

Device for installing an internal clamp in an inaccessible pipe

The invention relates to a device for
5 installing an internal clamp in an inaccessible pipe.
It furthermore relates to a clamp 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
10 this type and a clamp 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
15 the manner of internal clamps. 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
20 fastening means of the fastening elements, said rings
being pressed against the inner wall of the pipe and
expediently 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
25 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
30 the robot in detail.

The invention is based on the object of
providing a device for installing an internal clamp in
an inaccessible pipe and a clamp carriage which is
suitable, in particular, for use with an installation
35 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 internal clamp in order to expand the latter in the circumferential direction and therefore to install it in the
5 inaccessible pipe.

The device is particularly suitable for installing a self-contained internal clamp as is disclosed, for example in EP Patent Application 98 102 682.6 and in the corresponding International Patent
10 Application No. PCT [lacuna]. With regard to the design and operation of this internal clamp, express reference should be made to this patent application.

With regard to the clamp carriage, the object is achieved by the characterizing features of Claim 19.
15 A clamp carriage of this type is suitable, in particular, for use with the abovementioned installation device.

Particularly preferred embodiments of the device and of the clamp carriage are specified in the
20 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
25 which is arranged in an inaccessible pipe and is intended for installing an internal clamp using an assigned clamp carriage, with the pipe cut open in the longitudinal direction,

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

Figure 3 shows a partially sectioned illustration of the clamp-placing module of the installation device in which, in addition, the supporting
35 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 clamp-placing module,
- Figure 5 shows a cross section through the clamp-placing module of the installation device,
- Figure 6 shows a partially transversely sectioned end view of the clamp-placing module looking from the associated coupling pipe,
- Figure 7 shows a schematic partial illustration of the clamp-placing module together with the coupling adapter placed onto the coupling pipe,
- Figure 8 shows a schematic partial illustration of the clamp-placing module together with an illustrated cylinder/piston unit for actuating the holding jaws of the clamp head,
- Figures 9a -9f show various views of the coupling region between the clamp-placing module of the installation device and the clamp carriage,
- Figure 10 shows a cross sectional illustration of the clamp carriage,
- Figure 11 shows a schematic, partially transversely sectioned view of the clamp carriage,
- Figure 12 shows a schematic illustration of the clamp magazine taking up its inoperative position with the clamp carriage coupled to the clamp-placing module,
- Figure 13 shows a schematic illustration of the clamp magazine taking up its transfer position,
- Figure 14 shows a schematic illustration of the clamp magazine taking up its transfer position, the conveying member already gripping the foremost clamp of the clamp stack from behind,
- Figure 15 shows a schematic illustration of the clamp magazine taking up its transfer position with the foremost clamp pushed over the

clamp-placing head by the conveying member,
and

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

10 The installation device 10 which is shown in Figures 1 to 16 together with the associated clamp carriage 11 is intended for installing an internal clamp 12, shown, for example, in Figure 1, in an inaccessible pipe 14, such as, for example, a sewage
15 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
20 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
25 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
30 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
35 the robotic conduit vehicle 18, on that end side of the robotic conduit vehicle 18 which faces the clamp magazine 11. A rotary drive for this rotary plate 26 is accommodated in the robotic conduit vehicle 18.

A clamp-placing 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
5 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
10 assemblies accommodated in the robotic conduit vehicle 18.

The clamp-placing module 30 has a housing 36 which is, for example, approximately cuboidal and to which that part of the bayonet fastener 28 which is
15 assigned to this clamp-placing 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
20 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
25 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.

30 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,
35 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 driven 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 clamp-placing module 30 is a clamp-placing 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 a respective clamp 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 clamp-placing 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. Figures 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 clamp-placing head in the radial direction. The two output shaft [sic] 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 clamp 12, i.e. a section different to the fastening part 58, is mounted pivotably about an axis 68 in or on the clamp-placing 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 [sic] can be pivoted in a plane perpendicular to this longitudinal axis 18' (cf. Figures 5 and 6, in particular). The pinion 88 is driven by an electric motor 72. In the present exemplary embodiment, this electric motor 72 is also accommodated in the clamp-placing 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 clamp-placing head 64.

5 A respective clamp 12 can therefore be expanded by radial extension of the clamp-placing head 58 [sic] and swinging out of the pinion 78 [sic] 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 clamp-placing head 64.

10 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 clamp-placing module 30, the driving means 62, 66 assigned to the clamp-placing 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 clamp 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 clamp-placing 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 $\pm 3^\circ$, with regard to the housing 36 of the clamp-placing module 30.

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

30 As already indicated, the clamp-placing module 30 may contain at least some of the electronics and/or pneumatics which are required. The clamp-placing 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 levers 40 may be used depending on the pipe inside diameter. If appropriate, corresponding centering adapters can also be used. In order to fix
5 the clamp-placing head 64 with respect to the housing 36 of the clamp-placing module 30 for the purpose of placing individual clamps 12 (without the clamp carriage 11), a coupling adapter 86, for example, may be placed onto the coupling pipe 80 (cf. Figure 7, in
10 particular).

It can also again be gathered from Figures 7 and 8 that the two holding jaws 56 of the clamp-placing head 64 which are expediently provided with pins and are intended for holding a relevant fastening part 58
15 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 clamp-placing module 30 can be provided for this purpose. The TV camera 84 fixed on the housing 36 can also again be seen in
20 Figures 7 and 8. If required, the clamp-placing 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 clamp-placing
25 module 30 is preferably actuated from the outside.

The covering 48' which is connected fixedly to the housing 36 of the clamp-placing module 30 and is intended for the toothed wheel mechanism serving for centering purposes, and the support 78 which is
30 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 clamp-placing head 64 to the rack 62 is indicated
35 at 94. A corresponding drive then enables the clamp-placing head 64 to be moved along the guide rail 60. In Figure 6, the end side, facing the clamp carriage 11,

of the coupling pipe 80 assigned to the clamp-placing 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 clamp-placing head 64. This cylinder/piston unit 96 serves to release the fastening part 58, which is provided as a clamping fastener, of the relevant clamp 12, after the clamp 12 has been expanded and placed against the pipe inner wall 14', in order thereby to cause the clamp 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 clamp 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 clamp-band section lying radially within the outer clamp-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 clamp-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 clamp 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 clamp carriage 11 which is equipped with a respective clamp magazine 106 (cf. Figures 1 and 9 to 16, in particular). To this end, the coupling pipe 80 provided on the clamp-placing 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 clamp 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 clamp carriage 11 can be provided. As can be gathered in particular from Figures 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 clamp 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 clamp-placing 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 clamp 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 clamp-placing head 64 can be equipped with an individual clamp 12 prior to the coupling up of the clamp 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 clamp 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 clamp-placing 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 clamp 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.

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

10 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 clamp magazine 106 relative to the base part
15 122, 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 clamp 12 in each case situated nearest the clamp-placing head 30
20 can be transferred to the clamp-placing head 64.

 In this case, the clamp 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.
25 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 clamp magazine 106 can be coupled to the slide 128 via at least one latching
30 coupling 132 (cf. Figures 10 and 11).

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

 A spindle 136, which can be rotated with respect to the slide 128, but cannot be displaced 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 [sic] 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 clamp magazine 106 is guided are provided on the base part 122 of the clamp 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 clamp 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 clamps 12 can be displaced relative to the clamp magazine 106 along two receiving rails 148 provided on the clamp magazine 106. Two clips 150 of a respective clamp 12 are in each case snapped onto these rails 148 (cf. Figures 10 and 12, in particular). In the present case, each clamp 12 is provided with a total of seven such clips 150 (cf. Figure 6, in particular). As Fig. 10 shows, the clamp 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 clamp 12, on the other hand, are offset with respect to one another. As soon as a respective clamp 12 is pushed over the clamp-placing 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).

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

10 The clamp magazine 106 may be provided with a casing 152 (cf. Figure 1). In principle, a casing on the clamp 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
15 adapters is also conceivable, for example.

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

 The clamp carriage provided with a magazine
25 holder and the pipe coupling 108 can in particular be provided with the driving means serving for the advancing and isolating of the clamps, as has previously been explained in detail by way of example. In addition, the electronic and pneumatic components
30 required for this can be provided in the clamp 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
35 Figure 1, a camera 154 directed rearward is provided on the undercarriage 122 of the clamp carriage 11.

 In the case of a particular installation device and a particular clamp 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.

5 The operation of the previously described exemplary embodiment of an installation device 10 having an associated clamp carriage 11 during the installation of internal clamps 12 is as follows:

 Depending on the space conditions, the remote-
10 controlled, self-propelled robotic conduit vehicle 18 with or without the clamp-placing 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
15 which the internal clamps 12 are to be moved. The clamp-placing head 64 is then equipped with a clamp 12.

 The clamp carriage 11 is then lowered into this shaft and equipped with a clamp magazine 106. For this purpose, the clamp carriage 11 is erected in the manner
20 indicated in Figure 1 and the clamp magazine 106 pushed onto the guide rails 148 on the base part 122 of the clamp 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
25 clamp magazine 106. After that, the clamp 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
30 provided on the clamp-placing module 30. The sliding coupling 118 on the clamp 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
35 pneumatic connections are produced via the plug-in couplings 110, 111. As already mentioned, the clamp-placing head 64 can be equipped with an individual

clamp 12 prior to the coupling up of the clamp carriage 11, as is illustrated, for example, in Figure 1.

5 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 clamp 12 is to be placed. For this purpose, the clamp-placing module 30 and the rotatable base part 122 of the clamp carriage 11 having the clamp magazine 106 are brought by means of the rotary plate 26 into the
10 desired rotational position. In order to place the clamp 12, the clamp-placing head 64 is extended in the radial direction and at the same time the pinion 88 causes the clamp to expand until the latter bears against the inner wall 14' of the inaccessible pipe 14.

15 Unlocking of the fastening part 58 of the clamp 12 via the piston/cylinder unit 96 causes the clamp 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 clamp-placing head 64
20 apart, the fastening part 58 is released, whereupon the clamp-placing 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
25 a color TV camera. Then, by rotation of the rotary plate 26, the clamp-placing module 30 and the rotatable base part 122 of the clamp carriage 11 are brought into the position in which the base part 122 can be locked to the undercarriage 120 of the clamp carriage 11.

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

35 Figure 12 shows a schematic illustration of the clamp magazine 106 taking up its inoperative position with the clamp carriage 11 coupled to the clamp-placing

module 30 via the coupling pipes 108 and 80. The conveying member 134 holds back the clamps 12.

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

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

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

Figure 16 shows, in a schematic illustration, the clamp magazine 106 which has now been moved back
25 again into its inoperative position, the clamp-placing head 64 having already grasped the fastening part 58 of the previously transferred clamp 12 and the conveying member 134 already gripping again behind the foremost
30 clamp 12 of the remaining clamp stack.

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

This process is repeated until the clamp magazine 106 is empty. The installation device 10, with the associated clamp 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.

5 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 clamp 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 clamp carriage 10 11, and a new, filled and complete clamp magazine 106 having the desired number of clamps 12 is placed onto the base part 122 of the clamp carriage 11. After that, the process described further above can be repeated.

15 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.

Patent claims



1. A device (10) for installing an internal clamp (12) in an inaccessible pipe (14), having a frame (16) which can be supported on the pipe inner wall (14') in a manner such that it is movable in the pipe longitudinal direction (R), a clamp-placing head (64) which is arranged on the frame (16) in a manner which allows it to move radially with regard to the longitudinal direction (18') thereof, and can be brought into engagement with a section (58) of the internal clamp (12), and also a pinion (88) which can be brought into engagement with a further section (12') of the internal clamp (12) and is intended for expanding the internal clamp (12), and respective driving means (66, 66; 72, 74) which enable, in order to install the internal clamp (12) by expanding it, the clamp-placing head (64) to be moved radially outward and the pinion (88) to be made to rotate.
2. The device as claimed in claim 1, characterized in that the pinion (88) can be pivoted out and in with respect to the clamp-placing head (64), preferably in a plane running at right angles to the longitudinal direction (18') of the frame (16), by means of driving means (74).
3. The device as claimed in claim 1, characterized by supporting elements (40, 42) which can be moved from an inoperative position into a supporting position in which they bear against the pipe inner wall (14') and keep the longitudinal axis (18') of the device (16) at least approximately in the central axis of the pipe (14).
4. The device as claimed in one of the preceding claims, characterized in that the frame (16) comprises a self-propelled robotic conduit vehicle (18) which is provided with a rotary apparatus (26) for rotating the clamp-placing head (64) about the longitudinal axis (18').

5. The device as claimed in one of the preceding claims, characterized in that the radially movable clamp-placing head (64) is mounted in or on a clamp-placing module (30) which can preferably be attached to
5 the rotary apparatus (26) of the robotic conduit vehicle (18).

6. The device as claimed in claim 5, characterized in that the supporting elements (40, 42) are arranged on the clamp-placing module (30).

10 7. The device as claimed in claim 5 or 6, characterized in that at least some of the respective driving means (66, 66; 72, 74; 50, 50') for the radially movable clamp-placing head (64), the pivotable pinion (88) and/or the supporting elements (40, 42) are
15 provided in or on the clamp-placing module (30).

8. The device as claimed in claim 7, characterized in that the pinion (88) is mounted pivotably in or on the clamp-placing head (64).

9. The device as claimed in claim 7 and 8,
20 characterized in that the pivotable pinion (88) can be pivoted out and in via a cylinder/piston unit (74) arranged in or on the clamp-placing head (64), and can be made to rotate by means of a motor (72) arranged in or on the clamp-placing head (64).

25 10. The device as claimed in one of the preceding claims, characterized in that, it can be coupled to a clamp carriage (11) which can be equipped with a respective clamp magazine (106).

11. The device as claimed in claim 10,
30 characterized in that the coupling part (80) which is assigned to it and interacts with a complementary coupling part (108) of the clamp carriage (11) is arranged on the clamp-placing module (30).

12. The device as claimed in claim 10 or 11,
35 characterized in that it can be coupled to the clamp carriage (11) in such a manner that the latter can be pivoted through approximately 90° relative to it into



an essentially perpendicular position for a respective change of magazine.

13. The device as claimed in one of claims 10 or 12, characterized in that means (110, 111) are provided
5 for automatically separating and automatically restoring respective electrical and pneumatic connections to the clamp carriage (11).

14. A clamp carriage (11), in particular for use with an installation device as claimed in one of the
10 preceding claims, characterized in that it can be equipped with a respective interchangeable clamp magazine (106).

15. The clamp carriage as claimed in claim 14, characterized in that it comprises a base part (122)
15 which serves to hold a respective clamp magazine (106) and along which the clamp magazine (106) can be displaced.

16. The clamp carriage as claimed in claim 14 or 15, characterized in that means (126) are provided in
20 order to move the clamp magazine (106) concerned relative to the base part (122), in the longitudinal direction thereof, between an inoperative position and a transfer position in which the foremost clamp (12) in each case situated nearest the placing head (30) can be
25 transferred onto the placing head (64).

17. The clamp carriage as claimed in claim 16, characterized in that means (134) are provided in order to isolate the foremost clamp (12) situated in each case nearest the placing head (64) for transfer and to
30 push it over the placing head (64).

18. The clamp carriage as claimed in one of claims 14 to 17, characterized in that the clamps (12) can be displaced in the longitudinal direction of the clamp magazine (106) relative to the latter.

35 19. The clamp carriage as claimed in one of claims 14 to 18, characterized in that the clamp magazine (106) which can be displaced along the base part (122) can be coupled, preferably via at least one



latching coupling (132), to a driveable slide (128) guided on the base part (122).

20. The clamp carriage as claimed in one of claims 14 to 19, characterized in that the clamps (12) can be isolated by at least one conveying member (134) which is guided displaceably on the clamp magazine (106) in the longitudinal direction thereof, and the conveying member (134) can be coupled, preferably via at least one latching coupling (140), to driving means (136, 138) mounted on the slide (128), and can be moved relative to the slide (128) by these driving means (136, 138).

21. The clamp carriage as claimed in one of claims 14 to 20, characterized in that it comprises an undercarriage (120), in that the base part (122) which can preferably be coupled to the placing module (30) of the installation device (10) can be rotated relative to the undercarriage (120) about an axis extending in the longitudinal direction, and in that the base part (122) can be locked in a rotationally fixed manner to the undercarriage (120) for movement purposes.

