

INVENTION PERTAINING TO A SECURED DEVICE FOR LOCKING AND UNLOCKING A PLUG ON A FRAME USING A WRENCH

FIELD OF THE INVENTION

The present invention relates to a secured device for locking and unlocking a plug on a frame using a wrench.

It applies in particular but in a non-limiting manner to a manhole.

Such a manhole has a frame connected to pavement and a cover or plug for closing the opening of the frame, and it can be locked on the frame by means of a wrench that accesses a lock connected to the cover.

BACKGROUND

A device for locking and unlocking a plug on a frame using a wrench is known through document FR-A-2780996 or document FR-A-2898614.

The locking and unlocking device as described in either of these two earlier documents entails a lock connected to the plug and a wrench with a maneuvering arm, one end of which bears a socket that can be introduced into an opening of the cover in order to access the lock that has a rotor mounted so as to rotate in the plug and that, at one of its ends, bears a bolt that cooperates with a keeper of the frame and whose other end can be coupled with the socket of the wrench in order to make possible the pivoting of the bolt around the longitudinal axis of the rotor between a locking position in which the bolt is captured by the keeper and the wrench can freely come out of the opening of the plug, and an unlocking position in which case the bolt is disengaged from the keeper and the wrench is held captured in the opening of the plug.

This known device has the drawback that unauthorized persons can make a wrench with a shape similar to the specific wrench used in this device in order to access the rotor for moving the bolt and can unlock the lock with respect to the keeper of the frame.

SUMMARY OF THE INVENTION

The present invention aims to palliate the drawback of the known device above.

To this effect, the invention proposes a device for locking and unlocking of a plug on a frame using a wrench, which entails a lock with a bolt connected to the plug that has an opening for access to the lock for the wrench that has an arm, one end of which bears a socket

making it possible to maneuver the lock when the wrench is introduced into the opening of the plug, from a locking position in which the bolt of the lock is captured by a keeper of the frame, to an unlocking position in which the bolt is disengaged from the keeper, the lock having a rotor mounted so as to rotate in the plug, accessible at one of its ends through the opening of the plug and bearing the bolt at its opposite end so as to make possible the pivoting of the bolt around the longitudinal axis of the rotor between its positions, captured by and disengaged from the keeper, under the action of the wrench whose socket is engaged with the corresponding end of the rotor, and which is characterized by the fact that the wrench has a means with an identification code of the wrench that can be read by a code reading means integrated in the plug when the wrench is introduced into the opening of the plug and that can be compared to a code stored beforehand in an electronic module integrated in the plug, and by the fact that it has an obstructing component that is mobile with respect to the plug and is arranged in the opening of the plug in order to block the passage of the wrench to its position engaged with the rotor of the bolt, and that can be brought to an unobstructing position in which the wrench can be made to engage with the rotor of the bolt when the identification code of the wrench read by the reading means is in agreement with the code stored in the electronic module.

Preferably, the mobile obstructing component consists of a bar mounted so as to be given a translational movement in the plug in a place of the opening of the plug situated between the end of the rotor of the bolt and the socket of the wrench when introduced into this opening.

According to one embodiment, the bar is a rack engaged with a pinion gear moved by an electric motor connected to the plug and controlled by the electronic module in order to move the bar in a direction clearing the passage between the end of the rotor of the bolt and the socket of the wrench when the identification code of the wrench that is read is in agreement with the code stored in the electronic module.

Advantageously, the rack extends perpendicularly to the axis of the rotor of the bolt, parallel to the upper wall of the plug, and has a recessed part that can be brought facing the end of the rotor of the bolt and the socket of the wrench in an unobstructing position of the rack.

According to another embodiment, the bar is an electromagnetic bar extending radially with respect to the rotor of the bolt, and the coil of the electromagnet is powered by the electronic module in order to move the bar in a direction clearing the passage between the end of the rotor of the bolt and the socket of the wrench when the identification code of the wrench that is read is in agreement with the code stored in the electronic module.

The bar projects, in the space between the end of the rotor of the bolt and the socket of the wrench, a distance from the external peripheral edge of the socket that is at least equal to the thickness of the socket.

Preferably, the means with the wrench identification code is a memory chip in the form of a chip with an integrated antenna connected to the wrench and that is coded during manufacturing of the chip before it is attached to the wrench, and the reading means has an antenna making it possible to read the identification code of the wrench by radio frequency when the antenna of the chip of the wrench is placed facing the antenna of the reading means with introduction of the wrench into the opening of the plug, in order to transmit the signal that is read, that represents the code of the wrench, to the electronic module and to compare it to the code stored in the electronic module associated with the identification code of the wrench.

Advantageously, the remote link between the two antennas of the chip of the wrench and of the code reading means uses so-called RFID radio frequency identification technology.

Housed in the bottom of the opening for introduction of the wrench into the plug and connected to the electronic module, the device has a sensor for detection of the presence of the wrench in the opening of the plug and capable of providing the electronic module with a signal to trigger a time delay for reading of the identification code of the wrench.

This sensor also makes it possible to provide the electronic module with a signal of detection of the presence of the wrench in the bottom of the opening when it is disconnected from the rotor of the bolt in order to enable the electronic module to bring the mobile obstructing component to its position for blocking access to the rotor of the bolt.

The device can also have a sensor for detection of the locking or unlocking position of the bolt lock and a sensor for detection of the open or closed position of the plug with respect to the frame.

Advantageously, the memory chip is of the passive type with reading-writing of other information that can be written in the chip when its antenna is facing the antenna of the reading means, such as the duration of unlocking of the bolt lock, the duration of opening of the plug, the number of the wrench that opened the plug, the date and time of opening of the plug, and the charge level of a battery for powering the electronic module.

The electronic module brings the mobile obstructing component to its position for blocking access to the rotor of the bolt when the corresponding sensors detect the closed position of the plug in the frame and the locking of the bolt in the keeper, and when the corresponding sensor detects the presence of the wrench at the bottom of the opening of the plug after disconnection of the wrench from the rotor of the bolt.

According to one embodiment, the electronic module has a memory card containing the identification code of the wrench and associated with a reading card of PCMCIA type containing the antenna for acquisition of the code of the memory chip of the wrench.

The electronic module is advantageously connected to a remote monitoring station capable of communicating with the module, particularly in order to erase the code stored in

the electronic module in the case of loss of the coded wrench, or in order to receive an abnormality signal from the module, such as an alarm signal indicating that the bolt lock does not occupy its locking position after laying of the plug in its frame.

The opening of the plug emerges into an internal cavity of the plug at the bottom of which the socket of the wrench can rest, and it is partially obstructed by a plate of the plug in which the antenna of the reading means is integrated, situated facing the antenna of the memory chip when the socket of the latter is housed at the bottom of the cavity that emerges toward the rotor of the bolt in order to allow the wrench to be moved by translation toward the rotor so as to engage the socket of the wrench with the rotor.

Advantageously, the electronic module is housed in a casing connected to the plug and sunken in a protective resin.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and other aims, characteristics, details and advantages of it will appear more clearly in the course of the following explanatory description in reference to the appended diagrammatic drawings, given only by way of example, illustrating an embodiment of the invention and in which:

- Figure 1 is an exploded perspective view of a part of a plug for closing a manhole provided with the locking and unlocking device according to the invention;
- Figure 2 is a cross section according to line II-II of Figure 1, showing the device of the invention in a position prohibiting a wrench from accessing the bolt of the lock of the plug;
- Figure 3 is a cross section according to line III-III of Figure 2;
- Figure 4 is a cross section similar to that of Figure 2 and representing the device in a position in which the wrench is allowed to access the bolt of the lock;
- Figure 5 is a cross section according to line V-V of Figure 4;
- Figure 6 is a perspective view from below, of a part of the plug and of the locking and unlocking device of the invention;
- Figure 7 is a side view according to arrow VII of Figure 6;
- Figure 8 is a top view according to arrow VIII of Figure 2;
- Figure 9 is a top view according to arrow IX of Figure 4;
- Figure 10 is a perspective view of a rack of the device of the invention, which is used for prohibiting or allowing access of wrench to the lock of this device; and
- Figure 11 is a functional block diagram of the electronics of the locking and unlocking device of the invention.

DETAILED DESCRIPTION

The locking and unlocking device of the invention will be described in reference to the object of French Patent Application No. 2 898 614 in the name of the applicant, but it can also apply to the device described in French Patent Application 2 780 996, also in the name of the applicant.

Furthermore, the device of the invention is intended for equipping plug or cover 1 making it possible to close frame or casing 2 delimiting the opening of a manhole, but this device can apply to the locking of a cover closing a frame of any piece of equipment other than a manhole.

The locking and unlocking device can be actuated by wrench 3 as will be seen later.

Upper wall 1a of plug 1 is essentially planar and has opening 4 emerging, on one hand, toward the exterior of plug 1, and on the other hand, into internal cavity 5 of plug 1, near the bottom of which a part of lock 6 of plug 1 is accessible.

Wrench 3 has maneuvering arm 7, one end of which is provided with socket 8 whose longitudinal axis is perpendicular to the longitudinal axis of arm 7 that has a planar shape and a rectangular cross section. Socket 8 has internal cavity 8a with a square cross section, but it is obvious that this cavity can have a cross section of a different shape, for example, hexagonal. Access opening 4 for wrench 3 is partially obstructed by plate 9 of plug 1, which can be made in one piece with this plug and which gives opening 4 an L shape. Thus, plate 9, square or rectangular in shape, obstructs one of the corners of rectangular opening 4 of plug 1 in such a way that the remaining emerging part of this opening in upper wall 1a of plug 1 is essentially L-shaped, allowing introduction and maneuvering of wrench 3.

Cavity 5 of plug 1 situated below plate 9 is delimited by internal wall 10 that is connected to upper wall 1a of plug 1 perpendicularly to it on the opposite side from the part of cavity 5 emerging with opening 4 and that is perpendicular to inclined wall 11 of cavity 5, ensuring the guiding of the end part of wrench 3 in cavity 5 to the bottom of the cavity. Linear groove or channel 12 is executed in inclined wall 11 right below one of the branches 4a of opening 4 extending parallel to wall 10, groove 12 being situated under branch 4a. Thus, by introducing the end part of wrench 3 into the opening, socket 8 engages in channel 12, and the flat end part of arm 3 of the wrench rests on inclined wall 11 in order to ensure the guided sliding of the end part of arm 3 of socket 8 to the bottom of cavity 5.

Lock 6 of plug 1 has rotor 13 that has bolt 14 at one end and that is mounted so as to rotate around its longitudinal axis under plug 1 parallel to the upper wall of this plug.

Rotor 13 has two parts connected to one another having generally cylindrical shaft 15 mounted so as to rotate in bore 16 of wall 10 and generally cylindrical joining piece 17 mounted so as to rotate in bore 18 made through second wall 19 connected to upper wall 1a of plug 1 and consequently parallel to wall 10. Joining piece 17 bears bolt 14 projecting from

wall 19 on the opposite side from wall 10. Bolt 14 has the general form of a hollow cylindrical sector.

Joining piece 17 is provided with cylindrical part 20 of smaller diameter situated between the two walls 10 and 19, and cylindrical shaft 15 of rotor 13 is housed in bore 21 of cylindrical part 20 while being connected in rotation to the latter by two cooperating flats 22, 23, respectively, of shaft 15 and of bore 21 of part 20. Furthermore, shaft 15 is connected in translation in part 20 of joining piece 17 by screw 24 passing through bores 20a and 15a of part 20 and of shaft 15, perpendicularly to their respective coaxial longitudinal axes.

Part 20 of joining piece 17 has external transverse notch 25 with a flat bottom extending in a plane parallel to the longitudinal axis of cylindrical part 20 and on which an end of bar 26 forming a lock maneuvering component rests attached, which lock maneuvering component extends perpendicularly to the longitudinal axis of part 20. Preferably, lock maneuvering component 26 is attached in the flat bottom of notch 25 by screw 24 whose threaded end is anchored in threaded hole 26a made in the end of lock maneuvering component 26. Thus, lock maneuvering component 26 is connected in rotation to part 20 and consequently to rotor 13. End 26b of this lock maneuvering component on the opposite side from cylindrical part 20 is curved at a right angle in such a way that this free end can rest on the internal surface of upper wall 1a of plug 1, as will be seen later on.

Chain 27 or any other equivalent means, such as a cable, is attached by one of its ends to curved end 26b of lock maneuvering component 26. Free end 28 of cylindrical shaft 15 of rotor 13 on the opposite side from bolt 14 projects in cavity 5 near the bottom of it and is present in the form of a square head that can engage with conjugate-shaped internal cavity 8a of socket 8. Head 28 of shaft 15 rests on the internal surface of wall 10 by the intermediary of washer 29.

Helical torsion spring 30 is mounted concentrically on the part of shaft 15 of rotor 13 situated between cylindrical part 20 of joining piece 17 and washer 31 resting on the external surface of wall 10. The assembly consisting of head 28, washers 29, 31 and spring 30 makes it possible to axially maintain rotor 13 with practically no play with respect to walls 10, 19. One end, 30a, of torsion spring 30 is bent at a right angle resting on the dorsal surface of lock maneuvering component 26, and its opposite end 30b, also bent at a right angle, rests on the internal surface of upper wall 1a of plug 1, ends 30a, 30b being parallel and in opposite directions from one another. In this way, the torsion spring is pre-stressed so as to exert a couple of forces tending constantly to elastically return lock maneuvering component 26 resting, by its free end 26b, on the internal surface of upper wall 1a of plug 1.

Thus, the assembly consisting of cylindrical part 20 of joining piece 17, lock maneuvering component 26, torsion spring 30 and washer 31 is situated between the two walls 10 and 19 of plug 1. Bolt 14 is capable of cooperating with part of longitudinal part 32 projecting inside frame 2 in order to be captured under it in the locking position of plug 1 in

frame 2. Longitudinal part 32 has end 32a defining a space relative to rib 1b of plug 1, which rests on seating stop 2a of frame 2, space through which the bowed part of bolt 14 can pivot during unlocking of plug 1 from frame 2. Seating stop 2a is situated below the longitudinal part forming keeper 32.

The device described above operates as follows.

Plug 1 is first of all considered locked in frame 2 by lock 6 whose rotor 13 is maintained in locking position by spring 30 with lock maneuvering component 26 resting under plug 1 and bolt 14 captured under keeper 32 as represented in Figures 2, 4 and 5.

The end part of wrench 3 is introduced into cavity 5 through opening 4, and this introduction can only take place in a single direction of the wrench that can be seen in Figure 1, that is to say that socket 8 slides in guide channel 12, and the planar end part of arm 3 slides over inclined wall 11 until socket 8 arrives practically at the bottom of cavity 5. In this position, wrench 3 is blocked by its arm 7 between the edge of L-shaped branch 4b of opening 4 perpendicular to wall 10 and edge 9a of plate 9 facing it.

Under these conditions, wrench 3 cannot be actuated except by a translational movement by sliding socket 8 in the bottom of cavity 5 toward head 28 of rotor 13 so that the socket directly engages with the head. The translational movement emerges from Figures 2 and 4.

Once socket 8 is engaged with head 28 of rotor 13, arm 7 of wrench 3 is aligned with branch 4a of opening 4 parallel to wall 10 so that wrench 3 can be rotationally maneuvered in order to rotate the assembly consisting of shaft 15, cylindrical part 20, lock maneuvering component 26, joining piece 17 and consequently bolt 14, in opposition to the return force exerted by torsion spring 30 in such a way as to enable bolt 14 to disengage from keeper 32 through the space between the keeper and rib 1b. Figures 3, 6 and 7 represent the position of bolt 14 disengaged from keeper 32.

Consequently, plug 1 can be lifted and completely disengaged from frame 2 by the operator using wrench 3.

When the operator places plug 1 on the ground near frame 2, torsion spring 30 automatically returns rotor 13 of lock 6 to its locking position, and wrench 3 is also automatically returned by torsion spring 30 to its position in which arm 7 rests on the edge of opening 4 situated in the angle of the two branches of the L shape of this opening. In this position of wrench 3, the wrench can then be withdrawn from plug 1 by moving it by translation perpendicularly to wall 10 in the opposite direction from this wall to the position represented in Figure 1.

Plug 1 can then be put back in closing position on frame 2 with wrench 3 introduced into cavity 5 and rotationally maneuvered in order to rotate rotor 13 to its unlocking position and therefore bolt 14 that will occupy its position enabling it to be introduced into the space

between keeper 32 and rib 1b. Then, the operator releases handle 3 so that torsion spring 30 automatically returns bolt 14 to its position captured under keeper 32.

Wrench 3 can then be withdrawn from plug 1 by translation perpendicular to wall 10 to the position of Figure 1 and then sliding wrench 3 out of opening 4 of this plug.

Wrench 3 in cavity 5 must therefore execute a translational movement and then a rotational movement, or vice versa, in order to respectively unlock or lock the plug on its frame, and this happens while going from one of the branches of the L to the other formed by opening 4 with its associated plate 9.

In the situation in which the operator has withdrawn wrench 3 from plug 1 after removal of the plug from its frame in order to use this wrench for purposes of opening one or more other plugs from their respective frames, the first plug no longer containing this wrench cannot be put back in place in its frame. In effect, because return spring 30 automatically and constantly returns lock 6 to its locking position, bolt 14 cannot be introduced into the space between keeper 32 and rib 1b and will rest on the corresponding part of the longitudinal part forming keeper 32. Furthermore, even if the operator had to manually maneuver bolt 14 in order to make it pivot in opposition to the return force of torsion spring 30 to a position corresponding to that of introduction into this space of keeper 32, this spring would return lock 30 to its locking position even before bolt 14 could be introduced into the space. In other words, torsion spring 30 makes it impossible to introduce bolt 14 into the space between the longitudinal part forming keeper 32 and rib 1b of plug 1. In order to make this introduction possible, the operator must necessarily use wrench 3 that is introduced into cavity 5 and made to engage with head 28 of rotor 13 in order to rotate the latter in opposition to the return force of torsion spring 30 and enable the introduction of bolt 14 into the space in position, and once the plug is resting on frame 2, the operator releases wrench 3 in such a way that torsion spring 30 automatically returns bolt 14 to its position captured under keeper 32.

The presence of chain 27 enables a person inside the chamber of the manhole to exert a traction force on lock maneuvering component 26 so that it brings about the rotation of rotor 13 and bolt 4 to their position for unlocking of plug 1 from frame 2.

Lock maneuvering component 26, by its curved free end 26b resting under plug 1 by torsion spring 30, in a way indexes bolt 14 in its position captured under keeper 32.

According to the invention, the locking and unlocking device is secured by the arrangements described below that make it possible to reliably identify the wrench associated with lock 6 of plug 1 in order to allow it to engage with end 28 of shaft 15 of rotor 13 so as to unlock plug 1 from frame 2.

To this effect, wrench 3 has means 40 with an identification code of the wrench that can be read by code reading means 41 connected to plug 1 when the wrench is introduced through opening 4 to the bottom of cavity 5 of plug 1.

Casing 42 is attached, for example, by the intermediary of feet 43, under plug 1, and in particular contains electronic module 44 connected to code reading means 41 that can at least be part of module 44.

Electronic module 44 is capable of comparing a code, stored beforehand in an internal memory of module 44 or in memory card 45 attached in a removable manner in casing 42, to the identification code of wrench 3 read by reader 41, and in the case of agreement between the identification code of wrench 3 and the stored code, it is capable of bringing about the movement of obstructing component 46 relative to plug 1 to a position allowing socket 8 of wrench 3 to move by translation at the bottom of cavity 5 of plug 1 to its position of coupling with end 28 of shaft 15 of rotor 13.

According to the embodiment represented in the figures, mobile obstructing component 46 consists of a bar with a square cross section forming a rack mounted so as to slide in a guided way in plug 1 parallel to upper planar wall 1a along a direction perpendicular to the longitudinal axis of rotor 13.

A part of bar 46 moves by translation in internal cavity 5 of plug 1 in a place between end 28 of shaft 15 of rotor 13 and the end of socket 8 of wrench 3 when this socket occupies its position in the bottom of cavity 5 before being moved by translation toward the end 28 of shaft 15 in order to engage socket 8 with this end. As emerges more clearly from Figure 10, bar 46 has bowed recessed part 47 executed through the thickness of the bar and capable of coming right over socket 8 of wrench 3 and end 28 of shaft 15 in order to allow the movement by translation of socket 8 toward end 28 through recessed gate 47 and make socket 8 engage with this end as represented in Figures 4 and 5.

Bar 46 can furthermore occupy the position represented in Figures 2 and 3 in which a part of it is placed between end 28 of shaft 15 and socket 8 of wrench 3 in order to block the movement of socket 8 toward end 28 of shaft 15.

In order to ensure the movement of bar 46 in plug 1, the latter has conjugate groove 1c, and the movement of rack bar 46 in its longitudinal direction is ensured by electric motor 48 controlled by electronic module 44 and whose driving shaft bears pinion gear 49 engaged with the rack part projecting to the exterior of plug 1 below its upper wall 1a.

According to another embodiment that is not represented, mobile obstructing component 46 can consist of an electromagnetic bar extending radially with respect to end 28 of shaft 15 of rotor 13 and can occupy a position in which its free end is placed between socket 8 of wrench 3 and end 28 of shaft 15 in order to prevent coupling of socket 8 with end 28 of shaft 15 and a position in which the end of electromagnetic bar 46 is completely disengaged from between socket 8 and end 28 of shaft 15 in order to allow the translational movement of socket 8 toward end 28 and to couple it with the latter. The electromagnetic coil and a part of its bar 46 can be housed in wall 1a of plug 1 perpendicularly to wall 1a, and the coil is connected to electronic module 44 that can power it in order to move electromagnetic

bar 46 out of the space between end 28 of shaft 15 and socket 8 of wrench 7 in opposition to the return force of a spring.

Preferably, the part of bar 46 situated between socket 8 of wrench 3 and end 28 of shaft 15 in order to prevent socket 8 from coupling with end 28 as represented in Figure 2 is situated a distance or height d from the external circular peripheral edge of socket 8 that is at least equal to thickness e of this socket, configuring its internal cavity 8a in order to keep unauthorized persons from attempting to introduce a socket wrench with the same cavity 8a but whose thickness is smaller than e of socket 8 in order to couple it with end 28 of shaft 15.

According to the preferred embodiment of the invention, means 40 with an identification code of wrench 3 consists of a memory chip in the form of a chip with an integrated antenna and coded at the time of its manufacture before being attached to the wrench. Chip 40 is attached, for example, by gluing, in a conjugate blind hole executed in arm 7 of wrench 3 near socket 8. Furthermore, code reading means 41 has antenna 50 connected to means 41 and integrated in wall 9 of plug 1 and making it possible to acquire by radio frequency the identification code of chip 40 of wrench 3 when the integrated antenna in chip 40 is placed facing antenna 50 with introduction of the wrench into opening 4 to its position in which socket 8 is in the bottom of cavity 5 of plug 1 represented in Figures 2 and 8.

Chip 40 of wrench 3 and code reading means 41 operate advantageously by using known so-called RFID radio frequency identification technology.

The signal coming from antenna 50 and representative of the identification code of chip 40 of wrench 3 can be decoded in electronic module 44 and compared to the code stored beforehand in an internal memory of this module. In case of agreement between the decoded signal coming from antenna 50 and the code stored in electronic module 44, the latter then transmits a signal that controls electric motor 48 in such a way as to bring about the translation of rack 46 relative to plug 1 from a position in which the rack prevents coupling of socket 8 of wrench 3 with end 28 of shaft 15 to a position in which recessed part 47 of rack 46 is over socket 8 and end 28 of shaft 15 in order to allow socket 8 to be coupled with end 28 by translation in cavity 5.

In the domain of RFID radio frequency identification technology, various solutions of code readers with an antenna are offered.

One of them consists of using memory card 45 of the "Compact Flash" type, in which is stored the code associated with the identification code stored in chip 40 of wrench 3, and reading card 51 of PCMCIA type with antenna 50 for acquiring the identification code in chip 40 and comparing it to the code stored in memory card 45.

Preferably, memory chip 40 is of the passive type with reading-writing of other information that can be written in and read from the chip as will be seen later on.

Sensor 52 is arranged in the bottom of cavity 5 of plug 1 in a place making it possible to detect the presence of wrench 3 when the latter is introduced into opening 4 in its position before being moved by translation toward end 28 of shaft 15 in order to couple it with the latter. As represented, detector 52 consists of a blade micro-contactors attached in the bottom of internal cavity 5 of plug 1 and connected by the intermediary of electric cord 53 to electronic module 44. This micro-contactors thus forms a switch that occupies an open position represented in Figure 11 in the absence of a wrench in plug 1 and that closes when socket 8 of wrench 3 is placed at the bottom of internal cavity 5 of plug 1. Of course, detector 52 can consist of any other type of contactors, such as, for example, an inductive contactors.

When wrench 3 is introduced into plug 1, the electrical signal provided by detector 52 indicating the presence of wrench 3 in the plug is applied to electronic module 44 so that it triggers a time delay, so that code reader 51 with antenna 50 can read the identification code of the wrench stored in chip 40. Furthermore, detector 52 also makes it possible to provide electronic module 44 with a signal of detection of the presence of wrench 3 at the bottom of internal cavity 5 of plug 1 after disconnection of socket 8 of this wrench from end 28 of shaft 15 in order to allow electronic module 44 to bring rack 46 to its position for blocking access to rotor 13 of bolt 14.

The device of the invention moreover has sensor 53, for detection of the locking or unlocking position of lock 6 with bolt 14, and sensor 54, for detection of the open or closed position of plug 1 with respect to frame 2.

Each of these two sensors 53, 54 is connected to electronic module 44 and can consist of blade micro-contactors.

Sensor 53 can be arranged under longitudinal part 32 forming a keeper of lock 6 in a position such that when bolt 14 occupies its position for locking plug 1 to frame 2 represented in Figure 2, the micro-contact of this sensor is closed. The sensor is then opened when bolt 14 occupies its position for unlocking plug 1 from frame 2 represented in Figure 4 in order to indicate to electronic module 44 the unlocking position of lock 6.

Sensor 54 can quite simply be arranged between seating stop 2a and plug 1 in such a way that the micro-contactors constituting this sensor is closed when plug 1 occupies its position for obstructing the frame and is opened when plug 1 is disengaged from frame 2.

Electronic module 44 is powered by battery 54, rechargeable if necessary, which is housed in casing 42.

Advantageously, casing 42 is attached to plug 1, which is sunken in a protective resin.

Furthermore, electronic module 44 can communicate remotely, as symbolized by the double arrow 55 in Figure 11, with remote monitoring station 56, entailing a computer in particular. This communication can take place through a linking network, for example, using optical fibers, or a GPRS-type linking network.

The computer of remote monitoring station 56 contains software making it possible to configure the different electronic components of the device of the invention.

More precisely, using a bar code wand, not represented, which is connected to the computer of station 56, an operator reads the identification code stored in the factory in each chip 40 of a wrench and stores it in a memory of this computer in order to associate it with a code also stored in this memory that will identify the lock of a plug normally associated with the identification code of wrench 3. Thus, the operator can associate as many codes with the plug locks as there are identification codes of wrenches 3. Then, the lock codes associated with the identification codes of the corresponding wrenches are stored on memory cards assigned to these plug locks or stored in the internal memory of electronic module 44 by the intermediary of bidirectional link 55 in the case of a device that does not have a memory card. Thus, the assignment of the codes to the plug locks can be such that they are associated with a given identification code assigned to several wrenches, that is to say that a wrench will enable one to unlock several different plug locks. As a variant, a given code assigned to each plug lock can be associated with different wrench identification codes, that is to say that several wrenches with different identification codes will be able to unlock the same plug lock.

The computer of monitoring station 56 can be connected to electronic module 44 of each plug for the purpose of testing different functions of the locking and unlocking device of the invention including, for example, regulating the internal clock that can be situated in electronic module 44, correct unlocking and locking of the lock of the plug, etc.

The operation of the device of the invention already emerges from the preceding description and will now be explained.

With insertion of wrench 3 in opening 4 of plug 1 to the point that socket 8 is placed at the bottom of internal cavity 5 of this plug, sensor 52 detects the presence of wrench 3 at the bottom of the cavity and provides electronic module 44 with a signal triggering the process of acquisition, by the intermediary of antenna 50, of the identification code of the wrench, and of comparison of this code to that stored in electronic module 44 or in memory card 45 inserted in casing 42.

If these two codes do not match, the obstructing component with rack 46 remains in its blocking position prohibiting the translational movement of socket 8 of wrench 3 toward end 28 of shaft 15 of rotor 13, and electronic module 44 can be suitable for transmitting a sound and/or visual alarm signal to remote monitoring station 56, with it possible for this alarm signal to be also emitted in situ by electronic module 44 of the associated plug.

If the two codes match, electronic module 44 sends a signal for controlling electric motor 48 to bring about the movement of rack 46 with respect to plug 1 to its position in which recessed part 47 of rack 46 is over end 28 of shaft 15 and socket 8 of wrench 3 in order to enable the latter to be moved by translation toward end 28 and make it engage with this

end in order to turn rotor 13 in a direction that disengages bolt 14 from keeper 32 and to unlock plug 1 from frame 2. Simultaneously with triggering of the unlocking of lock 6, various elements of information defined beforehand during the above-mentioned configuration of the device by the computer can be written both in memory chip 40 of wrench 3 and the internal memory of electronic module 44. These elements of information can include the time at which wrench 3 was recognized for permitting the unlocking of plug 1 from frame 2, the number of the wrench used for unlocking the plug, the charge level of battery B, the triggering of a duration of unlocking of lock 6 coming from sensor 53 and of a duration of opening of plug 1 coming from sensor 54 once this plug has been disengaged from frame 2.

Once the maintenance operations have been performed in the manhole, plug 1 is again put back in place in frame 2 in order to actuate sensor 54 that will provide electronic module 44 with a signal of the end of the duration of opening of the plug. Then, the operator maneuvers wrench 3 by translation in order to disengage it from rotor 13 of lock 6 and bring it to its position in internal cavity 5 in which memory chip 40 is again placed facing antenna 50 that will transmit to electronic module 44 the signal for identification of wrench 3 that will again be compared to the code stored in memory card 45 or in the internal memory of electronic module 44, and if these codes match, electronic module 44 will transmit a signal for controlling electric motor 48 to move rack 46 to its position for obstructing the passage between socket 8 and end 28 of shaft 15 of rotor 13. The elements of information relating to the duration of opening of plug 1, the duration of unlocking of lock 6 of this plug through sensors 53, 54, the charge level of battery B, etc., can be written in memory chip 50 by the intermediary of antenna 50 before withdrawing wrench 3 from plug 1.

Electronic module 44 can make the movement of rack 46 to its obstructing position dependent not only on the detection by sensor 52 of the presence of wrench 3 at the bottom of cavity 5, but also on the detection by sensor 54 of the closing of frame 2 by plug 1 and the detection by sensor 53 of the locking position of bolt 14 with respect to keeper 32.

If an abnormality should be observed, such as, for example, a poor positioning of bolt 14 during its movement toward its locking position, observed by sensor 53, electronic module 44 can trigger a sound and/or visual alarm signal at the site of insertion of the plug and/or transmit this alarm signal to monitoring station 56.

Electronic module 44, for example, of the type with a microprocessor, can be programmed in order to bring about the movement of rack 46 by motor 48 over a path of travel making it possible to position it in its obstructing position between end 28 of shaft 15 and socket 8 of wrench 3 or in its unobstructing position between these two parts. As a variant, the path of travel of rack 46 between its two positions, obstructing and unobstructing, can be defined by one or two end-of-travel sensors attached to plug 1 or by detection by

electronic module 44 of the over-intensity of the supply current of motor 48 ensuring the movement of rack 46.

When the operator returns to monitoring station 56, the computer present at this station can read the information recorded in the memory chip of wrench 3 in order to do an update and, if necessary, modify the parameters of the wrench, such as a new assignment of it to a lock or locks of plugs.

In the case of loss of a wrench, monitoring station 56 can transmit to electronic module 44 of each concerned plug lock 6 a signal for erasing the code stored in the internal memory of electronic module 44 and can replace it with a new code associated with an identification code of a different wrench other than that of the lost wrench. In the case of use of memory card 45, this change of lock code can be done in situ by means of a portable computer.

The locking and unlocking device of the invention thus provides optimal securing, dissuading any unauthorized person from attempting to unlock a plug from a frame.

Claims

1. A device for locking and unlocking of plug (1) on frame (2) using wrench (3), which entails lock (6) with bolt (14) connected to plug (1) that has opening (4) for access to lock (6) by wrench (3) making it possible to maneuver lock (6), when wrench (3) is introduced into opening (4) of plug (1), from a locking position in which bolt (14) of lock (6) is captured by keeper (32) of frame (2) to an unlocking position in which bolt (14) is disengaged from keeper (32), characterized by the fact that wrench (3) has means (40) with an identification code of wrench (3) that can be read by code reading means (41) integrated in plug (1) when wrench (3) is introduced into opening (4) of plug (1) and that can be compared to a code stored beforehand in electronic module (44) integrated in plug (1), and by the fact that it has obstructing component (46) that is mobile with respect to plug (1) and is arranged in opening (4) of plug (1) in order to block the passage of wrench (3) to its position for maneuvering of lock (6) and that can be brought to an unobstructing position in which wrench (3) can be brought to its position for maneuvering of lock (6) when the identification code of wrench (3) read by reading means (41) is in agreement with the code stored in electronic module (44).

2. A device according to Claim 1, characterized by the fact that wrench (3) has arm (7), one end of which bears socket (8), lock (6) having rotor (13) mounted so as to rotate in plug (1), which can be accessed at one of its ends through opening (4) of plug (1) and bearing bolt (14) at its opposite end so as to make possible the pivoting of bolt (14) around the longitudinal axis of rotor (13) between its position captured by and position disengaged from keeper (32) under the action of wrench (3), whose socket (8) is engaged with the corresponding end (28) of rotor (13), and by the fact that mobile obstructing component (46) is arranged in opening (4) of plug (1) in order to block the passage of wrench (3) to its position engaged with rotor (13) of bolt (14) and can be brought to its unobstructing position in which wrench (3) can be made to engage with rotor (13) of bolt (14) when the identification code of wrench (3) read by reading means (41) is in agreement with the code stored in electronic module (44).

3. A device according to Claim 2, characterized by the fact that mobile obstructing component (46) consists of a bar mounted so as to be given a translational movement in plug (1) in a place of opening (4) of plug (1) situated between end (28) of rotor (13) of bolt (14) and socket (8) of wrench (3) when introduced into this opening.

4. A device according to Claim 3, characterized by the fact that bar (46) is a rack engaged with pinion gear (49) moved by electric motor (48) connected to plug (1) and controlled by electronic module (44) in order to move bar (46) in a direction clearing the passage between end (28) of rotor (13) of bolt (14) and socket (8) of wrench (3) when the identification code of wrench (3) that is read is in agreement with the code stored in electronic module (44).

5. A device according to Claim 4, characterized by the fact that rack (46) extends perpendicularly to the axis of rotor (13) of bolt (14), parallel to upper wall (1a) of plug (1), and has recessed part (47) that can be brought facing end (28) of rotor (13) of bolt (14) and socket (8) of wrench (3) in an unobstructing position of rack (46).

6. A device according to Claim 3, characterized by the fact that bar (46) is an electromagnetic bar extending radially with respect to rotor (13) of bolt (14), and by the fact that the coil of the electromagnet is powered by electronic module (44) in order to move bar (46) in a direction clearing the passage between end (28) of rotor (13) of bolt (14) and socket (8) of wrench (3) when the identification code of wrench (3) that is read is in agreement with the code stored in electronic module (44).

7. A device according to one of Claims 3-6, characterized by the fact that bar (46) projects, in the space between end (2) of rotor (13) of bolt (14) and socket (8) of wrench (3), a distance (d) from the external peripheral edge of socket (8) that is at least equal to the thickness of this socket.

8. A device according to one of the preceding claims, characterized by the fact that the means with an identification code of the wrench is memory chip (40) in the form of a chip with an integrated antenna connected to wrench (3) and that is coded during its manufacture before it is attached to wrench (3), and by the fact that reading means (41) has antenna (50) making it possible to read the identification code of wrench (3) by radio frequency when the antenna of chip (40) of wrench (3) is placed facing antenna (50) of reading means (41) with introduction of wrench (3) into opening (4) of plug (1), in order to transmit the signal that is read that represents the code of wrench (3) to electronic module (44) and to compare it to the code stored in electronic module (44) associated with the identification code of wrench (3).

9. A device according to Claim 8, characterized by the fact that the remote link between the two antennas of chip (40) of wrench (3) and of code reading means (41) uses the so-called RFID radio frequency identification technology.

10. A device according to one of the preceding claims, characterized by the fact that housed in the bottom of opening (4) for introduction of wrench (3) into plug (1) and connected to electronic module (44), it has sensor (52) for detection of the presence of wrench (3) in opening (4) of plug (1) and capable of providing electronic module (44) with a signal for triggering of a time delay for reading of the identification code of wrench (3).

11. A device according to Claim 10, characterized by the fact that sensor (52) also makes it possible to provide electronic module (44) with a signal for detection of the presence of wrench (3) in the bottom of opening (4) when it is disconnected from rotor (13) of bolt (14) in order to enable electronic module (44) to bring mobile obstructing component (46) to its position for blocking access to lock (6).

12. A device according to one of the preceding claims, characterized by the fact that it has sensor (53) for detection of the locking or unlocking position of lock (6) with bolt (14) and sensor (54) for detection of the open or closed position of plug (1) with respect to frame (2).

13. A device according to one of Claims 8-12, characterized by the fact that memory chip (40) is of the passive type with reading-writing of other information that can be written in chip (40) when its antenna is facing antenna (50) of reading means (41), such as the duration of unlocking of lock (6) with bolt (14), the duration of opening of plug (1), the number of wrench (3) that opened plug (1), the date and time of opening of plug (1), and the charge level of battery (B) for powering electronic module (44).

14. A device according to Claims 11 and 12, characterized by the fact that electronic module (44) brings mobile obstructing component (46) to its position for blocking access to lock (6) when the corresponding sensors (53, 54) detect the closed position of plug (1) in frame (2) and the locking of bolt (14) in keeper (32), and sensor (52) detects the presence of wrench (3) at the bottom of opening (4) after disconnection of wrench (3) from lock (6).

15. A device according to one of Claims 8-14, characterized by the fact that electronic module (44) has memory card (45) containing the identification code of wrench (3) and associated with reading card (51) of PCMCIA type containing antenna (50) for acquisition of the code of memory chip (40) of wrench (3).

16. A device according to one of the preceding claims, characterized by the fact that electronic module (44) is connected to remote monitoring station (56) capable of communicating with module (44) particularly in order to erase the code stored in electronic module (44) in the case of loss of coded wrench (3) or in order to receive an abnormality signal from the module, such as an alarm signal indicating that lock (6) with bolt (14) does not occupy its locking position after laying of plug (1) in its frame (2).

17. A device according to one of Claims 8-16 when considered in combination with Claim 2, characterized by the fact that the opening of plug (1) emerges into internal cavity (5) of plug (1), at the bottom of which socket (8) of wrench (3) can rest and is partially obstructed by plate (9) of plug (1) in which antenna (50) of reading means (41) is integrated, situated facing the antenna of memory chip (40) of wrench (3) when socket (8) of the latter is housed at the bottom of cavity (5) that emerges toward rotor (13) of bolt (14) in order to allow wrench (3) to be moved by translation toward rotor (6) so as to engage socket (8) of wrench (3) with rotor (6).

18. A device according to one of the preceding claims, characterized by the fact that electronic module (44) is housed in casing (42) connected to plug (1) and sunken in a protective resin.