REMOTE ELECTRONIC LOCK APPARATUS AND METHODS

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ABSTRACT

Apparatus for remote electronic lock operation. Electronic locks are associated with respective mobile instrumentalities such as railway cars or semi-trailers, the locks each operating according to a preselected lock code for the instrumentality. Provision is included for establishing a voice frequency communication link having a first terminus at a central lock control facility as to which the instrumentalities are remotely located. A second terminus is near one of the remote instrumentalities. The apparatus includes means for transmitting a lock operation code over the communication link from the first to second terminus and provision for transferring the lock operation code from the second terminus to the last-said instrumentality for operation of its lock means.

As a method of remote electronic lock operation, the identification of one of the instrumentalities is transmitted to the central facility, determination is then made of the corresponding lock operation code, and the latter is transmitted in coded format to the instrumentality to provide access to it.

15 Claims, 3 Drawing Figures
REMOTE ELECTRONIC LOCK APPARATUS AND METHODS

BACKGROUND OF THE INVENTION

The present invention relates to locks and more particularly to an electronic lock system for remote operation of electronic locks of vehicles or other mobile instrumentalties.

Pillage or theft from unattached boxcars or semitrailers is a serious problem in the transportation industry. Conventional practice with railway boxcars, for example, is to employ seals or locks on the doors. Seals are easily broken and serve only to indicate that someone has broken into the car, while locks can often be picked or broken. Moreover, locks either require keys (the control or use of which may be burdensome in many cases) or a lock combination. A problem with using combination locks is that unauthorized persons may easily maintain a file of combination numbers.

Electronic remote control lock systems have been known for some time. For example, see U.S. Pat. Nos. 3,093,994; 3,134,254; 3,320,490; 3,392,558; Re. 27,013; and references cited therein. However, such electronic lock systems of the prior art have not been useful for controlling access to highly mobile instrumentalties such as boxcars or semitrailers which are likely to be widely geographically separated from any central facility from which such access is to be controlled.

SUMMARY OF THE INVENTION

Among the several objects of the invention may be noted the provision of apparatus for and methods of electronic lock operation for controlling access to remote mobile instrumentalties such as railway boxcars or semitrailers; the provision of such apparatus and methods which are highly secure and not prone to tampering or unauthorized use; the provision of such apparatus and methods which do not require the mobile instrumentalties to carry a source of internal power for operation; and the provision of such apparatus and methods which are relatively simple and foolproof in use.

Briefly, apparatus for remote electronic lock operation according to the invention comprises a plurality of electronic lock means associated with respective ones of a plurality of vehicles or other mobile instrumentalties, each of the lock means including an electrically energizable lock for controlling access to the respective vehicle. The lock is operable to provide access to the respective vehicle in response to receiving of a preselected lock operation code associated uniquely with the respective vehicle. There is a central lock control facility and the vehicles are adapted to be located at locations which are geographically remote from the central facility. The apparatus includes means for establishing a telephone or other voice frequency communication link having a first terminus at the central facility and a second terminus near a predetermined one of the vehicles. Means is provided for transmitting a lock operation code over the telephone link from the first terminus to the second terminus. Provision is made for interconnecting the electronic lock means of the predetermined vehicle with the second terminus transferring the transmitted lock operation code to the vehicle's lock means. Its lock is accordingly operated to provide access to the vehicle if the transmitted code is correct, i.e., is the preselected lock operation code.

In use, the apparatus involves a method comprising transmitting the identification of the predetermined vehicle to the central facility, determining at the central facility the lock operation code corresponding to the transmitted identification, and transmitting the corresponding lock operation code in coded format from the central facility to the last-said vehicle.

Preferably the vehicle identification is transmitted, e.g., by telephone, from a location near the last-said vehicle and the lock operation code corresponding to said identification is transmitted as tone-coded signals over the telephone to said location and transferred electronically to the vehicle.

Other objects and features will be in part apparent and in part pointed out hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation of a vehicle depicted as including electronic lock means of the invention;

FIG. 2 is a pictorial representation of a telephone communication link as employed in the invention; and

FIG. 3 is a schematic block diagram of circuitry of the invention.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, a railway boxcar 11 is represented as one of a plurality of vehicles such as semitrailers or other mobile instrumentalties provided with electronic lock apparatus 13 of the invention. Apparatus 13 includes a solenoid 15 which, when energized in response to a preselected lock operation code received by apparatus 13, is adapted to operate a latch 17 for permitting opening of the doors 19 of car 11 and thereby to provide access to the car.

The lock operation code is associated with, i.e., corresponds to, the respective vehicle and for this purpose the vehicle is identified by an identification number or the like. It will be understood that lock apparatus 13 may similarly control access to a semitrailer or many other types of mobile instrumentalties.

Positioned on the side of boxcar 11 is a cable receptacle 21 for receiving a cable plug 23 at one end of an electrical cable 25 as explained hereinbelow. Receptacle 21 is interconnected with the electronic lock apparatus 13 by suitable electrical wiring 27 within the boxcar.

In accordance with the invention, a central lock control facility 29 is selected. This facility may be located, for example, at a central dispatch office or the like with respect to which the boxcars 11 (or other vehicles) are subject to being remotely geographically located. At the control facility 29 is maintained a file of boxcar or vehicle identification numbers and the lock operation codes respectively corresponding to those identification numbers.

A touch button tone-coded telephone 31 provides a first terminus of a voice-frequency communication link at the central facility 29. At a location (such as a switchyard office) near the respective boxcar 11, a second such telephone 35 provides a second terminus of
the link. Thus the communication link is constituted by the telephone circuit 37 which is established between telephones 31 and 35 when a call is made from one to the other.

The touch button tone-coded dialing mechanism 36 of telephone 31 (or other tone-coding equipment) constitutes means for transmitting a lock operation code over the telephone circuit 37 to telephone 35. As is known, such dialing mechanisms generate dialing tones. These tones are utilized in accordance with the invention to provide a binary format for the lock operation code. That is, the lock operation code may be defined by a binary number such as 010011 which can be transmitted simply by operating the 0 and 1 touch buttons of the dialing mechanism.

Cable 25 constitutes means for transferring the lock operation code received via telephone 35 to the nearby boxcar 11. Accordingly, cable 25 is flexible and of sufficient length to reach from the telephone 35 (which may be located at a rail siding or at a switchyard, etc.) to the boxcar 11 on the siding or in the railyard.

For this purpose, the end 39 of cable 25 at facility 33 is suitably connected as shown at 41 to telephone 35. In addition, a suitable source of power (e.g., line voltage a.c.) is supplied to the cable via a lead 43 for providing operating power for electronic lock apparatus 13.

Referring now to FIG. 3, electronic lock apparatus 13 includes conventional filter circuits 45 and 47 constituting tone decoders for detecting predetermined tone frequencies of the touch button tone signals received by telephone 35 and transferred to electronic lock apparatus 13 when cable plug 23 is connected as receptacle 21. Filter circuit 45 decodes the 0 and 1 tones which define the received lock operation code received by a lead 41' interconnecting with lead 41 thereby to provide a data signal represented at 49. The data is supplied to the data input of a binary shift register 51.

Tone decoder circuit 47 is responsive to the tones representative of a touch button phone number such as 6, providing a signal for clearing register 51 in response to receiving a "clear" signal. The "clear" signal is thus generated by operating the 6 button of telephone 31.

Interconnected via leads A1,A2, ... An with the shift register 51 is a binary comparator 53 for comparing the received lock operation code shifted into and thus electronically stored by register 51 with a preselected lock operation code previously wired or set into the apparatus 13 by means 55 defining the preselected code. Means 55 may be constituted by a plurality of switches, for example, each defining one bit of the preselected code and interconnected with comparator 53 by leads B1,B2, ... Bn.

An output lead 57 supplies an output signal from comparator 53 if the codes compare correctly. Conventional buffer circuitry 59 is provided for energizing solenoid 15 in response to an output signal on lead 57. Low-voltage d.c. suitable for operation of decoders 45 and 47, register 51, comparator 53 and buffer 59 is provided by a low-voltage power supply 61 which receives a.c. power from a lead 43' interconnecting via receptacle 21 and plug 33 with lead 43 (FIG. 2). Lead 43' also supplies a.c. power for operation of solenoid 15.

In operation, it is assumed that boxcar 11 (or other vehicle, etc.) is at a location 33 remote from central control facility 29. When it is desired to gain access to the boxcar, the plug 23 of cable 25 is inserted in receptacle 21. A telephone call is then initiated from telephone 35 to telephone 31. The caller provides the called person with appropriate identification and then transmits (e.g., verbally) to the central facility the car seal or identification number or other indicia identifying the boxcar.

At the central facility 29, the person to whom the car identification has been transmitted then determines the lock operation code corresponding to the transmitted car identification. This code may be punched into a dialing card, etc. This corresponding lock operation code is then transmitted in coded (i.e., binary) format to telephone 35 by operation of appropriate 0 and 1 buttons of the dialing mechanism 36 of telephone 31. The transmitted code is electronically transferred by cable 25 to apparatus 13. The received code is then electronically stored by register 51 and compared by comparator 53 with the preselected lock operation code determined by means 55. If the comparison is correct, solenoid 15 is energized by the a.c. power also supplied by cable 25 to operate latch 17. Accordingly, the doors 19 of boxcar 11 may be opened.

If an incorrect lock operation code is transmitted (through error, for example), the register 51 may be cleared by the person at central facility 29 by transmitting a "clear" signal. As noted, this is accomplished by operating the 6 button, for example, of dialing mechanism 36. A correct lock operation code may then be transmitted for entry into register 51.

While a telephone communications link has been illustrated, it is within the purview of the invention that other types of voice frequency communication links may be employed, e.g., radio communication.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions and methods without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Apparatus for remote electronic lock operation comprising:

   a plurality of electronic lock means associated with respective ones of a plurality of mobile instrumentality, each of said electronic lock means being adapted for operation according to a preselected lock operation code which is associated with the respective mobile instrumentality;

   a central lock control facility, said mobile instrumentality each being adapted to be located at locations which are geographically remote with respect to said central facility;

   means for establishing a voice frequency communication link having a first terminus at said central facility and a second terminus near a predetermined one of said remote instrumentality;

   means for transmitting a lock operation code over said communication link from said first terminus to said second terminus; means for transferring said lock operation code from said second terminus to the predetermined mobile instrumentality, the last said lock operation code causing operation of said
electronic means if said last-said code compares correctly with the preselected lock operation code associated with said predetermined mobile instrumentality.

2. Apparatus as set forth in claim 1 wherein said electronic lock means comprises an electrically energizable lock, means for defining said preselected lock operation code, means for receiving said transmitted lock operation code, means for comparing the preselected and received lock operation codes, and means, operative in response to comparison of the codes by said comparing means, for controlling electrical energization of said lock.

3. Apparatus as set forth in claim 2 wherein said means for receiving the transmitted lock operation code is constituted by a binary register and said comparing means is constituted by a binary comparator.

4. Apparatus as set forth in claim 3 wherein said binary register is a shift register and further comprising frequency-responsive means for controlling entry into the shift register of the transmitted lock operation code and further frequency-responsive means for controlling clearing of the shift register.

5. Apparatus as set forth in claim 2 wherein the voice frequency communications link is a telephone circuit and transmitted lock operation code is adapted to be generated by a touch button tone-coded dialing mechanism of a telephone at said first terminus.

6. Apparatus as set forth in claim 5 wherein the transmitted lock operation code is adapted to be generated in a binary format by operation of a plurality of touch buttons of the dialing mechanism.

7. Apparatus as set forth in claim 1 wherein said mobile instrumentalities are constituted by vehicles, said electronic lock means each including an electrically energizable lock for controlling access to a respective vehicle.

8. Apparatus as set forth in claim 7 wherein said transferring means includes provision for supplying electric power for energizing said lock, said lock being energized to permit access to the vehicle if the transmitted lock operation code compares correctly with the preselected lock operation code.

9. Apparatus as set forth in claim 8 wherein said communications link includes a receiver means at said second terminus and said transferring means comprises a cable connection for connecting the receiver means with one of the vehicles.

10. Apparatus as set forth in claim 7 wherein said vehicles comprise railway cars.

11. Apparatus as set forth in claim 7 wherein said vehicles comprise semtrailers.

12. Apparatus for remote electronic lock operation comprising:

a plurality of electronic lock means associated with respective ones of a plurality of vehicles, each of said lock means including an electrically energizable lock for controlling access to the respective vehicle, the lock being operable to provide access to the respective vehicle in response to receiving of a preselected lock operation code associated uniquely with the respective vehicle:

a central lock control facility, said vehicles being adapted to be located at locations which are geographically remote from the central facility;

means for establishing a telephone link having a first terminus at said central facility and a second terminus near a predetermined one of the vehicles;

means for transmitting a lock operation code over said telephone link from said first terminus to said second terminus;

means for interconnecting the electronic lock means of said predetermined vehicle with said second terminus for transferring the transmitted lock operation code to said lock means, whereby said lock is operated to provide access to said vehicle if the transmitted code is said preselected lock operation code.

13. A method of remote electronic lock operation for controlling access to one of a plurality of instrumentalities adapted to be geographically remotely located with respect to a central control facility, each of said instrumentalities having a predetermined identification, and electronic lock means providing access to the instrumentality in response to receiving of a preselected lock operation code corresponding to the respective identification, said method comprising transmitting to the central facility from a location near to one of said instrumentalities the identification of the last-said instrumentality, determining at the central facility the lock operation code corresponding to the transmitted identification, transmitting as tone-coded signals the corresponding lock operation code in coded format to said location from the central facility for electronic transfer to the last-said instrumentality, and electronically storing and comparing the transmitted lock operation code with the preselected lock operation code corresponding to the identification of the last-said instrumentality whereby access to the last-said instrumentality is provided.

14. A method as set forth in claim 13 wherein the transmitting of said identification and corresponding lock operation code is carried out telephonically.

15. A method as set forth in claim 13 including the step of supplying electrical power from an outside source to the last-said instrumentality for operation of said electronic lock means when a lock operation code is transferred to the instrumentality.