Position mit den Schrauben blockiert sind, wobei die Schrauben die Umstellung der Bolzen (14.1) bezüglich der Seilen (6) ermöglichen.

9. Die induktivmagnetische Anlage (laut Forderung 1 und 7) wird dadurch charakterisiert, dass die Löcher und die Schlitze (9.1), die die Bolzen (14.1) der Walzen (14) oder die Buchsen (17) und die Löcher (9.2) oder die Schlitze für das Einstecken der Griffe für die Verankerung der Anlage enthalten, in Spanneisen angefertigt und auf die Stützen (9) fixierten sind.

10. Die induktivmagnetische Anlage (laut Forderung 1, 7 und 9) wird dadurch charakterisiert, dass die Löcher und die Schlitze (9.1), die die Bolzen (14.1) der Walzen (14) oder die Buchsen (17) und die Löcher (9.2) oder die Schlitze für das Einstecken der Griffe für die Verankerung der Anlage enthalten, in Spanneisen angefertigt und auf die Platten (10, 11) fixierten sind, die die polare Expansionen errichten.

11. Die induktivmagnetische Anlage (laut Forderung 1 und 11) wird dadurch charakterisiert, dass die Walzen (14) glatt und/oder genutet sind.

12. Die induktivmagnetische Anlage (laut Forderung 1 und 11) wird dadurch charakterisiert, dass die Walzen (14) durch die Gleitschuhe ersetzt sind.

Revendications

1. Dispositif magnéto-inductif pour le contrôle des câbles multiples d'acier, consistant en deux modules (1, 2) essentiellement spéculaires, dont l'un principal (1) et l'autre secondaire (2), reliés entre eux par des charnières (3) ou des tourillons emboîtables et par des éléments de serrages tels des fermetures à levier (4) ; chaque module (1, 2) est équipé d'au moins un aimant (5) permanent réalisé avec du matériel à haute stabilité et aisément remagnétisable, d'au moins une bobine (7, 7.1), d'une prise de signal (8), de deux rouleaux (14) et d'une gaine de support et/ou de protection de ces éléments; les perturbations du champ magnétique créent une force électromotrice induite qui produit du courant électrique arrivant aux prises de signal (8); celles-ci, à travers des câbles, le dirigent vers un enregistreur analogique, situé à distance, capable de l'amplifier convenablement et d'imprimer son diagramme sur du papier sans fin; un rouleau (14) positionné orthogonalement par rapport à l'axe des câbles (6) est situé au-dessus et au-dessous de chaque module (1, 2); a chaque rouleau (14) du module (1) principal en correspond un autre (14) sur le module secondaire, formant ainsi deux paires de rouleaux (14), l'une supérieure, l'autre inférieure, qui positionnent les câbles (6) multiples au centre du dispositif, entre les deux modules (1, 2); ce dispositif se **caractérise par le fait que** les aimants (5) permanents, ancrés à une plaque supérieure (10) et à une plaque inférieure (11) constituant les épanouissements polaires, forment, avec ces dernières, l'inducteur magnétique; les aimants (5) sont positionnés, au moins, sur un plan parallèle à celui des câbles (6) mêmes et produisent un champ magnétique dont l'axe longitudinal est parallèle à celui des câbles (6) mêmes; l'axe longitudinal de chaque aimant (5) est parallèle à celui des câbles (6); les bobines (7) sont enroulées autour d'un ou plusieurs aimants (5) et se terminent par une prise de signal (8) ancrée à l'extérieur du module (1, 2); les bobines (7) sont reliées entre elles en série et avec ladite prise de signal (8); des dispositifs à l'intérieur du module (1) principal gardent les câbles (6) multiples au centre de celui-ci par rapport aux plaques latérales; de petits éléments dudit dispositif règlent la distance entre le rouleau (14) du module (1) principal et le rouleau correspondant du module (2) secondaire et celle des rouleaux (14) à conformation différente; dans les plaques sont réalisés des trous (9.2) ou des lumières pour introduire des poignés ou d'autres éléments aptes à l'ancrage du dispositif dans la position désirée.

2. Dispositif magnéto-inductif, selon la revendication n. 1, **caractérisé par le fait qu'**une bobine (7.1) est positionnée, à l'intérieur de chaque module (1, 2), entre les aimants (5) permanents et les câbles.

3. Dispositif magnéto-inductif, selon les revendica-

tions n. 1 et 2, **caractérisé par le fait que** la bobine (7.1) est remplacée, à l'intérieur de chaque module (1, 2), par un ou plusieurs capteurs électroniques Hall, positionnés entre les aimants (5) permanents et les câbles (6) d'acier.

4. Dispositif magnéto-inductif, selon la revendication n. 1, **caractérisé par le fait que** la gaine se compose d'une plaque supérieure (10), d'une plaque inférieure (11), de deux plaques (9) formant les supports latéraux et d'une plaque (13) formant le couvercle frontal postérieur, où les deux plaques (12) délimitent une cage dans laquelle glissent les câbles; l'axe longitudinal des plaques (9) formant les supports latéraux est parallèle à celui des câbles; ces plaques sont ancrées à la plaque supérieure (10) et à la plaque inférieure (11); l'axe de ces deux dernières plaques (10, 11) est orthogonal à celui des câbles (6); la plaque (12) formant le couvercle frontal antérieur et celle (13) formant le couvercle frontal postérieur ont un gabarit en U, et leur axe est parallèle à celui des câbles (6).

5. Dispositif magnéto-inductif, selon la revendication n. 1, **caractérisé par le fait que** le module (1) principal est équipé d'un dispositif intérieur apte à garder les câbles (6) multiples au centre du dispositif par rapport aux plaques (9) formant les supports latéraux; ce dispositif-ci se compose de deux lames (19), l'une supérieure, l'autre inférieure, orthogonales par rapport aux câbles (6) et ancrées aux plaques (9) latérales du module (1) principal; ces lames (18) ont des lumières (18.1) allongées dont l'axe est orthogonal par rapport à celui des câbles (6); des vis (19) logées dans ces lumières (18.1) ancrent les deux lames (18) à deux tiges, positionnées latéralement aux câbles (6), et dont l'axe longitudinal est parallèle à celui des câbles (6); on fait déplacer les tiges (20) orthogonalement par rapport aux câbles (6) vers l'intérieur du dispositif ou en direction opposée, en faisant glisser les vis (19) dans les lumières (18.1) jusqu'au moment où la distance entre les deux tiges (20) est faiblement supérieure à la somme des diamètres des câbles (6), espaces entre câble (6) et câble (6) compris, permettant ainsi leur correct positionnement.

6. Dispositif magnéto-inductif, selon la revendication n. 1, **caractérisé par le fait que** le dispositif à l'intérieur du module (1) principal gardant les câbles (6) multiples au centre du dispositif par rapport aux lames formant ses supports (9) latéraux se compose de barreaux (21) ancrés aux supports (9) latéraux, reliés à deux tiges (24) au moyen de tourillons (22) et de vis (23) de rappel; l'axe longitudinal desdites tiges (24), positionnées latéralement aux câbles (6), est parallèle à celui des câbles (6); les tourillons (22) et les vis (23) de rappel sont orthogonaux aux câbles (6); les vis (23) de rappel permettent de pousser les tiges (24) vers les câbles (6) ou de les tirer en direction opposée jusqu'au moment où la distance entre les deux tiges (20) est faiblement supérieure à la somme des diamètres des câbles (6), espaces entre câble (6) et câble (6) compris.

7. Dispositif magnéto-inductif, selon la revendication n. 1, **caractérisé par le fait que** les arbres (14.1) des rouleaux (14) du module (1) principal sont logés dans des trous réalisés dans les plaques (9) latérales; le diamètre de ces trous est faiblement supérieur à celui des axes (14.1); les arbres (14.1) des rouleaux (14) du module (2) secondaire sont au contraire logés dans des lumières (9.1) allongées dans les plaques (9) latérales; les lumières (9.1) sont orthogonales par rapport à l'axe des câbles (6) multiples, permettant ainsi le déplacement des rouleaux (14) du module (2) secondaire par rapport aux rouleaux (14) du module (1) principal et aux câbles (6); le contact simultané de chaque paire de rouleaux (14) avec les câbles (6) est obtenu et gardé au moyen d'éléments élastiques appliqués entre les arbres (14.1), sur chaque côté.

8. Dispositif magnéto-inductif, selon les revendications n. 1 et 7, **caractérisé par le fait que** les arbres (14.1) des rouleaux (14) du module (1) principal sont insérés dans des douilles (17) au trou désaxé, bloquées dans leur position par des vis, qui permettent le déplacement des arbres (14.1) mêmes par rapport aux câbles (6).

9. Dispositif magnéto-inductif, selon les revendications n. 1 et 7, **caractérisé par le fait que** les trous et les lumières (9.1) logeant les arbres (14.1) des rouleaux (14) ou les douilles (17) et les trous (9.2) ou lumières d'insertion de poignées ou d'ancrage du dispositif sont réalisés dans des étriers fixés aux plaques (9) latérales.

10. Dispositif magnéto-inductif, selon les revendications n. 1, 7 et 9, **caractérisé par le fait que** les trous et les lumières (9.1) logeant les arbres (14.1) des rouleaux (14) ou les douilles (17) et les trous (9.2) ou lumières d'insertion des poignées ou d'ancrage du dispositif sont réalisés dans des étriers fixés aux plaques (10, 11) formant les épanouissements polaires.

11. Dispositif magnéto-inductif, selon la revendication n. 1, **caractérisé par le fait que** les rouleaux (14) sont lisses et/ou cannelés.

12. Dispositif magnéto-inductif, selon les revendications n. 1 et 11, **caractérisé par le fait que** les rouleaux (14) sont remplacés par des patins.

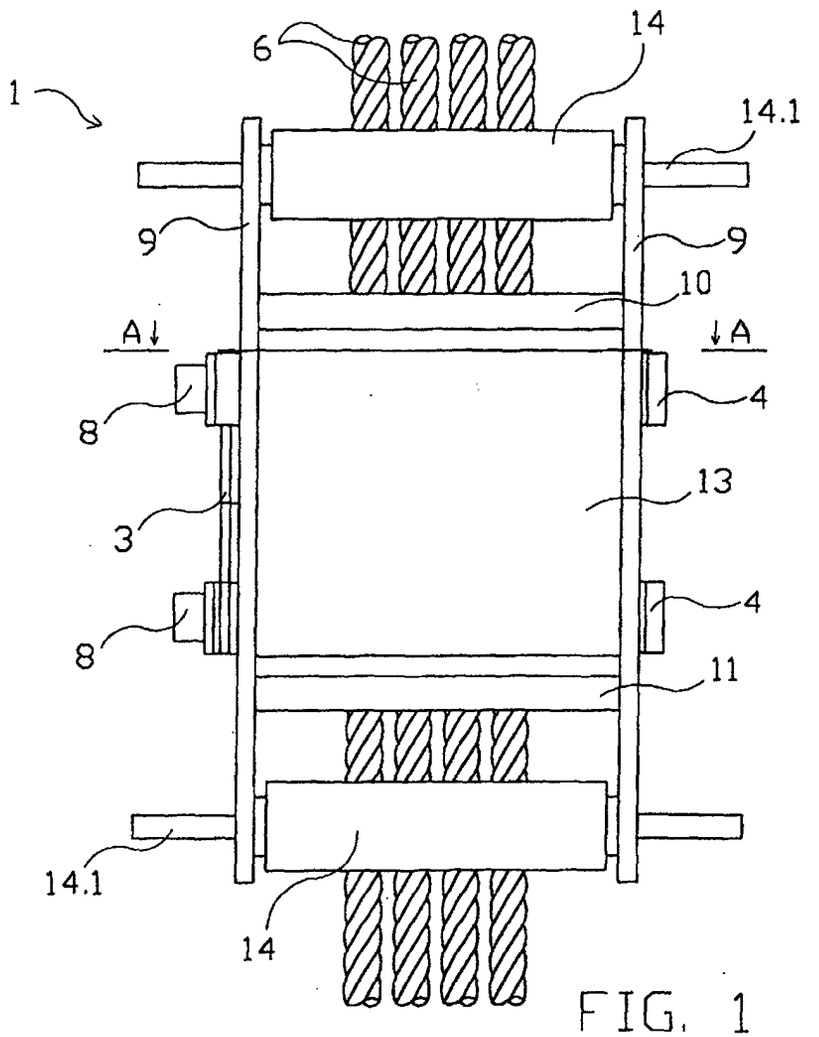

1
6
14
14.1
9
9
10
A
A
8
4
3
13
4
8
11
14.1
14

FIG. 1

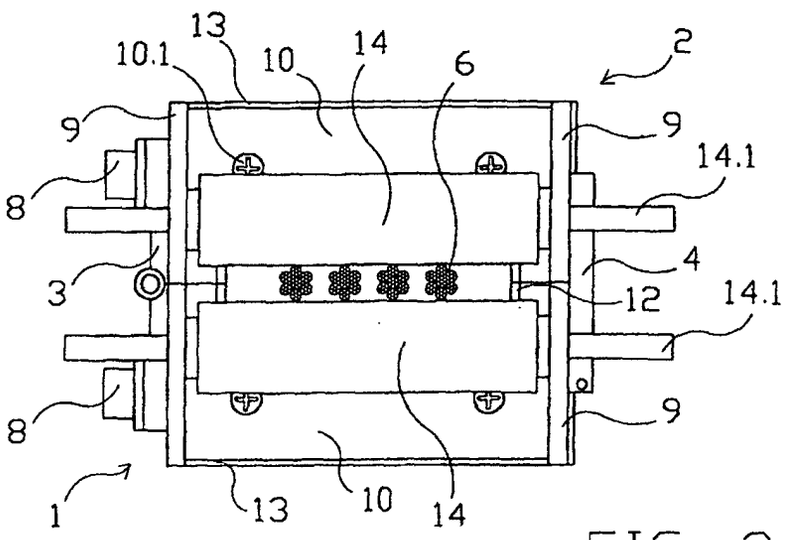

13
10.1
10
14
6
2
9
9
14.1
8
4
3
12
14.1
8
9
1
13
10
14

FIG. 2

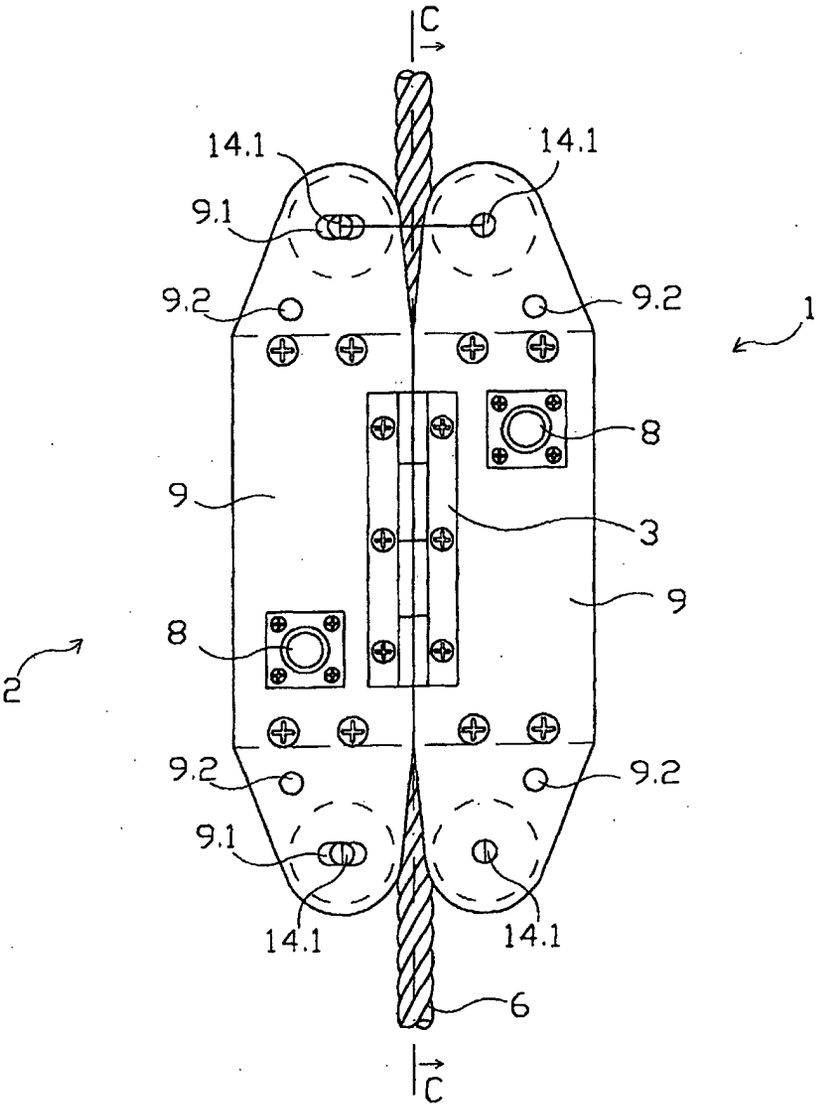


FIG. 3

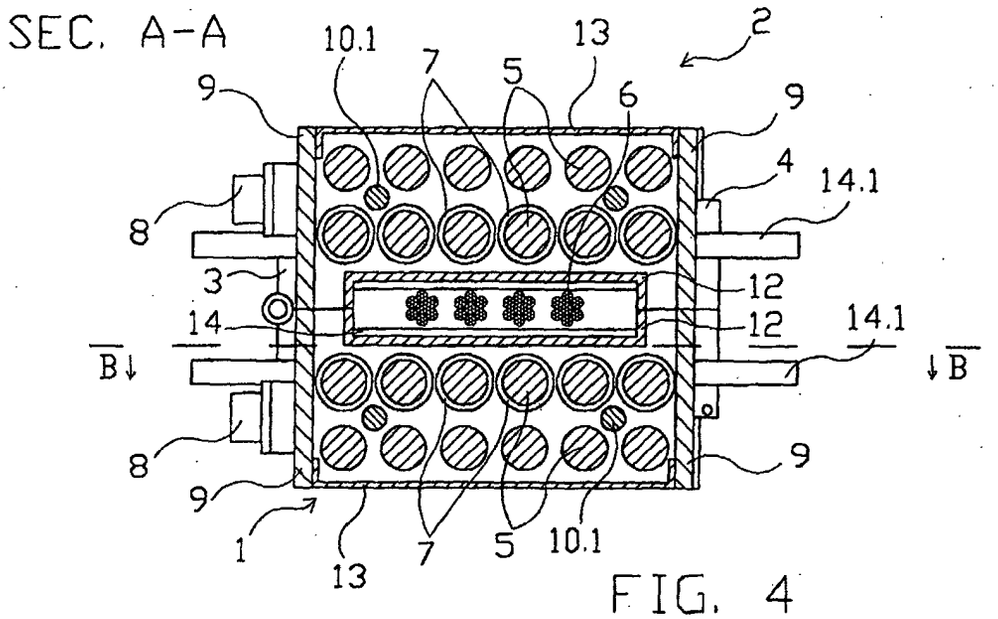

SEC. A-A
10.1
13
2
7
5
9
6
9
4
14.1
8
3
12
14
12
14.1
B
B
8
9
9
1
13
7
5
10.1

FIG. 4

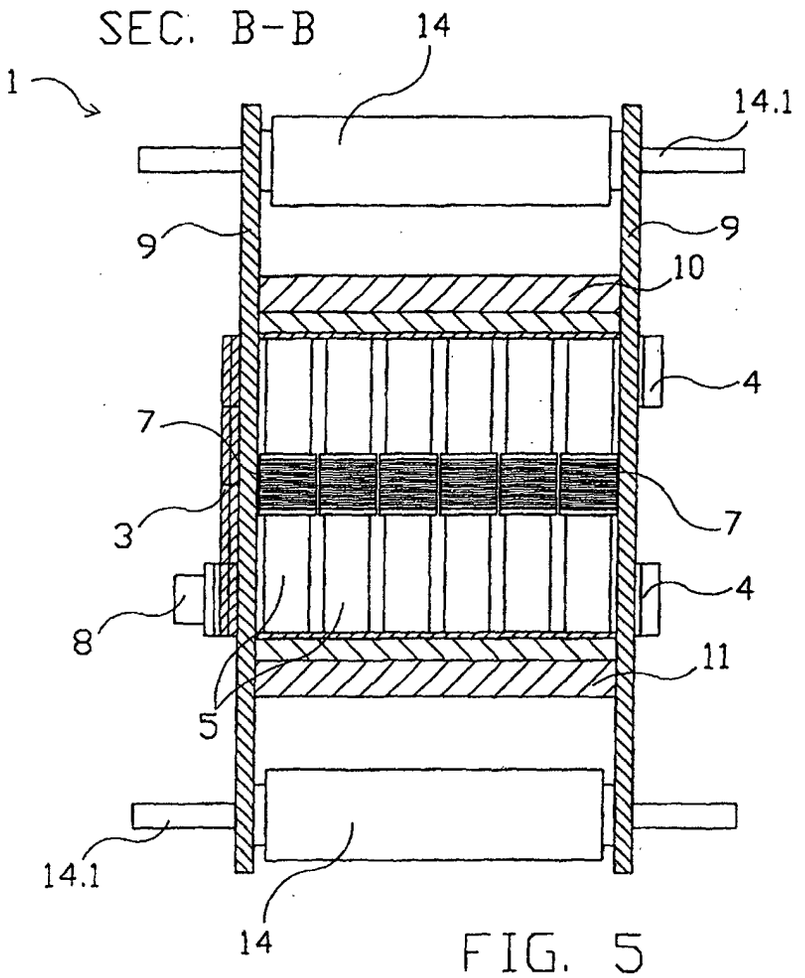

SEC. B-B
14
1
14.1
9
9
10
4
7
3
7
4
8
11
5
14.1
14

FIG. 5

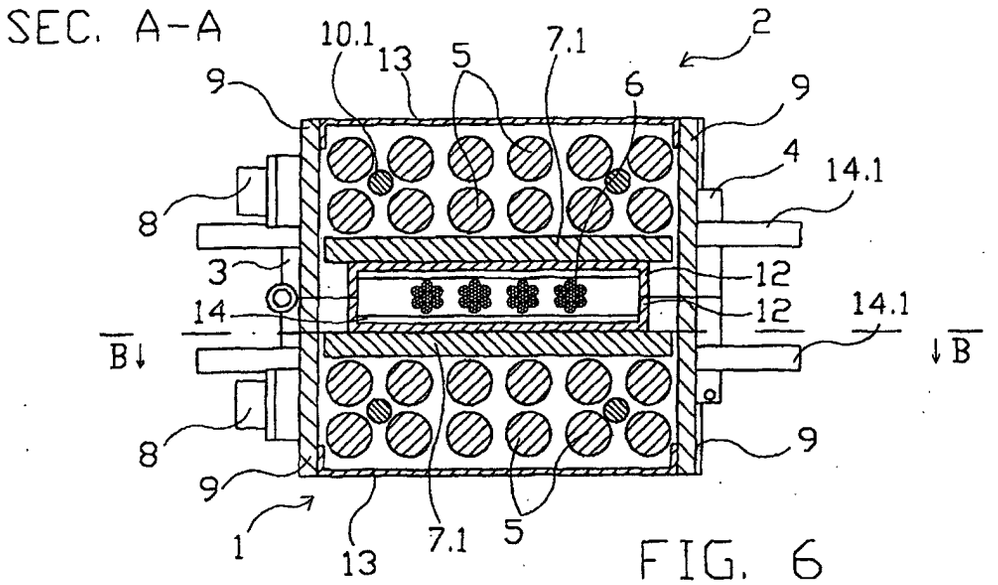

SEC. A-A
10.1
13
5
7.1
2
9
6
9
4
14.1
8
3
12
14
12
14.1
B↓
↓B
8
9
9
1
13
7.1
5

FIG. 6

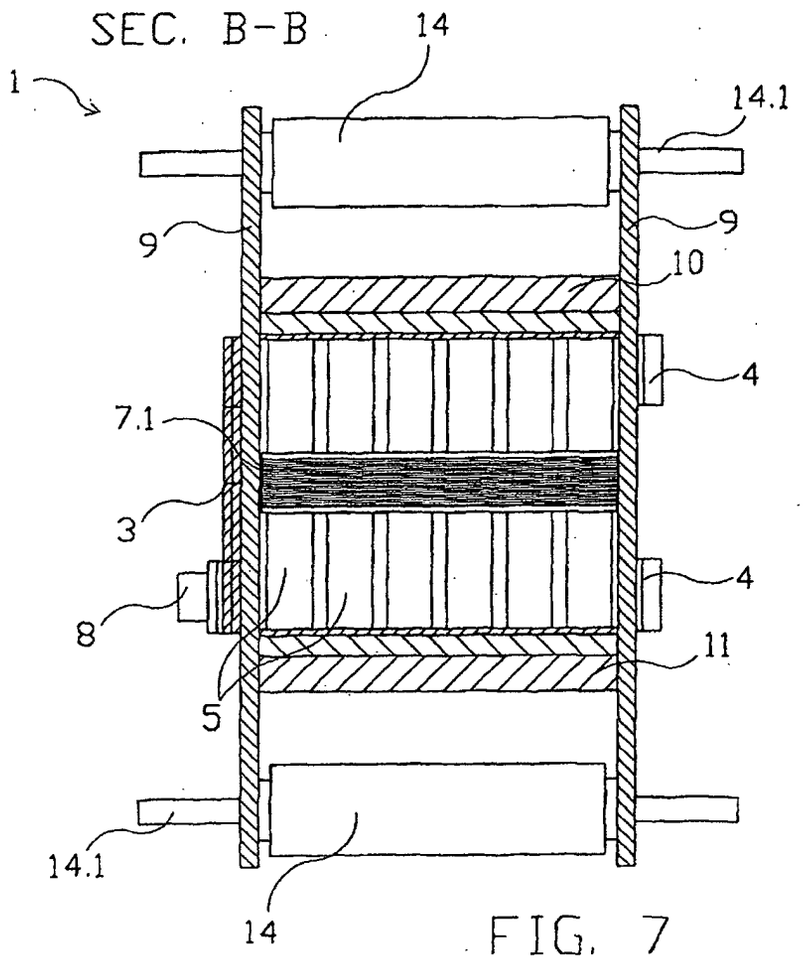

SEC. B-B
14
1
14.1
9
9
10
4
7.1
3
4
8
11
5
14.1
14

FIG. 7

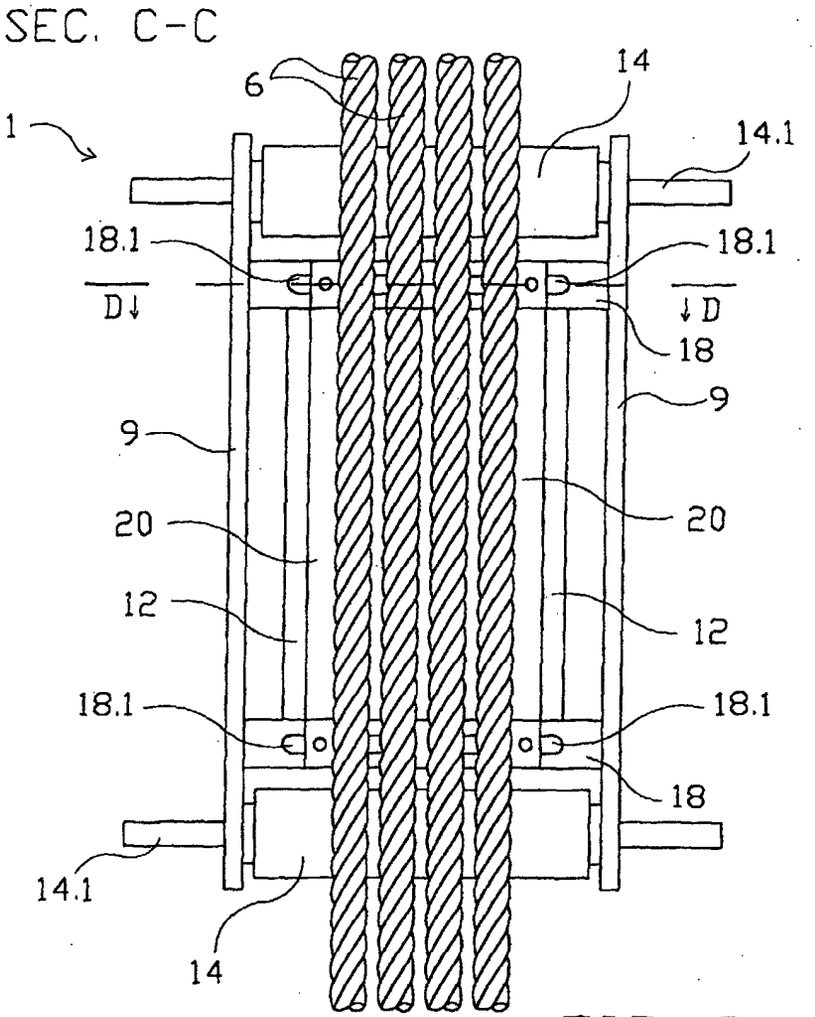

SEC. C-C
6
14
1
14.1
18.1
18.1
D↓
↓D
18
9
9
20
20
12
12
18.1
18.1
18
14.1
14

FIG. 8

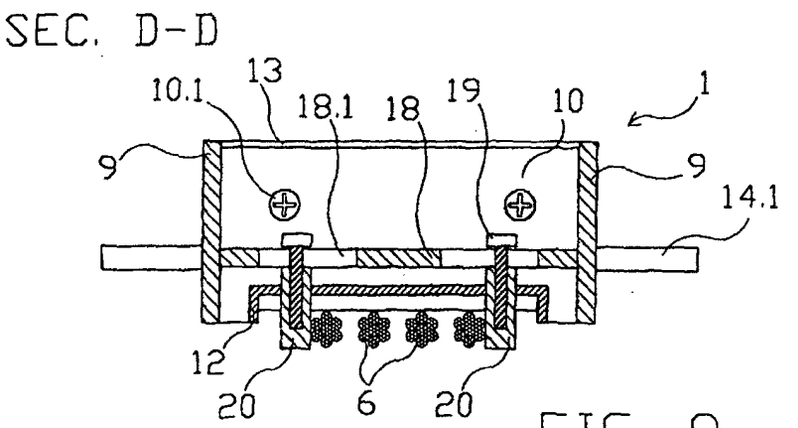

SEC. D-D
10.1
13
18.1
18
19
10
1
9
9
14.1
12
20
6
20

FIG. 9

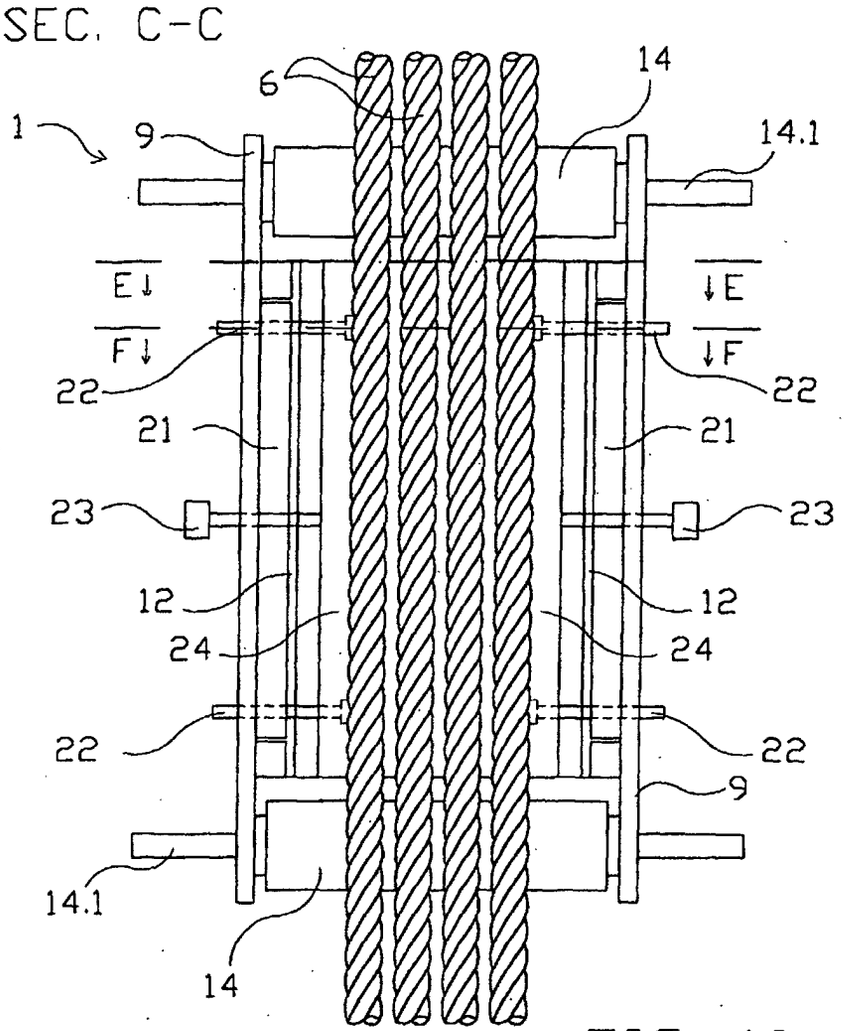

SEC. C-C
6
14
1
9
14.1
E↓
↓E
F↓
↓F
22
22
21
21
23
23
12
12
24
24
22
22
9
14.1
14

FIG. 10

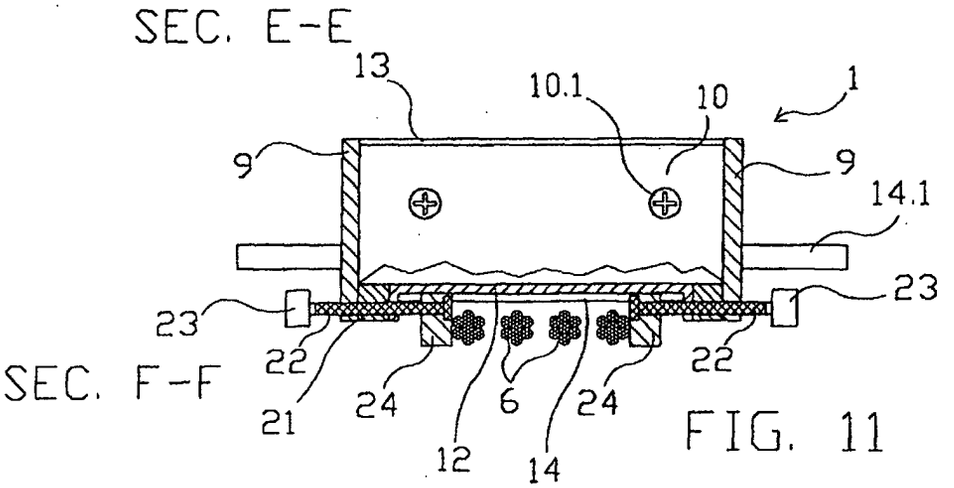

SEC. E-E
13
10.1
10
1
9
9
14.1
23
23
22
22
SEC. F-F
21
24
6
24
12
14

FIG. 11

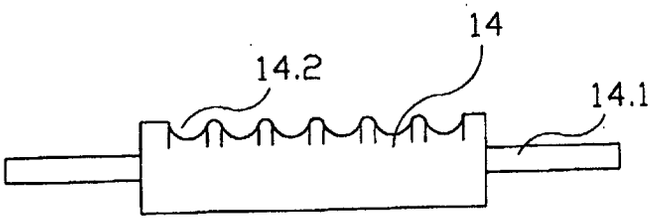


FIG. 12

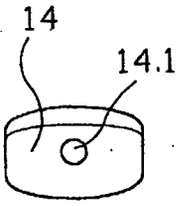


FIG. 13

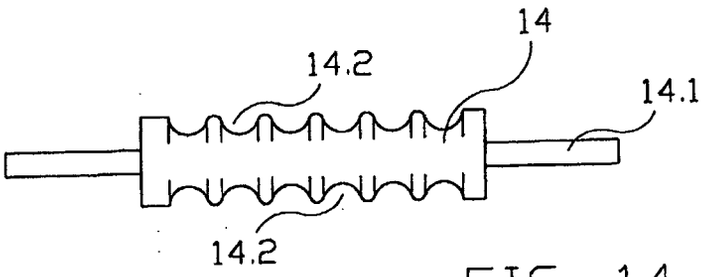


FIG. 14

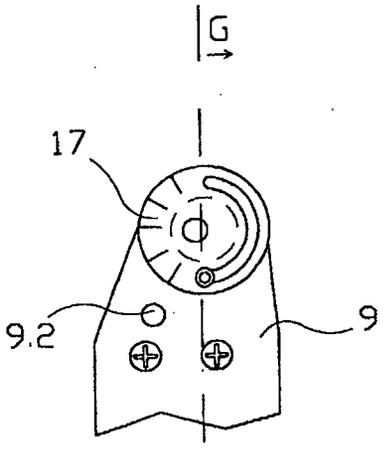


FIG. 15

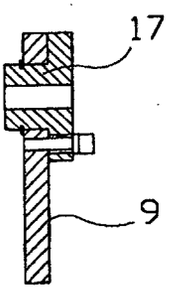


FIG. 16

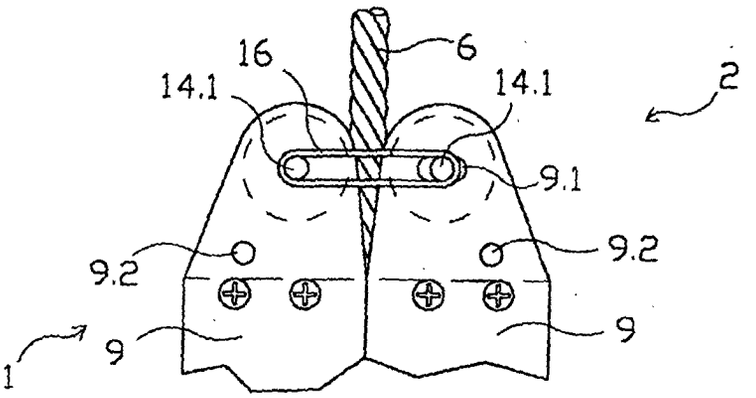


FIG. 17

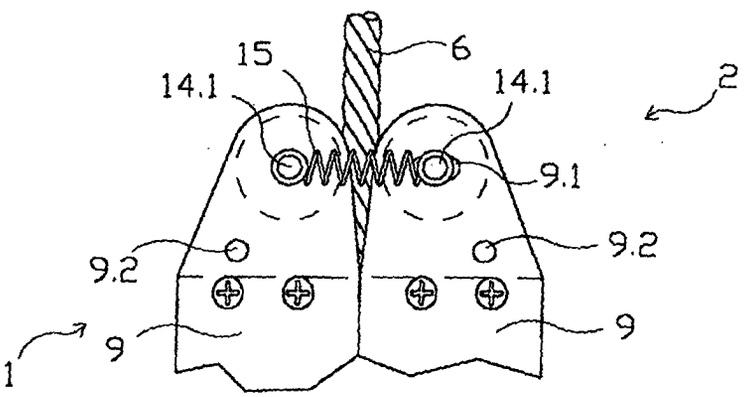


FIG. 18