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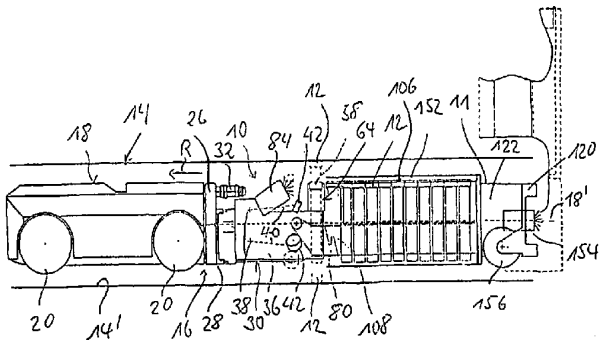
(54) **Title:** DEVICE FOR MOUNTING AN INTERNAL CLAMP IN A PIPE WHICH IS NOT MAN–SIZED

(54) **Bezeichnung:** VORRICHTUNG ZUM MONTIEREN EINER INNENBRIDE IN EINEM NICHT BEGEHBAREN ROHR

(57) **Abstract**

The invention relates to a device (10) for mounting an internal clamp in a pipe (14) which is not man–sized. Said device comprises a mount (16) which can be movably supported in the longitudinal direction (R) of said pipe, on its internal wall (14'), as well as a clamp mounting head (64) which is placed on the mount (16) in such a way that it can move in a radial direction relatively to the longitudinal direction (18') of said mount and engage a part (58) of the internal clamp (12). The inventive device also comprises a pinion (88) which can rotate relatively to the clamp mounting head (64) and engage another part (12') of the internal clamp (12), said pinion being used to move away the internal clamp (12) as well as driving elements used to displace in a radial outward direction the clamp mounting head (64) in order to mount the internal clamp (12) by means of its displacement, and also used to rotate and turn the pinion (8). The inventive mounting device (10) can be used to couple a clamp carriage (11) which can be equipped with an interchangeable clamp magazine (106).



Device for installing an internal clamp in an inaccessible pipe

The invention relates to a device for installing an inner sleeve in a pipe which is inaccessible on foot. It furthermore relates to a carriage which is suitable, in particular, for use with an installation device of this type. Finally, the invention also relates to the combination of an installation device of this type and a carriage of this type.

It is known from DE-U-29 700 912 to lay conductor cables for light sources in inaccessible conduit or pipe systems and to fasten them to the pipe inner wall by means of fastening elements designed in the manner of inner sleeves. The use of fastening elements of this type has the advantage that the pipe does not have to be damaged, which would be necessary, for example when fastening them on with pegs. Spring-prestressed special steel rings are proposed as the fastening means of the fastening elements, said rings being pressed against the inner wall of the pipe and expendiently bearing against the pipe inner wall over an angular range at the circumference of at least 180°. To insert these open special steel rings into the pipe use may be made of a self-propelled, remote-controlled robot which is fitted with a camera, removes the premanufactured fastening means from a magazine carried along by it and inserts them into the pipe. This document does not reveal the design and operation of the robot in detail.

The invention is based on the object of providing a device for installing an inner sleeve in an inaccessible pipe and a sleeve carriage which is suitable, in particular, for use with an installation device of this type.

With regard to the installation device, this object is achieved by the features of Claim 1.

The device according to the invention is used to act upon various sections of the inner sleeve in order to expand the latter in the circumferential direction and therefore to install it in the inaccessible pipe.

The device is particularly suitable for installing a self-contained inner sleeve as is disclosed, for example in EP Patent Application 98 102 682.6 and in the corresponding International Patent Application No. PCT/CH98/00331. With regard to the design and operation of this inner sleeve, express reference should be made to this patent application.

With regard to the sleeve carriage, the object is achieved by the characterizing features of Claim 19. A sleeve carriage of this type is suitable, in particular, for use with the above-mentioned installation device.

Particularly preferred embodiments of the device and of the sleeve carriage are specified in the dependent claims.

The invention is explained in greater detail below using an exemplary embodiment and with reference to the drawing; in the drawing:

Figure 1 shows a schematic illustration of a device which is arranged an inaccessible pipe and is intended for installing an inner sleeve using an assigned sleeve carriage, with the pipe cut open in the longitudinal direction,

Figure 2 shows an enlarged, partially sectioned illustration of part of the installation device,

Figure 3 shows a partially sectioned illustration of the sleeve-setting module of the installation device in which, in addition, the supporting elements can be seen taking up their supporting position,

Figure 4 shows a horizontal longitudinal section through a part of the installation device comprising the sleeve-setting module,

Figure 5 shows a cross section through the sleeve-setting module of the installation device,

Figure 6 shows a partially transversely sectioned end view of the sleeve-setting module looking from the associated coupling pipe,

Figure 7 shows a schematic partial illustration of the sleeve-setting module together with the coupling adapter placed onto the coupling pipe,

Figure 8 shows a schematic partial illustration of the sleeve-setting module together with an illustrated cylinder/piston unit for actuating the holding jaws of the sleeve head,

Figure 9a -9f show various views if the coupling region between between the sleeve-setting module of the installation device and the sleeve carriage,

Figure 10 shows a cross section illustration of the sleeve carriage

Figure 11 shows a schematic, partially transversely sectioned view of the sleeve carriage,

Figure 12 shows a schematic illustration of the sleeve magazine taking up its inoperative position with the sleeve carriage coupled to the sleeve-setting module,

Figure 13 shows a schematic illustration of the sleeve magazine taking up its transfer position,

Figure 14 shows a schematic illustration of the sleeve magazine taking up its transfer position, the conveying member already gripping the foremost sleeve of the sleeve stack from behind,

Figure 15 shows a schematic illustration of the sleeve magazine taking up its transfer position with the foremost sleeve pushed over the sleeve-setting head by the conveying member, and

Figure 16 shows a schematic illustration of the sleeve magazine moved back again into its inoperative position, the sleeve-setting head having already grasped the previously transferred sleeve and the conveying member already again gripping the foremost sleeve of the remaining sleeve stack from behind.

The installation device 10 which is shown in Figures 1 to 16 together with the associated sleeve carriage 11 is intended for installing an inner sleeve 12, shown, for example, in Figure 1, in an inaccessible pipe 14, such as, for example, a sewage pipe. A frame 16 of the installation device 10 comprises a remote-controlled, self-propelled robotic conduit vehicle 18 which is supported via wheels 20 on the pipe inner wall 14' and can be moved in the pipe longitudinal direction R by means of a driving assembly for the wheels 20, which assembly is arranged in the robotic conduit vehicle 18. It is possible for a measuring wheel (not shown) to be mounted in a freely rotatable manner at the side of the robotic conduit vehicle 18, which measuring wheel likewise bears against the pipe inner wall 14' and can be connected to a rotary sensor (not shown) which passes on its signals, for example via a signaling and feeder cable, to a monitoring and control apparatus arranged outside the pipe system, in order to determine the location of the installation device 10 in the pipe 14.

A rotary plate 26 which is assigned to a rotary apparatus of the robotic conduit vehicle 18 and serves as a supporting element is mounted, in a manner such that it can rotate about the longitudinal axis 18' of the robotic conduit vehicle, on that end side of the robotic conduit vehicle 18 which faces the sleeve magazine 11. A rotary drive for this rotary plate 26 is accommodated in the robotic conduit vehicle 18.

A sleeve-setting module 30 is fastened in a boom-like manner to the rotary plate 26 via a locked bayonet fastener 28. Connections 32 for control, feed and signaling lines and also a compressed-air feed line may also be provided on the rotary plate 26. In addition, as can best be seen with reference to Figure 4, two output shafts 34, 34' lying approximately diametrically opposite each other are mounted rotatably on the rotary plate 26 and are connected to driving assemblies accommodated in the robotic conduit vehicle 18.

The sleeve-setting module 30 has a housing 36 which is, for example, approximately cuboidal and to which that part of the bayonet fastener 28 which is assigned to this sleeve-setting module 30 is fastened. In addition, two parallel supporting shafts 38 which run at right angles to the longitudinal axis 18' are mounted rotatably on the housing 36 and, at their ends protruding on both sides over the housing 36, bear supporting levers 40 with a supporting element, namely a supporting roller 42 in each case, mounted in a freely rotatable manner on the ends thereof. Within the housing 36 a worm wheel segment 44 is seated in each case in a rotationally fixed manner on each supporting shaft 38 (cf. Figures 2 and 3, in particular). The two worm wheel segments 44 mesh with a worm 46 which is formed on a worm shaft 46' which runs in the direction of the longitudinal axis 18' and is mounted in a freely rotatable manner on the housing 36.

Seated on that free end of the worm shaft 46' which faces away from the worm wheel segments 44 (cf. Figure 2) is a toothed wheel 50 which meshes with a driving wheel 50' seated on a coupling shaft 52 which is mounted in a freely rotatable manner in a region, protruding laterally over the housing 36, of a transmission housing part 48' which is connected fixedly to the housing 36 (cf. Figure 4, in particular). The coupling shaft 52 is connected via a

connecting shaft 54' (indicated by dashed lines) to the corresponding output shaft 34' mounted on the rotary plate 26. With this output shaft 34' being driving by means of the corresponding driving assembly arranged in the robotic conduit vehicle 18, the supporting levers 40 can be pivoted out of an inoperative position (shown by dash-dotted lines in Figure 3), in which they run approximately in the direction of the longitudinal axis 18' (cf. Figure 1, for example), into a supporting position (illustrated in Figure 3 by unbroken lines) in which the supporting rollers 42 are supported against the pipe inner wall 14'. This enables the longitudinal axis 18' to be centered with respect to the pipe 14.

As can be gathered from Figure 3, for example, when the supporting levers 40 take up their supporting position the axes of the supporting rollers 42 situated at the top run at least approximately parallel to the longitudinal axis 18' and the axes of the supporting rollers 42 situated at the bottom run at right angles to the longitudinal axis 18'. Damage to the pipe inner wall 14' is thereby avoided and at the same time the installation device 10 is blocked with regard to the pipe 14. Mounting the supporting rollers 42 in such a manner makes it possible, with the supporting levers 40 slightly pivoted back out of the supporting position, for the position of the installation device 10 to be adjusted axially by an appropriate movement of the robotic conduit vehicle 18.

Mounted radially, i.e. in a perpendicularly displaceable manner with respect to the longitudinal axis 18', in the sleeve-setting module 30 is a sleeve-setting head 64 which is provided at its outer, free end with holding jaws 56 which, in particular, can be actuated pneumatically and can be brought into engagement with the fastening part 58 of the respective sleeve 12 (cf. Figures

1, 6, 7 and 8, in particular). In this case, the holding jaws 56 can be provided with pins so as to ensure engagement with the respective fastening part 58 in as reliable manner as possible.

The sleeve-setting head 64 which is designed as a slide, is arranged on a guide rail 60 fixed on the housing and is connected to a rack 62 is correspondingly moved in the radial direction via a toothed wheel 66 which meshes with the rack 62. The toothed wheel 66 is coupled via a further connecting shaft 52 to a further output shaft 34 which is again connected to a relevant driving assembly accommodated in the robotic conduit vehicle 18 (cf. Figure 4 to 6, in particular).

Like the output shaft 34', the output shaft 34 is mounted rotatably on the rotary plate 26 of the robotic conduit vehicle 18 and is coupled to a driving assembly accommodated in the robotic conduit vehicle 18. Whereas the output shaft 34' is used for centering purposes, the output shaft 34 is used to adjust the sleeve-setting head in the radial direction. The two output shaft 34 and 34' may, in particular, be driven under closed-loop control.

Furthermore, a pinion 88 which can be brought, for expansion purposes, into engagement with a further section of the sleeve 12, i.e. a section different to the fastening part 58, is mounted pivotably about an axis 68 in or on the sleeve-setting head 64. In this case, a lever 70 which can be pivoted about the axis 68 is provided and the pinion 88 is mounted rotatably at the free end of said lever. The pivot axis 68 extends parallel to the longitudinal axis 18' of the robotic conduit vehicle 18, with the result that the pinion 68 can be pivoted in a plane perpendicular to this longitudinal axis 18' (cf. Figures 5 and 6, in particular). The pinion 88 is drivin by an electric motor 72. In the present exemplary embodiment, this electric motor 72 is also

accommodated in the sleeve-setting head 64 (cf. Figure 6, in particular). The pivot lever 70 is pivoted by means of a cylinder/piston unit 74. As can be gathered from Figure 6, this cylinder/piston unit 74 is also arranged in or on the sleeve-setting head 64.

A respective sleeve 12 can therefore be expanded by radial extension of the sleeve-setting head 58 and swinging out of the pinion 78 and driving said pinion 88, and can be placed against the inner wall 14' of the inaccessible pipe 14. In addition, at least some of the electronics 76 required for the drives can also be arranged in the sleeve-setting head 64.

While the driving means 50, 50' serving for centering purposes are accommodated in a transmission housing part 48' connected fixedly to the housing 36 of the sleeve-setting module 30, the driving means 62, 66 assigned to the sleeve-setting head 64 are arranged in a transmission housing part 48" which is connected fixedly to a support 78 which is itself connected fixedly to a coupling pipe 80 used to couple on the sleeve carriage 11 (cf. Also Figure 2, in particular). The coupling pipe 80 and the support 78 connected fixedly to it are connected via a joint 82 to the sleeve-setting module 30. In this case, the support 78 and the coupling pipe 80 can be jointly pivoted in all directions by some degrees, for example by approximately ± 3°, with regard to the housing 36 of the sleeve-setting module 30.

Furthermore, a TV camera 84 used for monitoring the sleeve-setting process is provided on the housing 36 of the sleeve-setting module 30. This camera 84 may be mounted, for example pivotably, on the housing 36 of the sleeve-setting module 30.

As already indicated, the sleeve-setting module 30 may contain at least some of the electronics and/or pneumatics

which are required. The sleeve-setting head 64 may be centered and raised and lowered, in particular via articulated shafts. For the purpose of adaptation to different pipe inside diameters, the TV camera 84 may be attached via corresponding adapters. Different support leavers 40 may be used depending on the pipe inside diameter. If appropriate, corresponding centering adapters can also be used. In order to fix the sleeve-setting head 64 with respect to he housing 36 of the sleeve-setting module 30 for the purpose of placing individual sleeves 12 (without the sleeve carriage 11), a coupling adapter 86, for example, may be placed onto the coupling pipe 80 (cf. Figure 7, in particular).

It can also again be gathered from Figures 7 and 8 that the two holding jaws 56 of the sleeve-setting head 64 which are expediently provided with pins and are intended for holding a relevant fastening part 58 can be moved toward each other and away from each other. According to Figure 8, a cylinder/piston unit 90 arranged on the housing 36 of the sleeve-setting module 30 can be provided for this purpose. The TV camera 84 fixed on the housing 36 can also again be seen in Figures 7 and 8. If required, the sleeve-setting head 64 may also be assigned a lifting adapter 92, as is indicated, for example, in Figure 7. Finally, if appropriate, a casing adapter may also be used. As already emerges from the above, the sleeve-setting module 30 is preferably actuated from the outside.

The covering 48' which is connected fixedly to the housing 36 of the sleeve-setting module 30 and is intended for the toothed wheel mechanism serving for centering purposes, and the support 78 which is connected fixedly to the coupling pipe 80 and to which the guide rail 60 is fastened and on which the toothed wheel 66 meshing with the rack 62 is mounted rotatably can again also be seen in

Figure 5. The fastening of the sleeve-setting head 64 to the rack 62 is indicated at 94. A corresponding drive then enables the head 64 to be moved along the guide rail 60. In Figure 6, the end side, facing the sleeve carriage 11, of the coupling pipe 80 assigned to the sleeve-setting module 30 can also be seen.

As emerges best from Figure 6, a further cylinder/piston unit 96, on whose piston rod an impact weight can be seated is arranged on the sleeve-setting head 64. This cylinder/piston unit 96 serves to release the fastening part 58, which is provided as a clamping fastener, of the relevant sleeve 12, after the sleeve 12 has been expanded and placed against the pipe inner wall 14', in order thereby to cause the sleeve band 12 to be placed under compressive stress, by means of a release spring force, and to be correspondingly pressed against the pipe inner wall 18', with the result that it retains its position particularly even when there is a relatively heavy flow of media in the pipe.

The fastening part 58 may be designed in different ways for this. Thus, the fastening part 58 designed as a clamping fastener may be provided, for example, with a spring-loaded latching beam 102 which is acted upon by the cylinder/piston unit 96 and is flanked, for example, by two helical springs (not shown). That end wall of the housing of the fastening part 58 which is adjacent to the cylinder/piston unit 96 may, for example, have a latching incision through which a lug 104 of the latching beam 102 is passed for the purpose of clamping the fastening part 58 (cf. Figure 6, in particular). A radially outer section of the sleeve band 12, which is initially wound up, for example in coiled form, can be connected fixedly to the fastening part 58. With the fastening part 58 still under stress, an inner sleeve-band section lying radially within the outer sleeve-band section

can then be passed freely in the desired direction through the fastening part 58 on account, for example, of a free wheel. The lock can finally be released by the lug 104 of the latching beam 102 being correspondingly acted upon by the cylinder/piston unit 96. As soon as the fastening part 58 is released via the cylinder/piston unit 96, via the latching beam 102, which is now released, and, for example, a blocking element assigned to the free wheel, the radially inner sleeve-band section is placed under compressive stress, corresponding to the spring force acting on the latching beam 102, and is correspondingly pressed against the pipe inner wall 14' thereby ensuring a reliable fit. The fastening part 58 is generally only released if the sleeve band, which initially is wound up in particular in coiled form, has been sufficiently expanded and at least substantially already bears against the pipe inner wall 14'.

The track width of the robotic conduit vehicle 18 can be adjusted to match the particular pipe inside diameter.

The installation device 10 can be coupled to the sleeve carriage 11 which is equipped with a respective sleeve magazine 106 (cf. Figure 1 and 9 to 16, in particular). To this end, the coupling pipe 80 provided on the sleeve-setting module 30 interacts, in the manner which can be seen, for example, in Figures 1, 2, 4, 9 and 11, with a complementary coupling pipe 108 provided on the sleeve carriage 11. In this case, the installation device 10 can be coupled, in the manner which can be seen, for example, in Figure 1, to the clamp carriage 11 in such a manner that the latter can be pivoted up through approximately 90° relative to the installation device 10 into an essentially perpendicular position for a respective change of magazine. Moreover, to this end, means for automatically separating and automatically restoring the respective electrical and pneumatic connections between the installation device 10 and

the sleeve carriage 11 can be provided. As can be gathered in particular from Figure 9a and 9d, the two coupling pipes 80 and 108 are each provided with interacting parts of a pneumatic plug-in coupling 111 and an electrical plug-in coupling 110. Also, the support 78 which is connected fixedly to the coupling pipe 80 can again be seen in Figures 9d and 9e.

The coupling pipe 108 provided on the sleeve carriage 11 has a downwardly directed, hook-shaped part 112 which comes into engagement with a complementary hook-shaped part 114 of the coupling pipe 80 on the sleeve-setting module 30 of the installation device 10. As can best be seen with reference to Figure 9, a sliding coupling 118 which can be slid to and fro via an actuating lever 116 is provided. By this sliding coupling 118 being extended on the sleeve carriage 11 into a coupling position, firstly the two coupling pipes 80, 108 are connected fixedly to each other and secondly, the electrical and pneumatic connections are produced. Generally, the sleeve-setting head 64 can be equipped with an individual sleeve 12 prior to the coupling up of the sleeve carriage 11, as is shown, for example, in Figure 1. In Figure 9b, the sliding coupling 118 is illustrated in its uncoupled position. Starting from this uncoupled position it can be displaced to the right into its coupling position, as a result of which, as already mentioned, the pneumatic and electrical connections are produced automatically and the two coupling pipes 80, 108 are locked mechanically to each other, thereby preventing these coupling pipes from separating.

As can be gathered in particular from Figures 1 and 11, the sleeve carriage 11 comprises an undercarriage 120 provided with at least one wheel 158, and a base part 122 which is provided with the coupling pipe 108 and can be rotated relative to the undercarriage 120 about an axis

which extends in the longitudinal direction and in particular can coincide with the longitudinal axis 18'. The base part 122 can therefore be rotated together with the sleeve-setting module 30 via the rotary plate 26 of the robotic conduit vehicle 18. As can be gathered in particular from Figure 11, a ball bearing 124 is provided between the rotatable base part 122 and the undercarriage 120 of the sleeve carriage 11. For movement purposes, the base part 122 can be locked in a rotationally fixed manner to the undercarriage 120 by means of a lock 146.

As can be gathered in particular from Figures 1 and 11, the base part 122 of the sleeve carriage 11 serves to hold a respective sleeve magazine 106, the respective sleeve magazine 106 being displaceable along this base part 122.

The coupling pipe 108 is provided on a lower carrier part 122' of the base part 122. A cylinder/piston unit 126 supported on the base part 122 or on its lower carrier part 122' serves to move the respective sleeve magazine 106 relative to the base part 122, in the longitudinal direction thereof, between an inoperative position (cf. Figures 11 and 12, in particular), and a transfer position (cf. Figures 13 to 15, in particular) in which the foremost sleeve 12 in each case situated nearest the sleeve-setting head 30 can be transferred to the sleeve-setting head 64.

In this case, the sleeve magazine 106 which can be displaced along the base part 122 can be coupled to a slide 128 which is guided on the base part 122 and can be acted upon by the cylinder/piston unit 126 (cf. Figures 10 and 11, in particular). As can best be gathered from Figure 10, this slide 128 is guided in a C-rail 130 which is arranged fixedly on the base part 122. In this case, the sleeve magazine 106 can be coupled to the slide 128 via at least one latching coupling 132 (cf. Figure 10 and 11).

At least one conveying member 134, which is guided displaceably on the sleeve magazine 106, in the longitudinal direction thereof, serves to isolate the foremost sleeve 12 in each case situated nearest the sleeve-setting head 64 for the transfer and to push it over the sleeve-setting head 64.

A spindle 136, which can be rotated with respect to the slide 128, but cannot be displace in the longitudinal direction, and a running nut 138, which is seated on the spindle 136 and can be coupled to the conveying member 134, are provided for driving the conveying member 134 (cf. Figures 10 and 11, in particular). The running nut 188 can be coupled to the conveying member 134 via a latching coupling 140.

As can be gathered in particular from Figure 10, guide rails 142 on which the sleeve magazine 106 is guided are provided on the base part 122 of the sleeve carriage 11.

According to Figure 11, the spindle 136 is driven by an electric motor 144 which is arranged in the base part 122 of the sleeve carriage 11. With reference to Figure 11, the lock 146 via which the base part 122 can be locked in a rotationally fixed manner to the undercarriage 120 for movement purposes, can also be seen.

As can be seen in particular with reference to Figures 10 and 12, the sleeve 12 can be displaced relative to the sleeve magazine 106 along two receiving rails 148 provided on the sleeve magazine 106. Two clips 150 of a respective sleeve 12 are in each case snapped onto these rails 148 (cf. Figures 10 and 12, in particular). In the present case, each sleeve 12 is provided with a total of seven such clips 150 (cf. Figure 6, in particular). As Fig. 10 shows, the sleeve 12 may, for example, also be provided with three clips 150 and, on both sides of this group of clips, with, for example, two base structures 151 onto which further clips can be subsequently fitted.

Looking in the circumferential direction of the pipe 14, the fastening part 58, on the one hand, and the clips 150 of a respective sleeve 12, on the other hand, are offset with respect to one another. As soon as a respective sleeve 12 is pushed over the sleeve-setting head 64, the latter is brought into engagement with the fastening part 58 of this clamp 12, for which purpose the holding jaws 56 of said fastening part, which in particular are provided with pins, are correspondingly brought together (cf. Figure 19, in particular).

Like the robotic conduit vehicle 18, the sleeve carriage 11 or its undercarriage 120 can also be adjusted in its track width to match the respective pipe inside diameter.

The sleeve magazine 106 may be provided with a casing 152 (cf. Figure 1). In principle, a casing on the sleeve carriage 11 is also conceivable. Moreover, a casing with a set of wheels is also conceivable. The casings may differ depending on the respective pipe inside diameters. Therefore, the use of shell-type adapters is also conceivable, for example.

In addition, different sleeve magazines 106 may be provided for different sleeve 12. In this case, a respective magazine contains at least two sleeves in each case. In practice, ten sleeves, for example, may be provided per magazine. The respective magazine 106 can be fixed in the sleeve carriage 12. The advancing of the sleeves 12 and the isolation thereof may, for example, take place in the previously described manner.

The sleeve carriage provided with a magazine holder and the pipe coupling 108 can in particular be provided with the driving means serving for the advancing and isolating of the sleeves, as has previously been explained in detail by way of example. In addition, the electronic and pneumatic

components required for this can be provided in the sleeve carriage 11. At a suitable location, such as in particular on the undercarriage 122, a ring or the like serving for recovery work may, for example, be provided.

As can be seen in particular with reference to Figure 1, a camera 154 directed rearward is provided on the undercarriage 122 of the sleeve carriage 11.

In the case of a particular installation device and a particular sleeve carriage or in the case of a particular combination of two such modules, the previously described features can in each case be realized both individually and in various combinations with one another.

The operation of the previously described exmplary embodiment of an installation device 10 having an associated sleeve carriage 11 during the installation of inner sleeve 12 is as follows:

Depending on the space conditions, the remote-controlled, self-propelled robotic conduit vehicle 18 with or without the sleeve-setting module 30 placed on it is lowered into a shaft. The robotic conduit vehicle 18, with the rotary plate in front, is then moved to the next shaft through the inaccessible pipe 14 into which the inner sleeve 12 are to be moved. The sleeve-setting head 64 is then equipped with a sleeve 12.

The sleeve carriage 11 is then lowered into this shaft and equipped with a sleeve magazine 106. For this purpose, the sleeve carriage 11 is erected in the manner indicated in Figure 1 and the sleeve magazine 106 pushed onto the guide rails 148 on the base part 122 of the sleeve carriage 11 until the latching couplings 140, 132 have latched between the running nut 138 and the conveying member 134 and between the slide 128 and the sleeve magazine 106. After that, the sleeve carriage 11 is deposited, its coupling pipe 108 coming into engagement, by means of the downwardly directed,

hook-shaped part 112, with the complementary, upwardly directed, hook-shaped part 114 of the coupling pipe 80 provided on the sleeve-setting module 30. The sliding coupling 118 on the sleeve carriage 11 is then extended into the coupling position, as a result of which firstly the two coupling pipes 80, 108 are connected fixedly to each other and secondly the electrical and pneumatic connections are produced via the plug-in couplings 110, 111. As already mentioned, the sleeve-setting head 64 can be equipped with an individual sleeve 12 prior to the coupling up of the sleeve carriage 11, as is illustrated, for example, in Figure 1.

The installation device 10 is now moved, with the robotic conduit vehicle 18 in front, to the location in the inaccessible pipe 14 at which the first sleeve 12 is to be placed. For this purpose, the sleeve-setting module 30 and the rotatable base part 122 of the sleeve carriage 11 having the sleeve magazine 106 are brought by means of the rotary plate 26 into the desired rotational position. In order to place the sleeve 12, the sleeve-setting head 64 is extended in the radial direction and at the same time the pinion 88 causes the sleeve to expand until the latter bears against the inner wall 14' of the inaccessible pipe 14.

Unlocking of the fastening part 58 of the sleeve 12 via the piston/cylinder unit 96 causes the sleeve 12 to be placed under compressive stress, with the result that it is fixed against the pipe inner wall 14'. By moving the holding jaws 56 of the sleeve-setting head 64 apart, the fastening part 58 is released, whereupon the sleeve-setting head 64 is retracted again in the radial direction.

The abovementioned processes are monitored by means of the TV camera 84, which may, in particular, be a color TV camera. Then, by rotation of the rotary plate 26, the sleeve-setting module 30 and the rotatable base part 122 of

the sleeve carriage 11 are brought into the position in which the base part 122 can be locked to the undercarriage 120 of the sleeve carriage 11.

The installation device 10 is now moved to the next sleeve-setting location. The sleeve-setting head 64 is equipped there with a sleeve 12 from the sleeve magazine 106, as is illustrated, for example, in Figures 12 to 16.

Figure 12 shows a schematic illustration of the sleeve magazine 106 taking up its inoperative position with the sleeve carriage 11 coupled to the sleeve-setting module 30 via the coupling pipes 108 and 80. The conveying member 134 holds back the sleeves 12.

According to Figure 13, the sleeve magazine 106 has already been displaced into its transfer position. The conveying member 134 is now moved behind the foremost sleeve 12 of the sleeve stack, which sleeve is situated nearest the sleeve-setting head 64.

Figure 14 shows a schematic illustration of the sleeve magazine 106 taking up its transfer position, the conveying member 134 already gripping the foremost sleeve 12 of the sleeve stack from behind.

Figure 15 shows, in a schematic illustration, the sleeve magazine 106 taking up its transfer position with the foremost sleeve 12 pushed over the sleeve-setting head 64 by the conveying member 134. This foremost sleeve 12 has therefore been isolated by the conveying member 134. The holding jaws 56 of the sleeve-setting head 64 are still at the maximum distance apart from each other. The sleeve-setting head 64 is extended in the radial direction into a take-over position so as then, by moving the holding jaws 56 towards each other, to grasp the sleeve 12 on the fastening part 58 (also cf. Figure 16).

Figure 16 shows, in a schematic illustration, the sleeve magazine 106 which has now been moved back again into

its inoperative position, the sleeve-setting head 64 having already grasped the fastening part 58 of the previously transferred sleeve 12 and the conveying member 134 already gripping again behind the foremost sleeve 12 of the remaining sleeve stack.

After the rotatable base part 122 has been unlocked, the sleeve-setting head 64 is brought together with the sleeve magazine 106 via the rotary plate 26 into the desired rotational position for placing the sleeve 12.

This process is repeated until the sleeve magazine 106 is empty. The installation device 10, with the associated sleeve carriage 11 in front, is then moved back to the shaft. The further TV camera 154 provided on the undercarriage 120 is used for this.

In the shaft, the sliding coupling 118 is pulled back into the uncoupled position, as a result of which the electrical and pneumatic connections are automatically separated, so that the sleeve carriage 11 can be put upright again. The latching couplings 132, 140 are now accessible and can be detached by hand. The empty magazine 106 is removed from the sleeve carriage 11, and a new, filled and complete sleeve magazine 106 having the desired number of sleeve 12 is placed onto the base part 122 of the sleeve carriage 11. After that, the process described further above can be repeated.

Of course, parts or subassemblies of the device may be of different design while retaining their function. For example, the spindle drive for driving the conveying member 134 may be designed as a chain drive.

Claims

1. Device (10) for mounting an inner sleeve (12) in a pipe (14) not accessible on foot, with a frame (16) that can be supported on the inner wall (14') of the pipe so as to be movable in the longitudinal direction (R) of the pipe, a sleeve setting head (64) which is arranged radially movably on the frame (16) in relation to its longitudinal direction (18') and can be engaged with a section (58) of the inner sleeve (12), and a pinion (88) which can be engaged with a further section (12') of the inner sleeve (12) for expanding the inner sleeve (12), and respective drive means (66, 72, 74) by which for mounting the inner sleeve (12) by expansion the sleeve setting head (64) is movable radially outwards and the pinion (88) can be set in rotation.

2. Device according to claim 1, characterised in that the pinion (88) is pivotable in and out relative to the sleeve setting head (64) by drive means (74), preferably in a plane running at right angles to the longitudinal direction (18') of the frame (16).

3. Device according to claim 1, characterised by support elements (40, 42) which are movable from a rest position into a support position in which they abut against the inner wall (14') of the pipe and keep the longitudinal axis (18') of the device (16) at least approximately in the centre axis of the pipe (14).

4. Device according to one of the preceding claims, characterised in that the frame (16) includes a self-propelled sewer robot vehicle (18) which is provided

with a rotating device (26) for rotation of the sleeve setting head (64) about the longitudinal axis (18').

5. Device according to one of the preceding claims, characterised in that the radially movable sleeve setting head (64) is mounted in or on a sleeve setting module (30) which preferably can be attached to the rotating device (26) of the sewer robot vehicle (18).

6. Device according to claim 5, characterised in that the support elements (40, 42) are arranged on the sleeve setting module (30).

7. Device according to claim 5 or 6, characterised in that at least part of the respective drive means (66, 66; 72, 74; 50, 50') is provided in or on the sleeve setting module (30) for the radially movable sleeve setting head (64), the pivotable pinion (88) and/or the support elements (40, 42).

8. Device according to claim 7, characterised in that the pinion (88) is mounted pivotably in or on the sleeve setting head (64).

9. Device according to claims 7 and 8, characterised in that the pivotable pinion (88) is pivotable in and out by a piston and cylinder unit (74) arranged in or on the sleeve setting head (64) and set in rotation by a motor (72) arranged in or on the sleeve setting head (64).

10. Device according to one of the preceding claims, characterised in that it can be coupled to a sleeve car

(11) that can be equipped with a respective sleeve magazine (106).

11. Device according to claim 10, characterised in that the coupling portion (80) associated with it and co-operating with a complementary coupling portion (108) of the sleeve car (11) is arranged on the sleeve setting module (30).

12. Device according to claim 10 or 11, characterised in that it can be coupled to the sleeve car (11) in such a way that the latter is pivotable relative to it through about 90° into a substantially upright position, for respective magazine changing.

13. Device according to one of claims 10 to 12, characterised in that means (110,111) are provided for automatic disconnection and automatically restoring respective electrical and pneumatic connections to the sleeve car (11).

14. Sleeve car (11), characterised in that it is coupled to a device for mounting an inner sleeve (12) in a pipe (14) not accessible on foot according to one of claims 1 to 13.

15. Sleeve car according to claim 14, characterised in that it can be equipped with a respective exchangeable sleeve magazine (106).

16. Sleeve car according to claim 15, characterised in that it includes a base portion (122) which serves to receive

a respective sleeve magazine (106) and along which the sleeve magazine (106) is slidable.

17. Sleeve car according to claim 15 or 16, characterised in that means (126) are provided for moving the respective sleeve magazine (106) relative to the base portion (122) in its longitudinal direction between a rest position and a transfer position in which the foremost sleeve (12) closest to the setting head (30) is transferable to the setting head (64).

18. Sleeve car according to claim 17, characterised in that means (134) are provided for separating for transfer the foremost sleeve (12) closest to the setting head (64) and for sliding it over the setting head (64).

19. Sleeve car according to one of claims 15 to 18, characterised in that the sleeves (12) are slidable in the longitudinal direction of the sleeve magazine (106) relative to the latter.

20. Sleeve car according to one of claims 15 to 19, characterised in that the sleeve magazine (106) which is slidable along the base portion (122) can be coupled, preferably by at least one latch coupling (132), to a drivable carriage (128) guided on the base portion (122).

21. Sleeve car according to one of claims 15 to 20, characterised in that the sleeves (12) can be separated by at least one conveying member (134) guided slidably on the sleeve magazine (106) in its longitudinal direction, and the conveying member (134) can be

coupled, preferably by at least one latch coupling (140), to drive means (136, 138) mounted on the carriage (128), and moved by these drive means (136, 138) relative to the carriage (12B).

22. Sleeve car according to one of he claims 15 to 21, characterised in that it includes a chassis (120), in that the base portion (122) which can preferably be coupled to the setting module (30) of the mounting device (10) is rotatable relative to the chassis (120) about an axis extending in the longitudinal direction and in that the base portion (122) is lockable non-rotatably to the chassis (120) for travel.

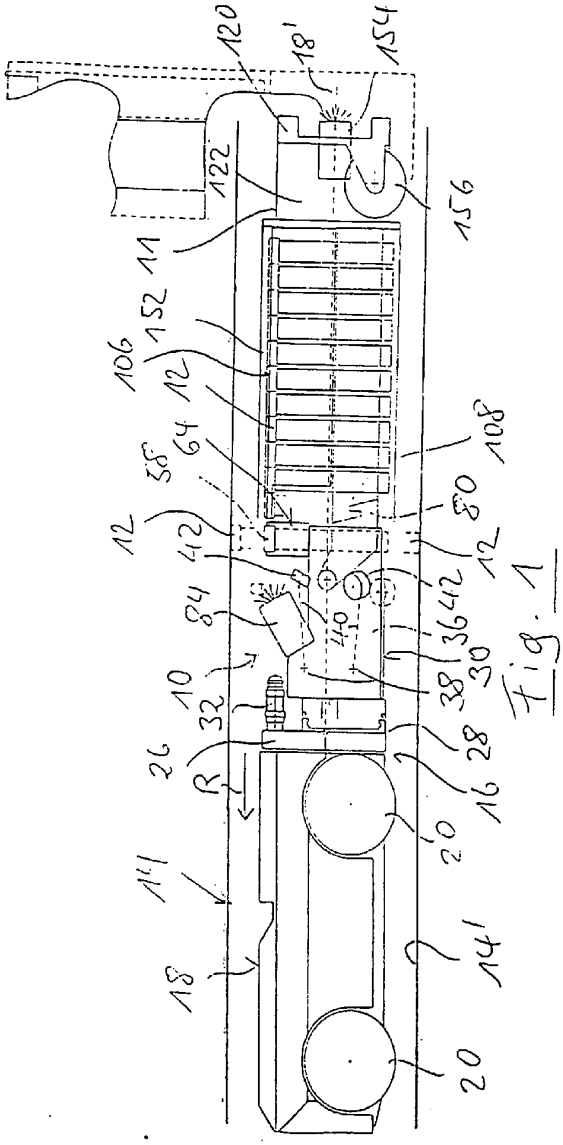

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Fig. 1

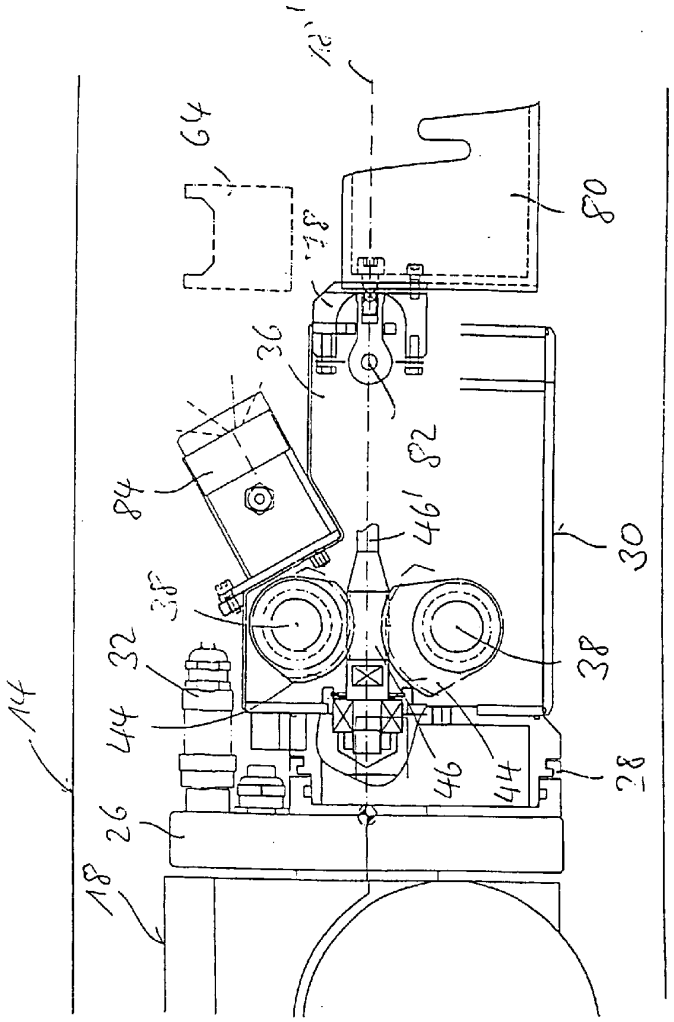


Fig. 2

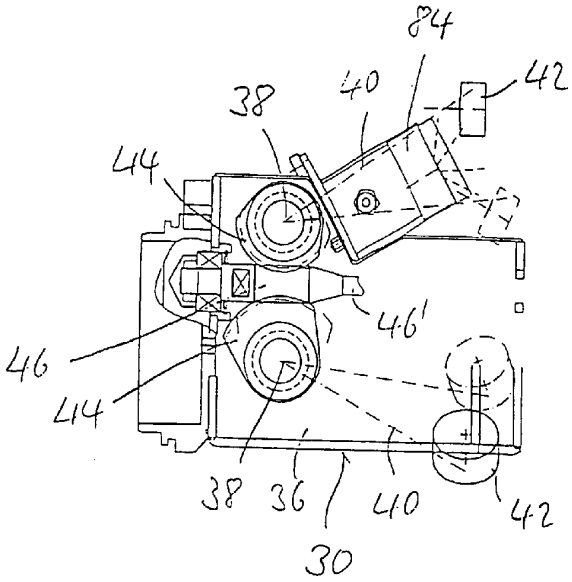


Fig. 3

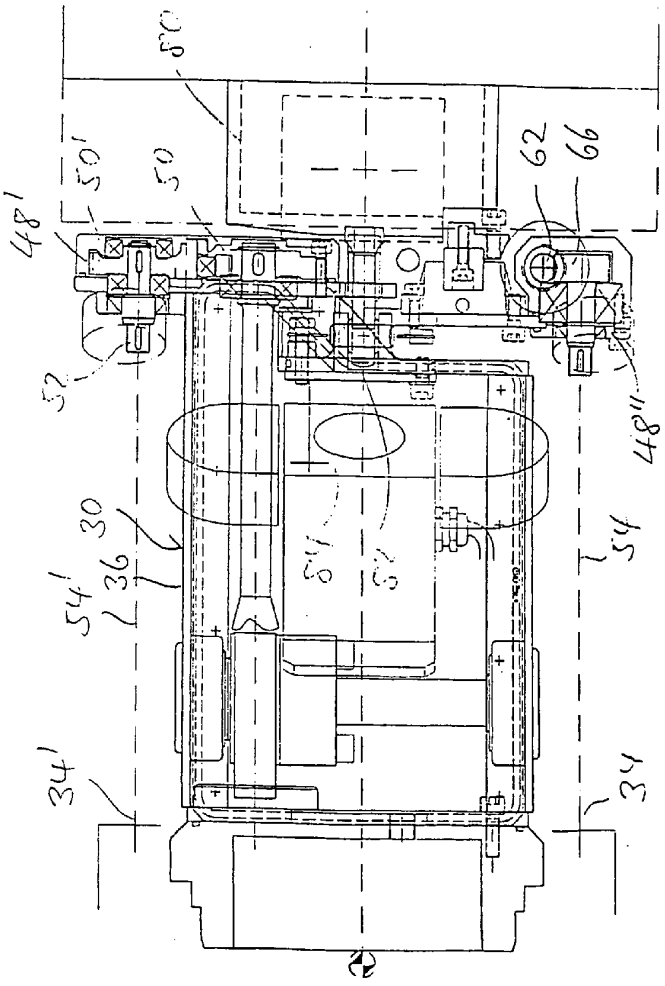
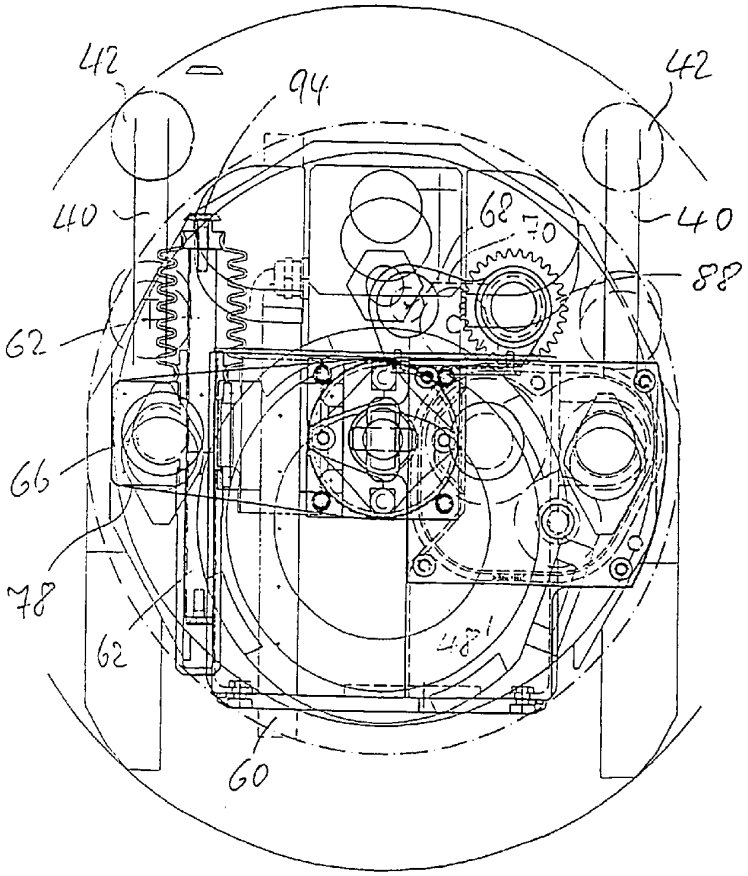


Fig. 4



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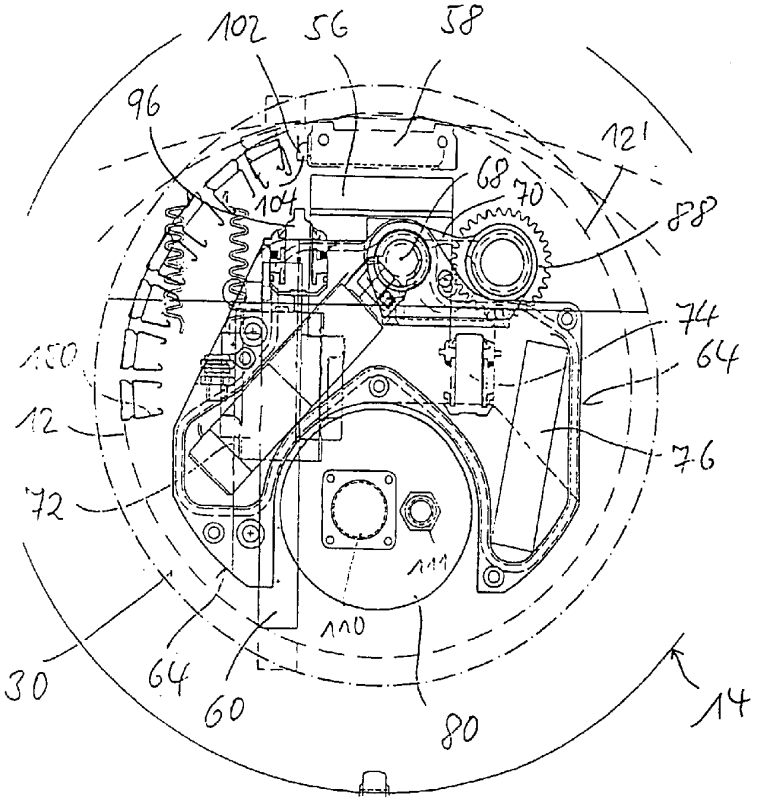
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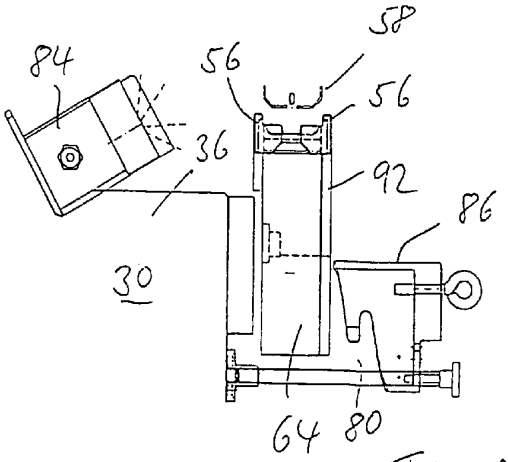
Fig. 6



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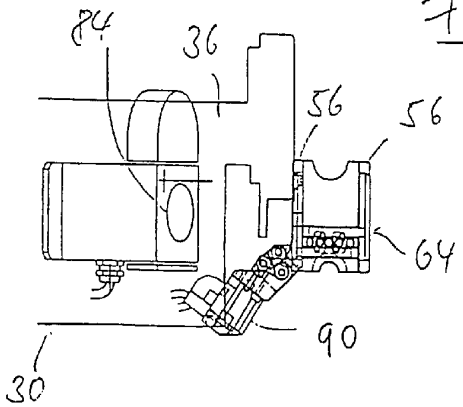

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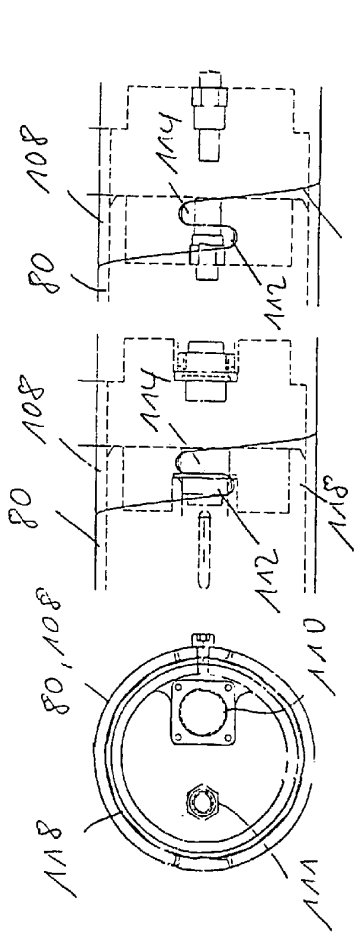

Fig. 9c

Fig. 9b

Fig. 9a

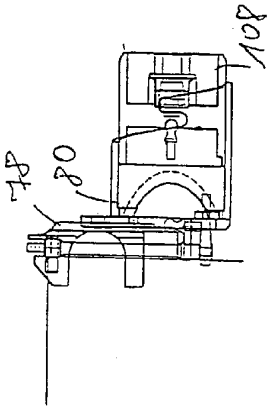

Fig. 9e

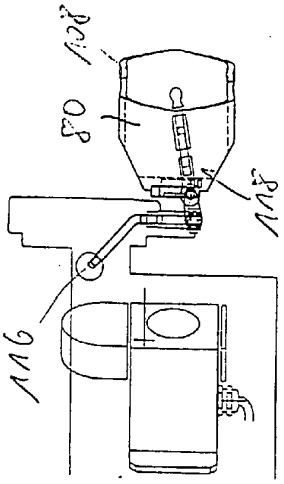

Fig. 9f

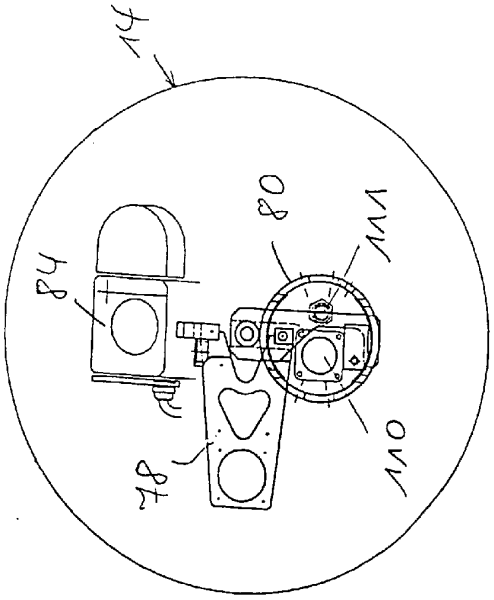

Fig. 9d

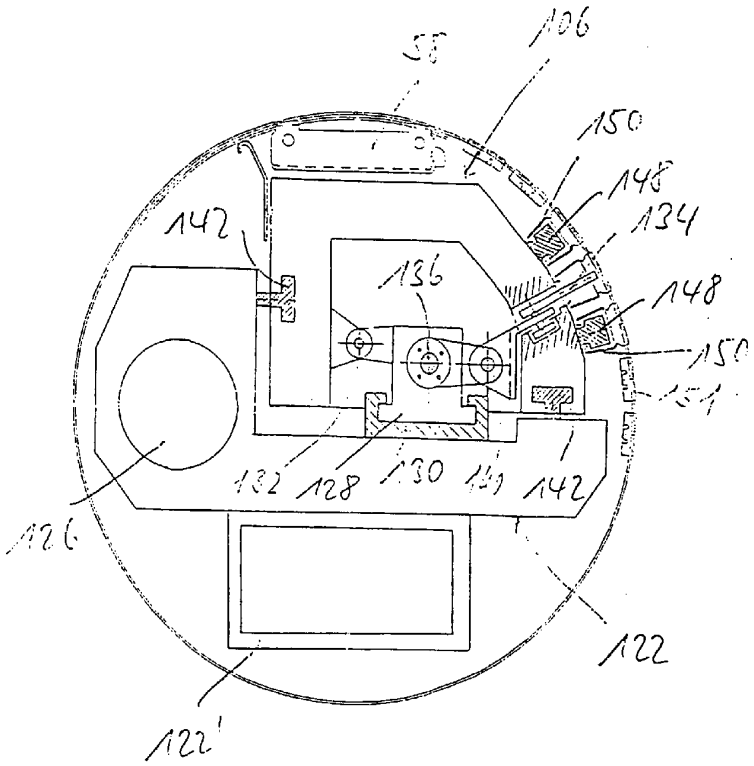
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Fig. 10

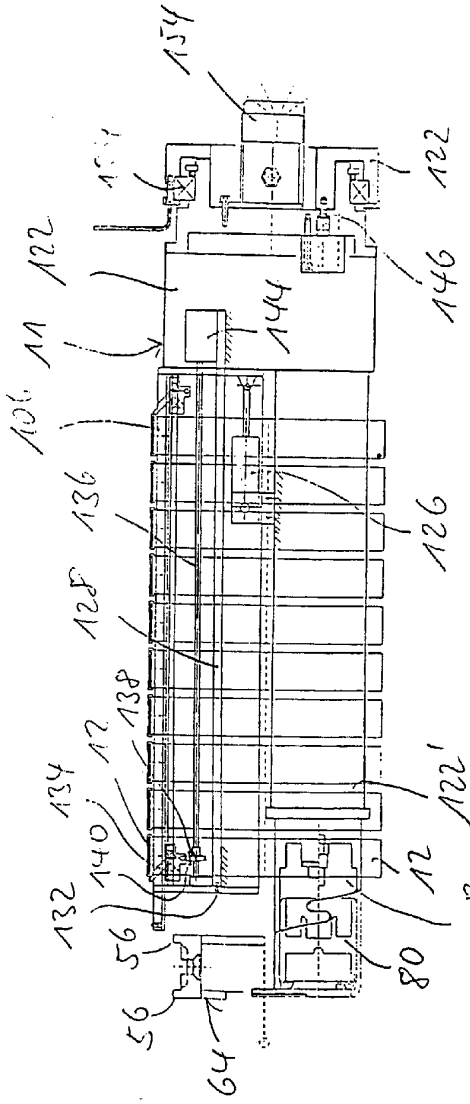
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Fig. 11

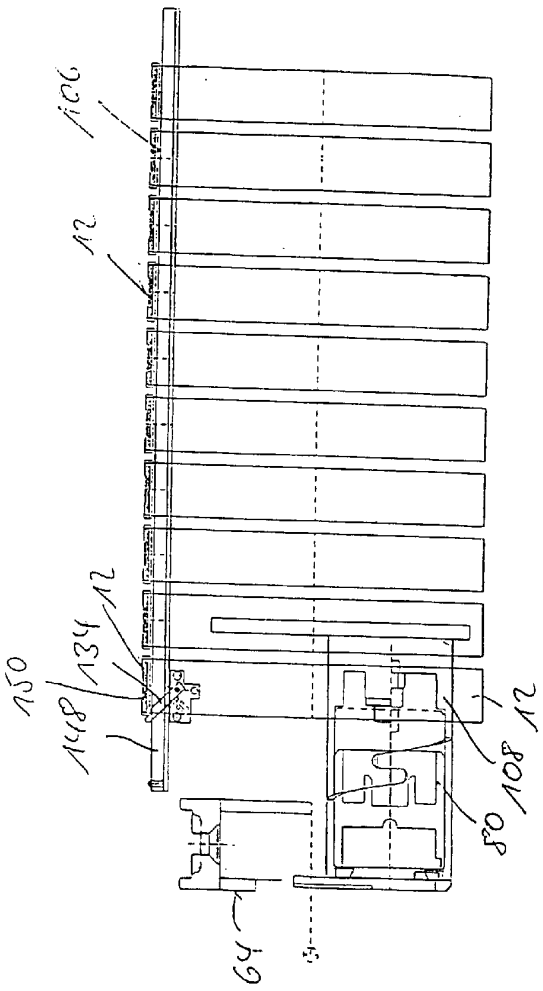

Fig. 12

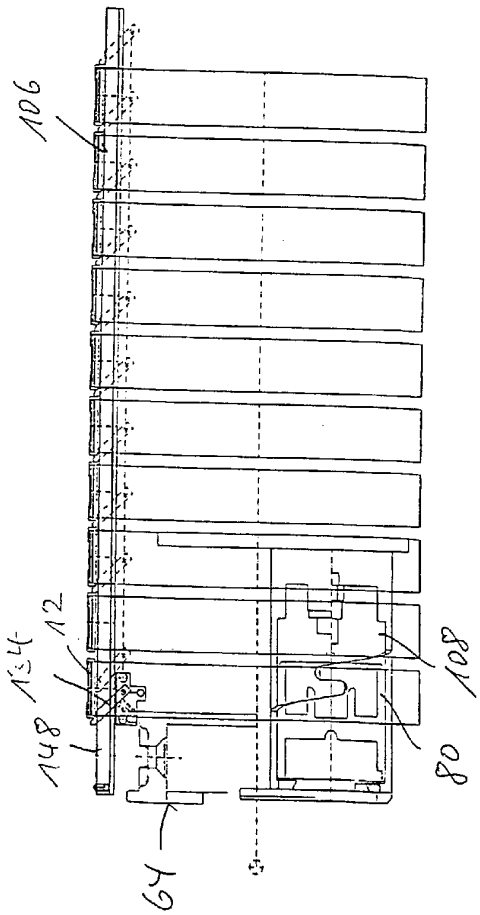

Fig. 13

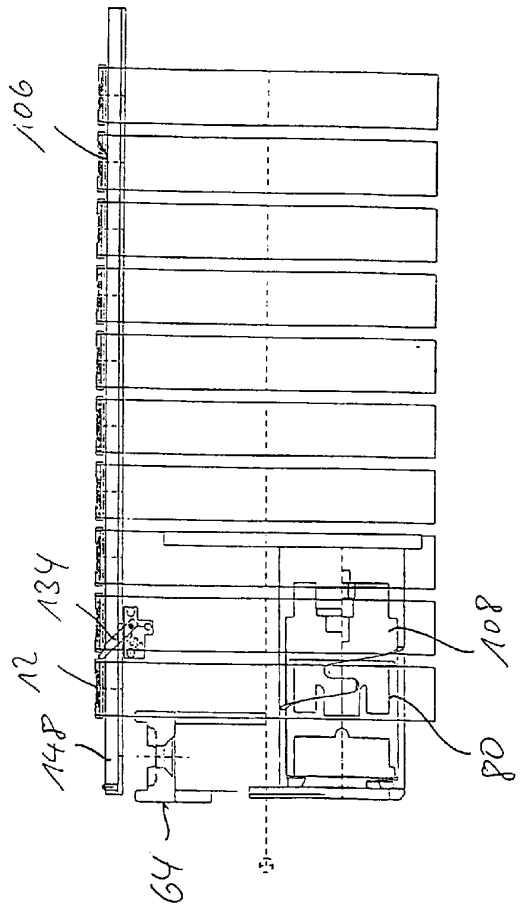

Fig. 14

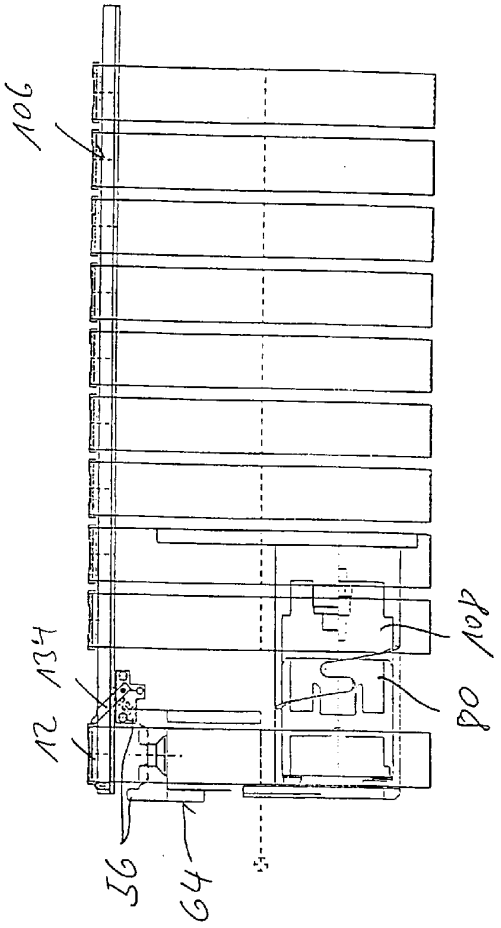

Fig. 15

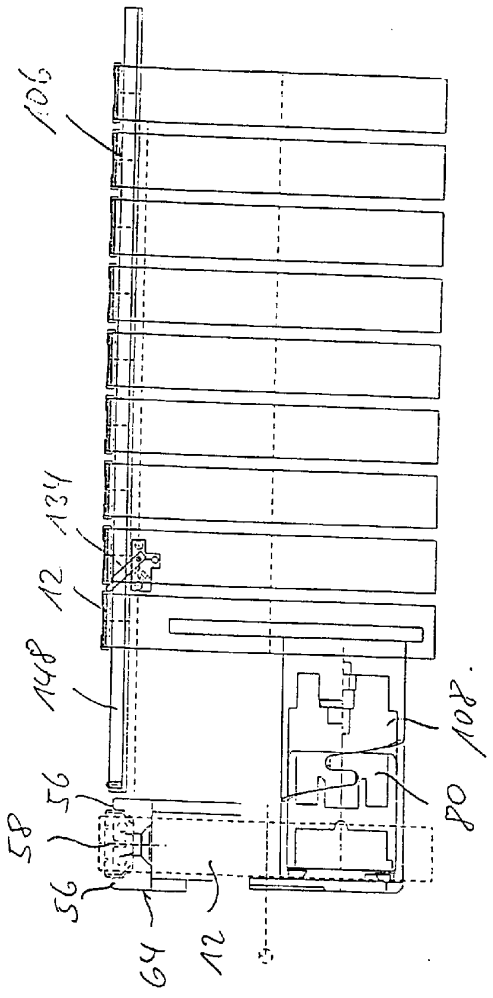

Fig. 16