

[54] **KEY-RECEIVING LOCK ASSEMBLIES AND APPARATUS INCORPORATING SUCH ASSEMBLIES**

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Related U.S. Application Data

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[51] Int. Cl. **E05b 11/00**

[58] Field of Search 70/239, 429; 200/42 R, 200/44; 340/147 R, 147 LP; 307/10 R, 10 AT

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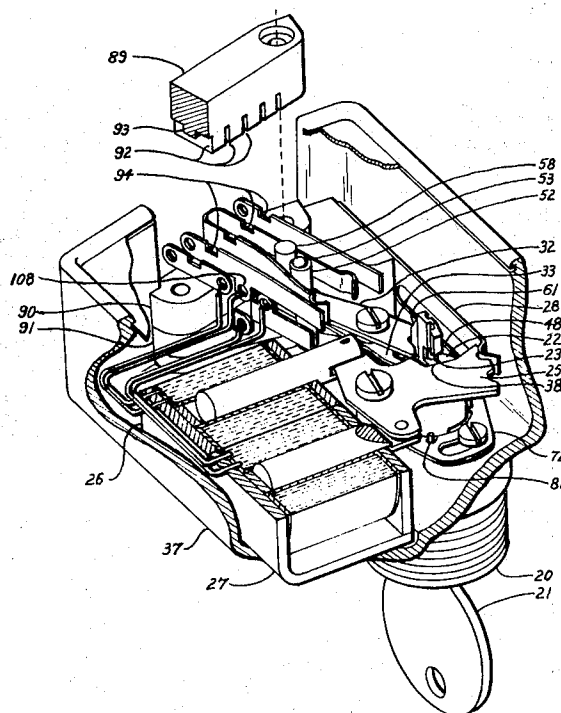
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Primary Examiner—Robert K. Schaefer
Assistant Examiner—William J. Smith

ABSTRACT

In a key-receiving lock assembly for controlling access to or use of leased apparatus, two remotely energized electromagnets may be operated alternately to engage and disengage a securing member relative to the operable elements of the lock, said securing member, when engaged, securing the key within the lock and securing the operable elements of the lock in a position preventing access to or use of the apparatus protected by the lock. A switch inhibits engagement of the securing member unless the key is in the lock and the lock is in the securing position. A second switch, closed by lock rotation to a position other than the securing position or the position in which the key is insertable into and removable from the lock, provides continuous operational access to the apparatus protected by the lock. A third switch provides transient energization of a circuit such as required for starting of an internal combustion engine. Disconnectable remote control means, with protective features, are included.

44 Claims, 29 Drawing Figures



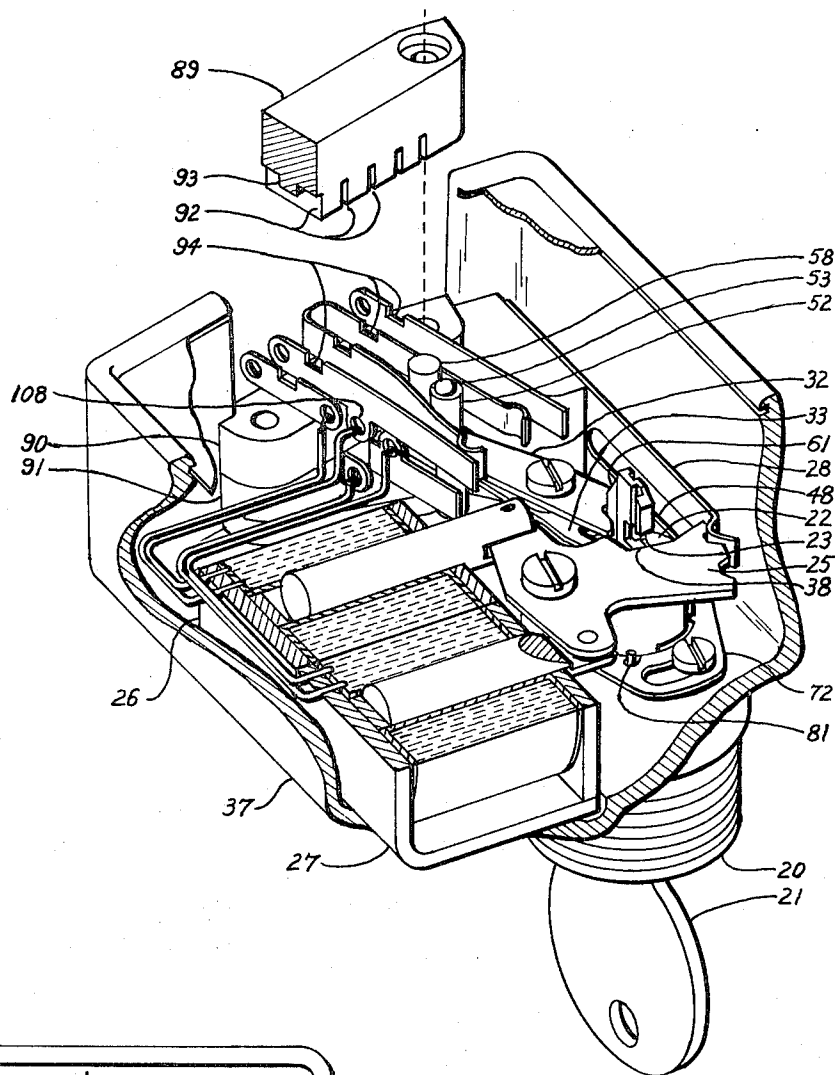


Fig. 1

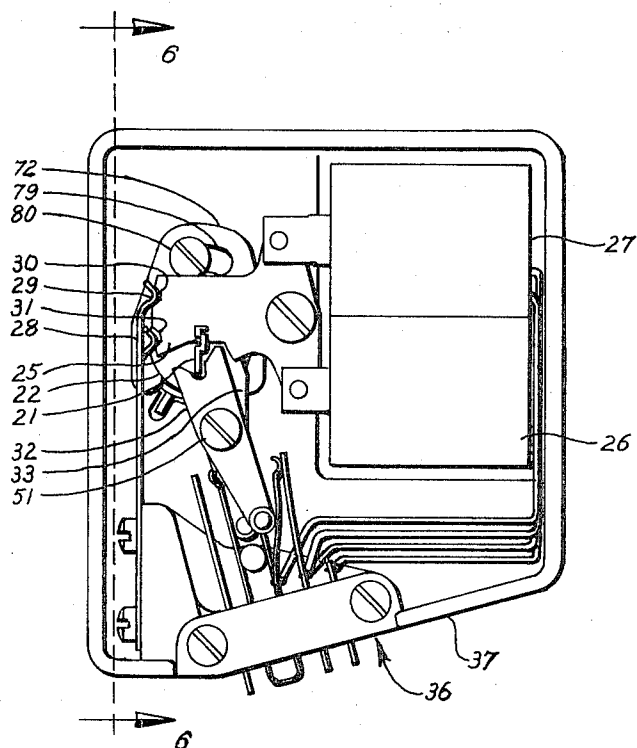
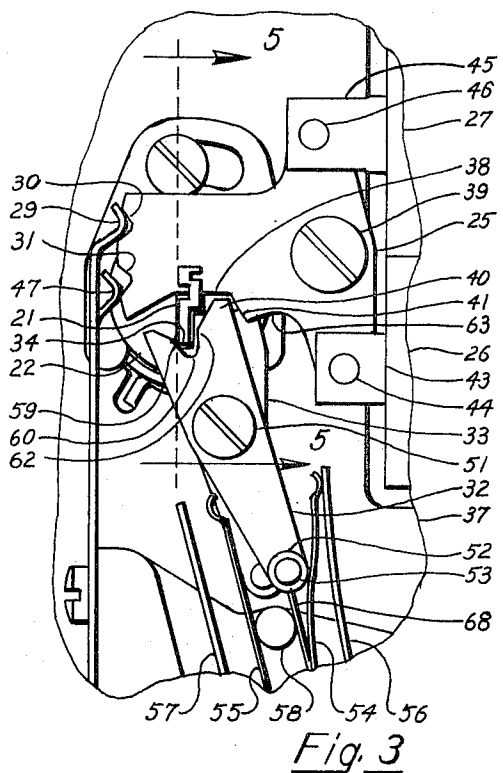
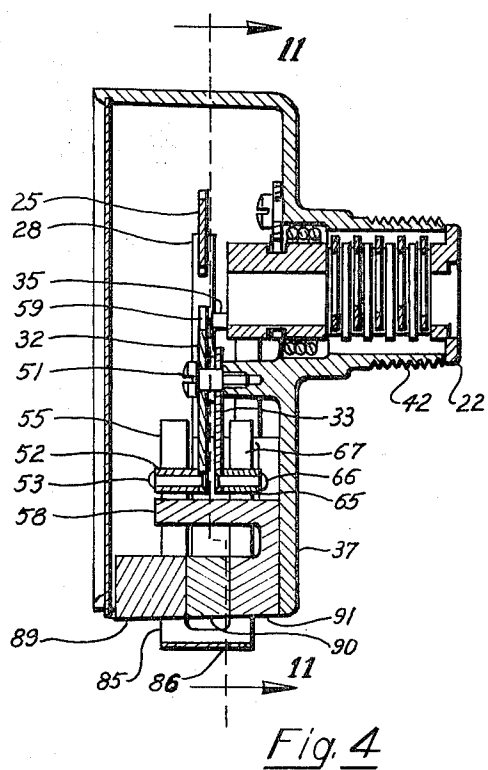
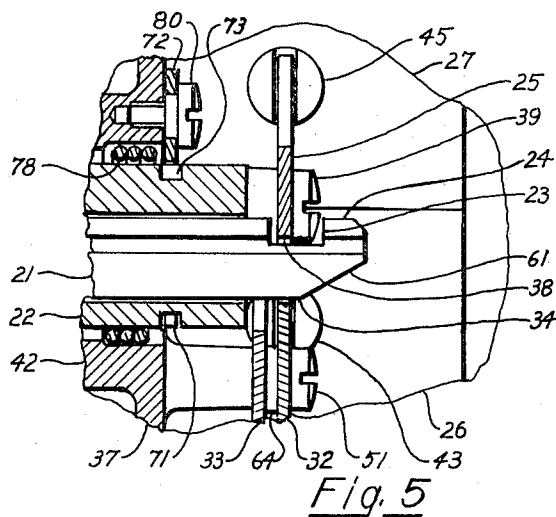
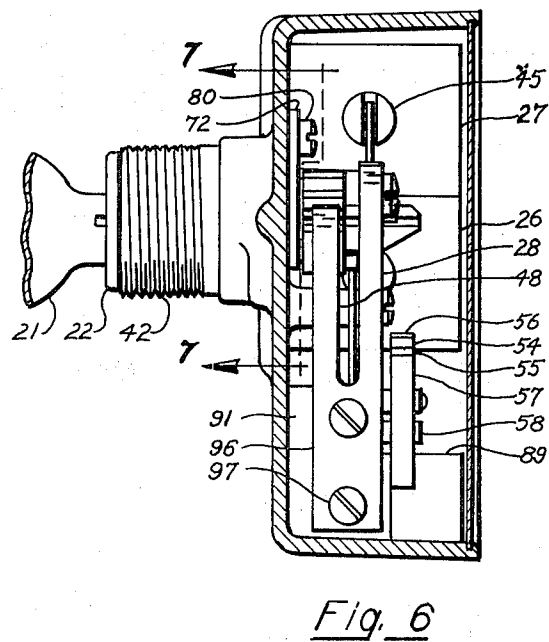
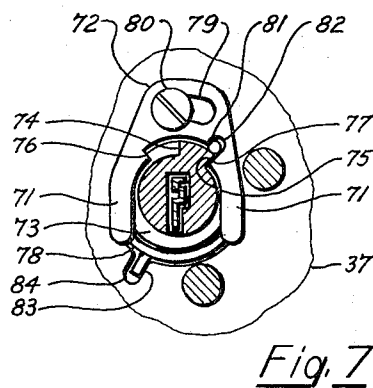
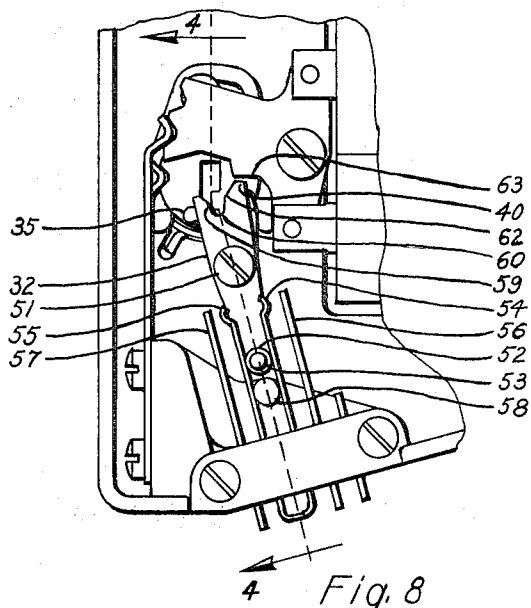
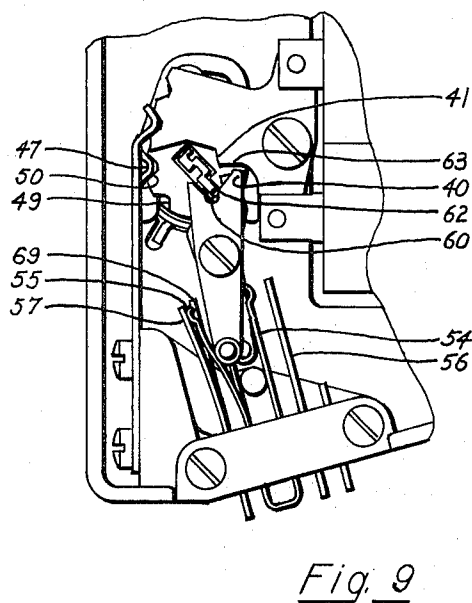
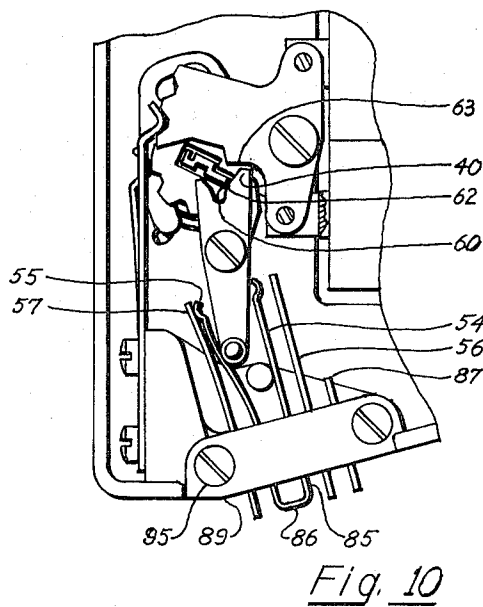
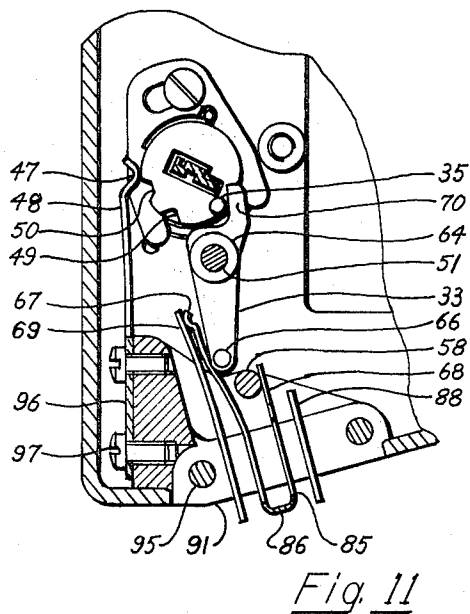
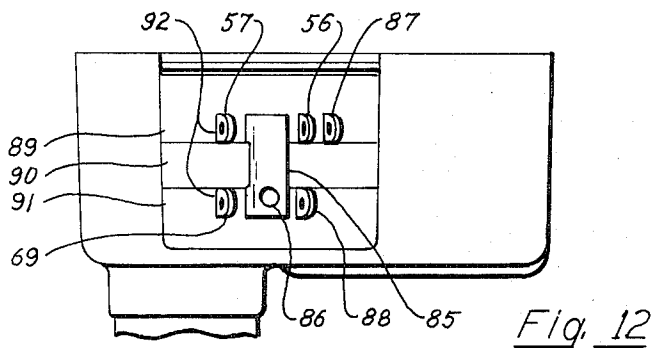


Fig. 2





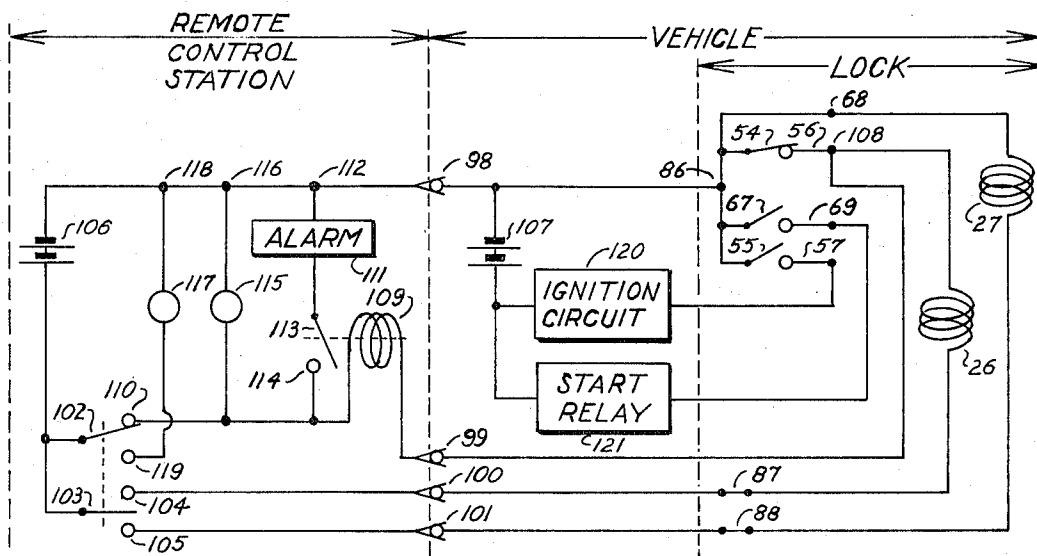


Fig. 13

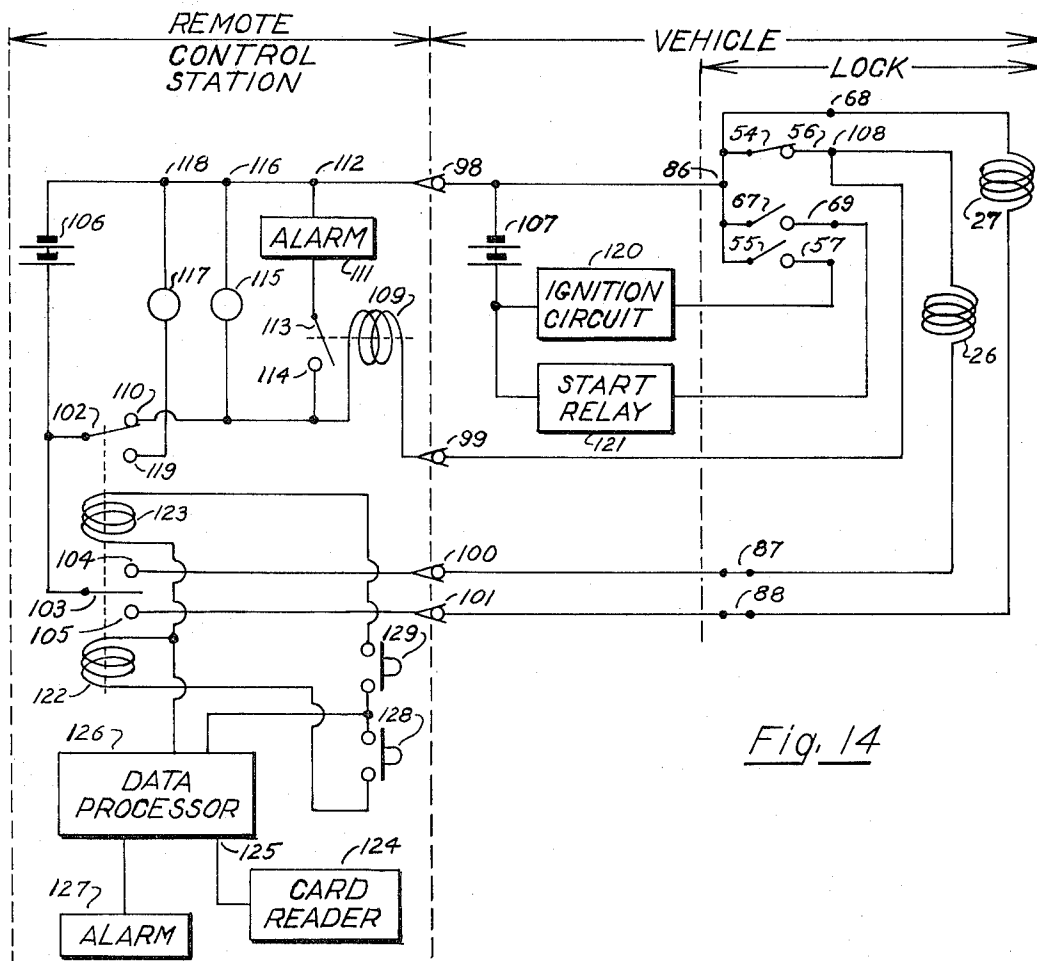


Fig. 14

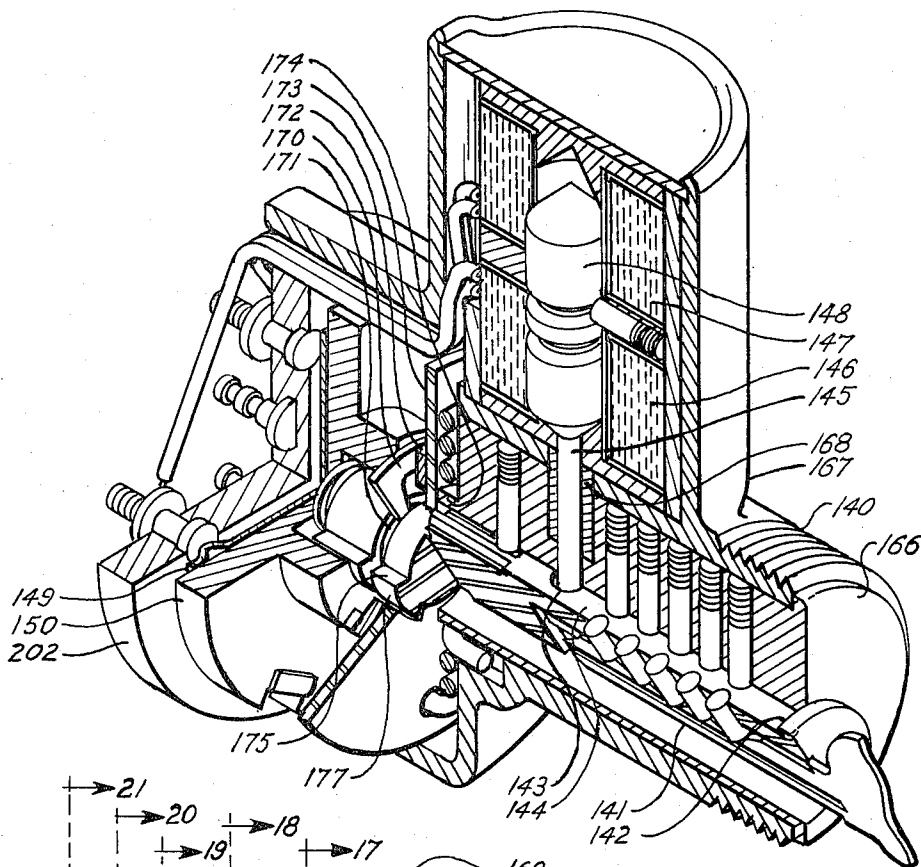


Fig. 15

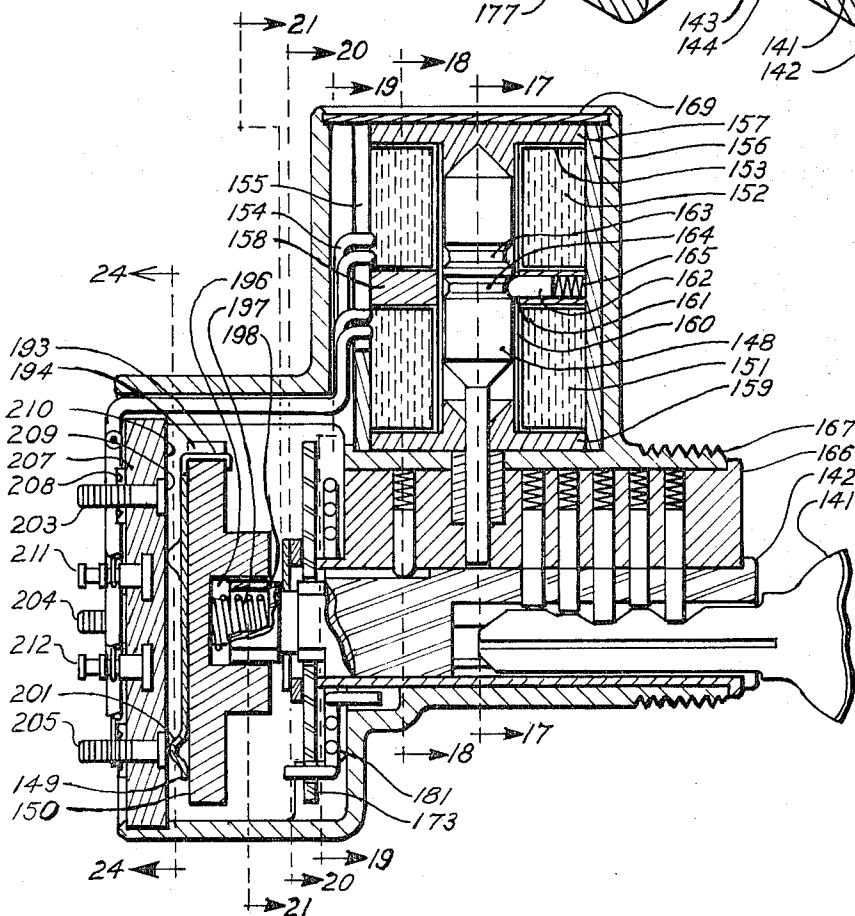


Fig. 16

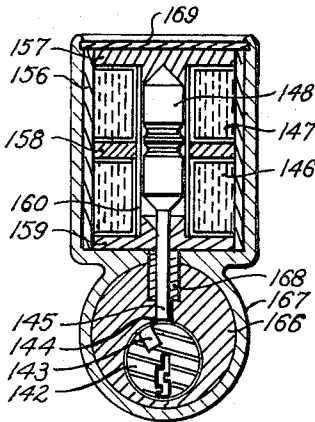


Fig. 17

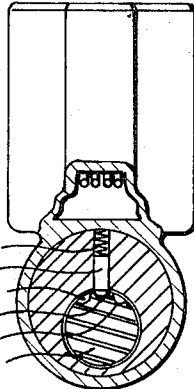


Fig. 18

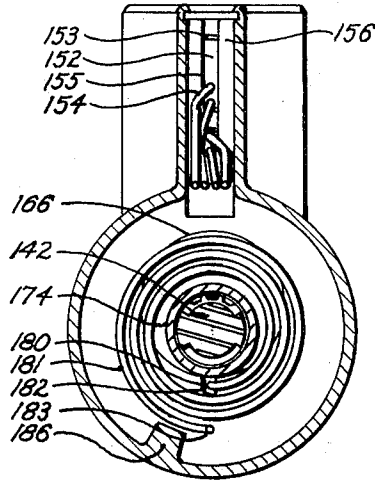


Fig. 19

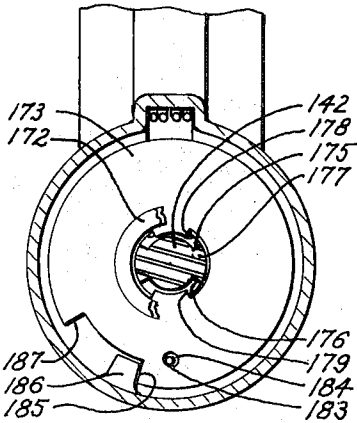


Fig. 20

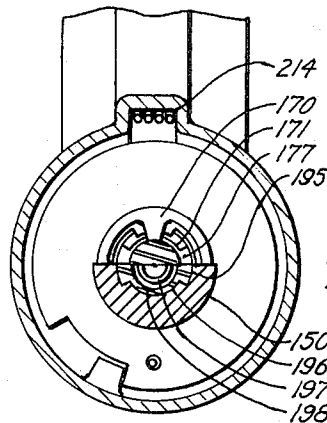


Fig. 21

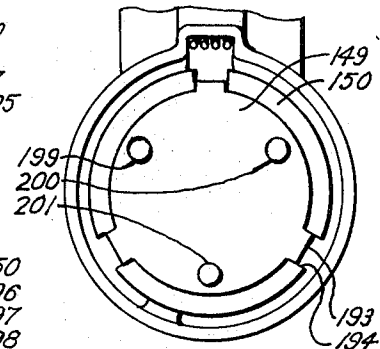


Fig. 22

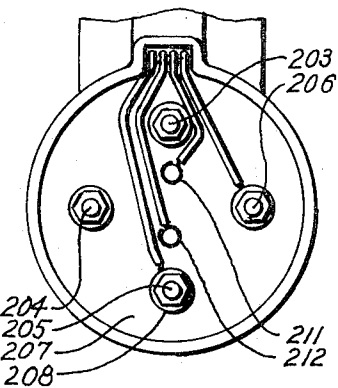


Fig. 23

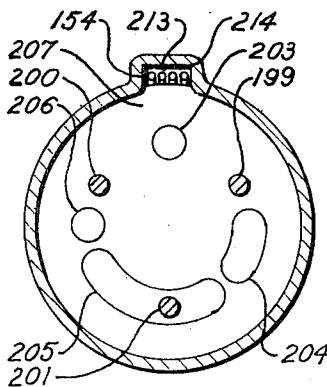


Fig. 24

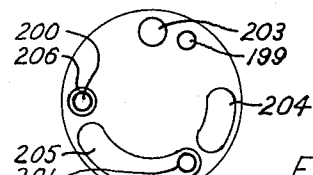


Fig. 25

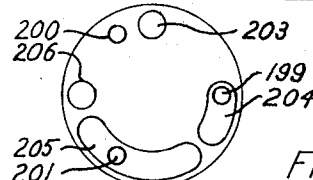


Fig. 26

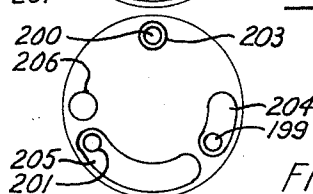
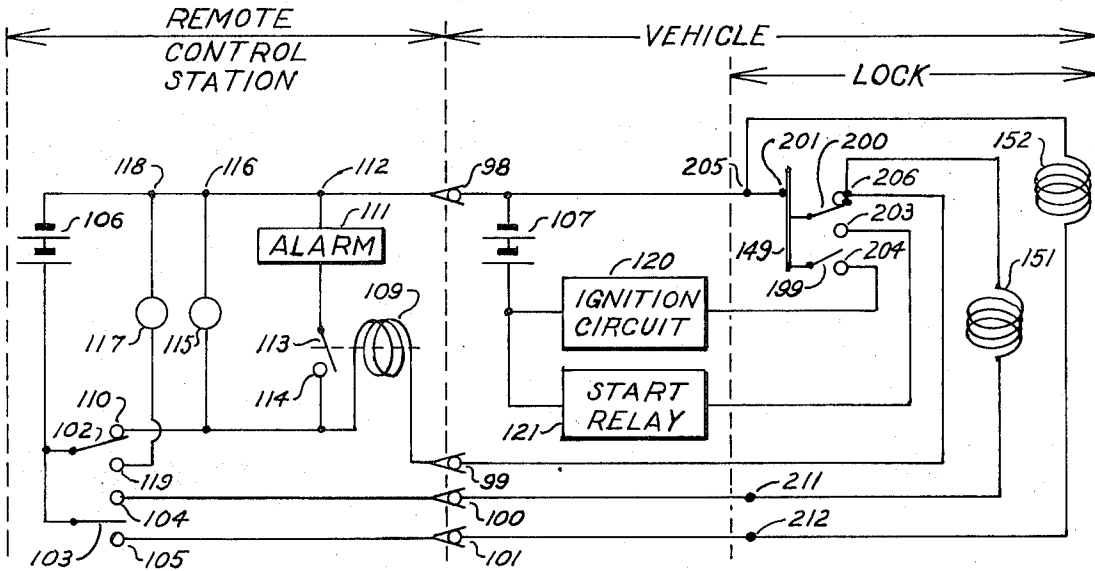
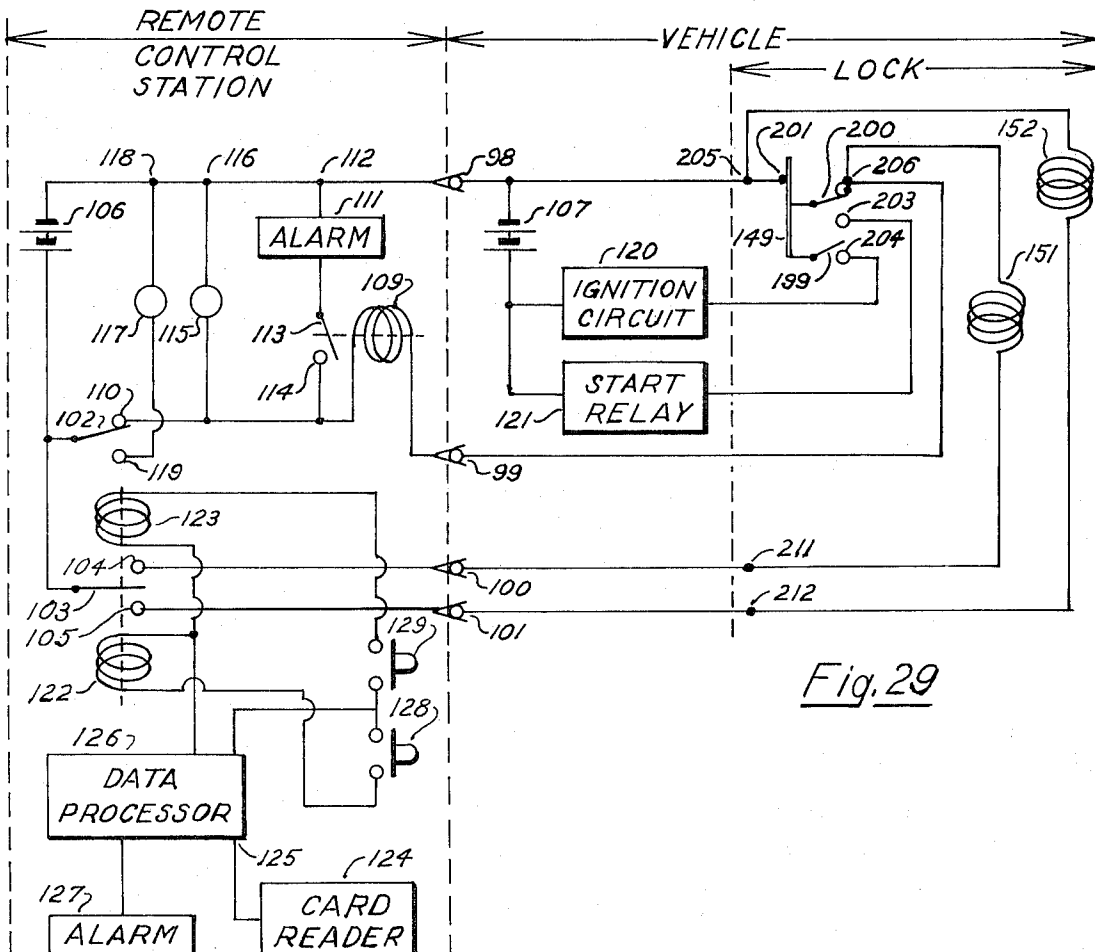


Fig. 27



KEY-RECEIVING LOCK ASSEMBLIES AND APPARATUS INCORPORATING SUCH ASSEMBLIES

This application is a continuation-in-part of my application Ser. No. 240,996, filed Apr. 4, 1972, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to key-receiving lock assemblies for use in controlling access to or use of leased apparatus, and to apparatus incorporating such assemblies.

The leasing of tools, vehicles, construction machinery and similar capital equipment has become a recognized industry, partly as a matter of convenience and partly with the recognition of the economic inadvisability of committing capital funds to ownership of infrequently used items. Responsibility for the leased equipment is vested in the lessee and it is desirable to provide the lessee with a method of control over spurious use of such equipment by unauthorized persons.

The lock and key assemblies described and claimed herein permit exposure of equipment to prospective lessees with the key in situ in the lock but, by securing the key against removal from the lock and by securing the lock against rotation to a position in which the controlled apparatus is operable by the lock, permits controlled access for use or removal of such equipment, for example only upon satisfactory identification of a prospective lessee either by personal representation or by use of a machine readable identification card. Thereafter, and by use of the lock and key in a conventional manner, the lessee has repeated and exclusive access to the leased equipment for the duration of the lease and until termination of the lease has been recognized by the leasing agency and the key has once again been rendered captive in the lock and the lock secured against rotation into a position in which the controlled apparatus is operable by the lock.

SUMMARY OF THE INVENTION

In accordance with the first embodiment of this invention the key-securing position of the key-receiving member is coincident with the locked position in which the key is normally insertable into and removable from the lock. Alternate energization of a pair of electromagnets mounted on the lock but controlled by a remote agency causes a key-retaining latch to move either into or out of engagement with a retaining slot in the key. The said key-retaining latch cooperates with a key-sensing member to prohibit rotation of the key-receiving member out of the locked position, in which the key is otherwise normally insertable into and removable from the lock, whenever the key is retained in the lock by said latch, and also to prohibit inadvertent movement of the key-retaining latch from the key-release position into the key-retain position at all times while the key is removed from or incompletely inserted into the lock or while the lock is in any position other than the locked position.

Further in accordance with the first embodiment the key-sensing member engages two electrical switches in such a manner as to cause both switches to be open when the key is removed from or incompletely inserted into the lock, but to cause one or the other to be closed when the key is fully inserted into the lock, dependent

upon whether the lock is in the locked or unlocked position. One switch, closed when the lock is in the locked position, is connected in series with the electromagnet which moves the key-retaining latch from the key-release into the key-retaining position, and hence inhibits energization of this electromagnet by the remote agency if the key is absent from or incompletely inserted into the lock, or if the lock is in any position other than the locked position. The second switch, closed when the lock is in either of two unlocked positions, completes the enabling circuit to the article to be leased and hence permits use or operation of this article.

Finally in accordance with the first embodiment of this invention a lever, operated by additional rotation of the key-receiving member against a return spring and into the second unlocked position, causes momentary closure of a third switch such as might be required for starting of an internal combustion engine or the momentary retraction of an electromagnetically operated drawbolt for access to a locked compartment.

In accordance with the second embodiment of this invention the key-securing position of the key-receiving member is a position other than the locked position in which the key is insertable into and removable from the lock. Alternate energization of a pair of electromagnets mounted on the lock but controlled by a remote agency causes a securing pin to move into or out of engagement with a recess in the key-receiving member, the said pin, when engaged, prohibiting rotation of the key-receiving member out of the key-securing position. Since the key-securing position is a position other than the locked position in which the key is insertable into and withdrawable from the lock, and since the key-receiving member cannot be rotated into the key-securing position if the key is absent from the lock, and since the apparatus controlled by the lock is inoperable when the key-receiving member is in the key-securing position, and since engagement of the securing pin prohibits rotation of the key-receiving member to a position permitting operation of or access to the apparatus, then the key is rendered captive in the lock and the lock is rendered inoperative relative to the apparatus controlled by the lock unless and until the securing pin is disengaged from the recess by one of the above mentioned electromagnets. Misalignment between the securing pin and its recess for all positions of the key-receiving member except the key-securing position prevents inadvertent movement of the securing pin into the securing recess at all times when the key is removed from the lock or when the lock is in any position other than the key-securing position.

Also in accordance with the second embodiment a switch plate, mounted to rotate with the key-receiving member, causes all lock circuits to be open when the lock is in the locked position, independently of the presence of the key in the lock. The key-securing electromagnet circuit is closed by the switch plate only when the key-receiving member is in the key-securing position, preventing energization of this electromagnet by the remote agency if the key is absent from the lock or if the lock is in any position other than the key-securing position. With the key-receiving member in either of two unlocked positions other than the key-securing position the switch plate completes the enabling circuit to the article to be leased and hence permits use or operation of this article.

Finally in accordance with the second embodiment of this invention rotation of the key-receiving member and the switch plate against a return spring and into the second unlocked position causes momentary closure of a circuit such as might be required for starting of an internal combustion engine or the momentary retraction of an electromagnetically operated drawbolt for access to a locked compartment.

In both embodiments the lock and the equipment controlled by the lock are disconnectably connected to the remote agency, permitting mobility of the equipment. The remote agency is provided with means indicating spurious disconnection of the lock, the leased or available status of the equipment, and failure to achieve the conditions necessary for securing the key within the lock at the time of return of the equipment.

The invention as described in this disclosure has specific application to internal combustion engines in which it is necessary to provide a momentary start circuit while maintaining a continuous operate or run circuit to the ignition. It will be understood that by elimination of the momentary switching capability and use of only the continuous operate circuit the invention is applicable to machine tools, electrically propelled vehicles and such equipment as is dependent solely upon an electrical supply for their operation and, conversely, by eliminating the continuous operate circuit and using only the momentary switching capability in association with an electromagnetically operated drawbolt, the lock may be used to control access to equipment contained within a locked enclosure.

It is a further object of this invention that the key, when acquired in the manner described, shall permit the lessee exclusive access to the passenger compartment of the vehicle for the duration of the lease. To this end it is intended that the door(s) of the vehicle shall be equipped with lock(s) operable by the subject key, but that these lock(s) shall not be equipped with the switches and key-retaining features described in this disclosure.

It is another object of this invention that the lock, when used with an electric credit or identification card and card reader system possibly but not necessarily of the type described in U. S. Pat. Nos. 3,200,194 or 3,544,769, and when used in association with a long term pre-arranged lease agreement, shall permit periodic lease acquisition of equipment without recourse to personal contact and the delays and inconveniences currently associated with such periodic lease procedures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially sectioned perspective view of the first embodiment of the lock assembly showing the key in the assembly lock and the lock in the first or locked position, and with the key released to permit turning or removal;

FIG. 2 is a rear view of the assembly of FIG. 1 with the cover plate removed and with the key in the lock and the lock in the first or locked position, but with the key secured within the lock;

FIG. 3 is an enlarged view of a portion of FIG. 2;

FIG. 4 is a transverse section taken along line 4—4 of FIG. 8;

FIG. 5 is a partial transverse section taken along line 5—5 of FIG. 3;

FIG. 6 is a transverse section taken along line 6—6 of FIG. 2;

FIG. 7 is a rear sectional view taken along line 7—7 of FIG. 6 and showing the detail of an overtravel feature of the assembly;

FIG. 8 is a partial rear view of the assembly of FIG. 2 with the lock in the first or locked position but with key released and removed from or not fully inserted into the lock;

FIG. 9 is a partial rear view of the assembly of FIG. 2 with the key in but released by the lock and with the lock in the second or unlocked operate position;

FIG. 10 is a partial rear view of the assembly of FIG. 2 with the key in but released by the lock and with the lock in the third or unlocked start position;

FIG. 11 is a partial rear section taken along line 11—11 of FIG. 4, but with the lock in the condition described for FIG. 10;

FIG. 12 is a view of the external electric terminals used, in the first embodiment, for connecting the lock to an external circuit;

FIG. 13 is a schematic circuit diagram to illustrate the application of the first embodiment of the lock assembly to an associated vehicle and remote control station as arranged for operation by an attendant;

FIG. 14 is a schematic circuit diagram showing the circuit of FIG. 13 modified for use with an electronic credit card system;

FIG. 15 is a sectioned perspective view of the second embodiment of the lock assembly with the key in the lock and with the key-receiving member in, and secured in, the key-securing position;

FIG. 16 is a sectioned view taken along the axis of the second embodiment of the lock assembly with the key in the key-receiving member and with the key receiving member in the locked position;

FIG. 17 is a transverse section taken along line 17—17 of FIG. 16 with the lock in the condition described for FIG. 16, and showing the key-receiving member securing means;

FIG. 18 is a transverse section taken along line 18—18 of FIG. 16 with the lock in the condition described for FIG. 16, and showing the key-receiving member detenting means;

FIG. 19 is an offset transverse section taken along line 19—19 of FIG. 16 with the lock in the locked position, and showing the torsion return spring;

FIG. 20 is a transverse section taken along line 20—20 of FIG. 16 with the lock in the locked position, and showing the spring plate;

FIG. 21 is an offset transverse section taken along line 21—21 of FIG. 16 with the lock in the locked position, and showing the spring plate retaining means and the splined mounting of the contact plate carrier;

FIG. 22 is a rear view of the second embodiment of the lock with the lock in the locked position, and with the terminal plate removed to show the contact plate;

FIG. 23 is a rear view of the second embodiment of the lock, showing the terminal plate connections;

FIG. 24 is a transverse section taken along line 24—24 of FIG. 16, showing the switch configuration with the lock in the locked position;

FIG. 25 is a diagram of the switch configuration of FIG. 24, but with the lock in the key-securing position;

FIG. 26 is a diagram of the switch configuration of FIG. 24, but with the lock in the unlocked operate position;

FIG. 27 is a diagram of the switch configuration of FIG. 24, but with the lock in the unlocked start position;

FIG. 28 is a schematic circuit diagram to illustrate the application of the second embodiment of the lock assembly to an associated vehicle and remote control station as arranged for operation by an attendant, and;

FIG. 29 is a schematic circuit diagram showing the circuit of FIG. 28 modified for use with an electronic credit card system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The key-receiving lock 20 (FIG. 1) of the first embodiment of the assembly may be any conventional form of cylinder lock well known to the art and concerning which, except for specific modifications to the key and cylinder as described hereafter, detailed description is considered unnecessary. It is understood that the lock is of the type permitting insertion and removal of a key 21 in only one predetermined position, hereafter referred to as the locked position.

Referring specifically to FIGS. 2 and 5, the key 21 projects through a key-receiving member, in this embodiment being the cylinder 22 of the lock, to permit a key-retaining slot 23 provided in the back edge 24 of the key to receive a key-retaining latch 25 when said latch is in its key-securing position. The key-retaining latch is remotely movable between the said key-securing position and the key-release position by electric motor means, in this embodiment constituted by electromagnets 26 and 27, the latch being detented in either position by a latch detent spring 28 having a projecting portion 29 engageable in respective notches 30 and 31 in the latch. A key-sensing member 32 and a cylinder lever 33 (FIG. 11), constituting movable control members, are positioned by the bitted edge 34 of the key and by projection 35 (FIG. 11) of the lock cylinder respectively and permit operation of one or more of a plurality of switches, shown collectively in FIG. 2 as switch assembly 36, dependent upon the presence or absence of the key within the lock and the position of the lock cylinder relative to the frame 37 of the lock assembly.

referring now in more detail to FIGS. 3 and 5, the removal of key 21 from the lock is prevented by the presence of edge 38 of the key-retaining latch 25 in the key-retaining slot 23. The key-retaining latch is pivotally mounted at 39 to the frame 37 and is caused to move into or out of engagement with the key-retaining slot by energization of the key-retaining electromagnet 26 or the key-release electromagnet 27 respectively, being retained in the position to which it has been moved by the last energized electromagnet by engagement of the latch detent spring projection 29 with the key-retaining notch 30 or the key-release notch 31. With the key in and secured within the lock, and with the lock in the locked position, a projection 40 of the key-sensing member 32 is interposed between the bitted edge 34 of the key and edge 41 of the key-retaining latch, thus permitting only minor and insignificant rotation of the key 21 and lock cylinder 22 in the lock barrel 42. The key-retaining latch is pivotally con-

nected to the key-retaining electromagnet plunger 43 by pin 44, and to the key-release electromagnet plunger 45 by pin 46, and is moved from engagement in the key-retaining slot by energization of the key-release electromagnet, permitting removal of the key from the lock and also, by removing edge 41 of the key-retaining latch from interference with the projection 40, permitting rotation of the key and cylinder to the unlocked positions (FIGS. 9 and 10). The lock cylinder is positioned and, in the absence of manual force on the key, is retained in a first locked or second unlocked operate position by engagement of a projection 47 on the cylinder detent spring 48 with a locked detent groove 49 or an unlocked detent groove 50, respectively, in the lock cylinder (FIG. 11).

Referring to FIGS. 3, 4 and 8, the key-sensing member 32 is pivotally mounted to the frame of the lock by a shouldered screw 51. An electrically non-conductive sleeve 52 is secured to the key-sensing member by a pin 53 and is constrained between spring contacts 54 and 55, causing the key-sensing member to assume a median position with both spring contacts open relative to their respective contact plates 56 and 57 when the key is removed from the lock (FIG. 8). The said spring contacts are biased against an electrically non-conductive post 58 secured to the lock frame, thus providing a more positive delineation of said median position. During insertion of the key into the lock flank 59 of recess 60 in the key-engaged end of the key-sensing member is engaged by an inclined leading edge 61 of the key (FIG. 5), causing rotation of the key-sensing member and, through sleeve 52, causing closure of spring contact 54 upon its contact plate 56 while the lock is in the locked position.

The key-retaining slot 23 is extended lengthwise of the key sufficiently to ensure entry of the key-retaining latch into the slot when the key has been inserted into the lock to a depth sufficient to cause closure of spring contact 54 on contact plate 56. Rotation of the key in the lock causes spring contact 54 to break contact with contact plate 56 and, by engagement of the bitted edge of the key with flank 62 of recess 60, causes spring contact 55 to close upon its contact plate 57 when the lock is in either the unlocked operate (FIG. 9) or the unlocked start (FIGS. 10 and 11) position. The detenting force of the cylinder detent spring projection 47 engaging in grooves 49 and 50 is of sufficient magnitude to secure the lock cylinder in its manually set position against the centralizing force of spring contacts 54 or 55. With the key removed from the lock or incompletely inserted into the lock, or with the key fully inserted into the lock and the lock in any position other than the locked position, movement of the key-retaining latch from the key-release into the key-retain position, as might be inadvertently caused by shock or vibration or deliberately attempted by energization of the key-retaining electromagnet, is positively prevented by interference of projection 40 on the key-sensing member with edge 63 of the key-retaining latch (see for example FIG. 10).

Referring now to FIGS. 4 and 11, the cylinder lever 33 is also pivotally mounted to the frame by shouldered screw 51, being separated from the key-sensing member by a washer 64. An electrically non-conductive sleeve 65 is secured to the cylinder lever by a pin 66 and is constrained between spring contact 67 and spring extension 68, causing the cylinder lever

to assume a rest position with spring contact 67 open relative to its respective contact plate 69 in the absence of external force. The spring contact 67 and the spring extension 68 are biased against the electrically non-conductive post 58 as previously described in respect to spring contacts 54 and 55. Extension 70 on the cylinder lever is engaged by projection 35 on the lock cylinder when the lock cylinder is rotated beyond the second unlocked operate position and into the third unlocked start position, causing spring contact 67 to close upon contact plate 69. The cylinder lever is returned to its rest position by spring contact 67 upon return of the lock cylinder to its second unlocked operate position as will be subsequently described. The profile of flank 62 on the key-sensing member is formed to minimize angular motion of the key-sensing member due to rotation of the key between the unlocked operate and the unlocked start positions.

Referring especially to FIGS. 5, 6 and 7, the lock cylinder is axially constrained in the lock barrel by means of projection 71 on the cylinder retaining plate 72 which protrude into an interrupted groove 73 in the lock cylinder. The lock cylinder is free to rotate independently of the cylinder retaining plate through the range between the locked and unlocked operate positions, this range being limited by abutment of end surfaces 74 and 75 of the interrupted groove with edges 76 and 77, respectively, of the cylinder retaining plate. The cylinder retaining plate is caused to rotate with the lock cylinder and in opposition to torsion spring 78 (FIG. 5) by abutment of surface 74 against edge 76 when the lock cylinder is rotated beyond the unlocked operate position and into the unlocked start position in a counter-clockwise sense as viewed from the back of the lock (FIGS. 9 and 10). The range of this rotation is determined by the arcuate dimension of an arcuate slot 79 in the cylinder retaining plate through which a retaining shouldered screw 80, secured to the frame, protrudes. Upon removal of external torque applied by the key the lock cylinder is returned to the unlocked operate position by the torsion spring, the working end 81 thereof engaging in notch 82 of the cylinder retaining plate, the fixed end 83 of said torsion spring being constrained in recess 84 in the lock frame.

Referring to FIGS. 10, 11 and 12, a contact spring unit 85, forming a portion of the switch assembly shown collectively as 36 (FIG. 2), comprises spring contacts 54, 55 and 67 and spring extension 68, all of which are integral with and therefore electrically connected to a common connector section 86. The contact spring unit 85, contact plates 56, 57 and 69 and connector strips 87 and 88 are electrically insulated from each other by the upper, central and lower terminal blocks 89, 90 and 91 respectively, being mounted in slots 92 in the said upper and lower terminal blocks and secured therein by engagement of projections 93 in said slots with notches 94 in the contact spring unit, contact plates and connector strips (FIG. 1). The terminal blocks are secured to each other and to the frame of the lock assembly by screws 95. The key-retaining latch detent spring 28 and the cylinder detent spring 48 are integral extensions of the detent plate 96, being secured to the lower terminal block by screws 97 (FIG. 6).

The schematic circuits of FIGS. 13 and 14 are shown in the configuration applicable when the key is fully inserted into the lock and the lock is in the key-

securing position which, in this embodiment, corresponds with the locked position in which the key is insertable into and removable from the key-receiving member (corresponding to FIGS. 2, 3 and 5). The leasable equipment is shown as a vehicle connected to the remote control station through disconnectable plug and socket connections 98, 99, 100 and 101.

Plug and socket connections 98 and 101 are permanently connected to opposite ends of the operating winding of the key-release electromagnet 27, one end being connected through contact spring extension 68 and the common spring connector section 86 to connection 98, the other end being connected through connector strip 88 to connection 101. Plug and socket connections 98 and 100 are switchably connected through the operating winding of the key-retaining electromagnet 26, one winding end being connected internally to the lock at terminal 108 of contact plate 56 (FIG. 1) and hence, with the lock in the configuration stated, being connected through switching spring contact 54 and the common spring connector section 86 to connection 98, and the other end being permanently connected through connector strip 87 to connection 100. Plug and socket connections 98 and 99 are similarly switchably connected by a conductor joining connection 99 to contact plate 56 externally to the lock and, with the lock in the configuration stated, connected through spring contact 54 and the common spring connector section 86 to connection 98. With the key removed from or incompletely inserted into the key-receiving member, or with the key fully inserted into the key-receiving member and the key-receiving member in any position other than the key-securing position, spring contact 54 is open relative to contact plate 56, causing connections 100 and 101 to be electrically disconnected from connection 98 internally to the lock.

Vehicle ignition circuit 120 is connected between one terminal of the vehicle battery 107 and the exterior terminal of contact plate 57 and, when the lock is rotated to the unlocked operate position (FIG. 9) or to the unlocked start position (FIG. 10), is connected through spring contact 55 and the common spring connector section 86 to the opposite terminal of battery 107. Vehicle start relay 121 is connected between one terminal of the vehicle battery 107 and the exterior terminal of contact plate 69 and, when the lock is rotated into the unlocked start position (FIGS. 10 and 11), is connected through spring contact 67 and the common spring connector section 86 to the opposite terminal of battery 107, permitting starting of the vehicle in the usual manner. With the key-receiving member in the locked position and hence, in this embodiment, the key-securing position, spring contacts 55 and 67 are open relative to their respective contact plates 57 and 69 independently of the presence or absence of the key and independently of the key-secured or key-released condition of the lock, thus preventing operation of the vehicle.

With reference to FIGS. 15 to 29, and for descriptive purposes relative to this second embodiment, the various positions of the key-receiving member as viewed from the key end of the lock, and listed in clockwise order from the extreme counter-clockwise position, will be; the key-securing position, the locked position, the unlocked operate position, and the unlocked start position.

The key-receiving lock 140 (FIG. 15) of the second embodiment of the assembly may be any conventional form of cylinder lock well known to the art and concerning which, except for specific modifications to the cylinder and barrel as described hereafter, detailed description is considered unnecessary. It is understood that the lock is of the type permitting insertion and removal of a key 141 in only one predetermined position, hereafter referred to as the locked position.

Referring specifically to FIGS. 15 and 17, the key-receiving member, in this embodiment being the cylinder 142 of the lock, has a securing recess 143 so located in the periphery 144 as to permit the key-receiving member securing pin 145, hereafter referred to as the securing pin, to engage the recess and secure the key-receiving member against rotation only when the key-receiving member is in the key-securing position. The securing pin is remotely and alternately movable between the key-receiving member securing and release positions by electric motor means, in this embodiment constituted by securing and release electromagnets indicated generally by reference numerals 146 and 147 respectively, these electromagnets being arranged coaxially to operate on a common plunger 148 of which the securing pin is an integral extension. Energization of the releasing electromagnet causes retraction of the securing pin from recess 143, thereby permitting operation of the lock by the key in a conventional manner and permitting removal and insertion of the key when the key-receiving member is rotated into the locked position. A switch plate 149, mounted on and electrically insulated from the lock by switch plate carrier 150, is arranged to rotate with the key-receiving member and to selectively switch various circuits dependent upon the position of the key-receiving member as will be hereafter described.

Referring now in more detail to FIGS. 16 and 17, the key-securing and key-releasing electromagnet coils 151 and 152, respectively, are wound on bobbins 153, the wire leads 154 being brought out through slot 155 (FIG. 19) in the electromagnet sleeve 156. The electromagnet sleeve, upper, central and lower pole pieces 157, 158 and 159, respectively, and the common plunger 148 are of soft annealed iron or similar material having high magnetic permeability and low residual magnetism. A thin walled plunger sleeve 160 of non-magnetic material is pierced at 161 to permit plunger detent pin 162 to engage key-securing or key-releasing detent grooves 163 or 164, respectively, in the common plunger, this engagement being maintained by plunger detent pin spring 165. For all positions of the key-receiving member other than the key-securing position inadvertent movement of the securing pin into the securing position, as might be caused by road shock, vibration or impact during operation of the vehicle or when the vehicle is left with the lock in the locked position is positively prevented by abutment of the end of the securing pin against the periphery 144 of the key-receiving member, thus maintaining the common plunger and hence the securing pin within the control range of the detent pin in the key-releasing detent groove 164. The lock barrel 166 is secured in the lock frame 167 by sleeve 168 (FIGS. 15 and 17) within which the securing pin 145 is free to move axially. Sleeve 168 and the electromagnet assembly are retained within the lock frame by cover plate 169, se-

cured to the frame by staking of the frame over the plate.

Referring to FIGS. 15, 19, 20 and 21, retaining ring 170 engages groove 171 in the key-receiving member and, through spacer washer 172 and spring plate 173 in contact with an annular extension 174 on the lock barrel, axially secures the key-receiving member in the lock barrel. The key-receiving member is free to rotate independently of the spring plate over the range corresponding to the key-securing, locked, and unlocked operate positions, this range being limited by abutment of surfaces 175 and 176 of splines 177 on the key-receiving member against edges 178 and 179, respectively, of the spring plate (FIGS. 15 and 20). The fixed end 180 of torsion spring 181 (FIG. 19) is constrained within recess 182 in the lock frame, the working end 183 of the spring engaging hole 184 in the spring plate and causing edge 185 of the spring plate to be held against projection 186 of the lock frame in the absence of external torque by the key and key-receiving member. Rotation of the key and key-receiving member beyond the key-securing position in a clockwise sense as viewed from the back of the lock (FIG. 20) is thus prevented by engagement of surface 176 against edge 179 and edge 185 against projection 186. The spring plate is caused to rotate with the key-receiving member and in opposition to torsion spring 181 by abutment of surface 175 against edge 178 when the key and key-receiving member are rotated beyond the unlocked operate position and into the unlocked start position in a counter-clockwise sense as viewed from the back of the lock, the limit of this rotation being determined by abutment of edge 187 of the spring plate against projection 186 of the lock frame. The key and key-receiving member are returned to the unlocked operate position by the torsion spring upon removal of external torque on the key.

Referring to FIG. 18, compression spring 188 holds the key-receiving member detent pin 189 in engagement with the key-securing, locked, or unlocked operate detent grooves 190, 191, or 192, respectively, in the key-receiving member and, assuming the key-receiving member is not otherwise secured either in the key-securing position by engagement of the securing pin 145 in its recess or in the locked position by absence of the key from the lock, retains the key-receiving member in the corresponding position in the absence of external torque on the key. The absence of a detent groove corresponding to the unlocked start position permits unobstructed return of the key-receiving member from the unlocked start position into the unlocked operate position by torsion spring 181.

Referring to FIGS. 16, 21 and 22, extensions 193 on the electrically conductive switch plate 149 engage slots 194 in the electrically non-conductive switch plate carrier 150, thus securing the switch plate to the carrier. The switch plate carrier is constrained to rotate with, but is free to move axially on, the key-receiving member by engagement of channels 195 in blind hole 196 in the switch plate carrier with splines 177 on the key-receiving member. Compression spring 197 mounted in concentric recess 198 in the key-receiving member, and reacting on the switch plate carrier, causes raised contact points 199, 200 and 201 to be pressed against the terminal plate assembly, shown collectively as 202 on FIG. 15.

Referring to FIGS. 16, 23 and 24, switching terminals 203, 204, 205 and 206 extend through terminal plate 207 and are secured into the terminal plate by staked washers 208. The switching surfaces of the terminals, shown collectively as 209, are flush with the inside surface 210 of the terminal plate and selectively make and break electrical connection with raised contact points 199, 200 and 201 on the switch plate for various positions of the key-receiving member as will be subsequently described. Binding posts 211 and 212 are secured to, and electrically insulated from the lock by, the terminal plate and, with terminals 203, 204, 205 and 206, provide the means for connection of the lock to exterior circuits. The terminal plate assembly is secured into the frame of the lock by staking of the frame over the plate (FIG. 16), the electromagnet leads 154 being brought out of the lock through aperture 213 formed between the terminal plate and channel 214 of the frame.

The switching function of the switch plate relative to the terminal plate may be best understood by reference to FIGS. 24, 25, 26 and 27. The switching surface of terminal 205 is extended in an arcuate direction and maintains contact with raised contact point 201 for all positions of the key-receiving member, whence the switch plate 149 and its raised contact points 199 and 200 are at all times in electrical connection with terminal 205. With the key-receiving member in the locked position (FIG. 24) contact points 199 and 200 bear upon the electrically non-conductive terminal plate, and terminals 203, 204 and 206 are electrically isolated from the switch plate. With the key-receiving member in the key-securing position (FIG. 25) contact point 200 is closed upon terminal 206 and hence completes the circuit to the key-securing electromagnet coil as will be subsequently described. Contact point 199 bears upon the terminal plate and terminals 203 and 204 remain electrically isolated from the switch plate. With the key-receiving member in the unlocked operate position (FIG. 26) contact point 199 is closed upon terminal 204 while contact point 200 bears upon the terminal plate and terminals 203 and 206 remain electrically isolated from the switch plate. With the key-receiving member in the unlocked start position (FIG. 27) contact point 199 remains closed upon terminal 204 and contact point 200 is closed upon terminal 203 while terminal 206 is electrically isolated from the switch plate.

The schematic circuits of FIGS. 28 and 29 are shown in the configuration applicable when the lock is in the key-securing position (corresponding to FIGS. 15 and 25) which, in this embodiment, is a position other than that in which the key is insertable into and removable from the lock. It will be understood that the key-receiving member can only be rotated into the key-securing position if the key is fully inserted into the key-receiving member, whence securing of the key-receiving member in the key-securing position also secures the key against removal from the lock. The leaseable equipment is again shown as a vehicle connected to the remote control station through disconnectable plug and socket connections 98, 99, 100 and 101.

Plug and socket connections 98 and 101 are permanently connected to opposite ends of the key-release electromagnet coil 152, one end being connected through switching terminal 205 to connection 98 and the other end being connected through binding post

212 to connection 101. Plug and socket connections 98 and 100 are switchably connected through the key-securing electromagnet coil 151, one end of the coil being connected to switching terminal 206 and hence, with the lock in the key-securing position, connected through switch plate 149, contact points 200 and 201 and switching terminal 205 to connection 98, and the other end of the coil being permanently connected through binding post 211 to connection 100. Plug and socket connections 98 and 99 are similarly switchably connected by a conductor joining connection 99 to switching terminal 206 and, with the lock in the key-securing position, connected through switch plate 149, contact points 200 and 201 and switching terminal 205 to connection 98. With the key-receiving member in any position other than the key-securing position switching terminal 206 is electrically isolated from the switch plate 149 (FIGS. 24, 25, 26 and 27) whence connections 100 and 101 are electrically disconnected from connection 98 internally to the lock.

Vehicle ignition circuit 120 is connected between one terminal of the vehicle battery 107 and switching terminal 204 and, with the lock in the unlocked operate or unlocked start positions (FIGS. 26 and 27, respectively), is connected through switch plate 149 and contact points 199 and 201 to switching terminal 205 and hence to the opposite terminal of battery 107. Vehicle start relay 121 is connected between one terminal of the vehicle battery 107 and switching terminal 203 and, with the lock in the unlocked start position (FIG. 27), is connected through switch plate 149 and contact points 200 and 201 to switching terminal 205 and hence to the opposite terminal of battery 107, permitting starting of the vehicle in the usual manner. With the key-receiving member in either the locked or key-securing positions switching terminals 203 and 204 are electrically disconnected from the switch plate and hence from switching terminal 205, thus preventing operation of the vehicle.

Referring now more particularly to the remote control station portions of FIGS. 13 and 28, a remote control station battery or power supply 106 and the vehicle battery 107 preferably have their similar polarity terminals, herein shown as their negative terminals, connected through plug and socket connection 98. A two position switch 102 and a three position self-centering switch 103 are mechanically coupled so that switch 102 remains in a position corresponding to the last manually actuated position of switch 103 after switch 103 has returned to its central position, in which it is open relative to its contacts 104 and 105, upon removal of the actuating force. One end of relay coil 109 is connected to plug and socket connection 99, the other end of this relay coil being connected to contact 110 of switch 102. One terminal of alarm 111 is connected at 112 to the conductor joining battery 106 to plug and socket connection 98, the other terminal of the alarm being connected to a relay switch 113 controlled by relay coil 109. Contact 114 of relay switch 113 is connected to contact 110 of switch 102. One terminal of an indicator lamp 115 is connected at 116 to the conductor which joins battery 106 to plug and socket connection 98, while the other terminal of said lamp is connected to contact 110 of switch 102. A second indicator lamp 117 has one terminal connected at 118 to the conductor which joins battery 106 to plug and socket connection 98, the other terminal

of the lamp being connected to contact 119 of switch 102. The switching members of switches 102 and 103 are connected to the opposite terminal of battery 106, herein shown as the positive terminal, and contacts 104 and 105 of switch 103 are connected to plug and socket connections 100 and 101, respectively.

FIGS. 14 and 29 show an alternate circuit configuration to permit vehicle acquisition or return by use of a machine readable credit or identification card. All items common to FIGS. 13, 14, 28 and 29 are similarly numbered and operate in the manner and perform the functions described for FIGS. 13 and 28, with the single exception that switch 103 is electromagnetically actuated by a key-release coil 122 or a key retain coil 123 instead of being manually actuated. A card reader 124 is connected to input 125 of a data processor 126, the output of the data processor being applied to an alarm 127 in the case of an unacceptable card. In the case of an acceptable card the output of the data processor is applied to either the key-release coil 122 or the key-retain coil 123 by closure of a key-release switch 128 or a key-retain switch 129, causing switch 103 to close on contact 105 or 104 respectively. Switches 128 and 129 are spring loaded into the normally open position in the absence of manual force and, with the card reader 124, are accessible to and operable by the lessee to acquire or return a vehicle.

In the condition specifically illustrated by FIGS. 13 and 28 the leased vehicle has been returned to the remote control station or lease depot and has been connected to the remote control station or lease depot circuit; return of the vehicle has been recognized by the control station attendant by momentary closure of switch 103 on contact 104, causing switch 102 to close and remain closed upon contact 110 after switch 103 has been released and returned to an open circuit condition relative to contacts 104 and 105. Assuming the key to be fully inserted into the lock and the lock to be in the key-securing position at the time of vehicle return, the lock circuit between plug and socket connections 98 and 100 will be completed through the key-retaining or securing electromagnet of the lock, and energization of this electromagnet by closure of switch 103 on contact 104 will cause the key to be secured against removal from the lock and will cause the key-receiving member to be secured against rotation out of the key-securing position, thus preventing energization of the vehicle ignition circuit or start relay.

Also, assuming the key to be fully inserted into the lock and the lock to be in the key-securing position, circuit continuity through the lock between plug and socket connections 98 and 99 will cause energization of relay coil 109 when switch 102 is closed upon contact 110, thus holding relay switch 113 open relative to its contact 114 and preventing operation of the alarm 111 as long as circuit continuity is maintained between plug and socket connections 98 and 99 externally to the remote control station. Closure of switch 102 on contact 110 also completes the circuit of indicator lamp 115, thus displaying the returned status of the vehicle at the remote control station.

Any attempt to return the vehicle with the key removed from or incompletely inserted into the lock, or with the lock in any position other than the key-securing position, will, because of the open circuit condition of the lock relative to plug and socket connections 98 and 99, prevent energization of relay coil 109

when switch 102 is closed upon contact 110, thus causing switch 113 to remain closed upon its contact 114 and energizing the alarm 111. Similarly any attempt to return the vehicle with the plug and socket connection disconnected will, because of the open circuit condition between plug and socket connections 98 and 99, cause energization of the alarm 111. Also, spurious disconnection of the vehicle from the control station without prior disabling of the alarm circuit by the attendant will, by opening the circuit between connections 98 and 99, energize the said alarm.

Authorization of a lease by the control station attendant by momentary closure of switch 103 on contact 105 causes energization of the releasing electromagnet of the lock and retraction of the securing means, permitting rotation of the key-receiving member within the lock by the key and also permitting removal of the key from the lock. Said momentary closure of switch 103 on contact 105 causes switch 102 to open and remain open relative to contact 110 and to close and remain closed upon contact 119, thus opening the alarm circuit and preventing energization of alarm 111 when the vehicle is disconnected from the control station, or when lock circuit continuity between plug and socket connections 98 and 99 is interrupted by rotation of the key-receiving member out of the key-securing position or by removal of the key from the key-receiving member. Opening of switch 102 relative to contact 110 and its closure upon contact 119 also deenergizes indicator lamp 115 and energizes indicator lamp 117, displaying the leased status of the vehicle at the remote control station.

The circuit is now in a configuration permitting disconnection of the vehicle from the remote control station without energization of the alarm, and the lock assembly is in a configuration permitting operation of the vehicle by use of the key in a conventional manner. Retention of the securing means in the released position as previously described, and in the absence of a securing signal from the remote control station, permits repeated insertion and removal of the key relative to the lock, and permits repeated and exclusive operational access to the vehicle by the possessor of the key for the period of the lease and until the vehicle is returned to the remote control station or lease depot and the lease is terminated by securing of the key within the lock and securing of the key-receiving member against rotation out of the key-securing position, in which position it is inoperative relative to the equipment controlled by the lock.

Inadvertent movement of the securing means into the key and cylinder securing position, as might be caused by road shock, impact or vibration sufficient to overcome the detenting action of the detent member within the detent groove is positively prevented during operation of the vehicle by the previously described blocking action of the lock members, this blocking action also being operable when the vehicle is left parked with the key removed from the lock.

By equipping the means of access to the passenger and luggage compartments of the vehicle with locks operable by the above described key, the key when released and acquired in the manner described permits exclusive access to these compartments by the possessor of the key for the duration of the lease. Also, by omitting the internally lockable feature conventional to

vehicle doors and rendering such doors lockable only by use of the key in the door lock, the requirement that the key be in the key-securing lock to obtain recognition of vehicle return by the remote control station precluded the possibility of the vehicle being returned with the passenger compartment and hence the key-securing lock inaccessible to the next lessee due to locking of the passenger compartment door. The electrical switching and remote control key-securing means described herein are omitted on the passenger and luggage compartment locks.

In the case of untended remote control station or lease depot operation through use of machine readable credit or identification cards the output of the data processor, instead of being applied to status indicator lamps as described in the referenced U. S. Pat. Nos. 3,200,194 and 3,544,769, is instead applied to an alarm in the case of an unacceptable card or, in the case of an acceptable card, to the key-release coil 122 or the key-retain coil 123 at the option of the lessee. In this application the card reader 124, key release switch 128 and key-retain switch 129 are accessible to the lessee. In the case of a lease the lessee credit or identification card is inserted into the card reader and the key-release switch 128 is held closed by the lessee causing, in the case of an acceptable card, the output pulse from the data processor to energize the key-release coil 122 and cause momentary closure of switch 103 on contact 105, thereby releasing the key and key-receiving member as described above. For return of the vehicle upon termination of the lease the procedure is repeated but with the key-retain switch 129 being held closed, thus causing the output pulse from the data processor to energize the key-retain coil 123 and cause momentary closure of switch 103 on contact 104, thus securing the key and key-receiving member in the key-securing position as also described above.

It is to be understood that while the invention has been described in terms of specific embodiments and in general in terms of a specific vehicle lease application, the invention can be embodied in other forms and for application to use accessibility of other equipment without departing from the spirit or scope of the invention. In particular electronic switching means may be substituted for the mechanical relays and switches associated with the remote control station. Also in particular, use of the key-securing lock in controlling access to locked enclosures by the operation of a draw-bolt either directly connected to and mechanically operable by the lock or electromagnetically operable by the lock is anticipated. Also in particular, deletion of the momentary switching capability for applications requiring only continuous energization of an electric circuit is anticipated.

I claim:

1. A key-receiving lock assembly for use with apparatus and for controlling at least part of the apparatus by means thereof when the key is present in the assembly, the assembly including a key-receiving member having a primary predetermined position in which the key is insertable therein and removable therefrom, at least one control member movable when the key is in the key-receiving member, key-retaining means operable from a point remote from the lock assembly for securing the key against removal from said key-receiving member when said key-receiving member is in said pri-

mary predetermined position, said key-retaining means when operable preventing movement of said key-receiving member to a position other than said primary predetermined position, and said key-retaining means preventing movement of said at least one movable control member when said key is secured against removal from said key-receiving member.

2. An assembly as claimed in claim 1, and including key-releasing means operable remotely of the assembly for releasing the key for removal from the key-receiving member when said key-receiving member is in said primary predetermined position, said key-releasing means permitting movement of said key-receiving member to positions other than said primary predetermined position when said key is in said key-receiving member, and said key-releasing means permitting movement of said at least one movable control member when said key is in said key-receiving member and when said key is released to permit removal from said key-receiving member.

3. An assembly as claimed in claim 1, wherein the key-retaining means, when released to permit removal of the key from the key-receiving member, and when released to permit movement of said key-receiving member to positions other than said primary predetermined position, and when released to permit movement of the said at least one movable control member, permits repeated removal and insertion of said key when said key-receiving member is in said primary predetermined position and permits repeated movement of said key-receiving member to and from positions other than said primary predetermined position when said key is in said key-receiving member, and therefore permits repeated and exclusive operational access to the apparatus controlled by the lock assembly by the use of said key until the key is once again secured by said remotely operable key-retaining means against removal from the lock and the key-receiving member is once again secured against movement to a position other than said primary predetermined position, whereby the said at least one movable control member is secured against movement by said key or by said key-receiving member.

4. An assembly as claimed in claim 3, and including disconnectable connecting means between said lock assembly and said means operable remotely of said lock assembly whereby said apparatus controlled by said lock assembly may be disconnected from the remote means subsequent to release of said key and said repeated and exclusive operational access to the apparatus controlled by the lock assembly is thereafter independent of connection to said remotely operable means or location of the said lock assembly and said apparatus relative to said remotely operable means.

5. An assembly as claimed in claim 1, and including means positively preventing movement of the key-retaining means into the key-retaining position when the key is removed from or not fully inserted into the key-receiving member or when the key is fully inserted into said key-receiving member and said key-receiving member is in any position other than the said primary predetermined position.

6. An assembly as claimed in claim 1, and including means for providing an indication at the remote operating point upon an attempt to secure the key against removal from the key-receiving member when said key is removed from or not fully inserted into said key-

receiving member, or when said key is fully inserted into said key-receiving member and said key-receiving member is in any position other than said primary predetermined position.

7. An assembly as claimed in claim 1, wherein said key-receiving member has in addition to the said primary predetermined position in which the key is insertable therein and removable therefrom, a second position in which said key-receiving member will dwell in the absence of external force thereon to move it from the second position, and a third position in which the key-receiving member may be maintained only upon sustained application of external force.

8. An assembly as claimed in claim 7, and including a pair of electric switches operable by one of said movable control members, one switch being closed only when the key is fully inserted into the key-receiving member and said key-receiving member is in said primary predetermined position, and the other switch being closed only when said key is in said key-receiving member and said key-receiving member is in a position other than said primary predetermined position, and both switches being open when the key is removed from or not fully inserted into said key-receiving member.

9. An assembly as claimed in claim 7, and including an electric switch operable by a control member movable by said key-receiving member to close transiently a circuit in which said switch is connected when said key-receiving member is maintained in the said third position by application of an external force.

10. An assembly as claimed in claim 1, wherein the said key-retaining means comprises a movable latch member engagable mechanically with the key in the key-receiving member, and electric motor means connected to the latch means for movement thereof upon receipt of an electric signal.

11. An assembly as claimed in claim 10, wherein movement of said movable latch member to a disengaged position in which it is disengaged mechanically from the key permits movement of the movable control member to a blocking position in which it prevents return of said latch member to the key-retaining position until it is positively moved from the said blocking position.

12. An assembly as claimed in claim 10, and including means inhibiting the key-retaining signal to said electric motor means if the key is removed from or not fully inserted into said key-receiving member or if the key is fully inserted into said key-receiving member and said key-receiving member is in any position other than said primary predetermined position.

13. An assembly as claimed in claim 10, and including spring means for positively retaining the movable latch member in the key-retaining position or in the key-disengaged position in the absence of an electric signal to said electric motor means.

14. A key-receiving lock assembly for use with apparatus and for controlling at least part of the apparatus by means thereof when the key is present in the assembly, the assembly including a key-receiving member having a primary predetermined position in which the key is insertable therein and removable therefrom and said key-receiving member having at least one other secondary predetermined position in which the apparatus is inoperable by the lock and in which said secondary predetermined position the key is not insertable

into or removable from the key-receiving member and into which said secondary predetermined position the key-receiving member may be moved only when the key is in the key-receiving member, and including at least one control member movable when the key is in the key-receiving member, key-receiving member securing means operable from a point remote from the lock assembly for securing said key-receiving member against movement out of said secondary predetermined position, and said key-receiving member securing means preventing movement of said at least one movable control member when said key-receiving member is secured against movement out of said secondary predetermined position.

15. An assembly as claimed in claim 14, and including key-receiving member releasing means operable remotely of the assembly for releasing the key-receiving member for movement to positions other than said secondary predetermined position when the key is in the key-receiving member, and for releasing the key for removal from and insertion into said key-receiving member when said key-receiving member is moved into said primary predetermined position, and said key-receiving member releasing means permitting movement of said at least one movable control member when said key is in said key-receiving member and when said key-receiving member is released to permit movement out of said secondary predetermined position.

16. An assembly as claimed in claim 14, wherein the key-receiving member securing means, when released to permit movement of the key-receiving member to positions other than said secondary predetermined position, and when released to permit removal of the key from said key-receiving member when said key-receiving member is moved into said primary predetermined position, and when released to permit movement of the said at least one movable control member, permits repeated insertion and removal of said key when said key-receiving member is in said primary predetermined position and permits repeated movement of said key-receiving member to and from positions other than said primary and secondary predetermined positions when said key is in said key-receiving member, and therefore permits repeated and exclusive operational access to the apparatus controlled by the lock assembly by the use of said key until the key-receiving member is once again secured by said remotely operable key-receiving member securing means against movement out of said secondary predetermined position, whereby the key is secured against removal from the key-receiving member and whereby the said at least one movable control member is secured against movement by said key or by said key-receiving member.

17. An assembly as claimed in claim 16, and including disconnectable connecting means between said lock assembly and said means operable remotely of said lock assembly whereby said apparatus controlled by said lock assembly may be disconnected from the remote control means subsequent to release of said key-receiving member and said repeated and exclusive operational access to the apparatus controlled by the lock assembly is thereafter independent of connection to said remotely operable means or location of said lock assembly and said apparatus relative to said remotely operable means.

18. An assembly as claimed in claim 14, and including means positively preventing movement of the key-receiving member securing means into the key-receiving member securing position when the key-receiving member is in any position other than the said secondary predetermined position or when the key is removed from or not fully inserted into said key-receiving member.

19. An assembly as claimed in claim 14, and including means for providing an indication at the remote operating point upon an attempt to secure the key-receiving member against movement out of said secondary predetermined position when the said key-receiving member is in any position other than said secondary predetermined position or when said key is removed from or not fully inserted into said key-receiving member.

20. An assembly as claimed in claim 14, wherein said key-receiving member, in addition to the said primary predetermined position in which the key is insertable therein and removable therefrom, and in addition to the said secondary predetermined position into which the key-receiving member may be secured against movement out of said secondary predetermined position, has a third position in which said key-receiving member will dwell in the absence of external force thereon to move it from the third position, and a fourth position in which the key-receiving member may be maintained only upon sustained application of external force.

21. An assembly as claimed in claim 20, and including a pair of electric switches constituted in part by and operable by said at least one movable control member, one switch being closed only when said key-receiving member is in said secondary predetermined position and the other switch being closed only when said key-receiving member is in a position other than said primary or secondary predetermined position, and both switches being open when said key-receiving member is in said primary predetermined position.

22. An assembly as claimed in claim 20, and including an electric switch constituted in part by and operable by said at least one movable control member to close transiently a circuit in which said switch is connected when said key-receiving member is maintained in the said fourth position by application of external force.

23. An assembly as claimed in claim 14, wherein the said key-receiving member securing means comprises a movable member engageable mechanically with the key-receiving member, and electric motor means connected to the movable member means for movement thereof upon receipt of an electric signal.

24. An assembly as claimed in claim 23, wherein movement of said movable member to a disengaged position in which it is disengaged mechanically from the key-receiving member permits movement of the key-receiving member to a blocking position in which it positively prevents return of said movable member to the key-receiving member securing position.

25. An assembly as claimed in claim 23, and including means inhibiting the key-receiving member securing signal to said electric motor means when said key-receiving member is in any position other than the said secondary predetermined position.

26. An assembly as claimed in claim 23, and including detenting means for positively retaining the said

movable member in the key-receiving member securing position or in the key-receiving member release position in the absence of an electric signal to said electric motor means.

27. Apparatus with key-receiving lock controlled access comprising, a lock connected to the apparatus and having a predetermined position for the key in only which position said key can be removed from the lock, a control member controlled by the lock and operable by the lock with the key therein to control a function of the apparatus, and the lock including means operable from a point remote therefrom upon receipt of respective signals for selectively securing the key against withdrawal from the lock and for releasing the key for removal from the lock.

28. Apparatus as claimed in claim 27, and including means for preventing operation of the control member when the key is secured within the lock by said remotely operable means and permitting operation of said control member when the key is released by said remotely operable means.

29. Apparatus as claimed in claim 27, and including means for permitting repeated insertion and removal of the key and permitting repeated and exclusive access to the apparatus controlled by the lock when the key has been released by said remotely operable means and until the key is once again secured by the said remotely operable means against withdrawal from the lock.

30. Apparatus as claimed in claim 29, wherein said repeated insertion and removal of the key and said repeated and exclusive access to the apparatus controlled by the lock is independent of connection to said remotely operable means and is independent of the location of said apparatus relative to said remotely operable means.

31. Apparatus as claimed in claim 27, wherein the said control member is an electric switch controlling an operation of the apparatus.

32. Apparatus as claimed in claim 27, wherein the lock includes means for preventing movement of the key-securing means into the key-securing position if the key is removed from or not fully inserted into the lock or if the key is fully inserted into the lock and the lock is in any position other than that position in which the key is securable within the lock.

33. Apparatus as claimed in claim 27, and including means inhibiting the key-securing signal to the key-securing means if the key is removed from or not fully inserted into the lock or if the key is fully inserted into the lock and the lock is in any position other than that position in which the key is securable within the lock.

34. Apparatus as claimed in claim 27, and including at least one other lock operable by the key of the first mentioned lock when said key has been released by and removed from said first mentioned lock.

35. Apparatus as claimed in claim 27, wherein there are provided means for releasably connecting the apparatus to a remote control station constituting the said remote point and the said remotely operable means are operable from said remote control station through said releasable connection.

36. Apparatus as claimed in claim 35, wherein the remote control station includes means operable to release and secure the key.

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37. Apparatus as claimed in claim 36, wherein said means operable to release and secure the key comprise operator controlled means.

38. Apparatus as claimed in claim 36, wherein said means operable to release and secure the key comprise an identity card reader.

39. Apparatus as claimed in claim 35, wherein the said releasable connection is an electrical connection and the said remotely operable means comprise an electric circuit.

40. Apparatus as claimed in claim 35, and including means indicating at the said remote control station the key-released and key-secured status of the lock.

41. Apparatus as claimed in claim 35, wherein the remote control station includes means detecting the absence of the key from or the incomplete insertion of the key into the lock, or the positioning of the lock in any position other than that in which the key is secur-

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able within the lock, said detecting means being operable at the time of and subsequent to an attempt being made to secure the key within the lock.

42. Apparatus as claimed in claim 35, wherein the remote control station includes means detecting failure to reconnect the said releasable connection prior to action being taken to secure the key within the lock.

43. Apparatus as claimed in claim 35, wherein the remote control station includes means detecting disconnection of said releasable connection or other severance of the electrical connection without prior release of the key by said remote control station.

44. Apparatus as claimed in claim 43, wherein the remote control station includes means inactivating said disconnection detection means upon and subsequent to release of the key.

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