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(54) **Title**: INVERSION CONTROL APPARATUS FOR CONTROLLING THE INVERSION OF A CALIBRATION HOSE

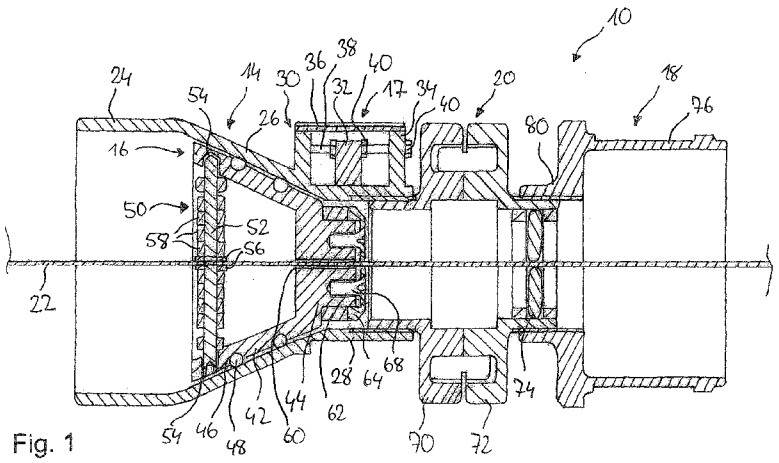


Fig. 1

(57) **Abstract**: The invention relates to an inversion control apparatus (10) for controlling the inversion of a calibration hose (12), in particular for use in an apparatus (106) for the rehabilitation of pipelines (102, 104). In order to control an inversion of the calibration hose (12), it is proposed according to the invention that the inversion control apparatus (10) has a stop (14), a control pull mechanism (22) and a counter element (16), wherein the control pull mechanism (22) is connected to an end region (113) of the calibration hose (12), wherein the counter element (16) is connected to the control pull mechanism (22), and wherein, upon an inversion, the counter element (16) is displaceable relative to the stop (14) such that, when the calibration hose (12) is in an inversion end setting, the counter element (16) butts against the stop (14).

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# Inversion control apparatus for controlling the inversion of a calibration hose

The invention relates to an inversion control apparatus for controlling the inversion of a calibration hose, in particular for use in an apparatus for the rehabilitation of pipelines.

Control apparatuses of this type are used in the rehabilitation of pipelines, in particular for the rehabilitation of the junction region of house pipe connections. For this purpose, a calibration hose, which has a main pipe calibration hose and a lateral pipe calibration hose, is inverted into the pipe section to be rehabilitated. For the inversion, the calibration hose is slipped onto an apparatus which is also referred to as a packer. The main pipe calibration hose is here respectively fastened at the end to the packer by means of clamping collars, so that an airtight joint is formed. In addition, a resined lining element is provided. The lining element can also be referred to as a liner. Preferably, the lining element comprises a layer of resin-absorbable material, in particular a nonwoven or fiber material. After this, the lateral pipe calibration hose is inverted together with the liner into the main pipe calibration hose. At the same time, the air in the main pipe calibration hose and the lateral pipe calibration hose is drawn off. The packer is then transported to the junction region which is to be rehabilitated. After the positioning, the main pipe calibration hose is blown against and the lateral pipe calibration hose is inverted with the liner into the house connection. The inversion is realized with the aid of a cable eel or tube eel attached externally to the free end of the lateral pipe calibration hose. As a result of the inversion, the liner is pressed against the site which

is to be rehabilitated. After the liner has hardened, the air is released from the calibration hose and the apparatus is moved out of the main pipe. The hardened liner bears positively and non-positively against the inner wall of the pipeline.

EP 1 519 100 A1 discloses an apparatus for rehabilitating the junction region of house connection pipes. The apparatus has a packer, onto which a calibration hose and a liner are slipped. The calibration hose comprises a main pipe calibration hose and a lateral pipe calibration hose, wherein the main pipe calibration hose is connected in an airtight manner to the packer by means of clamping collars. For the rehabilitation of the junction region or of a lateral pipe which discharges into the main pipe, the packer is brought into position and then the calibration hose is inverted by means of air pressure, whereupon the main pipe calibration hose comes to bear against the main pipe and the lateral pipe calibration hose inverts into the house connection pipe. The liner is hereupon pressed against the inner wall of the main pipe and of the house connection pipe. For the control of the inversion of the lateral pipe calibration hose, a winding box, in which a cable is coiled, is disposed on the packer. The cable is connected by its free end to the end region of the lateral pipe calibration hose. When the lateral pipe calibration hose is inverted into the house connection pipe, the cable is drawn out of the winding box. For the control of the inversion of the lateral pipe calibration hose, the winding box has a microswitch which is actuated when the cable is fully withdrawn from the winding box. The microswitch hereupon triggers a signal means, which indicates to the operator the full extent of the lateral pipe calibration hose and thus indicates the full inversion of the same into the lateral pipe. A drawback with this is that this known method involving winding box and cable attached to the lateral pipe calibration hose end is not suitable for long lateral pipe calibration

hoses, since a correspondingly long cable, in the coiled-up state, is much too large for the cramped spatial conditions.

The object of the invention is to define an inversion control apparatus which can be used for a wide variety of calibration hoses.

For the achievement of the object, an inversion control apparatus for controlling the inversion of a calibration hose, having the features of claim 1, is proposed.

The inventive inversion control apparatus for controlling the inversion of a calibration hose, in particular for use in an apparatus for the rehabilitation of pipelines, has a stop, a control pull mechanism and a counter element, wherein the control pull mechanism is connected to an end region of the calibration hose, wherein the counter element is connected to the control pull mechanism, and wherein, upon an inversion of the calibration hose, the counter element is displaceable relative to the stop such that, when the calibration hose is in an inversion end setting, the counter element butts against the stop. The inversion control apparatus enables the control of the inversion of a lateral pipe calibration hose into the house connection pipe. The inversion control apparatus is particularly suitable for liners up to about 30 m long, or even longer. In comparison thereto, a cable attached to the winding box and to the lateral pipe calibration hose end, in the coiled-up state, is much too large for the cramped spatial conditions in the pipe diameters. When the lateral pipe calibration hose is inverted into the house connection pipe, the control pull mechanism is drawn into the house connection pipe until, in an end setting, the counter element butts against the stop and prevents further inversion of the lateral pipe calibration hose. Preferably, the length of the cable corresponds to the

desired inversion length of the lateral pipe calibration hose. Accordingly, with the control apparatus, an overinflation of the lateral pipe calibration hose can be prevented. Preferably, the stop and the counter element are shaped and/or configured such that the counter element can at least partially be received by the stop. In this way, the counter element, in the inversion end setting, can be securely received by the stop. The inversion end setting is preferably constituted by the state in which the calibration hose is fully extended and/or is fully inverted into the lateral pipe. The inversion end setting can also, however, be a setting in which no full extension and/or inversion of the calibration hose is yet achieved.

In an advantageous embodiment, the inversion control apparatus has a stop detection device for detecting a contact of the counter element with the stop. In addition, the stop detection device advantageously comprises a permanent magnet connected to the counter element and a magnet sensor connected to the stop, wherein the magnet sensor detects a contact of the counter element with the stop and triggers a signal to terminate the inversion. By means of this stop detection device, it is possible to control and detect the inversion end setting of the lateral pipe calibration hose. For this purpose, the stop detection device, when the stop makes contact with the counter element, triggers a signal, which can be acoustic and/or optical in nature, in order thus to indicate to an operator that the lateral pipe calibration hose is, for instance, fully inverted. An overinflation of the lateral pipe calibration hose can thus be prevented. In addition, it is also possible to connect the stop detection device to a control device, so that, upon a signal of the stop detection device, the control device automatically halts the inversion process. Thus an automated control of the inversion process is possible. The magnet sensor advantageously has a response sensitivity of about 1.2 mT, wherein the field strength

of the permanent magnet is matched to this response sensitivity.

Advantageously, the magnet sensor is mounted in a receiving housing connected to the stop, the position of the magnet sensor within the receiving housing being adjustable. As a result of the adjustability of the position of the magnet sensor, the moment at which the signal is meant to be triggered when the stop makes contact with the counter element is able to be precisely adjusted. Advantageously, the magnet sensor is horizontally adjustable. Furthermore, the receiving housing protects the magnet sensor from damage and excessive pollution which might be caused during deployment in the pipelines.

The stop is advantageously configured as a hollow stop, preferably as a hollow stop cone. Furthermore, the counter element can be configured as a hollow counter element which can be received in the stop, preferably as a hollow conical counter element. Accordingly, when the stop and counter element come into contact, the counter element can be fully received in the stop. Particularly in a conical embodiment of the counter element, this can be introduced easily into the stop and allows self-centering of the counter element upon contact with the stop.

In a further advantageous embodiment, the counter element has on its outer side at least one circumferential seal. The seal, particularly in combination with the conical embodiment of the stop and of the counter element, ensures that, when the counter element makes contact with the stop, an almost complete seal is achieved. This is particularly of benefit when an inversion hose is connected to the inversion control apparatus, which inversion hose is subjected to air pressure to enable inversion of the lateral pipe calibration hose. The counter element preferably has

two circumferential seals, which are advantageously in the form of rubber O-rings.

On the counter element is advantageously disposed at least one fastening device, which connects the counter element to the control pull mechanism. The fastening device can be constituted by a threaded pin, which is positively and/or non-positively connected to the counter element. In addition, on the threaded pin can be disposed at least two washers, through which the control pull mechanism is guided. For the fixing of the washers, at least two nuts can be disposed on the threaded pin, wherein, for the securement of the washers, a plurality of counternuts can be arranged on the threaded pin.

In a further advantageous embodiment, a coupler element for the connection of an inversion hose is attached to the stop. Advantageously, the coupler element is detachably connected to the stop by a clutch. The inversion hose serves to introduce the lateral pipe calibration hose into the house connection pipe. Particularly in the case of relatively long lateral pipe calibration hoses, the calibration hose in question, together with the resined liner, can extend into the inversion hose, while the free end region is connected to the control pull mechanism. The introduction of air pressure into the inversion hose causes the lateral pipe calibration hose to be inverted, i.e. turned inside out, so that the liner is pressed against the inner wall of the lateral pipe. The inversion hose preferably corresponds roughly to the length of the lateral pipe calibration hose.

Advantageously, the stop and the counter element are made of a metal, in particular of aluminum or a stainless steel. In order not to adversely affect the operation of the magnet sensor, apart from the damping magnet only metals such as aluminum or V2A may be used. Through the use of aluminum or a stainless steel,

moreover, rusting due to environmental conditions, such as prevail in sewer pipes, is prevented.

Further advantageously, the control pull mechanism is a cable or a band. The cable can here be guided in guide rings disposed within the clutch.

In a further advantageous embodiment a traveling device is provided, which traveling device has a plurality of wheel sets, each wheel set comprising at least two wheels, wherein the wheels of a wheel set are rotatably mounted on a wheel holding element. This creates a traveling device in which the at least two wheels of each wheel set, which wheels are rotatably mounted on the wheel holding element, enable stable transportability as a result of the, for each wheel set, two contact points of the wheels against the pipe inner wall.

The traveling device can also be referred to as a moving unit, transport gear or transport unit. The traveling device enables the inversion control apparatus or a part of this apparatus to be easily transportable along the pipe inner wall of a pipeline.

The traveling device can be fastened to the inversion control apparatus by means of a supporting device. The supporting device can be a component part of the inversion control apparatus or can be attached thereto. The supporting device preferably forms a firm base and preferably extends substantially in a longitudinal direction which substantially corresponds to the longitudinal axis of the pipeline.

The plurality of wheel sets can also be referred to as a running gear or can form this same. Furthermore, this running gear can be adjustable. This adjustability can be given, in particular, by the fact that the wheel-holding element is adjustably connected to the supporting device by means of struts. At least a

plurality of or all of the struts can be configured as a scissor linkage. If the running gear is adjustable, it becomes possible to adapt the traveling device to pipe diameters of different size. In order to provide the adjustability, it is preferably provided that the running gear is pressed with its wheels in an elastically resilient manner against the pipe inner wall of the pipeline.

In addition, the wheel holding element can have a guide groove, in which one end of a strut is guided. Furthermore, the supporting device can comprise a first connection unit and a second connection unit. One of these connection units can in this case be arranged movably, in particular displaceably, with respect to the supporting device. Furthermore, one strut of each wheel set can be rotatably connected to the first connection unit and another strut of each wheel set can be rotatably connected to the second connection unit. In order to be able to achieve good adjustability of the running gear, the second connection unit can be pretensioned by means of at least one spring unit, so that the wheels are forced away in the direction of the supporting device. Finally, at least one adjusting unit, with which the at least one spring unit and/or the maximal adjustment of the wheel sets relative to the supporting device is adjustable, can be provided.

Preferably, a first wheel is rotatably mounted on a first end of the wheel holding element, and a second wheel on a second end of the wheel holding element. In particular, the rotational axis of each of the two wheels is positioned in the region of the respective end of the wheel holding element such that the wheel outer periphery protrudes beyond the end edge of the wheel holding elements.

Finally, at least one camera can be provided. The camera is preferably protected by means of a guard. The

camera can thus be protected from damage and pollution. The guard comprises, for instance, a metal plate.

The invention is explained in greater detail below with reference to the following illustrative embodiments represented schematically in the drawings, wherein:

fig. 1 shows a vertical section through a first embodiment of the inventive inversion control apparatus along the line I-I of fig. 2;

fig. 2 shows a side view of the first embodiment of the inventive inversion control apparatus;

fig. 3 shows a front view of the first embodiment of the inventive inversion control apparatus having a counter element accommodated in the stop;

fig. 4 shows a schematic representation of the first embodiment of the inventive inversion control apparatus having an apparatus for the rehabilitation of a junction region and having a calibration hose;

fig. 5 shows a schematic view of the first embodiment of one inversion control apparatus having an apparatus for the rehabilitation of pipelines having a lateral pipe calibration hose almost fully inverted into the lateral pipe;

fig. 6 shows a side view of a second embodiment of the inventive inversion control apparatus;

fig. 7 shows a top view, according to arrow VII in fig. 6, of the second embodiment of the inventive inversion control apparatus;

fig. 8 shows a front view, according to arrow VIII in fig. 6, of the second embodiment of the inventive inversion control apparatus, and

fig. 9 shows a vertical section through the second embodiment of the inventive inversion control apparatus.

In figures 1 to 3, a first embodiment of the inversion control apparatus 10 for controlling the inversion of a lateral pipe calibration hose 12 is shown.

The inversion control apparatus 10 comprises a stop 14, a counter element 16, a control pull mechanism 22, a stop detection device 17, a coupler element 18, and a clutch 20 which connects the stop 14 and the coupler element 18 one to another. The control pull mechanism 22 is connected to the counter element 16 and extends through the stop 16, the coupler element 18 and the clutch 20. In the present illustrative embodiment, the control pull mechanism 22 is configured as a band, though it is also possible to use a cable as the control pull mechanism 22. The counter element 16 can be fully received by the stop 14, as can be seen in figs. 1 and 3.

In addition, the stop detection device 17 has a magnet sensor 32 and a permanent magnet 62. By means of the stop detection device 17, it is possible to detect a contact of the counter elements 16 with the stop 14.

The stop 14 is configured as a hollow stop cone, the stop 14 having an opening portion 24, a stop portion 26 and a connecting portion 28. Via the opening portion 24, the counter element 16 makes its way into the stop 14. The stop portion 26 is conically configured and serves as a stop for the counter element 16. The connecting portion 28 comprises a connecting device in the form of a thread, by means of which the stop 14 is connected to the clutch 20.

Furthermore on the outer side of the stop 14 is disposed a receiving housing 30, on which the magnet sensor 32 is mounted such that it is horizontally displaceable. The receiving housing 30 has two housing walls 34, formed from the stop 14, and a sensor protection 36, connected to the housing walls 34, in the form of a curved metal plate, as is represented in fig. 2. For the horizontal displaceability of the magnet sensor 32, a threaded screw 38 is inserted between the housing walls 34, the threaded screw 38 extending through a bore (not detailed) made in the magnet sensor 32. On each of the end faces of the magnet sensor 32 is disposed a fastening means 40, preferably in the form of a hexagonal nut. In addition, the threaded screw 38 extends through a housing wall 34, a fastening means 40, preferably in the form of a hexagon nut, likewise being placed onto the end. For better horizontal displaceability, two threaded screws 38 arranged one behind the other are disposed in the receiving housing 30. Through rotation of the fastening means 40 disposed outside the receiving housing 30, the magnet sensor 32 is horizontally displaced. In addition, to the magnet sensor 32 is connected a right angle plug (not shown), which is connected by a connecting line (not represented) and a control device (not represented).

The counter element 16 is configured approximately as a conical counter element 16, wherein the shape of the outer side of the counter element 16 approximately corresponds to the shape of the inner side, the internal diameter, of the stop portion 26. The counter element 16 has a first portion 42 and a second portion 44. The first portion 42, upon contact with the stop 14, butts against the stop portion 26 and is hollow on the inside. For the formation of a seal when the stop 14 makes contact with the counter element 16, in the first portion are made circumferential grooves 46, in which a seal 48 in the form of an O-ring is

respectively inserted. Furthermore, the first portion 42 of the counter element 16 is provided with a fastening device 50, which is positively and/or non-positively connected to the counter element 16. According to figs. 1 and 3, the fastening device 50 comprises a threaded rod 52, two washers 56 and a plurality of fastening means 58, preferably in the form of hexagon screws. The fastening device 50 serves to fasten the control pull mechanism 22 to the counter element 16. For this purpose, the threaded rod 52 penetrates the control pull mechanism 22 and engages positively and/or non-positively in recesses 54 of the first portion 42. On the threaded rod 52 are disposed two washers 56, through which the control pull mechanism 22 is guided. For the fixing of the washers 56, a plurality of fastening means 58, preferably in the form of hexagon screws, which clamp the washers 56 together, are disposed on the threaded rod 52.

The second portion has a through hole 60, through which the control pull mechanism 22 is guided, as can be seen in fig. 1. Furthermore, on the second portion 44, on the periphery, is disposed a permanent magnet 62, which is clamped against the first portion 42 by means of a cover 64. For this purpose, the cover 64 is fixed to the second portion 44 with the aid of fastening screws 68.

in the present case, the clutch 20 comprises a first clutch element 70 and a second clutch element 72. The first clutch element 70 is detachably connected by a thread to the connecting portion 28. The second clutch element 72 is likewise detachably connected by a thread to the coupler element 18. Within the clutch is disposed a guide ring 74, through which the control pull mechanism 22 is guided.

The coupler element 18 has a coupling portion 76, for connection to an inversion hose 78, and a connecting portion 80, the connecting portion 80 having a thread

for engagement with the thread of the second coupling element 72.

A method for rehabilitating a pipeline, in particular a junction region 100 and a thereto joining house connection pipe 104, with the aid of the inventive inversion control apparatus 10 according to the first embodiment is described below with reference to figs. 4 and 5.

As can be seen, in particular, from figs. 4 and 5, a calibration hose 107, comprising a main pipe calibration hose 108 and the lateral pipe calibration hose 12, is used for the rehabilitation. In the present illustrative embodiment, the lateral pipe calibration hose 12 is connected by a detachable connecting device 109 to the main pipe calibration hose 108. As the detachable connecting device 109, a zipper, a Velcro fastener or a connection ring and a clamping ring are conceivable.

In figs. 4 and 5, the junction region 100 of a main pipe 102 and a house connection pipe 104, which junction region is to be rehabilitated, is shown. For the rehabilitation, the main pipe calibration hose 108 is slipped onto a packer 106, the main pipe calibration hose 108 being fastened at each end by means of clamping collars 110 to a cylindrical connection element 112 of the packer 106, so that an airtight joint is formed. In the region of the cylindrical connection element 112 is respectively disposed a moving unit 111, which enables the packer to be transported to the junction region 100 to be rehabilitated. Connected in an airtight manner to the connection element 112 is the inversion hose 78. In addition, at the free end of the inversion hose 78, the inversion control apparatus 10 is connected by its coupling portion 76 to the inversion hose 78, likewise by means of clamping collars 110. Furthermore, a free end region 113 of the lateral pipe calibration hose 12

is connected to the control pull mechanism 22. In addition, the control pull mechanism 22 is guided through the inversion hose 78, the coupler element 18, the clutch 20 and the stop 14 and connected to the counter element 16 by the fastening device 50. Preferably, the distance between the point of attachment to the counter element 16 and the point of attachment to the lateral pipe calibration hose 12 corresponds to the inversion length of the lateral pipe calibration hose 12.

After this, a resined lining element 114, which has a main portion 116 and a side portion 118, is slipped onto the calibration hose 107. In the slipped-on state, the main portion 116 surrounds the main pipe calibration hose 108 and the side portion 118 is disposed in the region of the lateral pipe calibration hose 12 such that the lateral pipe calibration hose 12, in the inflated state, can extend through the side portion 118, as is represented in fig. 5. The calibration hose 107 is then inflated for checking of its seal-tightness. After this, the air is released from the calibration hose 107 and the lateral pipe calibration hose 12 is inverted by means of the control pull mechanism 22 into the interior of the main pipe calibration hose 108 and inversion hose 78.

Next the packer 106 is transported with the aid of the moving unit 111 to the junction region 100 which is to be rehabilitated, such that the lateral pipe calibration hose 12 can be inverted into the house connection pipe 104. After the precise positioning, the calibration hose 107 and the inversion hose 78 are pressurized. As a result of the pressurization, the main pipe calibration hose 107 presses the main portion 116 of the lining elements 114 against the main pipe, and the lateral pipe calibration hose 12 inverts into the house connection pipe 104 and presses the side portion 118 of the lining element 114 against the inner wall of the house connection pipe 104. As the lateral

pipe calibration hose 12 is inverted into the house connection pipe 104, the counter element 16 is pulled in the direction of the stop 14. Once the lateral pipe calibration hose 12 is fully inverted, the counter element 16 butts against the stop portion 24 of the stop 14. Due to the seals 48, the inversion hose 78 is fully sealed. In the inversion end setting, the pressure within the calibration hose 107 and the inversion hose 78 can thus be maintained. The lining element 114 is hence pressed against the inner wall of the main pipe 102 and of the house connection pipe 104 at a constant pressure.

This abutted position is registered by the stop detection device 17 and a signal is triggered in order to indicate to an operator that the lateral pipe calibration hose 12 is fully inverted. The operator now cuts off the air supply.

Following the hardening of the lining element 114, the air is released from the calibration hose 107. The lateral pipe calibration hose 12 is inverted again with the aid of the control pull mechanism 22, after which the packer 106, the inversion hose 78 and the inversion control apparatus 10 are moved out of the main pipe 102.

The inventive inversion control apparatus 10 is distinguished by the fact that the control of the inversion of an up to 30 m long, or longer, lateral pipe calibration hose 12 into the house connection pipe 104 is possible. In addition, an overinflation of the lateral pipe calibration hose 12 can be prevented by means of the inversion control apparatus 10.

In figures 6 to 9, a second embodiment of the inversion control apparatus 10 for controlling the inversion of a lateral pipe calibration hose 12 is shown. The inversion control apparatus 10 of the second embodiment here differs from the inversion control apparatus 10 of

the first embodiment insofar as a traveling device 130, a camera 190 and a guard 192 for the camera are provided. For the consistent features, the same reference symbols 10 to 118 have been used as for the first embodiment. In this regard, reference is also made to the above comments concerning the first embodiment.

The traveling device 130 has a plurality of wheel sets 160. As can be seen from figs. 6 to 9, in the present example four wheel sets 160 are provided. However, a different number of wheel sets 160 can also be used. Each of the wheel sets 160 comprises at least two wheels, these wheels of a wheel set 160 being rotatably mounted on a wheel holding element 170. The wheel holding element 170 has a first end 172 and a second end 174, a first wheel 162 being rotatably mounted on the first end 172, and a second wheel 164 on the second end 174. As can be seen, in particular, in fig. 8, the four wheel sets 160 are arranged distributed substantially evenly over the periphery, so that two wheel sets 160 are respectively situated opposite each other. Each of the ends 172, 174 preferably has a forked mounting for the rotatable mounting of the wheels 162, 164. As can be seen from figs. 6, 7 and 9, for each wheel holding element 170 there are preferably provided two wheel holding parts, which lie close together in the region between the ends 172, 174 and are arranged in parallel. In the region of the ends 172, 174, the wheels 162, 164 are mounted between the wheel holding parts, so that the outer periphery of the wheel 162, 164 protrudes beyond the outer edge of the end 172, 174.

Each of the wheel holding elements 170 is connected to a supporting device 150 by means of two struts 180. Each strut 180 here comprises a first strut element 182 and a second strut element 184, these strut elements 182, 184 being connected to the wheel holding parts of the wheel holding element 170. This fastening of the

struts 180 to the wheel holding element 170 is preferably realized by means of one or more screw joints (see in particular fig. 6). The two strut elements 182, 184 form the strut 180, whereby the strut 180 can also be referred to as a double strut. In principle, the struts 180 can also be configured as a scissor linkage in order to be able to achieve adjustability of the traveling device.

The supporting device 150 has a first connection unit 152 and a second connection unit 156. These two connection units 152, 156 are connected, on the one hand, to the struts 180 and, on the other hand, to the inversion control apparatus 10. The connection units 152, 156 can here be configured in one piece with the struts 180. Alternatively, a fastening can also be realized by means of a screw joint or similar. In the present illustrative embodiment, the connection units 152, 156 are fastened to the stop 14 by means of the fastening elements 154, 158.

Finally, the inversion control apparatus 10 has a camera 190 and a guard 192. The guard 192 serves to protect the camera 190. In this way, the camera 190 can be protected from damage and/or pollution. In the present example, the guard 192 is formed by a metal plate. As can be seen in the cross section according to fig. 8, this plate runs in the shape of an arc and is fastened to two wheel holding elements 170. Fig. 7 shows a top view of this plate.

**Reference symbol list**

| | |
|---|---|
| 10 | inversion control apparatus |
| 12 | lateral pipe calibration hose |
| 14 | stop |
| 16 | counter element |
| 17 | stop detection device |
| 18 | coupler element |
| 20 | clutch |
| 22 | control pull mechanism |
| 24 | opening portion |
| 26 | stop portion |
| 28 | connecting portion |
| 30 | receiving housing |
| 32 | magnet sensor |
| 34 | housing wall |
| 36 | sensor protection |
| 38 | threaded screw |
| 40 | fastening means |
| 42 | first portion |
| 44 | second portion |
| 46 | groove |
| 48 | seal |
| 50 | fastening device |
| 52 | threaded rod |
| 54 | recess |
| 56 | washer |
| 58 | fastening means |
| 60 | through hole |
| 62 | permanent magnet |
| 64 | cover |
| 68 | fastening screws |
| 70 | first coupling element |
| 72 | second coupling element |
| 74 | guide ring |
| 76 | coupling portion |
| 78 | inversion hose |
| 80 | connecting portion |
| 100 | junction region |
| 102 | main pipe |

104 house connection pipe
106 packer
107 calibration hose
108 main pipe calibration hose
109 detachable connecting device
110 clamping collar
111 moving unit
112 connection element
113 free end region
114 lining element
116 main portion
118 side portion
130 traveling device
150 supporting device
152 first connection unit
154 fastening element
156 second connection unit
158 fastening element
160 wheel set
162 first wheel
164 second wheel
170 wheel holding element
172 first end
174 second end
180 strut
182 first strut element
184 second strut element
192 camera
192 guard

**Patent claims**

1. Inversion control apparatus (10) for controlling the inversion of a calibration hose (12), in particular for use in an apparatus (106) for the rehabilitation of pipelines (102, 104), having a stop (14), a control pull mechanism (22) and a counter element (16), wherein the control pull mechanism (22) is connected to an end region (113) of the calibration hose (12), wherein the counter element (16) is connected to the control pull mechanism (22), and wherein, upon an inversion of the calibration hose (12), the counter element (16) is displaceable relative to the stop (14) such that, when the calibration hose (12) is in an inversion end setting, the counter element (16) butts against the stop (14).

2. Inversion control apparatus according to claim 1, **characterized** by a stop detection device (17) for detecting a contact of the counter element (16) with the stop (14).

3. Inversion control apparatus according to claim 2, **characterized in that** the stop detection device (17) comprises a permanent magnet (62) connected to the counter element (16) and a magnet sensor (32) connected to the stop (14), wherein the magnet sensor (32) senses a contact of the counter element (16) with the stop (14) and triggers a signal to terminate the inversion.

4. Inversion control apparatus according to claim 3, **characterized in that** the magnet sensor (32) is mounted in a receiving housing (30) connected to the stop (14), the position of the magnet sensor (32) within the receiving housing (30) being adjustable.

5. Inversion control apparatus according to one of the preceding claims, **characterized in that** the stop (14) is configured as a hollow stop (14), preferably as a hollow stop cone.

6. Inversion control apparatus according to one of the preceding claims, **characterized in that** the counter element (16) is configured as a hollow counter element (16) which is receivable in the stop (14), preferably as a hollow conical counter element (16).

7. Inversion control apparatus according to one of the preceding claims, **characterized in that** the counter element (16) has on its outer side at least one circumferential seal (48).

8. Inversion control apparatus according to one of the preceding claims, **characterized in that** on the counter element (16) is disposed at least one fastening device (50), which connects the counter element (16) to the control pull mechanism (22).

9. Inversion control apparatus according to one of the preceding claims, **characterized in that** a coupler element (18) for the connection of an inversion hose (78) is attached to the stop (16).

10. Inversion control apparatus according to claim 9, **characterized in that** the coupler element (18) is detachably connected to the stop (14) by a clutch (20).

11. Inversion control apparatus according to one of the preceding claims, **characterized in that** the stop (14) and the counter element (16) are made of a metal, in particular of aluminum or a stainless steel.

12. Inversion control apparatus according to one of the preceding claims, **characterized in that** the control pull mechanism (22) is a cable or a band.

13. Inversion control apparatus according to one of the preceding claims, **characterized in that** a traveling device (130) is provided, which traveling device has a plurality of wheel sets (160), each wheel set (160) comprising at least two wheels (162, 164), the wheels (162, 164) of a wheel set (160) being rotatably mounted on a wheel holding element (170).

14. Inversion control apparatus according to claim 13, **characterized in that** a first wheel (162) is rotatably mounted on a first end (172) of the wheel holding element (170), and a second wheel (164) on a second end (174) of the wheel holding element (170).

15. Inversion control apparatus according to one of the preceding claims, **characterized by** at least one camera (190), which is preferably protected by means of a guard (192).

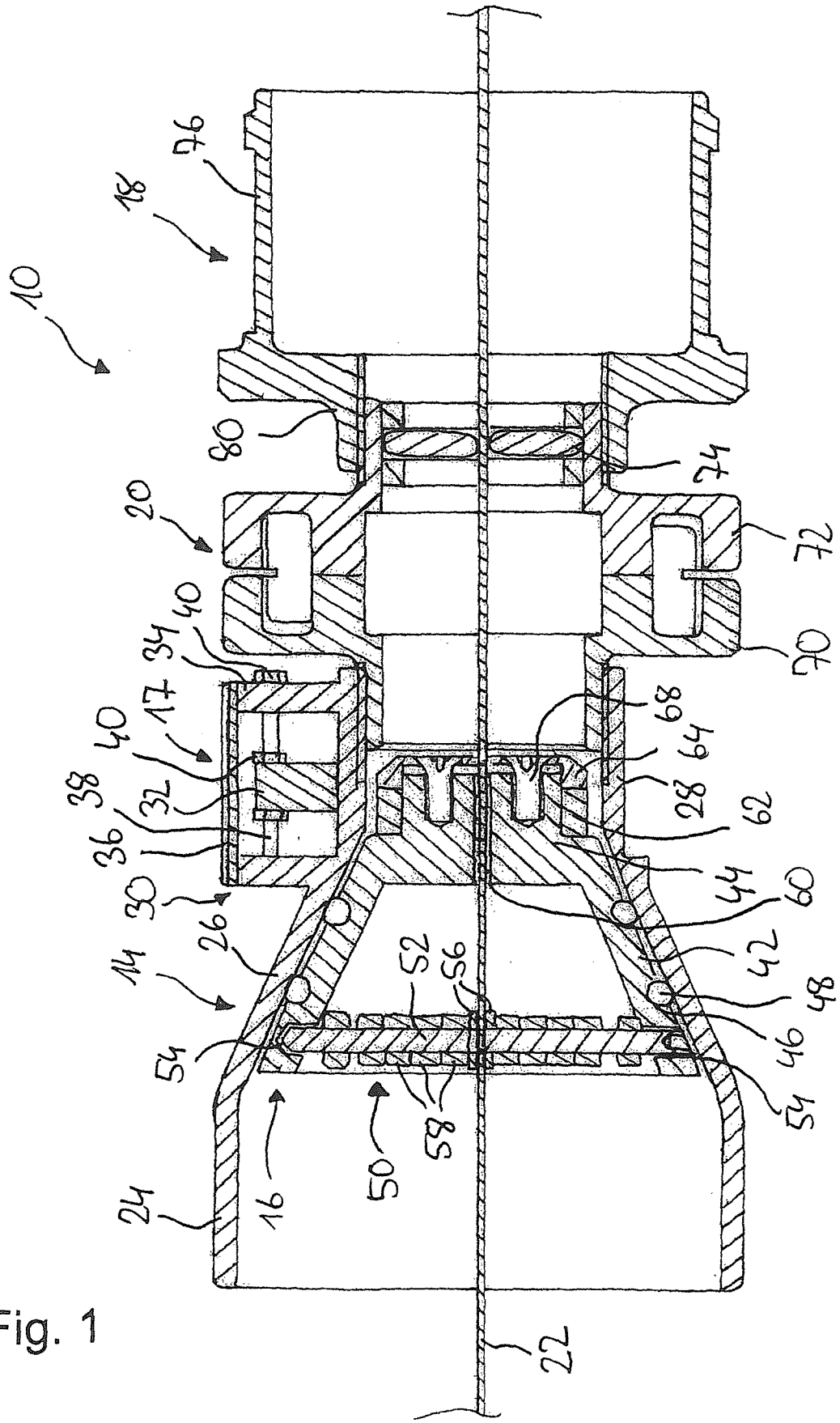
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Fig. 1

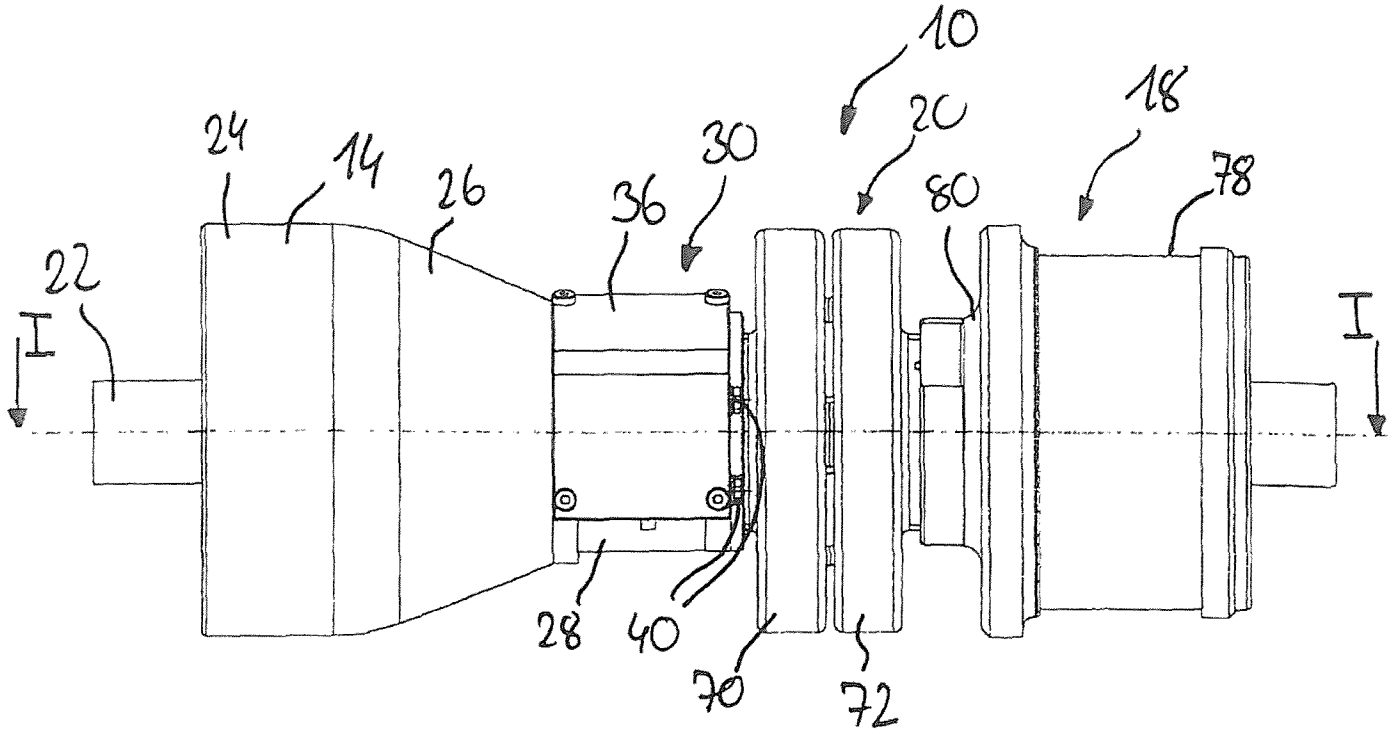


Fig. 2

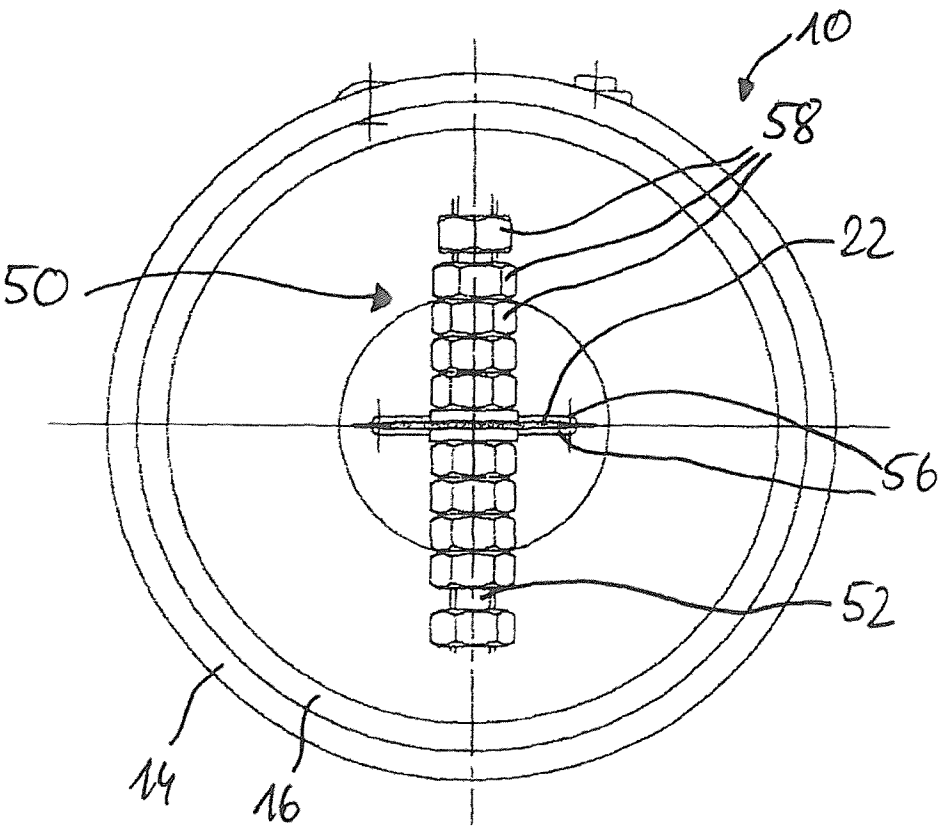


Fig. 3

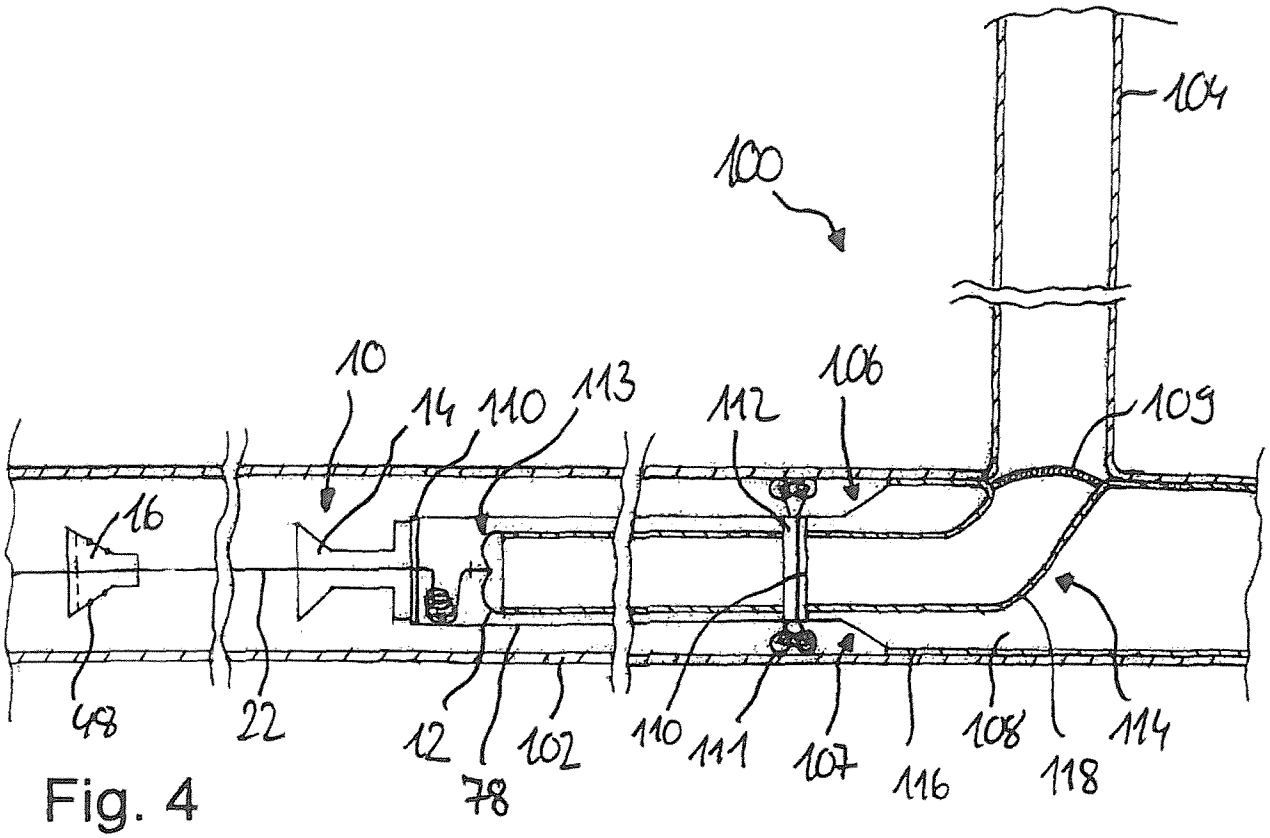
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Fig. 4

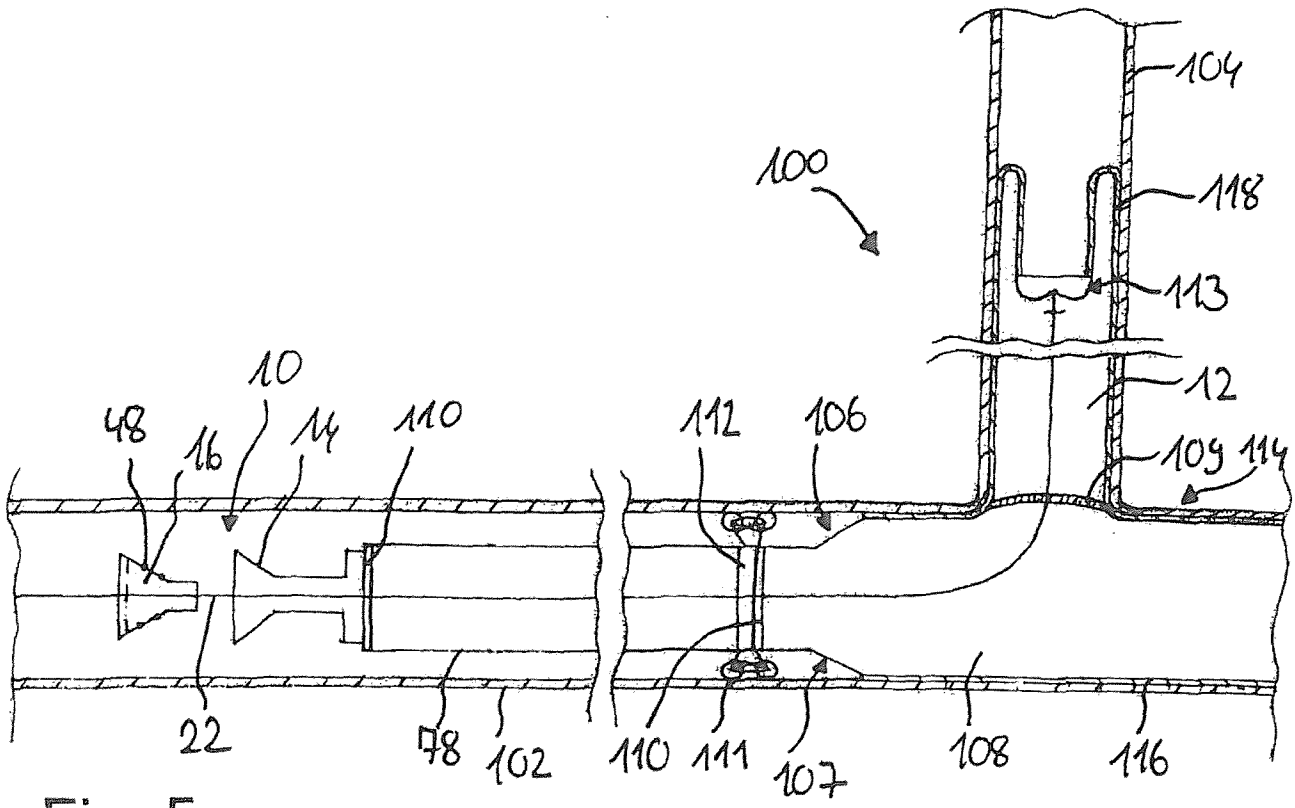
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Fig. 5

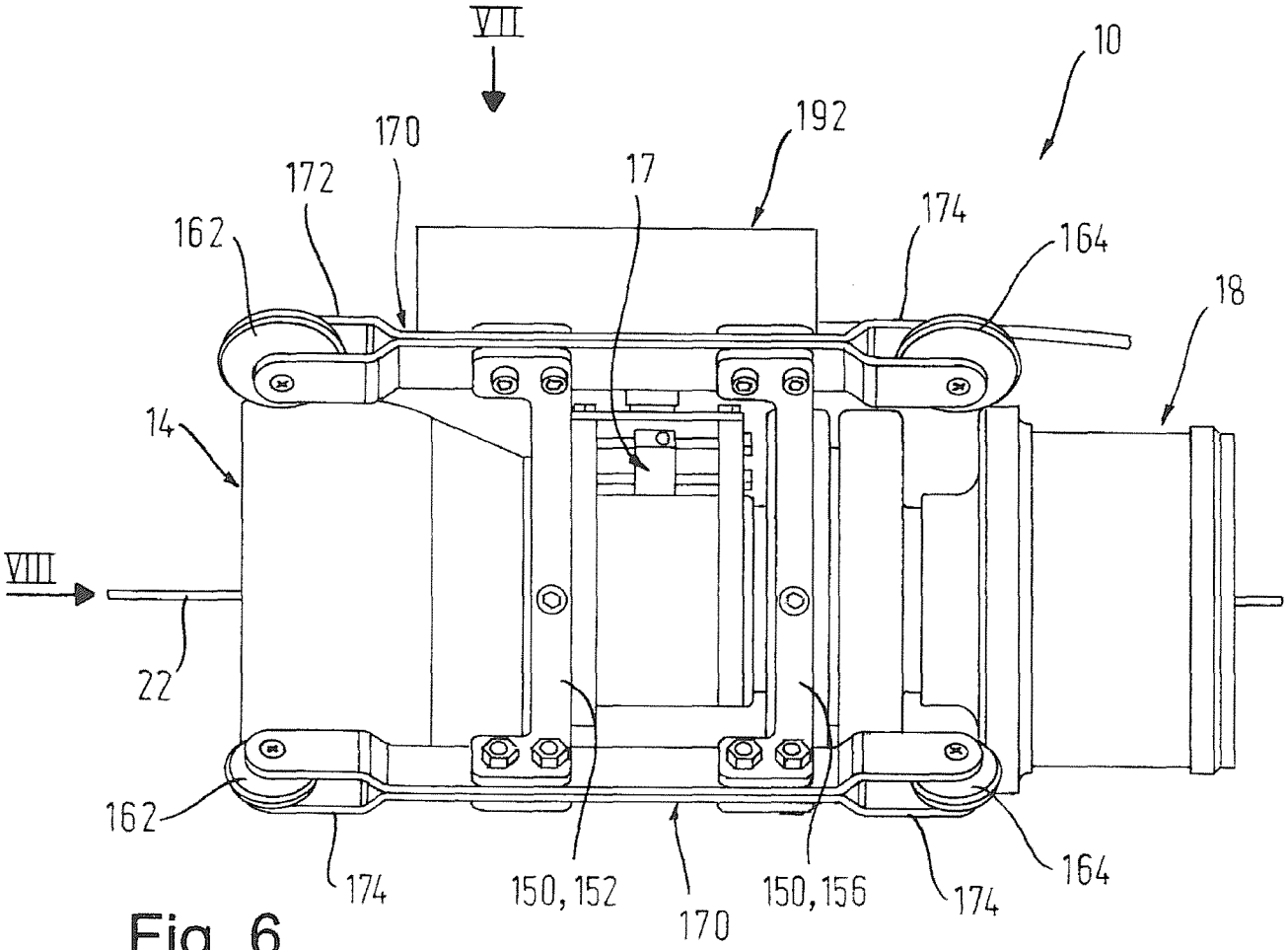
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Fig. 6

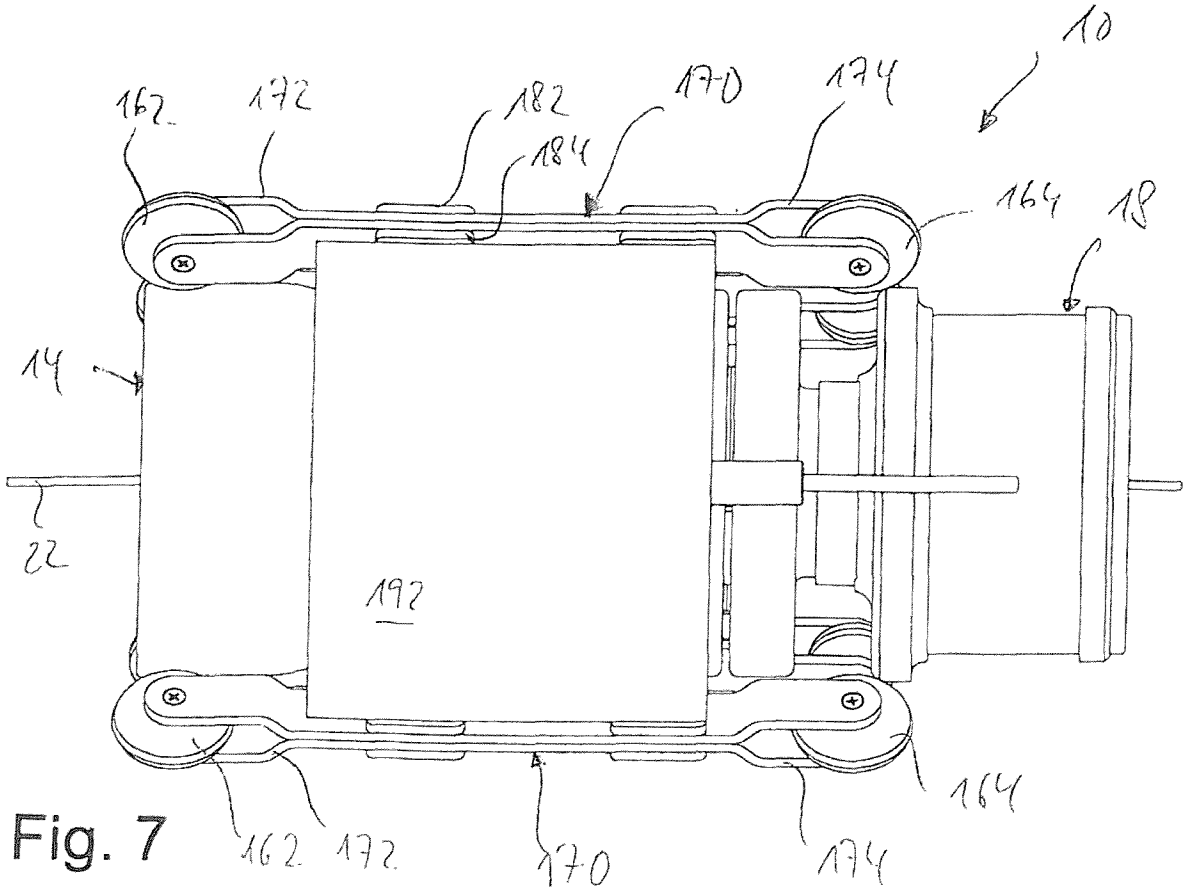
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Fig. 7

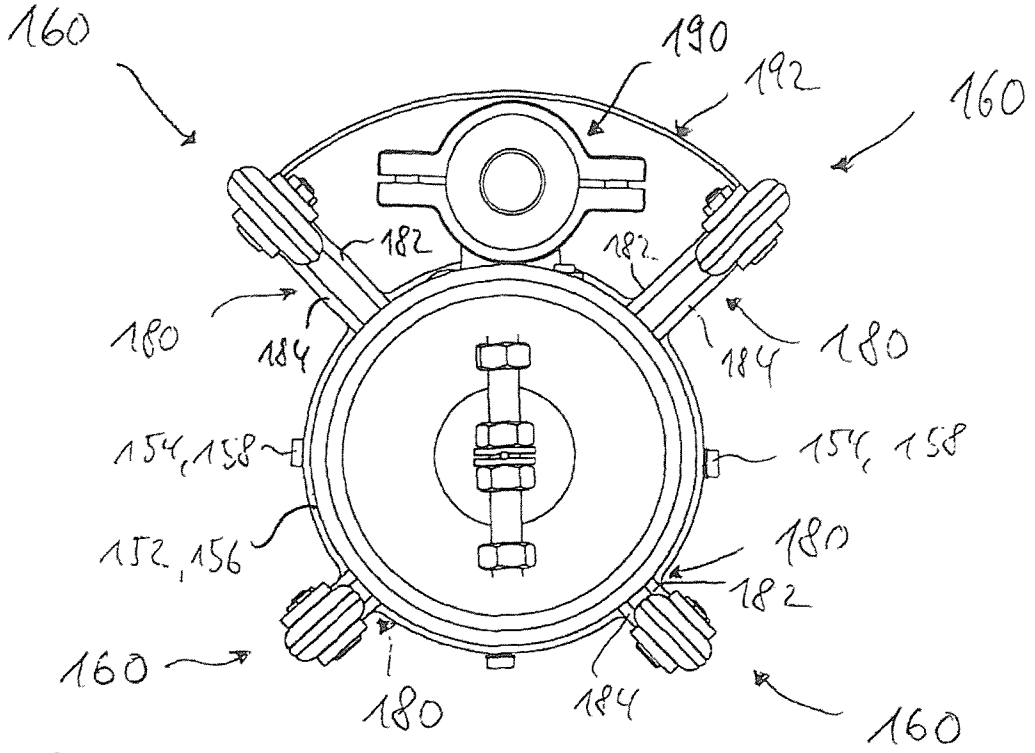
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Fig. 8

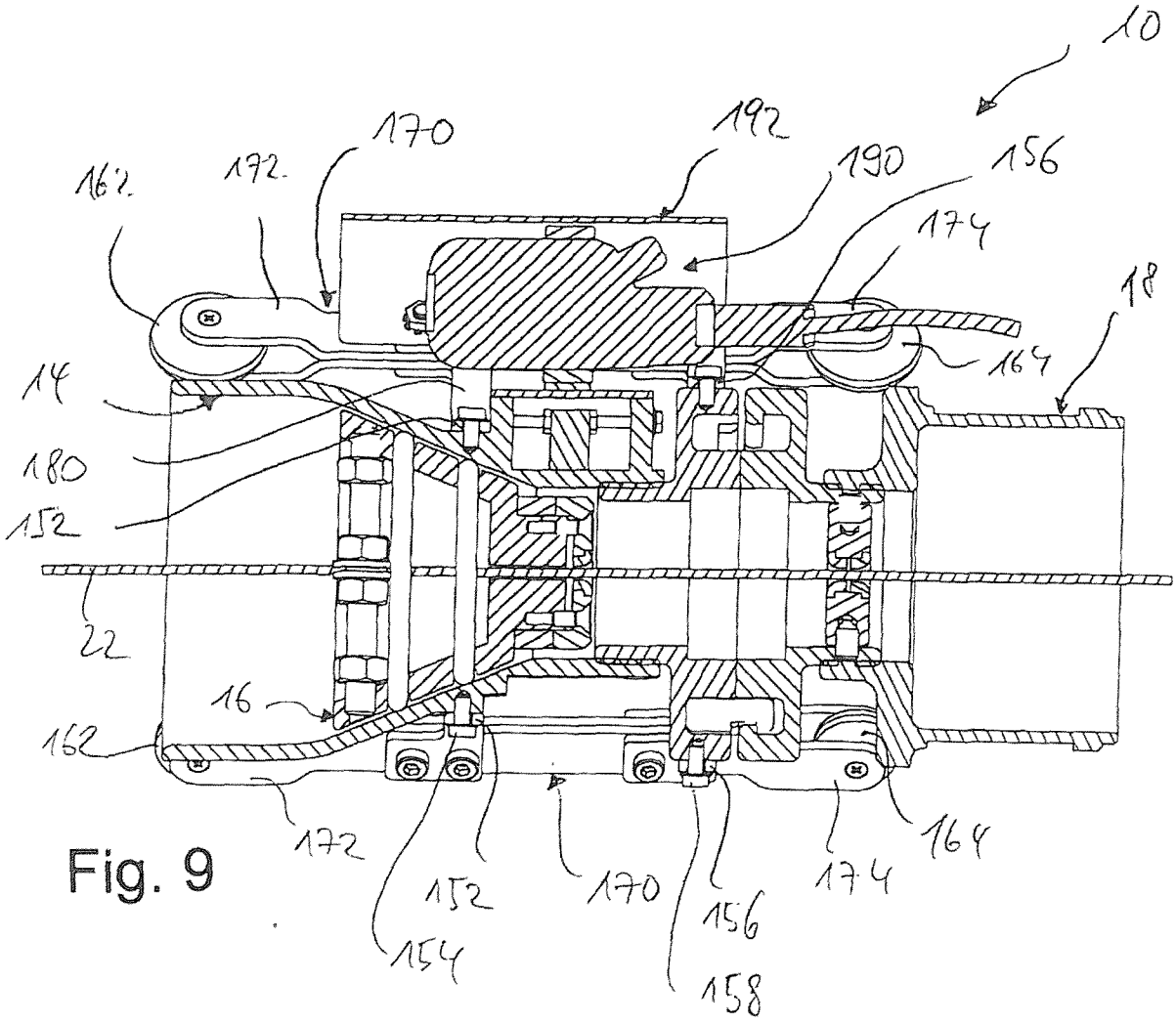
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Fig. 9