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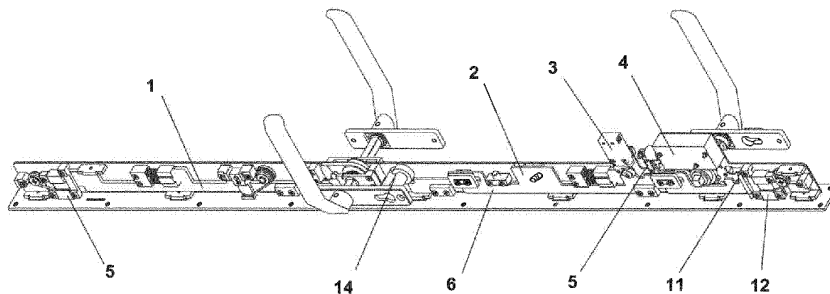
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(54) **A LOCK CONTROL SYSTEM FOR A TRAIN LOCOMOTIVE**

(57) The control system for a train locomotive lock interlock, especially a door lock, contains a locking bar (6) located above and along the base bar (1), a controlled actuator (4), which slides parallel to the base bar (1), or the lock longitudinal axis, coupled with the locking bar (6) via a tie rod (5), whereas the locking bar tongue (2) has an oblique bean-shaped hole (9), cooperating with the bolt lock pin (7), while the system also contains a

stabilizer (10), interlock limit switch and door closing limit switch (3), while the locking bar (6) contains recesses (11) cooperating with the key insert (13, 14), which limit its length, while the actuator (4) and interlock limit switch (3) are coupled within the electronic system with a control processor, a card reader and keyboard, display, Ethernet network access and USB input, and indirectly, via the power output with the actuator (4).



**Fig. 4**

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## Description

**[0001]** The aspect of the invention is a control system for a train locomotive lock, especially a door lock interlock.

**[0002]** The control system for mechanical access protections known from the Polish patent application No. P.390402 consists of a portable control device and a controlled device coupled with mechanical measures protecting access to facilities, equipped with a wireless signal transceiver, actuator as an electrical signal generator for the mechanical and electrical access protection and a controller, coupled to a joint power source, however without a described module and method enabling a change of access codes stored in the controller's memory.

**[0003]** The description of a Chinese utility model CN109057583 specifies a system that comprises a "main control unit", which is a computer controlling vehicle locks, with a wireless communication module and RS-485, as well as magnetic sensors in the form of switches. The system is powered by 220 VAC and charged through solar panels with the option to charge internal batteries.

**[0004]** The Chinese utility model CN208216705 describes a solution for a system protecting locomotive cabin door against unauthorized opening by the operators, thus, preventing falling out of the locomotive cabin door because they were unbolted. The device uses a 2.4 GHz frequency module for communication and 315 MHz frequency for card handling.

**[0005]** A locomotive door lock with a single long base bar connecting handles at two different levels is known. However, the upper level has an internal and external handle, while the lower level has an external handle. A lock bolt set is coupled with the base bar. Each handle has a rack, which after pressing the handle results in the bar moving upwards, thus the lock bolts retracting and the doors opening. The system is linked in such a way that depressing the lower handle causes the upper handle to move and vice versa. Each handle has a spring loaded stopper setting its horizontal position.

**[0006]** Such a solution does not enable monitoring all door unlocking functions, especially access control, with the exception of having a patent lock key.

**[0007]** Therefore, the objective of the invention is to develop an electronic system, also remote, for controlling lock interlock, enabling door unlocking signalling, and monitoring all these functions by the customer or user. The objective was to enable the customer to introduce ongoing changes in terms of access to the locomotive cabin.

**[0008]** The control system can be adapted to most locks, the design of which is based on a base bar coupling handles and lock bolts. The invention embodiment examples below illustrate its application with one of them, which does not exclude other lock designs. If the description refers to a customer, it should be understood as an entity - system operator, especially rolling stock owner,

whereas, when it refers to a user, it should be understood most usually as a train driver or any other person authorized by the customer to open the locomotive door.

**[0009]** The essence of the control system for a locomotive door lock interlock with a base bar, **is characterized in that** it contains a locking bar located above and along the base bar, a controlled actuator, which moves in a sliding manner in parallel to the base bar, or the lock longitudinal axis coupled with the locking bar via a tie rod, while the locking bar tongue contains a bean-shaped oblique hole, working with the lock bolt pin, contains also a stabilizer, interlock limit switch and a door locking limit switch, while the locking bar has recesses working with the key insert that limit its length, while the actuator and interlock limit switch are coupled within the electronic system with a control processor, a card reader and keyboard, display, Ethernet network access and USB input, and indirectly, via the power output with the actuator

**[0010]** It is preferable for the actuator to be an electric motor or an electromagnet.

**[0011]** The patent key insert enables moving the locking bar regardless of the actuator motion, hence, hiding the bolt lock and depressing the handle by the user. It is implemented, when the insert enters the recess upon turning the key causing an upward movement of the locking bar.

**[0012]** The invention aspect is described in more detail in the embodiments, which, however, do not exhaust its preferred embodiments and in the drawing, where:

Fig. 1 shows a block diagram of system-operator communication interfaces.

Fig. 2 is a lock interlocking system wiring diagram, while Fig. 3 is a wiring diagram of the lock interlocking system and the peripheral controls.

Fig. 4 shows the inside of a locomotive cabin door lock with an electronic locking system in the bolted position.

Fig. 5 is a view of a lock fragment with an electronic interlock system in the bolted position, from the side of the central handle with marked detail A. Whereas detail A, seen in Fig. 6 shows the interlock bolt position relative to the oblique opening in the bolted position.

Fig. 7 View of a lock fragment with an electronic interlock system in the unbolted position, from the side of the central handle with marked detail B. Whereas detail B, seen in Fig. 8 shows the interlock bolt pin position relative to the oblique opening in the unbolted position.

Fig. 9 is a view of a fragment of a broken view of a lock with an electronic interlock system in the bolted position, from the side of the upper and lower handles, showing the position of the actuator tie rod relative to the locking bar. Whereas Fig. 10 is a broken view fragment of a lock with an electronic interlock system in the unbolted position, from the side of the upper and lower handles, showing the position of the

actuator tie rod relative to the locking bar.

**[0013]** List of symbols:

1. base bar
2. lock bolt
3. door locking limit switch
4. actuator
5. actuator tie rod
6. locking strip
7. lock bolt pin
  
8. lock bolt block
9. oblique hole (bean)
10. stabilizer
11. selected key inserts
12. lock bolt
13. bottom handle key insert
14. upper handle key insert

**[0014]** Embodiment 1: The locomotive door lock contains handles at two levels, whereas the lower level handle is located on the outside of the door only.

**[0015]** The lock contains a single long base bar **1**, the downward movement of which causes the insertion of bolts **12**. The base bar **1** is moved via racks, with one driven by the lower handle, and one by the upper handle. The system is linked in such a way that depressing the lower handle causes the upper handle to move and vice versa. The lock also has an additional function of lifting any handle upwards, which leads to locking the lock bolts **12** and, additionally, releasing pressure from the central handle. The lock contains a safety element, which prevents lifting the handle upwards when the door is open.

**[0016]** Above the base bar **1** and along the lock axis there is a locking bar **6**, along the section between the upper handle key insert **14** and lower handle key insert **13**. The locking bar is fitted pivotally with a tie rod **5**, the other end of which is coupled also pivotally to the actuator **4**, which is the electric motor. Indirectly, the tie rod **5** is fixed at a second point to the locking bar **6** but with a possibility for slight compensation of the linear movement along the locking bar **6** axis. A process-controlled actuator **4**, coupled indirectly with the processor via a power output, slides in the direction parallel to the base bar **1**, that is the longitudinal axis of the lock. The locking bar **6** tongue contains an oblique, bean-shaped hole **9** that works with the lock bolt interlock pin **7**. Such a position of the hole **9** results in the lock bolt interlock pin **7** motion perpendicular to the locking bar **6** motion. This enables moving the lock interlock block **8** away and advancing the base bar **1**. The interlock control system also comprises a stabilizer **10**, which maintains the locking bar **6** position in locked/unlocked states. The locking bar **6** has recesses **11** cooperating with a key insert **13** and **14** that limit its length.

**[0017]** The electronic system also contains a keyboard, LED/OLED display and a card or chip reader coupled to the processor. The actuator **4** and interlock limit

switch **3** are coupled electronically with a control processor, a card reader and keyboard, display, Ethernet network access and USB input, and indirectly, via the power output, with the actuator **4**.

**[0018]** Door can be unlocked or locked via the reader, without using a key. Every ID card has its own unique number assigned directly to each user. This way, the customer obtains information on each opening by the user and also grants permissions to each user, depending on the vehicle.

**[0019]** The door interlock can also be unlocked by the electronic system via an interface in the form of a numeric keyboard located on the outside. It enables opening the lock without the need to hold a card or key.

**[0020]** Using an access code is monitored and verified by the system. The vehicle access code is valid for a specified period or is a one-time code. Access code is granted remotely via the Ethernet.

**[0021]** LEDs are visual signalling devices located on the external panel of the device. They provide direct notifications on the closing state. A green LED indicates lock unlocking or locking, with a red LED indicating system error. The display plays an important role in terms of system functioning. It enables displaying system messages notifying the user, potential operating errors and more.

**[0022]** Previous opening of the vehicle using a key is also monitored and is stored in the device memory for a period required by the customer.

Lock operation

**[0023]** The electronic control system enables unlocking locomotive cabin door in several possible ways. All door unlocking functions are monitored, which was impossible in the basic mechanical version of the door interlock. When the system gives permission to open the door, the actuator **4** slides the locking bar **6**, thus allowing to use of the handle and open the door. Such information is stored in the memory of the device and then forwarded to the customer via the Ethernet. The locking bar **6** position is monitored by the door locking limit switch **3**. This information is monitored and logged by the system.

Embodiment 2

**[0024]** Device the same as in embodiment 1, while the electronic system controller is fitted with a window opening sensor, which notifies the user or customer of the current state.

Embodiment 3:

**[0025]** Device the same as in embodiment 2, while the electronic system controller is fitted with a system preventing frost appearing on the window pane and if the window pane temperature falls below 0°C, the device enables activating electric heating paths or a blower.

## Ethernet communication

**[0026]** The system communicates with the customer's systems via the Ethernet. Direct remote connection is established this way, which ensures data transfer between the control system, vehicle onboard computer and the customer's systems at the company's premises.

**[0027]** The system sends reports errors, door opening/closing states, lock opening/closing states and other information to the vehicle onboard computer via the network.

**[0028]** Owing to a built-in RTC clock, the events are always saved with the current time of their occurrence. They can be later sent to the customer's system. This communication also enables synchronizing the system with the main server, which enables real-time access to information on a newly added card, code, permission change, etc.

**[0029]** Ethernet communication also allows to remotely configure the system and change controller software.

**[0030]** Operational description of individual blocks presented in Fig. 1:

Actuator activation - power output.

**[0031]** The door is unlocked by sliding the bolt lock away via a system of a pin 7 and an oblique bean-shaped hole 9. This is possible via several ways, namely, by using an authorized card on the reader, using a set temporary or one-time code or remote opening or closing command, which lock or unlocks the door.

**[0032]** A display displays the entered temporary or one-time code and diagnostic messages for the user.

**[0033]** An RFID card reader enables reading card numbers and comparing them with the ones stored in the device's memory. After detecting an authorized card, the door is opened.

**[0034]** A keyboard is used to enter door opening codes, as well as to execute additional servicing functions.

**[0035]** While a processor controls the operation of all peripherals.

**[0036]** A USB port enables local, inside the locomotive cabin, communication with the system using a laptop (RDIAG v2.0 diagnostic software). Reading the memory for events occurring on all peripherals is also possible without the possibility to erase them from the outside. The system also enables configuring the controller and updating its software.

**[0037]** Whereas internal Ethernet communication (IEEE 802.3 standard) enables, just like the USB port, reading the memory for events occurring on all peripherals without the possibility to erase them from the outside. It is possible to remotely configure the controller and change its software.

**[0038]** Digital inputs and outputs - each with a different pin - 24 VDC inputs and GND coupled outputs. They are used to couple peripheral devices, such as signal lamps, buttons and switches.

## Claims

1. The control system for a train locomotive lock interlock, especially a door lock, containing a single long base bar, joining handles at two different levels, with the upper level containing an external and internal handle and a lower level containing an external handle, with coupled set of bolt locks, while each handle is fitted with a rack that, when the handle is depressed, slides the bar upwards, thus retracting the bolts and opening the door and a spring tensioner, setting its horizontal position **is characterized in that** it contains a locking bar (6) located above and along the base bar (1), a controlled actuator (4), which slides parallel to the base bar (1), or the lock longitudinal axis, coupled with the locking bar (6) via a tie rod (5), whereas the locking bar tongue (2) has an oblique bean-shaped hole (9), cooperating with the bolt lock pin (7), while the system also contains a stabilizer (10), interlock limit switch and door closing limit switch (3), while the locking bar (6) contains recesses (11) cooperating with the key insert (13, 14), which limit its length, while the actuator (4) and interlock limit switch (3) are coupled within the electronic system with a control processor, a card reader and keyboard, display, Ethernet network access and USB input, and indirectly, via the power output with the actuator (4) 2. System as per claim 1, **characterized in that** the actuator (4) is an electric motor or an electromagnet.

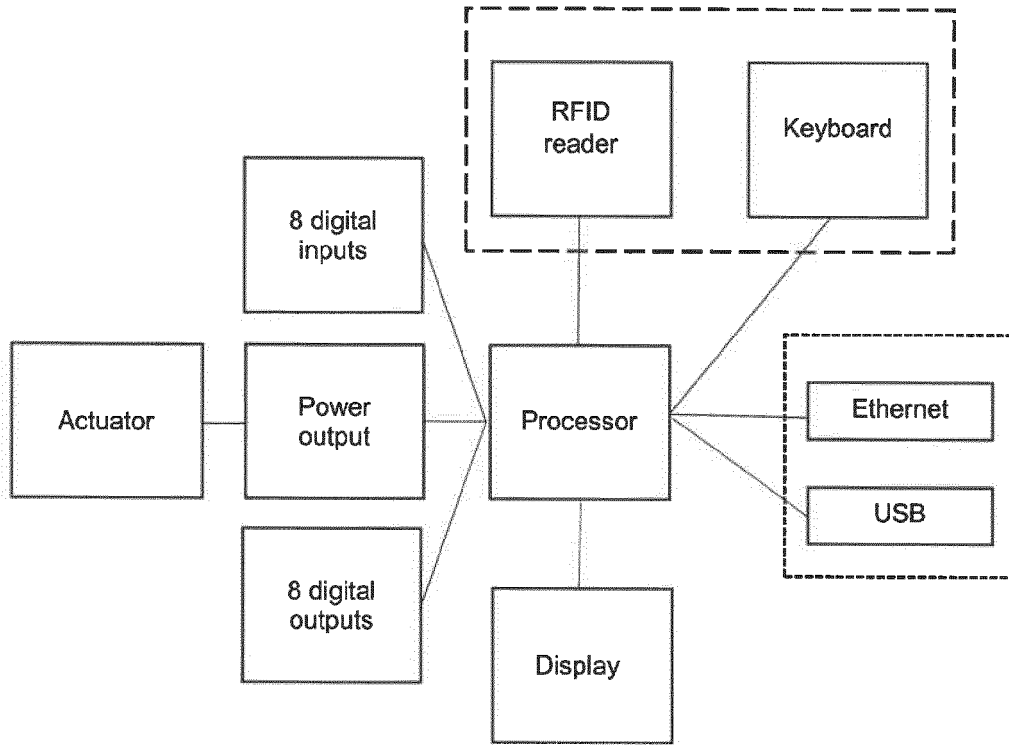


Fig. 1

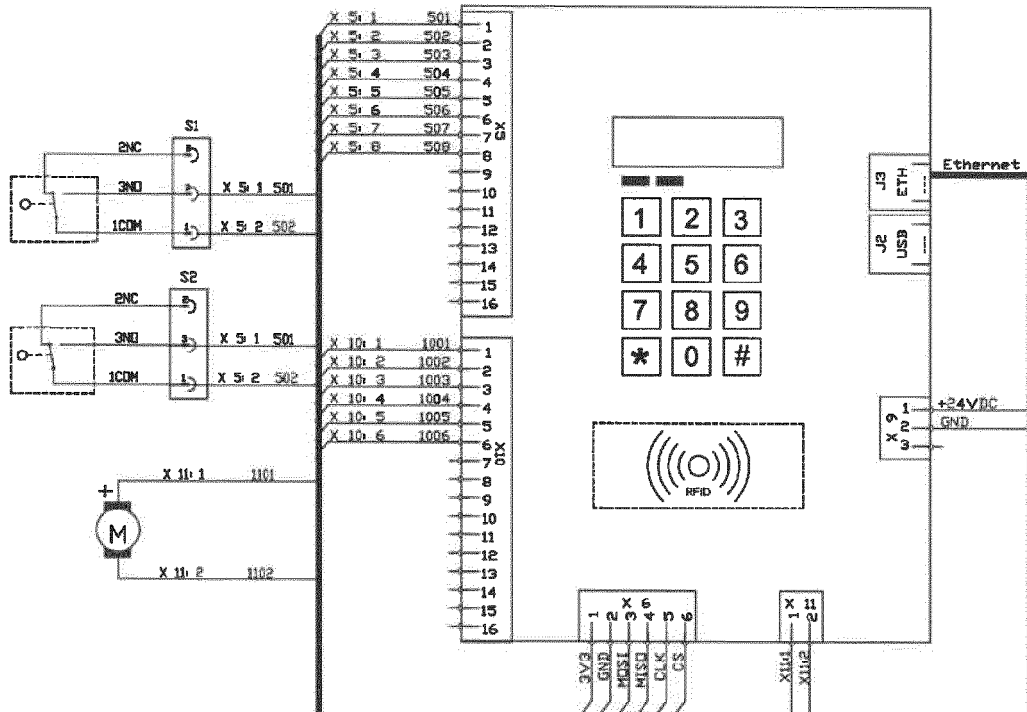


Fig. 2



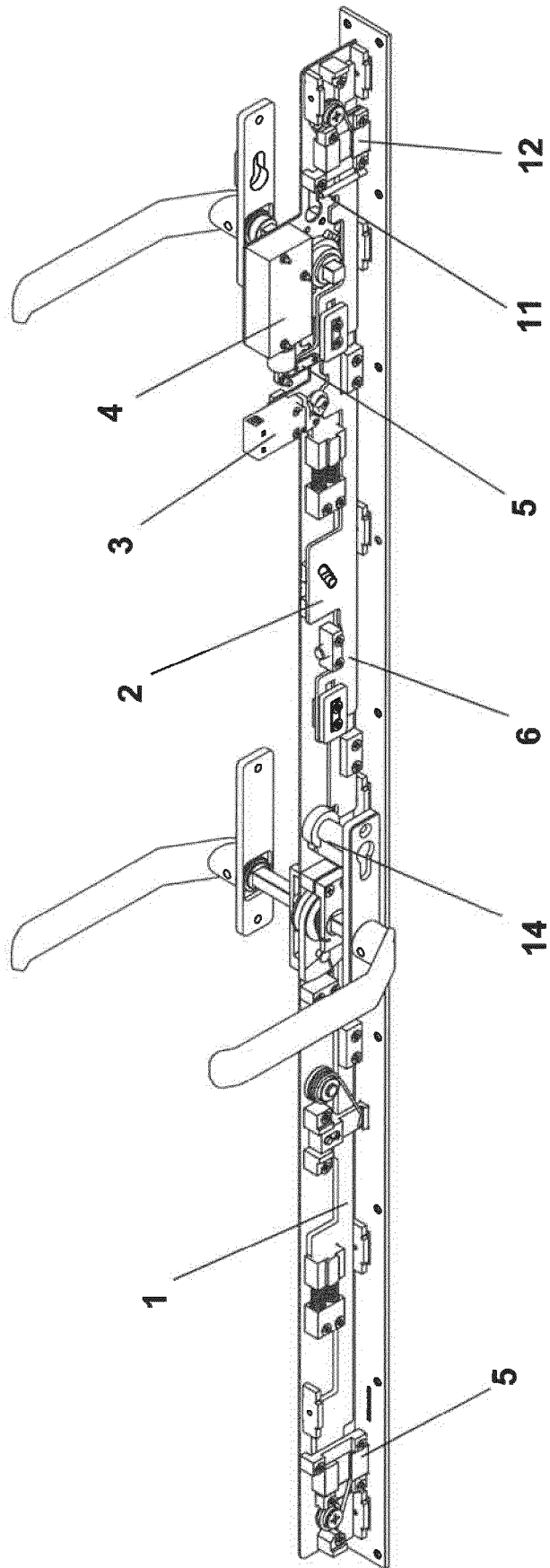
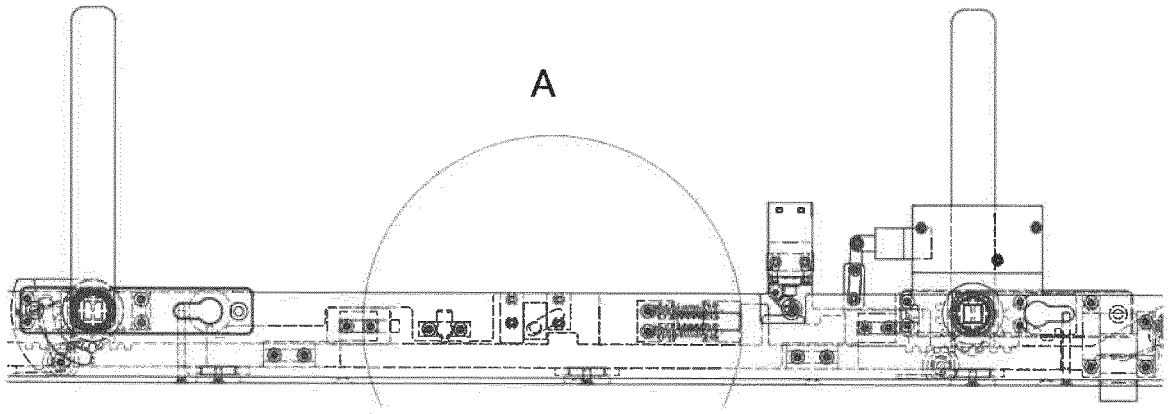
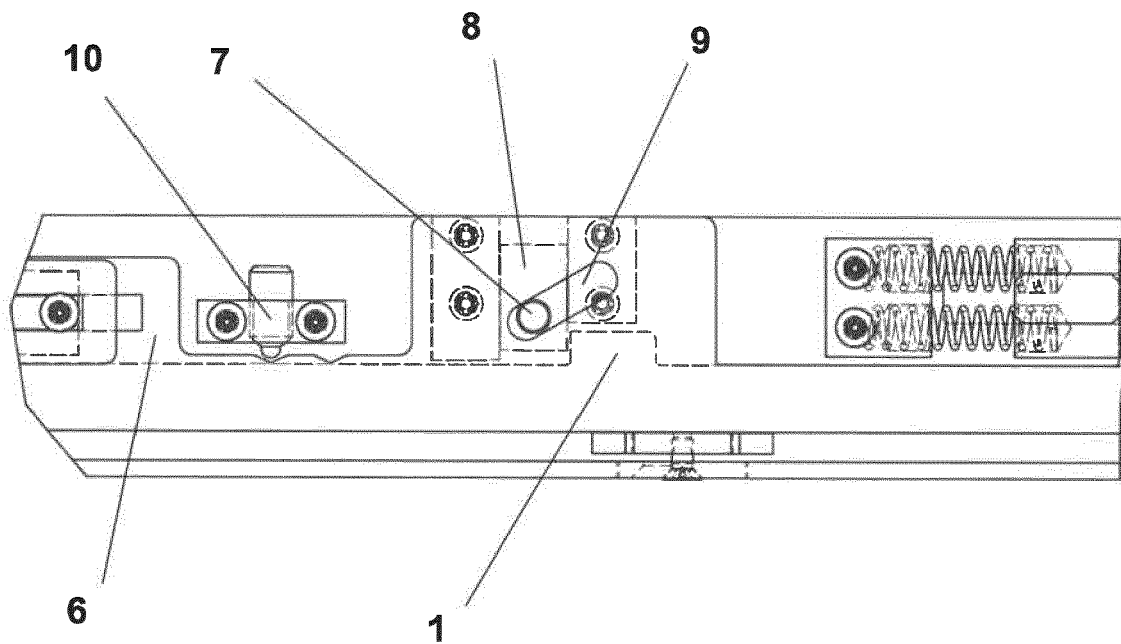


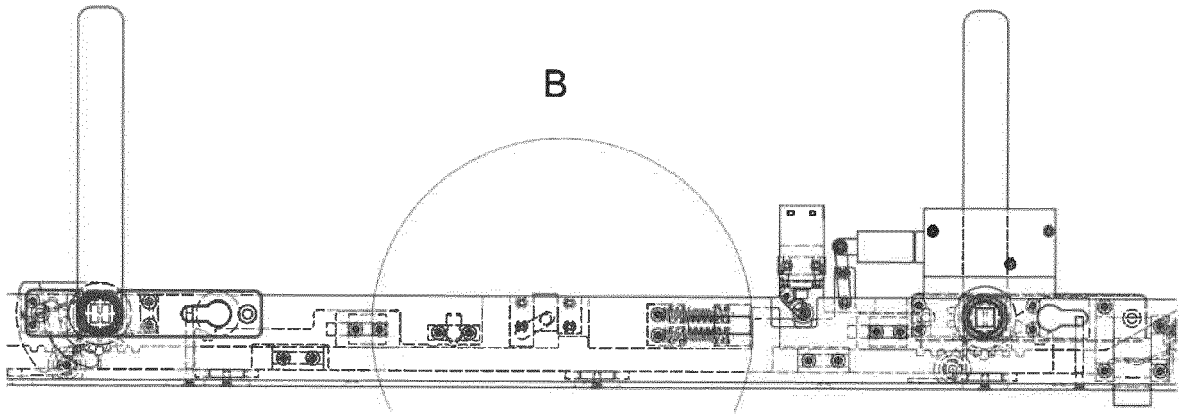
Fig. 4



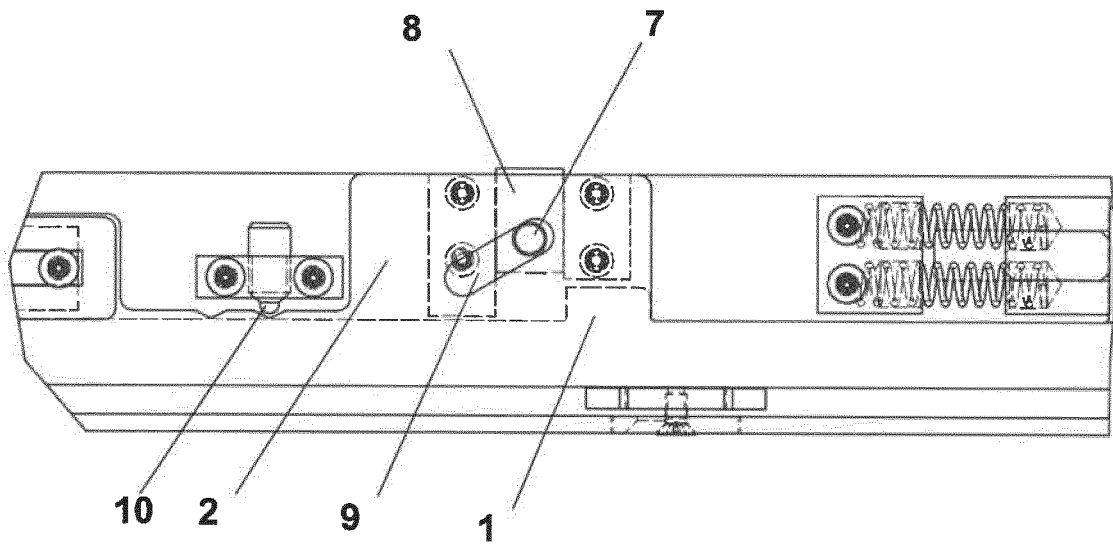
**Fig. 5**



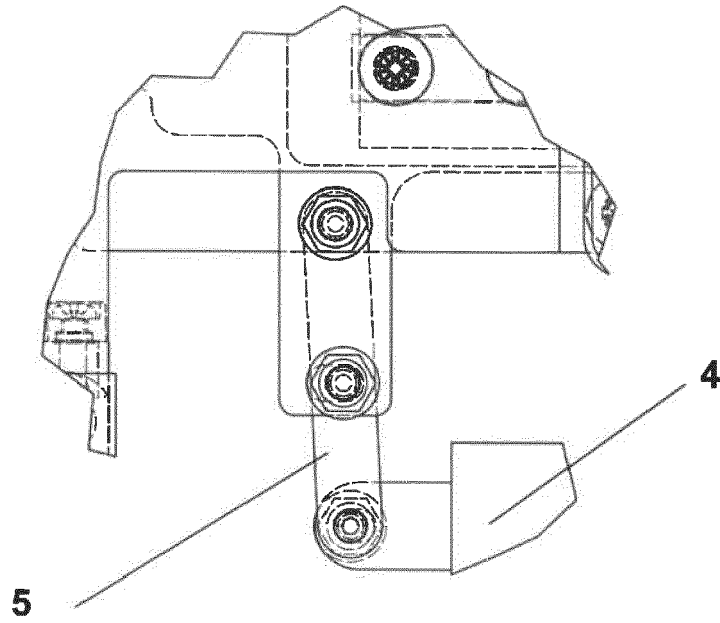
**Fig. 6**



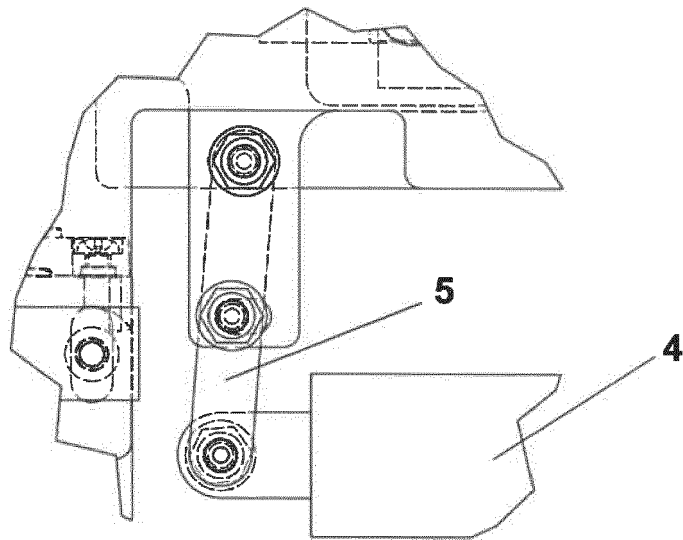
**Fig. 7**



**Fig. 8**



**Fig. 9**



**Fig. 10**



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Application Number  
EP 21 18 2573

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