United States Patent

Schendel

[15] **3,680,336**

[45] **Aug. 1, 1972**

[54] **MECHANICAL CODE ACTUATED SENSOR UNIT AND LOCK EMBODYING SAME**

[72] Inventor: **Herbert M. Schendel,** 13161 Crestline Drive, Santa Ana, Calif. 92705

[22] Filed: **March 15, 1971**

[21] Appl. No.: **123,995**

[52] **U.S. Cl.** **70/276,** 70/146, 70/298, 70/315, 70/352, 70/382, 70/405, 70/407

[51] **Int. Cl.**.....**E05b 47/00,** E05b 35/00

[58] **Field of Search**.....70/276, 298, 282, 283, 284, 70/315, 382

[56] **References Cited**

UNITED STATES PATENTS

2,558,619	6/1951	Lehman	70/315 X
3,256,723	6/1966	Lehman	70/315 X
3,271,983	9/1966	Schlage	70/276

FOREIGN PATENTS OR APPLICATIONS

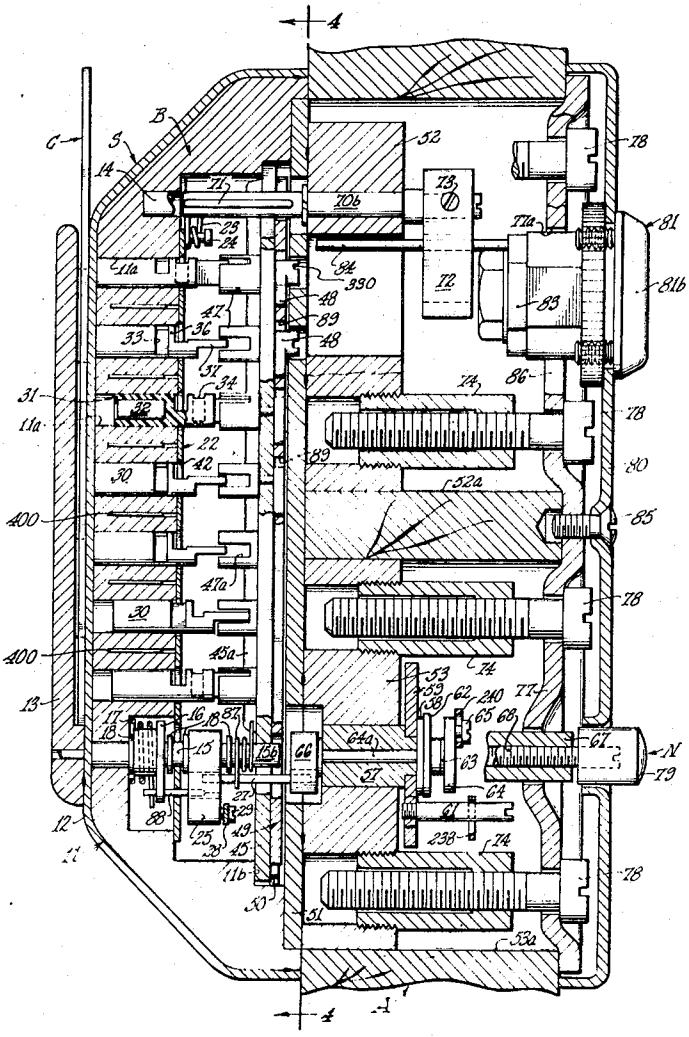
2,003,337	8/1970	Germany	70/298

Primary Examiner—Albert G. Craig, Jr.
Attorney—Forrest J. Lilly

[57] **ABSTRACT**

A mechanical, code actuated sensor unit having one or more sensing slides which are movable from retracted to extended positions to actuate an output member of the unit, and tumblers which normally block extension of the slides and are positioned axially to permit slide extension in response to preselected code pattern information introduced into the sensor unit by means of a coded card adapted to be inserted into the unit or a keyboard adapted to be manually preset. The sensor unit may be programmed for actuation in response to any of a vast number of different code patterns. The sensor unit may be utilized for a wide variety of security applications and is disclosed in conjunction with a door lock and an electrical switch controlled by the unit.

46 Claims, 21 Drawing Figures



PATENTED AUG 1 1972

3,680,336

SHEET 1 OF 8

FIG. 1.

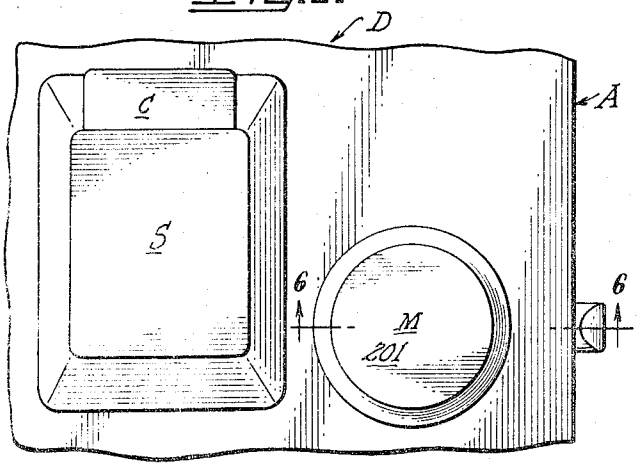


FIG. 8.

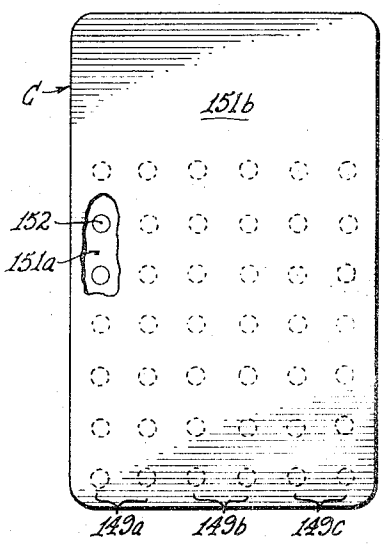


FIG. 5.

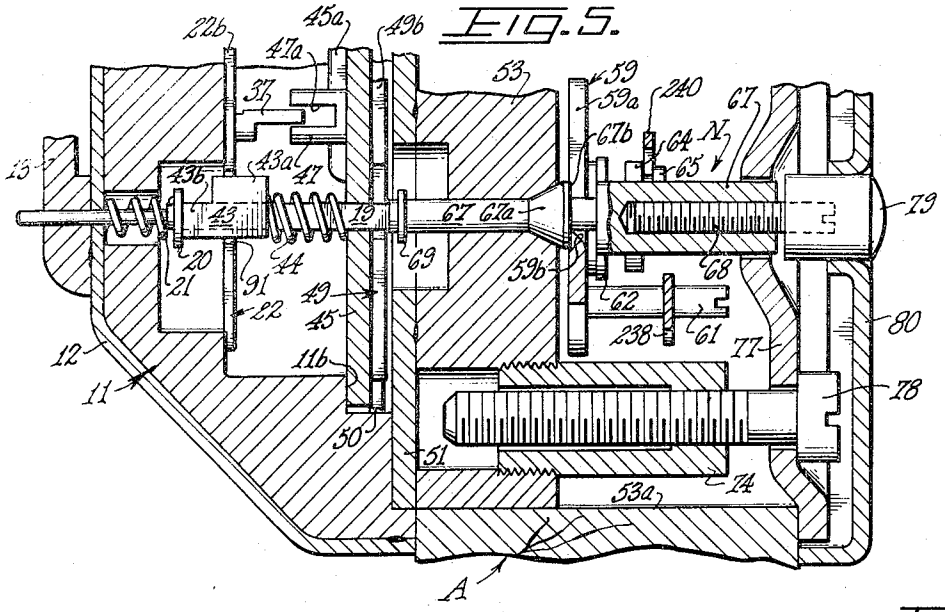


FIG. 11.

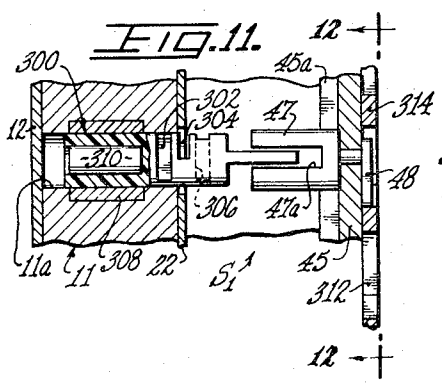


FIG. 12.

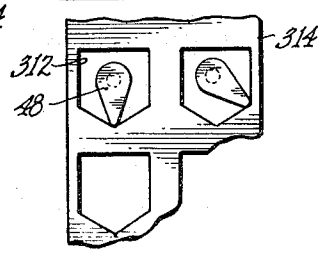
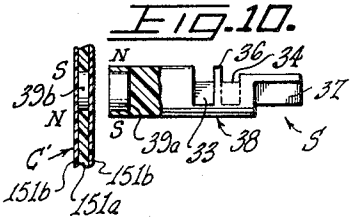
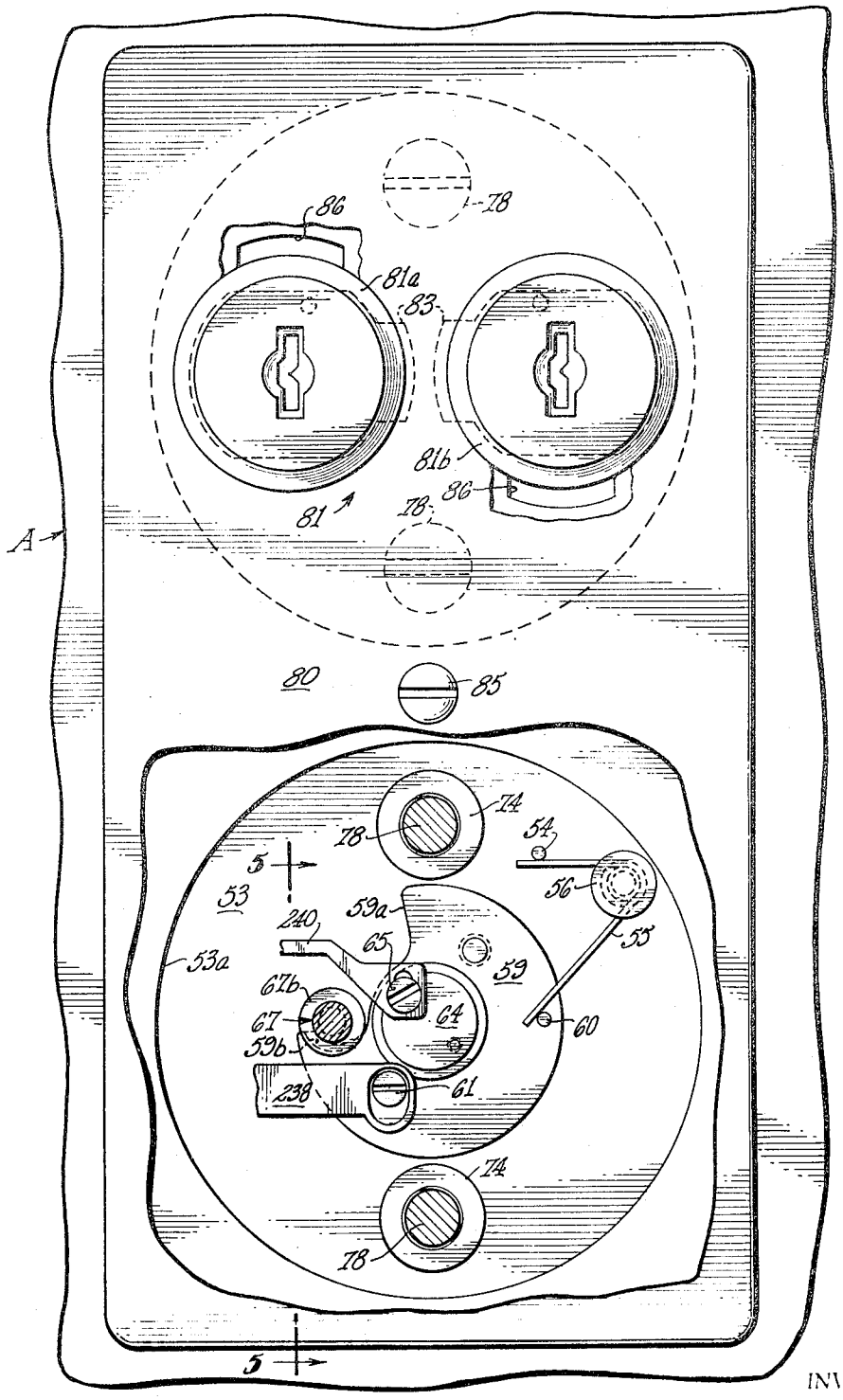


FIG. 10.



INVENTOR.
HERBERT M. SCHENDEL
BY
Forrest J. Lilly
ATTORNEY

FIG. 2.



INVENTOR.
HERBERT M. SCHENDEL
BY
Forrest J. Lilly
ATTORNEY

FIG. 3.

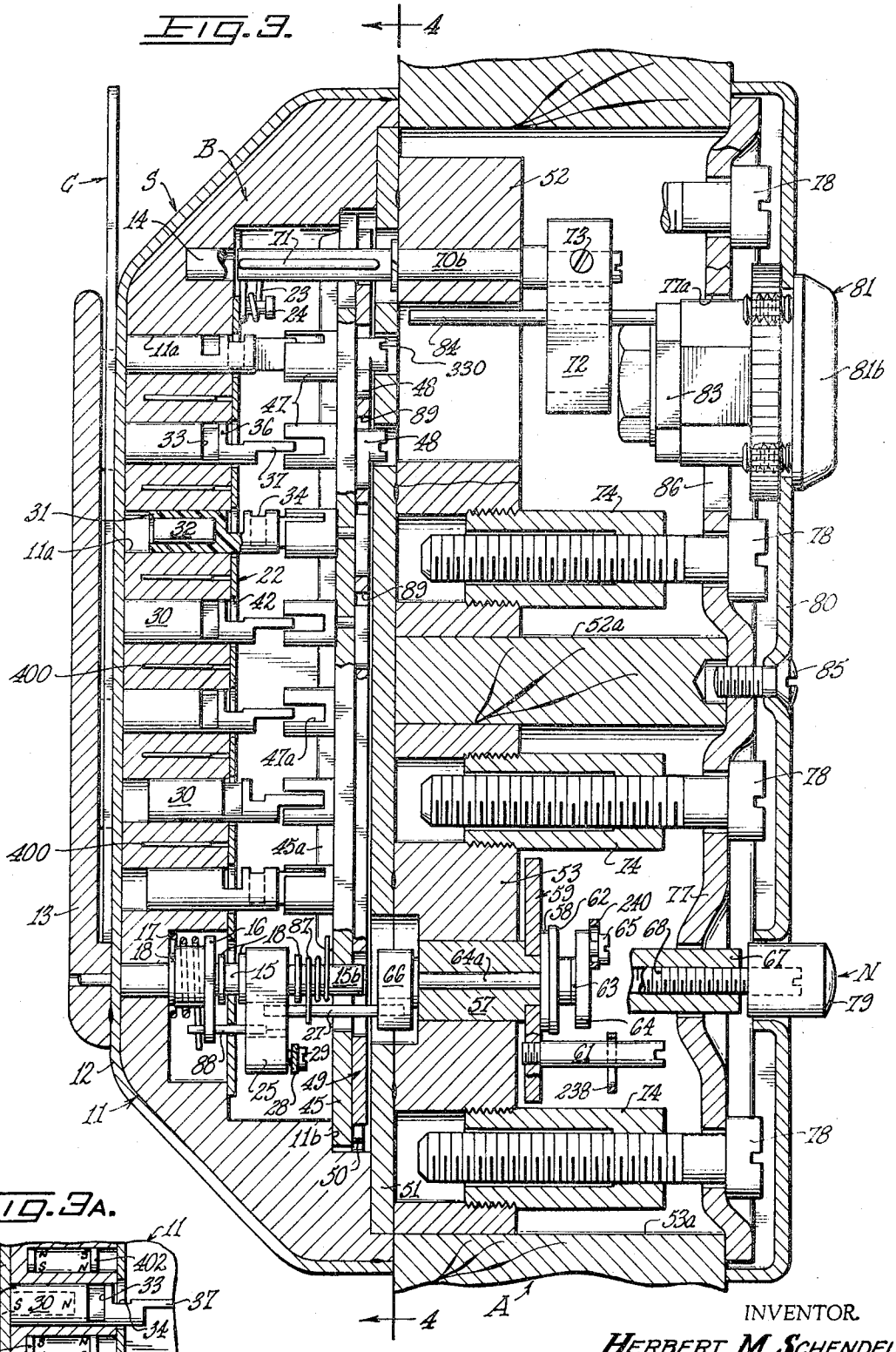
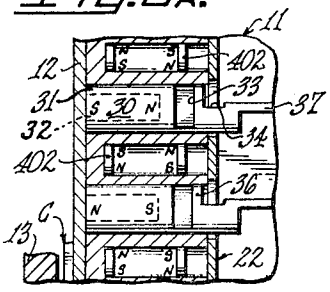
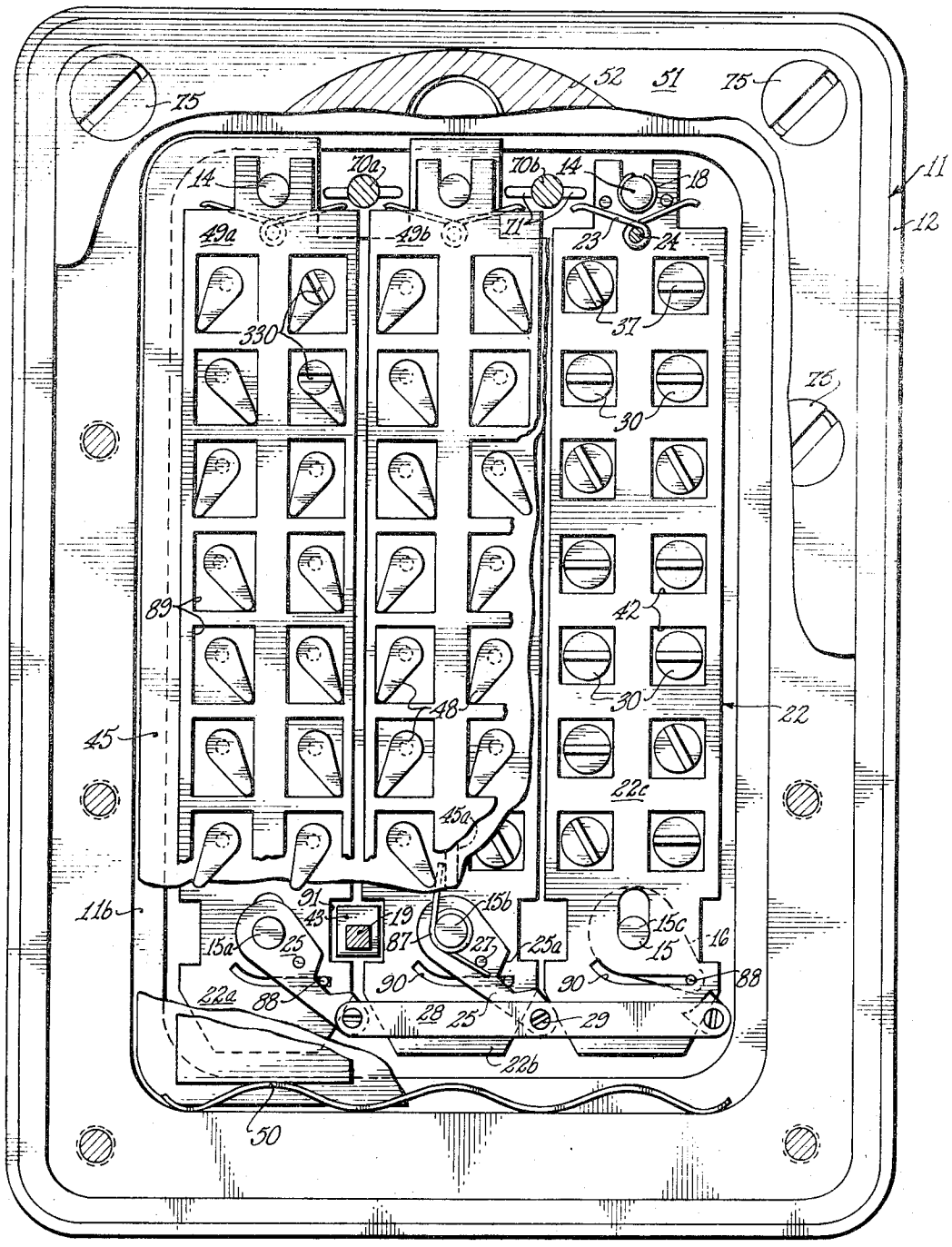


FIG. 3A.



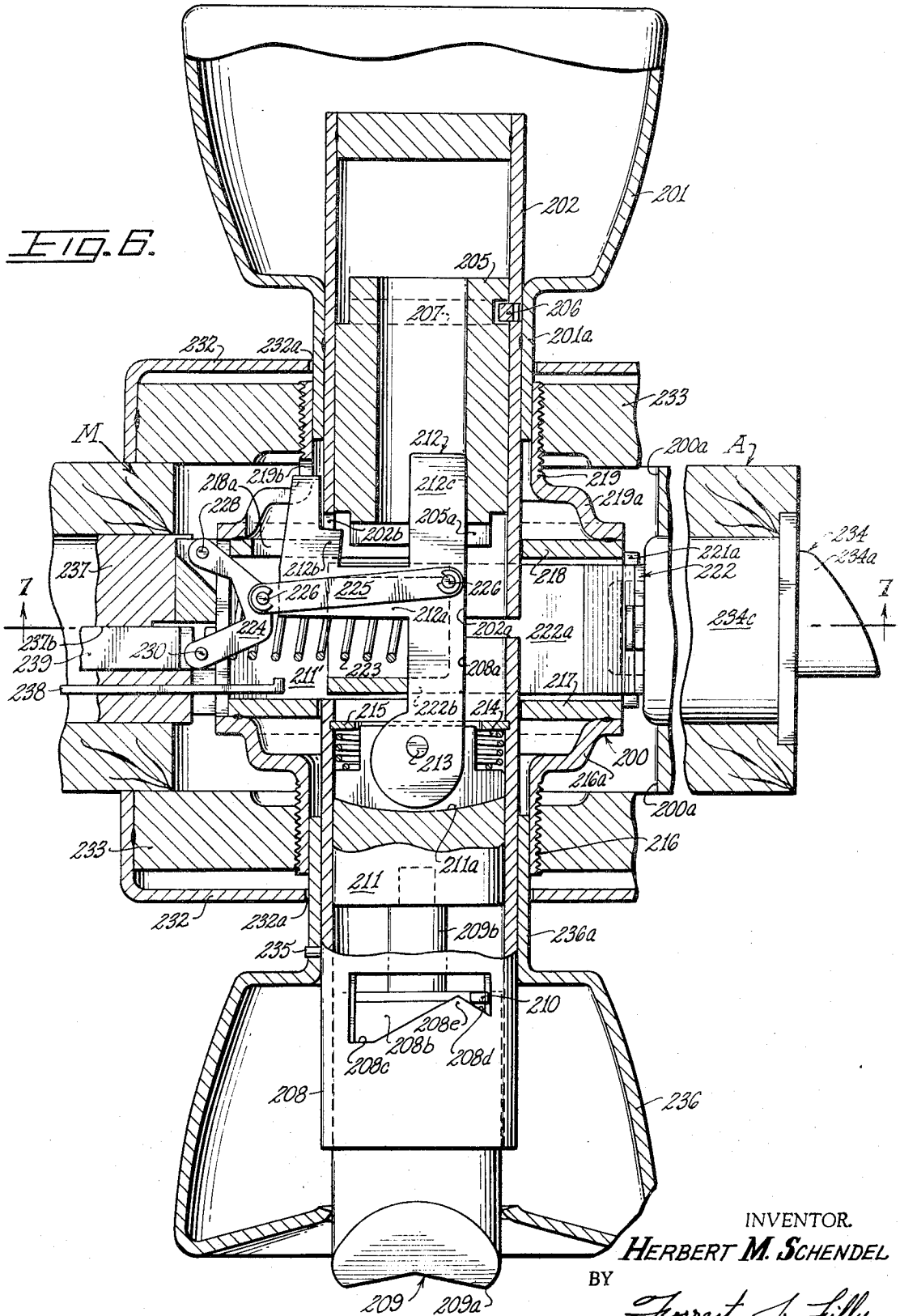
INVENTOR.
HERBERT M. SCHENDEL
BY
Forrest J. Lilly
ATTORNEY

FIG. 4.



INVENTOR.
HERBERT M. SCHENDEL
BY
Forrest J. Lilly
ATTORNEY

FIG. 6.



INVENTOR.
HERBERT M. SCHENDEL
BY
Forrest J. Lilly
ATTORNEY

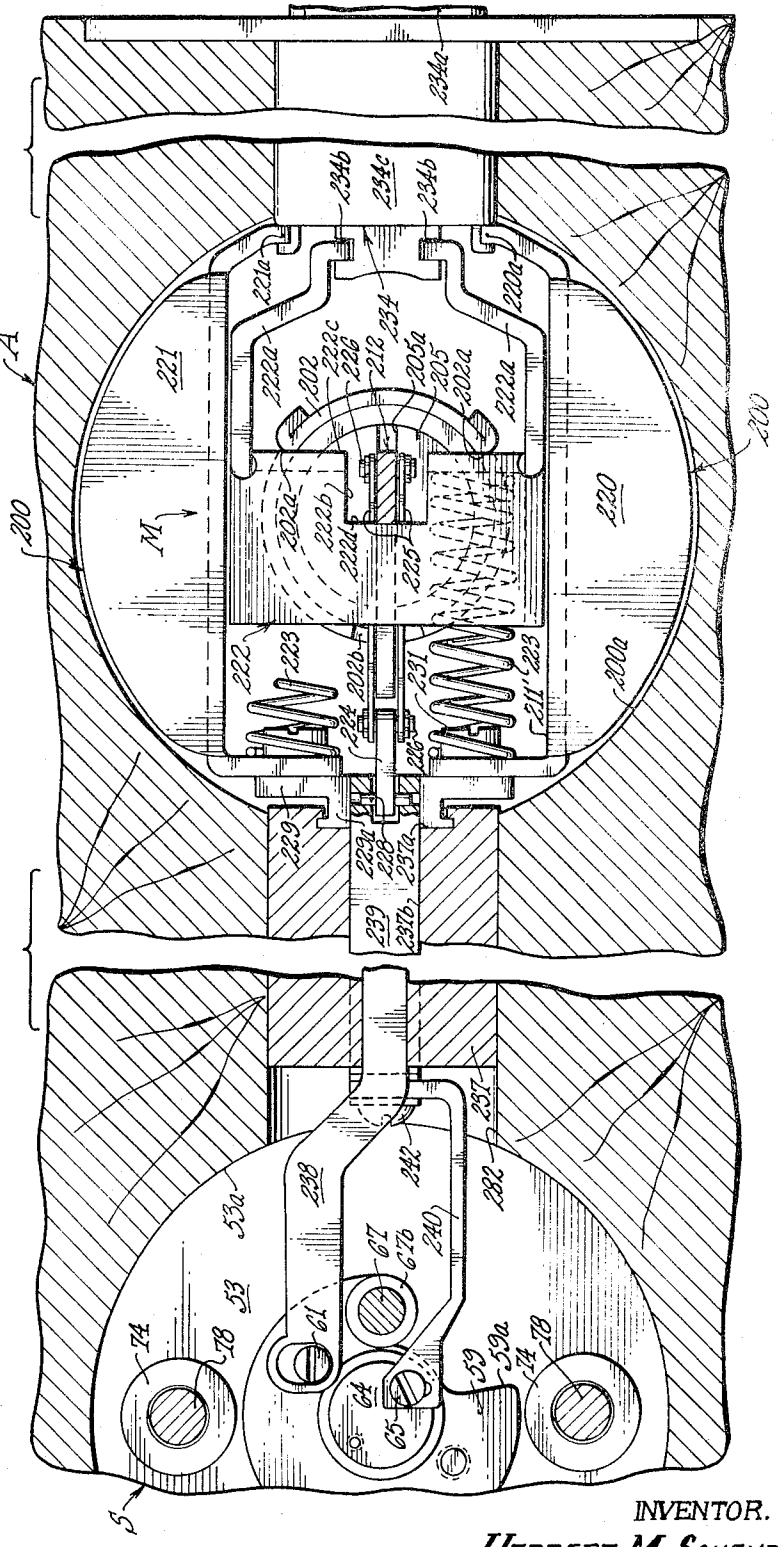


FIG. 7.

INVENTOR.
HERBERT M. SCHENDEL
BY
Forrest J. Lilly
ATTORNEY

FIG. 9.

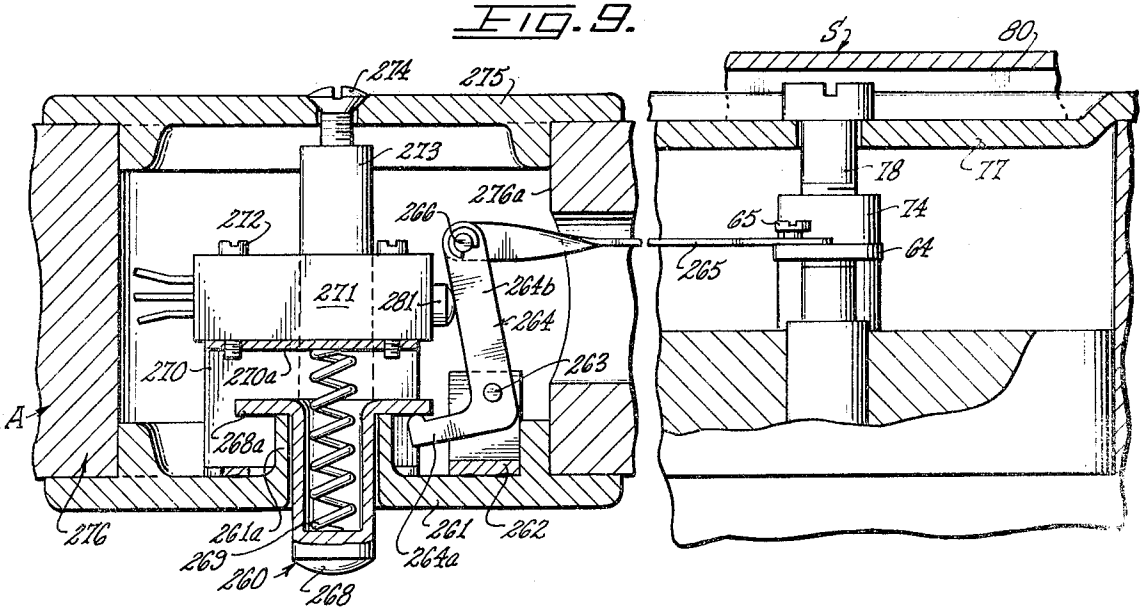


FIG. 13.

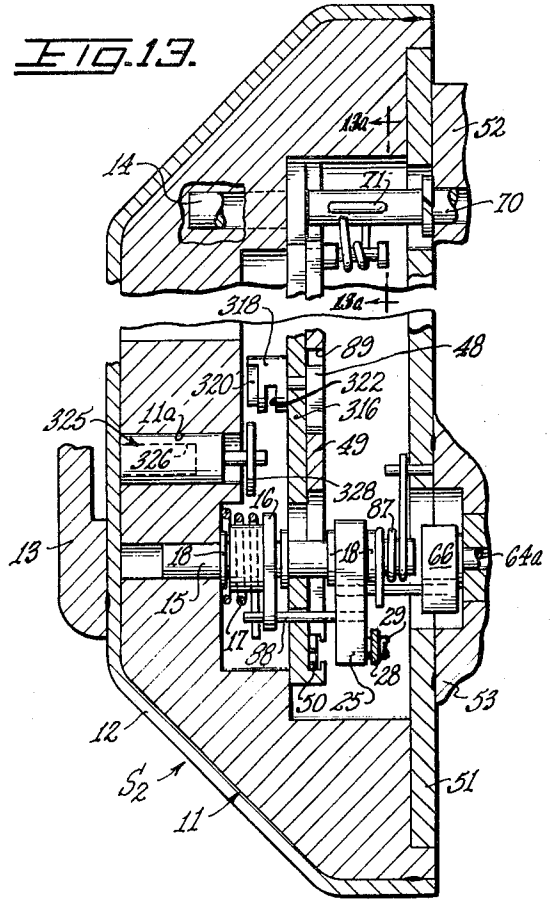


FIG. 14.

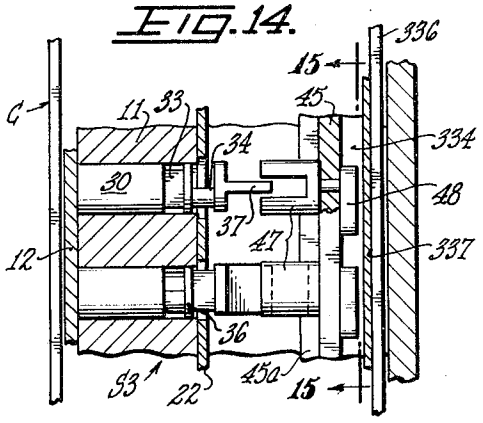
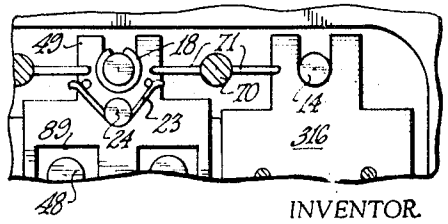


FIG. 13A.



INVENTOR.
HERBERT M. SCHENDEL
BY
Forrest J. Lilly
ATTORNEY

Fig. 17.

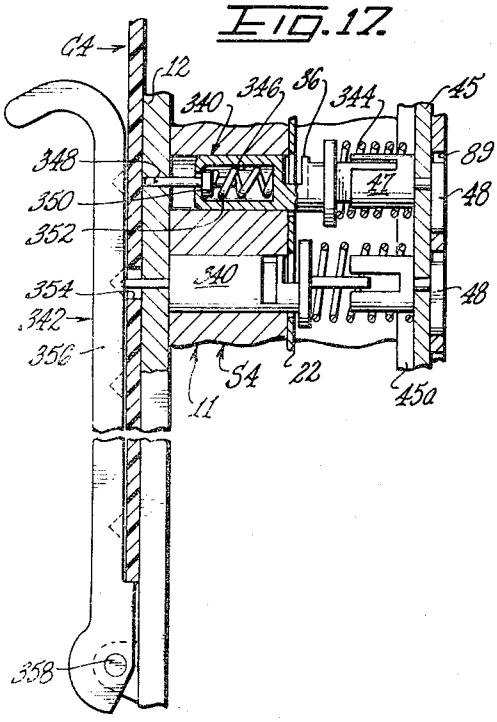


Fig. 15.

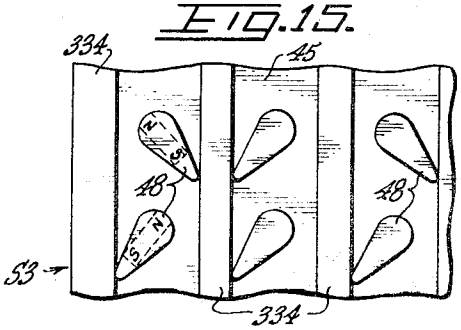


Fig. 16.

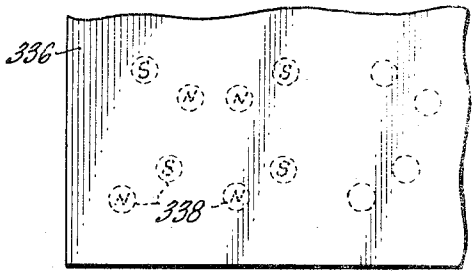


Fig. 18.

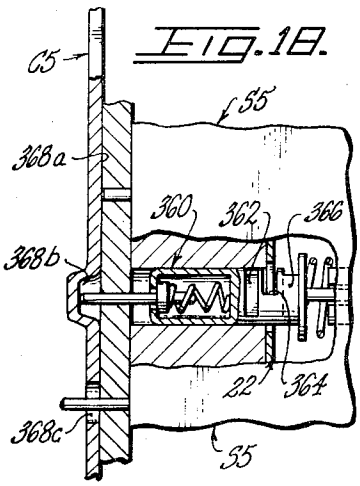
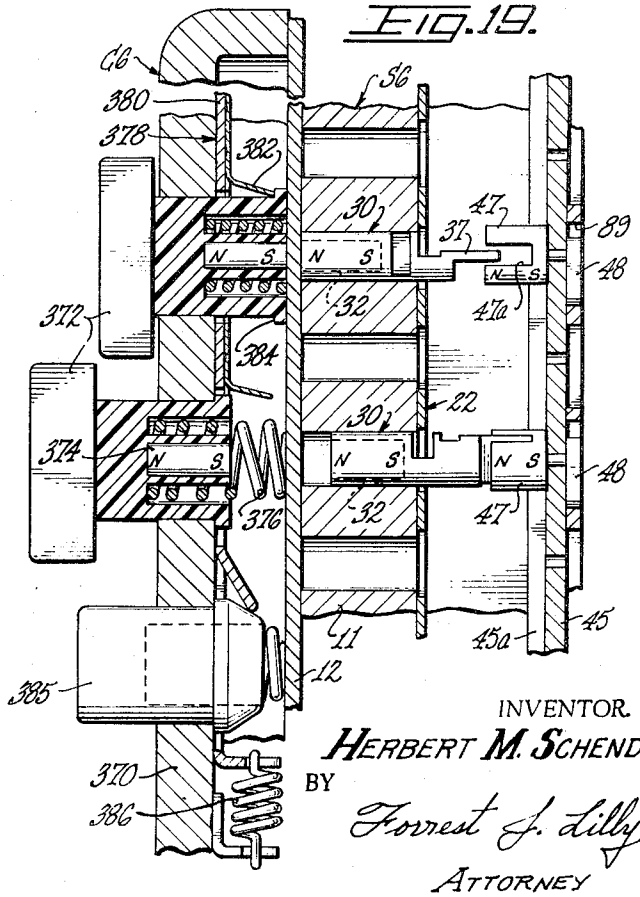


Fig. 19.



INVENTOR.
HERBERT M. SCHENDEL
BY
Forrest J. Lilly
ATTORNEY

MECHANICAL CODE ACTUATED SENSOR UNIT AND LOCK EMBODYING SAME

BACKGROUND OF THE INVENTION

1. Field

This invention relates generally to security devices of the class which are actuated by a coded key in the form of a coded card or key card having means representing a selected code pattern or a keyboard which is manually presettable to represent the code pattern. The invention relates more particularly to a coded key actuated sensor unit of the class described which may be programmed for actuation in response to any one or more of a vast number of different key code patterns. The invention relates also to a lock and electrical switch device embodying the sensor unit.

2. Prior Art

As will appear from the ensuing description, the sensor unit of the invention may be utilized for a great variety of security applications. Among these applications are personnel identification, coded card verification, and controlled entry to buildings, rooms, security areas and other controlled areas. The prior art is replete with a vast assortment of security devices of this general class. By way of example, a few of the prior art U.S. Pat. Nos. disclosing such devices are: 2,566,017; 2,648,729; 2,732,703; 2,769,873; 2,931,953; 3,111,834; 3,215,903; 3,271,983; and 3,320,781.

The invention will be disclosed in connection with a lock and an electrical switch device. In conventional key locks, a key, which is shaped in a unique pattern, is used in conjunction with the locking mechanism to accomplish the locking and unlocking function. Rekeying such a lock, that is changing the key pattern required to operate the lock, is expensive and time consuming, because the lock has to be partially disassembled and its tumblers replaced by someone skilled in the art. In addition, key locks are susceptible to picking, and their keys are easily duplicated for unauthorized entry. Special locks have been devised which utilize either a coded magnetic keycard or a keyboard as the lock actuating element or a key and an electrical locking solenoid or other electro-mechanical means as the key-actuated means which performs the actual locking and un-locking function. Such locks require electrical power and are thus costly to install and operate. Moreover, these locks may present operational problems during electrical power failures, and changing their combination or unlocking code pattern generally requires partial disassembly of the locking mechanism. Yet other magnetic-mechanical coded key card or keyboard actuated locks have been devised which operate without electrical power, but they, too, generally have to be partially disassembled to effect a change in their combination or unlocking code pattern.

SUMMARY OF THE INVENTION

The present invention overcomes the above noted and other disadvantages of the existing security devices of the class described and particularly those security devices which are actuated by coded key cards, keyboard and the like. In this regard, it is significant to note at the outset that the present invention is disclosed in connection with both coded card and keyboard actuated security devices and that the expression "coded key" is used as a generic descripter for both coded card and key board elements of these devices. The coded information provided by the "coded key" is referred to as a code pattern.

According to one of its important aspects, the invention provides a coded key actuated device, referred to herein as a sensor unit, which may be programmed for operation from a normal condition to an actuated condition in response to any one or more of a vast number of different key code patterns. This actuation of the sensor unit involves movement of one or more sensing plates or slides from a normal retracted position to an extended position. With regard to the number of sensing slides it will appear that the coded key may have one or more code groups or patterns. The sensor unit has one sensing slide for each group or pattern.

Extension of each sensing slide is controlled by a group of tumblers which are positioned axially in accordance with the corresponding code pattern on the coded key which actuates the sensor unit. These tumblers either permit or block extension of the slides depending upon whether the code pattern is a valid or authorized pattern, i.e., one for which the sensor unit is programmed to accept, or an invalid or unauthorized pattern, i.e., one which is not programmed into the sensor unit. Movement of a sensing slide to its extended position permits or effects movement of an output member of the sensor unit. This movement of the output member may be utilized for any function. By way of example in the present lock, movement of the output member actuates the lock to un-locked condition, and in the present switch device, movement of the output member actuates the switch contacts.

The tumblers of the sensor unit may be positioned axially in accordance with the key code pattern by either or both magnetic and mechanical interaction between the tumblers and the coded key. This interaction may be such as to enable a key to be coded to establish any one of two, three, or more axial positions for each tumbler, thus providing a vast number of possible tumbler position combinations and corresponding key code patterns from which may be selected the one or more combinations and hence valid key code patterns required to activate the sensor unit.

A highly important and unique feature of the sensor unit resides in its ability to be adjusted to change the key code pattern or patterns required to actuate the unit; that is the ability of the sensor unit to be programmed for actuation in response to any one or more of the vast number of possible key code patterns for the sensor unit. In some disclosed forms of the invention, for example, each tumbler of the sensor unit is rotatably adjustable on its axis to different angular positions equal in number to the different axial tumbler positions which may be established by different key code patterns. Each tumbler is so shaped that in any given angular position the tumbler blocks extension of its sensing slide and hence actuation of the sensor unit in all but a preselected one of its axial positions. Thus, rotating a tumbler from one position to another changes the axial position which the tumbler must assume in order to permit extension of the slide and actuation of the sensor unit, and hence the key code pattern required to actuate the unit. In another disclosed embodiment, the tumblers cooperate with sensing elements which are rotatably adjustable to program the sensor unit.

The tumblers or tumbler sensing elements are releasably locked in their preset angular positions after programming of the sensor unit has been completed. In the disclosed inventive embodiments, this locking function is accomplished by reset slides which are retractable to release the tumblers or sensing elements for rotation during programming of the sensor unit. Accordingly, any one or more of a vast number of key code patterns may be effectively stored in the sensor unit, and the latter will be actuated only in response to operation of the unit by a coded key with a matching, i.e., valid of authorized code pattern.

The sensor unit has three modes, a normal inoperative mode, a storage or programming mode, and a sensing mode. The normal inoperative mode is the mode or condition in which the sensor unit exists prior to operation of the unit by a coded key. In this mode, the tumblers block the sensing slides against extension. In the programming mode, the sensor unit is conditioned to be programmed for actuation in response to a selected key code pattern or selected key code patterns. The sensing mode involves introduction of a key code pattern into the sensor unit by inserting a coded card into the unit or depressing the keys of the sensor unit keyboard to determine the validity of the code pattern or patterns.

In the programming mode, the sensor unit may be adjusted or programmed in at least three different ways to store a selected code pattern or patterns. According to one method of programming, the selected code pattern or patterns is introduced into the sensor unit to position the tumblers axially in accordance with the code patterns on the card. The tumblers or their sensing elements are then released for programming rotation and the sensing slide or slides are extended to produce forces on the tumblers or sensing elements which rotate the same to their slide releasing positions, that is, the positions in which they permit sensing slide extension in the sensing mode. The tumblers or their sensing elements are then locked in their programmed angular positions.

According to a second programming method, the tumblers or their sensing elements are rotated individually by hand to their different angular positions. A third programming method involves the use of a magnetic programming card which positions the tumblers or their sensing elements angularly by magnetic action.

In the sensing mode, when a valid code pattern is introduced into the sensor unit by means of a key card or the keyboard, the tumblers assume their sensing slide releasing positions, and the sensing slide or slides are extended to actuate the output member of the unit. If other than a valid code pattern is introduced, one or more of the tumblers will assume a sensing slide blocking position in which they lock the respective sensing slide against extension to actuate the sensor unit.

In one disclosed embodiment, the sensor unit is embodied in a door lock. The locking mechanism of the lock has a normally locked condition in which at least one door knob is locked against turning to open the door. The locking mechanism is operatively connected to the output member of the sensor unit in a manner such that the locking mechanism is actuated to the unlocked condition to permit rotation of the locked knob to open the door when a proper code pattern is introduced into the sensor unit.

The lock is also intended for use on room doors of hotels, and other similar establishments. In these applications, occupants may be issued coded cards or keyboard combinations which permit them access to their own rooms only, employees may be issued cards or combinations which permit them access to selected groups of rooms and the manager may be issued a card or combination which permits access to all rooms.

In another disclosed embodiment, the output member of the sensor unit is connected to an electrical switch for operating an electrical device, such as a signal light, machine, etc., in response to insertion of a valid code pattern into the sensor unit. As will appear from the ensuing description, the sensor unit is capable of use in a wide variety of other applications.

DRAWINGS

FIG. 1 is a fragmentary view of the outer or front side of a door equipped with a key card actuated lock according to the invention.

FIG. 2 is an enlarged fragmentary view of the inner or rear side of the door with a portion of the door lock sensor unit broken away;

FIG. 3 is an enlarged vertical section through the sensor unit;

FIG. 3A illustrates one method of counteracting magnetic forces between neighboring plungers;

FIG. 4 is a section taken substantially on line 4—4 in FIG. 3;

FIG. 5 is an enlarged section taken on line 5—5 in FIG. 2;

FIG. 6 is an enlarged section taken on line 6—6 in FIG. 1;

FIG. 7 is a section taken on line 7—7 in FIG. 6;

FIG. 8 illustrates a key card for the lock;

FIG. 9 is a fragmentary section through a modified key card actuated sensor unit according to the invention embodying a push button actuator for the unit and a switch to be operated by the unit;

FIG. 10 illustrates a modified tumbler for the sensor unit;

FIG. 11 is a fragmentary section through a modified key card actuated sensor unit according to the invention;

FIG. 12 is a view taken on line 12—12 in FIG. 11;

FIG. 13 is a fragmentary section through a further modified key card actuated sensor unit according to the invention;

FIG. 13A is a section taken on line 13A—13A in FIG. 13;

FIG. 14 is a fragmentary section taken through a further modified key card actuated sensor unit according to the invention;

FIG. 15 is a section taken on line 15—15 in FIG. 14;

FIG. 16 is a fragmentary view of a programming card for the sensor unit of FIG. 14;

FIG. 17 is a fragmentary section through a further modified key card actuated sensor unit according to the invention;

FIG. 18 is a fragmentary section through a further modified sensor unit according to the invention;

FIG. 19 is a fragmentary section through a key board actuated sensor unit according to the invention;

PREFERRED EMBODIMENT OF THE INVENTION

The programmable coded card actuated device D of the invention selected for illustration in FIGS. 1–8 is a security lock to be installed in a door A or the like and operated by a coded key C, in this instance a coded key card having means defining a preselected code pattern. Lock D has a magnetic, key card code sensing mechanism or sensor unit S, and a locking mechanism M controlled by the sensor unit. As will appear presently, the key card C is insertable into the sensor unit S and, if properly coded, actuates the locking mechanism M to its locked condition to permit opening of the door A by manual operation of the locking mechanism M.

Sensor unit S has a housing **11** with a front cover **12** which seats against the front or outer side of door A. Accessible at the front side of the cover is a guide or slot **13** for receiving the key card C. A front mounting plate **51** is secured by screws **75** to the rear side of sensor housing **11**. Rigid on the rear side of plate **51** are a pair of circular mounting bosses **52, 53**, which fit within circular openings **52***a*, **53***a* extending through the door A to locate the sensor housing relative to the door. Fixed to and extending rearwardly from the mounting bosses **52, 53** through the door openings **52***a*, **53***a* are threaded inserts **74**. Seating against the rear side of the door A in overlying relation to the door openings and having indented portions projecting into the openings in a rear mounting plate **77**. Mounting screws **78** extend through this plate and thread into the inserts **74** to secure the sensor unit S to the door. A rear cover plate **80** overlies and is secured by screw **85** to the rear mounting plate **77** to conceal the latter and its mounting screws.

Removal of the sensor unit S from the door A requires removal of the rear cover plate **80** to expose the rear mounting plate **77** and then removal of the latter plate by removal of its mounting screws **78**. In order to prevent unauthorized removal of and tampering with the programming of the sensor unit, the rear cover plate **80** is locked to the rear mounting plate **77** by two key locks **81**, designated individually as **81***a*, **81***b*. These key locks are fixed side by side within openings in the rear cover plate. The barrels of the locks **81** project forwardly from the cover plate through openings **77***a* in the rear mounting plate **77**. At the font ends of the lock barrels are key operated rotatable locking lugs **83** which project radially beyond the edges of the mounting plate openings **77***a*. About the edge of each opening **77***a* is a clearance slot **86** for the respective locking lug **83**.

The rear cover plate **80** is installed by inserting the proper keys into the locks **81** and rotating their locking lugs **83** to positions where they register with the clearance slots **86**. The cover plate is then placed in position in such a way that the lock barrels and lugs pass through the rear mounting plate openings **77***a*. Thereafter, the cover plate is secured in position by inserting the cover plate mounting screw **85** and rotating the locking lugs **83** to their locking positions of FIG. 2. In these positions, the lugs **83** are angularly displaced from the clearance slots **86** and project radially beyond the edges of the rear mounting plate openings **77***a* to prevent removal of the rear cover plate **80** even though its mounting screw **85** is removed. As will appear presently, the locks **81** are also utilized when programming the sensor unit.

At certain times such as during the night, it may be desirable to prevent unlocking of the door lock D even in response to insertion of a properly coded card key C into the sensor unit S. This is accomplished by depressing a night latch button **79** which projects rearwardly through the rear cover plate **80**. The arrangement and operation of this night latch button will be explained presently.

The sensor unit S embodies key card code pattern sensing means B which will now be described by reference primarily to FIGS. **3, 4**, and **8**. Extending through the front wall of the sensor unit housing **11** normal to the front and rear wall faces, are bores **11***a* arranged in a number of vertical columns and horizontal rows. In the particular inventive embodiment shown, there are **42** bores **11**a arranged in six columns each containing seven bores. Longitudinally and rotatably movable within each bore **11**a is a generally cylindrical magnetic sensing pin or tumbler **30**. Each tumbler has a body **31** of non-magnetic material with an axial socket at its front end containing a permanent magnet **32**. Each magnet is magnetized in the axial direction such that it has a north pole at one end and a south pole at the opposite end. The front cover **12** of the sensor housing **11** and the housing itself are constructed of a non-magnetic material.

As shown in FIG. **8**, the key card C is laminated and includes a center layer **151***a* and two outer layers **151**b (only one shown) of plastic or other non-magnetic material which are bonded face to face. Fixed within holes in the center layer **151***a* are magnets **152** which are equal in number to and are arranged in the same pattern as the sensor unit tumblers **30**, such that when the key card is inserted into the sensor unit each magnet is aligned axially with a corresponding tumbler. Magnets **152** may comprise barium ferrite or other suitable magnetic material and are magnetized in a direction normal to the faces of the key card. Each magnet thus has a north pole adjacent one card face and a south pole adjacent the other card face. In place of separate magnets, as shown, the center card layer **151***a* may comprise a solid plate of magnetic material with individual magnetized regions corresponding to the location of the magnets. The key card may also have a single plastic layer in which the card magnets are embedded.

When the key card C is inserted into the sensor unit S, the tumblers **30** are either attracted forwardly toward or repelled away from the card depending on the polarity of the adjacent magnetic poles of each tumbler magnet **32** and the corresponding key card magnet **152**. As will appear from the ensuing description, the tumblers have limited freedom of axial movement so that the magnetic force on each tumbler causes the latter to assume either a forward or rearward limiting position depending on the polarity of the adjacent poles of the tumbler and card magnets. It is now evident that if the arrangement of the magnetic poles at the rear side of the key card C, i.e., the side which faces the tumblers **30** when the card is inserted into the sensor unit, is defined as the magnetic code pattern or simply code pattern of the card, the tumblers assume a combination of axial positions determined by the code pattern. As will appear from the ensuing description, and is obvious from the large number of tumblers and key card magnets and from the fact that the adjacent

poles of each pair of aligned tumblers and card magnets may have either like or unlike polarity, the key card may be provided with any one of a vast number of code patterns and each code pattern may establish any one of a vast number of tumbler position combinations.

As will appear presently, the sensor unit S may be designed for use with one or more key cards C each having a different code group or pattern. The particular sensor unit shown, for example, is designed for use with three different key cards each having separate code groups or patterns. In FIG. 8, these three code groups or patterns are shown on one card for convenience of illustration and are designated as **149***a*, **149***b*, **149***c*. In actual practice, each key card will have only one of the code groups or patterns **149***a*, **149***b*, **149***c*.

According to the present invention, the key card controlled lock D is arranged in a manner such that a a proper code pattern in any one of the code groups **149***a*, **149***b*, **149***c* will allow the actuation of the locking mechanism M to its unlocked condition, and will permit opening of the door A. The locking mechanism will remain in its locked condition to prevent opening the door if a key card with any other code pattern is inserted.

Continuing now with the description of the sensor unit S by reference to FIGS. 3 and 4, the unit has support pins **14**, **15** fixed in and projecting rearwardly from the front wall of the sensor housing **11** to its front mounting plate **51**. Fixed on the rear ends of the support pins **14**, **15** between rear shoulders **11**b on the sensor housing **11** and the plate **51** is a support plate **45**. Plate **45** rotatably mounts at its front side a plurality of axially slotted tumbler guides **47** equal in number to and axially aligned with the sensor tumblers **30**, respectively. Each guide thus turns on the longitudinal axis of its corresponding tumbler. Fixed to each guide for rotation therewith is a tumbler positioning lever **48** located at the rear side of the support plate **45**. Each lever and guide are joined by a reduced shaft which extends through and is journalled in the support plate, as shown in FIG. 3. On the rear end of each tumbler **30** is a narrow tongue **37** which fits slidably within the axial slot **47***a* in its corresponding guide **47**.

Referring to FIG. 3 it will be seen that each tumbler **30** has limited freedom of axial movement. Thus, each tumbler is movable between a forward limiting position wherein the front end of the tumbler seats against the front cover **12** of the sensor housing **11** and a rearward limiting position wherein the rear end of the tumbler tongue **37** bottoms against the end wall of the slot in its guide **47**. Each tumbler is keyed against rotation relative to its respective guide by the tumbler tongue and guide slot, such that the tumbler and guide are rotatable in unison on their common axis.

At the rear side of the support plate **45**, between the latter and the rear plate **51**, are three reset slides **49** including two outer slides **49***a*, **49***c*, and a center slide **49***b*. As shown best in FIG. 4, the upper and lower ends of these slides have longitudinal slots receiving the support pins **14**, **15**, such that each slide is located and supported for limited longitudinal movement by the pins. Each outer slide **49***a*, **49***c* is aligned with two outer columns of the tumbler positioning levers **48**. The center slide **49***b* is aligned with the two center columns of levers.

Slides **49** contain rectangular openings **89** receiving the tumbler positioning levers **48**. Referring to FIG. 4, it will be seen that each lever is tapered and each slide opening is sized such that the narrow lower end of each lever may engage in either lower corner of its slide opening **89** when the corresponding slide **49** occupies its illustrated upper limiting position. This corner engagement of each lever locks the latter and hence also its slotted guide **47** and corresponding tumbler **30** in a fixed angular position about their turning axis. Each slide **49** is movable downwardly to a lower limiting position wherein each lever is free to be rotatably positioned for locking engagement in either lower corner of its slide opening **89** when the slide is returned to its upper locking position of FIG. 4. From this description, it will be understood that the levers **48** and slides **49** provide means for releasably locking the guides **47** and hence their respective tumblers **30** in either of two angular positions on their turning axes. The manner in which the slides are moved longitudinally to release and lock the guides and tumblers will be explained presently. Suffice it to say here that the slides remain in their upper locking positions at all times except during programming of the sensor unit S.

Seating slidably against the rear face of the front wall of the sensor housing **11** are three sensing slides **22** including two outer slides **22***a*, **22***c* each aligned with two outer columns of tumblers **30** and a center slide **22***b* aligned with the two center columns of tumblers. The sensing slides **22***a*, **22***b*, **22***c* are aligned in the fore and aft direction with and are similar in shape to the reset slides **49***a*, **49***b*, **49***c*, respectively. Sensing slides **22** have upper and lower slots which receive the support pins **14**, **15**, to locate the sensing slides and support the latter for limited longitudinal movement. Retainer rings **18** on the pins restrain the sensing slides against rearward movement along the pins. The sensing slides have rectangular openings **42** through which the tumblers **30** extend.

Referring particularly to FIG. 3, it will be seen that each tumbler **30** has two axially spaced upwardly opening traverse slots **33** and **34** separated by an intervening shoulder **36**. As will be explained presently, this shoulder prevents unauthorized setting of the tumbler. Each slot is located in a plane normal to and has a flat bottom wall disposed approximately in a plane containing the longitudinal axis of its tumbler. The bottom walls of the two slots in each tumbler are angularly displaced by an angle equal to the angle between the two angular locking positions of the corresponding tumbler positioning lever **48** within its respective reset slide opening **89**. In the particular embodiment shown this angle is about 60°. Further, the two slots in each tumbler are so axially located along the tumbler that in the forward limiting position of the tumbler, the rear slot **34** is situated in the plane of the corresponding sensing slide **22**. In the rear limiting position of the tumbler, the forward slot **33** is situated in the plane of the sensing slide. Finally, the slots in each tumbler are angularly oriented so that in one angular locking position of its positioning lever **48**, the bottom wall of one slot parallels the upper edge of the corresponding sensing slide opening **42**. In the other lever locking position, the bottom wall of the other slot parallels the opening edge.

From the description to this point, it will be understood that when a keycard C is inserted into the sensor unit S, each of the tumblers **30** will be moved by magnetic force to either its forward or rearward limiting position. In each position one slot **33** or **34** in the tumbler will be aligned with, i.e., located in the plane of, the respective sensing slide **22**. Assuming that the reset slides **49** are in their upper locking position wherein they lock the tumbler positioning levers **48** and hence also the tumblers **30** in their current angular positions about their their respective rotation axes, one slot in each tumbler will be oriented with its bottom wall parallel to the upper edge of the respective sensing slide opening **42**. The bottom wall of the other tumbler slot will be inclined at an oblique angle, i.e., 60°, relative to the opening edge. In the ensuing description, the axial position of each tumbler wherein its slot with the parallel bottom wall, i.e., the bottom wall which parallels the upper edge of the corresponding sensing slide opening, is aligned with the corresponding sensing slide, is referred to as the "go" position of the tumbler. The axial position of the tumbler wherein its other with its oblique bottom wall is aligned with the sensing slide is referred to as the "no-go" position of the tumbler.

Assume now that all of the tumblers **30** for a particular sensing slide, say slide **22***a*, are in their "go" positions. Under these conditions, downward movement or extension of the slide results in entrance of the upper edges of the slide openings **42** into the tumbler slots **33** or **34** then aligned with the slide. These slots have depth sufficient to permit downward extension of the sensing slide to a lower limiting position. This slide position is hereafter referred to as its extended position. On the other hand if anyone or more of the tumblers **30** is in its "no-go" position, the upper edge of the corresponding slide opening or openings **42** cannot enter the tumbler slots aligned with the slide. Under these conditions, such tumbler or tumblers block downward extension of the sensing slide to its extended position and retain the slide in its upper limiting position, hereafter referred to as its retracted position.

For convenience, each of the three assemblies consisting of a sensing slide **22** and its corresponding tumblers **30**, tumbler positioning levers **48**, and reset slide **49** will be referred to as a key card code pattern sensing means or simply a sensing means. The three pattern sensing means are adapted to sense or read the three key card code patterns **149***a*, **149***b*, **149***c*, respectively.

From the description to this point, it will be understood that each pattern sensing means has a go condition wherein the corresponding sensing slide **22** is free to move to its extended position and a no-go condition wherein the slide is blocked against movement from its retracted position to its extended position. A key card C may be magnetically coded to place any one, any two, or all three of the pattern sensing means in their go condition. As will appear from the later description placement of any one or more of the pattern sensing means to go condition conditions the sensor unit S to release the locking mechanizing M for operation to its unlocked condition and permit opening of the door A. Accordingly, any one of the key card code patterns **149***a*, **149***b*, **149***c* in FIG. **8** may be coded to open the door A.

It will become evident from the description which follows that this ability of the sensor unit S to store key card C code patterns and the sensor unit S to recognize three different code patterns permits use of the lock in many diverse applications which require a master keying capability. For example, a large hotel may issue key cards as follows: to guests, key cards each with a different code pattern in code group **149***a* which permits each person to enter only his own room; to maids, bell boys and the like, key cards each with a code pattern in code group **149***b* which permits entrance to an assigned group of rooms and to the manager or other selected persons, a code pattern in code group **149***c* which permits entrance to all rooms.

The sensor unit S has three basic modes or conditions. These are (1) normal inoperative mode; (2) code pattern storing or programming mode; and (3) sensing or operating mode. FIGS. **3** and **4** illustrate the unit in its normal mode. In its storing or programming mode, a coded key card C with a selected code pattern or code patterns is inserted into the sensor unit and the latter is actuated in the manner explained shortly to effectively store the code pattern or patterns in the unit. In the sensing or operating mode, a key card is inserted into the sensor unit and the latter is manually actuated in the manner to be explained to effectively check the validity of the card. In the particular embodiment shown, this checking procedure involved turning the outside handle or knob of the door locking mechanism M to determine whether or not the mechanism has been released.

These operating modes will be explained in detail presently. Suffice it to say at this point that the programming mode involves positive manual extension of both the sensing and reset slides **22**, **49** to effect rotatable positioning of the tumblers **30** in accordance with the code pattern on the key card inserted into the sensor unit. The slides are then returned to retracted position to lock the tumblers in their programmed angular position. The sensing mode involves manual release of the sensing slides **22** to permit extension, by spring action of any slide whose tumblers **30** are all in go position to place the locking mechanism M in unlocked condition. The means whereby these slide movements are accomplished will now be described.

The means for extending the sensing and reset slides **22**, **49** in the programming mode comprises a pair of reset shafts **70***a*, **70***b* extending through and journalled in the upper sensor housing mounting boss **52** and the front sensor housing wall, between the center and outer slides. Each shaft has a pair of diametrically opposed cams **71** which extend laterally to opposite sides of the shaft and longitudinally of the shaft to the sensing and reset slides. The front ends of cams **71** are located just to the rear of the sensing slides **22** and in the planes of springs **23** mounted by a button **24** at the rear sides of the sensing slides. Each spring has an end underlying the adjacent cam as shown best in FIG. **4**. The rear ends of cams **71** are disposed in overlying relation to the upper ends of the reset slides **49**.

From this description and from FIG. **4**, it will be understood that counterclockwise rotation of reset shaft **70**a presses its left hand cam **71** against the spring **23** on sensing slide **22***a* and the upper edge of reset slide **49***a* to yieldably extend or depress the sensing slide and

positively extend or depress the reset slide. Similarly, clockwise rotation of the same reset shaft yieldably extends or depresses the center sensing slide **22***b* and positively extends or depresses the center reset slide **49***b*. In like manner rotation of reset shaft **70***b* in one direction depresses the center slides **22***b*, **49***b* and rotation of the shaft in the opposite direction depresses the outer slides **22***c*, **49***c*.

The reset shafts **70***a*, **70***b* are thus rotated by the proper keys inserted into the rear sensor housing locks **81***a*, **81***b*. To this end the locking lug **83** of each lock has a body from which the lug projects radially and which is concentric with the respective lock. Fixed in and extending forwardly from each lug body parallel to its rotation axis is a pin **84**. The pin of lock **81***a* extends through a radial slot in a radial arm **72** fixed by a screw **73** to the rear end of reset shaft **70***a*. Pin **84** of lock **81***b* extends through a radial slot in a similar radial arm fixed to the rear end of reset shaft **70***b*. As may be observed in FIGS. **2** and **3**, the lock and reset shaft axes are laterally displaced in such a way that rotation of each lock pin **84** by turning of the key in the respective lock rotates the corresponding reset shaft **70***a* or **70***b* and thereby it cams **71** in one direction or the other depending upon the direction of key rotation. As explained earlier, this reset cam rotation depresses one of the adjacent pair of sensing and reset slides **22**, **49** depending on the direction of shaft rotation. The parts are arranged such that rotation of the locking lugs **83** to their locking positions of FIG. **2** rotates the reset shafts and cams to their normal positions of FIG. **4** wherein all of the slides are free to return to their upper retracted positions shown.

At this point it is significant to recall that in the programming mode of the sensor unit S a key card C with one or more of the code patterns **149***a*, **149***b*, **149***c* is inserted into the unit. Accordingly, the corresponding tumblers **30** are positioned in their forward or rearward limiting positions according to the code pattern. Each tumbler then has a slot **33** or **34** aligned with its respective sensing slide. It is also significant to recall that depression of the reset slides **49** releases the tumbler positioning levers **48** for free rotation of the tumblers **30** between the two locking positions of their respective positioning levers.

Assume now that a key card C with selected code patterns **149***a*, **149***b*, **149***c* is inserted into the sensor unit S and that a proper key is inserted into lock **81***a* and turned in a direction to depress sensing and reset slides **22***a*, **49***a*. Depressing of the reset slide **49***a* releases the corresponding tumblers **30** for rotation between their respective positioning lever locking positions. Depression of the sensing slide **22***a* presses the upper edges of the slide openings **42** against the bottom walls of the tumbler slots **33** or **34** aligned with the slide, thereby producing a camming action in the tumblers for rotating the latter to positions wherein the bottom walls of all the aligned tumbler slots parallel the upper slide opening edges. These positions of the tumblers are their respective go positions referred to earlier. Depression of the remaining sensing and reset slides by turning the key in lock **81***a* and a key in lock **81***b* produces the same action on their respective tumblers. As will appear from the ensuing description, this tumbler positioning action effectively presets or programs into the sensor unit S code patterns in the form of angular tumbler positions corresponding to the key card code patterns **149***a*, **149***b*, **149***c*, such that a card with one or more of these patterns will place the locking mechanism M in an unlocked condition. After the programming action is completed, the keys in locks **81***a*, **81***b* are turned to return the locking lugs **83** to locking position and the reset cams **71** to normal position. The reset slides **49** are then returned to normal position by a spring **50** seating against the lower ends of the slides. The sensing slides **22** are returned in the manner explained below.

It will be recalled that the locking lugs **83** are rotatable to unlocked positions wherein they permit removal of the rear sensor housing cover **80**. The reset shaft actuating pins **84** are axially slidable into and from the slots in their reset arms **72** so as to permit removal and replacement of the cover.

As noted earlier, the sensing mode of the sensor unit S involves release of any sensing slide **22** for extension by spring action whose tumblers **30** are all in go position. The means for accomplishing this sensing slide extension will now be explained. Fixed to the front wall of the sensor housing **11** and extending rearwardly from the wall in a common plane normal to the center lines of the sensing slides and containing the central axes of the lower sensor housing mounting boss **53** are three support pins or shafts **15**, designated individually as **15***a*, **15***b*, **15***c*. Rotatable on each shaft **15** is a radial sensing slide actuating arm **16** having a forward hub and restrained axially by retainer rings **18** on the shaft. A torsion spring **17** surrounding each arm hub has one end anchored to the front wall of the sensor housing **11**. The other spring end engages a cross pin **88** fixed to the arm in spaced parallel relation to the shaft. Springs **17** urge arms **16** in the clockwise direction in FIG. **4**. The pins **88** extend rearwardly through arcuate cam slots **90** in their respective sensing slides **22**. Referring to FIG. **4** it will be seen that slots **90** extend crosswise across the lower ends of the sensing slides and curve upwardly as they approach the left hand vertical edges of the slides. When the sensing slides are in their upper retracted positions, the sensing slide actuating pins **88** are located at the extreme right hand ends of the cam slots, and the actuator arms **16** are rotated counterclockwise through an angle of about 45° from the longitudinal center lines of the slides. From this description, it will be understood that spring **17** urge the actuator arms **16** clockwise in FIG. **4** and thereby urge the arm pins **88** toward the left ends of their cam slots **90**. This motion of the pins along the slots produces downward camming forces on the sensing slides for extending the slides downwardly. Thus, the sensing slide actuator spring **17** yieldably urge the sensing slides **22** from their upper retracted positions to their lower extended positions. During their movement along the cam slots **90**, the pins **88** pass across the longitudinal center ends of the sensing slides and enter the upturned cam slot ends to lock the sensing slides in their extended positions.

Rotatable on the shafts **15** between the sensing slides **22** and support plate **45**, are sensing slide release arms **25**. Arms **25** are positioned axially of the shafts by retaining rings **18**. As shown best in FIG. **4**, the lower ends of the release arms are joined by a connecting bar **28** which is pivotally attached to the arms by screws **29**.

The three release arms are oriented in parallel relation to one another, as illustrated. Each release arm **25** has a notch **25***a* in its right hand edge, as viewed in FIG. **4**, in which seats the rear end of the cam pin **88** of the corresponding sensing slide actuating arm **16**. It is evident, therefore, that the actuating arm springs **17** urge the release arms **25** clockwise in FIG. **4**.

Surrounding the center shaft **15**; i.e., shaft **15***b*, between its release arm **25** and the support plate **45** is a torsion spring **87**. One end of this spring seats against an abutment **45***a* on the front side of the support plate. The other end of the spring seats against a cross pin **27** fixed in and extending rearwardly from the center release arm **25** in spaced parallel relation to shaft **15***b*. Pin **27** extends through a clearance opening in support plate **45** and a longitudinal clearance slot in the center reset slide **49***b*. Spring **87** urges the center release arm and hence the two outer release arms counterclockwise in FIG. **4**.

It will now be understood that the sensing slide actuating spring **17** and the release arm spring **87** oppose one another. Thus, the slide actuating springs **17** urge the sensing slide actuating arms **16**, their pins **88**, and the release arms **25** clockwise in FIG. **4** and thereby tend to yieldably urge the sensing slides **22** to and lock the slides in their lower extended positions. The release arm spring **87**, on the other hand, urges the slide actuating arms and the release arms counterclockwise in FIG. **4** and thus tends to urge the sensing slides to their upper retracted positions. Each sensing slide actuating spring **17** exerts a greater force or torque than does the release arm spring **87** and is thus capable of overriding the latter spring, as a consequence, in the absence of any force aiding the release arm spring **87**, the actuating spring **17** for any sensing slide **22** which is free to descend to its extended position by virtue of its tumblers **30** all being in go position, will rotate the corresponding slide actuating arm **16** and the three release arms **25** clockwise in FIG. **4**. This action extends each free sensing slide to its lower extended position.

Coaxially fixed in the lower sensor housing mounting boss **53**, on the axis of the center release arm shaft **15**, i.e., shaft **15***b* is a bushing **57** which projects a short distance rearwardly of the boss. Bushing **57** journals the shaft **64***a* of a disc **64** which is spaced from the rear end of the bushing **57** by a washer **63**. Fixed to the front end of shaft **64***a* is an arm **66** to which is secured in a radial slot the rear end of the center release arm pin **27**. Accordingly, release arms **25** and disc **64** rotate in unison.

As will appear from the ensuing description, disc **64** is operatively connected to the locking mechanism M in a manner such that a spring within the mechanism normally exerts a counterclockwise torque on the disc which aids the force of the release arm spring **87**. The combined force or torque of this aiding spring and the release arm spring is greater than the combined force or torque of the three sensing slide actuating springs **17**. Accordingly, when the aiding spring force is applied to the disc **64**, the release arms **25** and hence also the sensing slide actuating arms **16** and pins **88** are retained in their positions of FIG. **4**, and the sensing slides **22** are retained in their upper retracted positions. It will also appear that the locking mechanism M has a handle which may be rotated through a small angle to remove the aiding spring force from the disc **64**, thereby to permit clockwise rotation of the release arms **25** and disc **64** by the actuating spring **17** of any sensing slide **22** which is free to descend to extended position. As explained in the following description, the lock mechanism embodies a latch which is operatively connected to the disc **64** so that such clockwise rotation of the disc retracts the latch to place the locking mechanism in unlocked condition.

The lock M, which is essentially a conventional door lock set modified for use with the sensor unit S, will now be described. As best shown in FIG. **1**, the lock is mounted in a door A between the vertical door edge and the sensor unit S. Referring to FIGS. **6** and **7** the lock includes a generally cylindrical housing **200** fitted within a circular opening **200***a* in the door. This housing has upper and lower sheet metal center sections **220**, **221** of generally channel shape in transverse cross section having sector shaped flanges with arcuate edges which are circularly curved about the axis of the housing. At opposite sides of these center sections are tubular handle bearings **216**, **219** having inner circular flanges **216***a*, **219***a* coaxial with and welded to the flanges of the center sections **220**, **221**. Welded to the inner sides of the bearing flanges **216***a*, **219***a* are plates **217**, **218** which form with the center sections **220**, **221** a guideway **211'** extending normal to the vertical edge of the door A. The handle bearings **216**, **219** project a short distance beyond the sides of the door. Threaded on the projecting ends of the bearings **216**, **219** are circular mounting plates **233** which seat against opposite sides of the door A about the door opening **200***a* to position the lock housing **200** centrally in the opening. Cover plates **232** fit over and are secured to the mounting plates **233**. The cover plates **232** having openings **232***a* aligned with the lock housing bearings **216**, **219**.

Located at opposite sides of the door A, or the axis of the lock housing bearings **219**, **216** are an outside knob **201** and an inside knob **236**. The outside and inside knobs have concentric sleeve portions **201***a* and **236***a* each rotatable within its inner lock bearing **219** or **216**. Cylindrical spindles **202**, **208** extend through the knob sleeve portions **201***a*, **236***a*, respectively. The outer spindle **202** is welded to the sleeve portion **201***a* of the outer knob **201** and is closed at its outer end by a welded plug. The sleeve portion **236***a* of the inner knob **236** is releasably secured to the inner spindle **208** by a spring detent **235** which may be depressed to remove the inner knob.

Slidable within the guideway **211'** in the lock housing **200** is a slide **222** having arms **222***a* which extend toward the vertical edge of the door A. Mounted within a recess in the door edge, on the longitudinal axis of the guideway **211'** is a latch unit **234** having a barrel **234***c* containing a retractable latch member **234***a*. The lock housing **200** and latch barrel **234***c* are releasably joined by slidable engagement of inwardly bent flanges **220***a*, **221***a* of the housing center sections **220**, **221** in transverse grooves at the end of the barrel, as shown in FIG. **7**. Latch member **234***a* is normally extended by spring action to its position of FIGS. **6** and **7** wherein it projects beyond the door edge to engage a keeper in the door frame to latch the door in closed position. The slide arms **222***a* have in-turned ends which engage in grooves **234***b* in the inner end of the latch member

234*a* so that movement of the slide away from the latch unit 234 retracts the latch member clear of the keeper (not shown) to permit opening of the door.

Side 222 is urged by spring 223 toward the latch unit 234 to extend the latch member 234*a*. The slide is moved away from the latch unit against spring action by rotation of the door knobs 201, 236 to retract the latch member. To this end, a section of the inner ends of the knob spindles 202, 208 are cut away and the ends are bent to provide the spindles with camming shoulders 202*a*, 208*a* which project into the lock guideway 211′ and engage the edge 222*c* of the slide 222 in FIG. 7. Rotation of either knob in either direction urges one of its camming shoulders against the slide to retract the latter and hence the latch member 234*a* inwardly in FIG. 7.

The inner knob 236 is always free to turn to retract the latch member 234*a* and thus release the door A for opening. A latch mechanism 209 is provided for releasably locking the outside knob 201 against turning to open the door. This latch mechanism comprises a latch key 212 whose lower end in FIG. 6 fits within a slot 211*a* in a movable plunger 211 in the inside knob spindle 208. The key extends from the plunger 211, through a clearance slot 222*b* in the slide 222, into a slot 205*a* within a generally cylindrical guide 205 rotatable within the outer knob spindle 202. Guide 205 is fixed against axial movement in the spindle 202 by a stop 206 on the spindle engaging within a groove 207 in the guide.

Between its ends, key 212 has a lateral arm 212*a* which projects edgewise from the key in the direction of retraction movement of the slide 222 and then turns at right angles to form a latch detent 212*a*. This latch detent is engageable within aligned axial latching slots 202*b*, 218*a* (see FIG. 6) in the inner end of the outer knob spingle 202 and the housing side plate 218. Slot 219*b* in the outer lock housing bearing sleeve 219 provides clearance for key 212. Engagement of the key detent 212*b* within the latching slots 202*b* and 218*a* obviously lock the outer knob 201 against turning to retract the latch 234*a* and thereby open door A.

Latch key detent 212*b* is retractable in two ways from the outer knob spindle slot 202*b* to release the outer knob 201 for turning to open the door A. Thus, the key is movable longitudinally downward in FIG. 6 along the axis of the knob spindles 202, 208 to an unlatched position wherein the latch key detent 212*b* is retracted endwise from the latch slot. The latch detent 212 is also rotatable counterclockwise in FIG. 6 about its pivot 213 to an unlatching position wherein the detent is retracted laterally from the latch slots. As shown in FIG. 6, the upper end 212*c* of the latch key 212 projects a distance beyond the end of the latch key detent 212*b* and remains within the key guide slot 205*a* in both the longitudinal and lateral unlatching positions of the key.

The latch mechanism 209 is operable from the inside of the door A to lock the latch key 212 in and release the key for longitudinal movement from its latching position. This latch mechanism comprises a latch release turn button 209*a* rotatable and slidable in the inner knob spindle 208 and projecting through a central opening in the inner knob 236. The exposed end of the button is beveled so that the button may be depressed and rotated. The inner end of the button 209*a* has a reduced stem 209*b* rotatably connected to the plunger 211 as shown. Acting between the latter plunger and a snap ring 215 fixed within the inside knob spindle 208 is a compression spring 214 which urges the latch key plunger and the latch release button 209 downward in FIG. 6 to retract the latch key 212 to its longitudinal unlatching position. Such downward movement of the latch key is limited by engagement of a radial stop pin 210 on the latch release turn button 209 with a longitudinally presented edge of a wall opening 208*b* in the inside knob spindle 208 through which the pin projects. This longitudinally presented edge of the opening 208*b* is shaped to provide a relatively deep recess 208*c*, a relatively shallow recess 208*d*, and a bevelled shoulder 208*e* between the recesses. The latch release turn button 209 is rotatable by grasping its exposed bevelled end to position the plunger stop pin 210 in either recess 208*c* or 208*d*. Rotation of the stop pin into the deep recess 208*c* permits downward movement of the latch key 212 to its longitudinal unlatching position to release the outside knob 201 for turning to open the door A. Rotation of turn button 209*a* to position the stop pin in the shallow recess 208*d* locks the latch key 212 in latching position, thus latching the outside knob 201 against turning to open the door.

As thus far described, the door lock mechanism M is generally conventional. According to the present invention, the sensor unit S and lock mechanism M are interconnected in a manner such that spring extension of any one or more of the sensing slides 22 to their lower extended positions in response to insertions of a properly coded key card C into the sensor unit and initial partial rotation of the outside door knob 201, as explained below, rotates the latch key 212 to its lateral unlatching position to release the outside knob for full rotation to retract the door latch 234*a* and thereby release the door A for opening.

To these ends, the door is provided with an edgewise opening 282 which opens at its left end in FIG. 7 into the door opening 53*a* which receives the lower mounting boss 53 of the sensor unit S. The right end of the opening 282 opens to the door lock opening 200*a*. It will be seen that the door openings 53*a*, 200*a*, 282 have their axes located in a common plane normal to the vertical edge of the door A. Positioned within the opening 282 is a bushing 237. The lock housing 200 and bushing 237 are releasably joined by slidable engagement, within transverse grooves 237*a* at the right end of the bushing in FIG. 7, of flanges 229*a* on a plate 229 secured by screws 231 to inwardly bent end portions of the lock housing center sections 220, 221. When assembling the lock M in the door A, the bushing 237 is inserted endwise through the latch unit opening in the door and then into its opening 282 to the position of FIG. 7. The latch unit 234 is inserted endwise into its opening also to the position of FIG. 7. The lock housing 200 is then inserted from the outside of the door axially into the door lock opening in such a way that the right inturned ends of the lock slide arms 222*a* engage in the grooves 234*b* in the door latch 234, the lock housing flanges 220*a*221*a* engage in their grooves in the latch barrel 234*c*, and the lock housing flanges 229*a* engage in the bushing end grooves 237*a*.

Slideable within an opening 237*b* in the bushing 237 is a connector rod 239. The right end of this rod in FIG. 6 is attached by a pivot 230 to one end of a generally U-shaped lever 224. The opposite end of the lever enters a slot in the plate 229 and is attached by a pivot 228 to the plate. Connector links 225 extend between and are attached by pivots 226 to mid points of the latch key 212 and the lever 224. From this description, it will be understood that an aftward force on the connecting rod 239 in FIG. 6 retracts the latch key 212 from latch slot 202*b* to its lateral unlatching position.

Rotatably secured by a screw 242 to the left end of connector rod 239 in FIG. 7 is a connector bar 240. The left end of the connector bar is pivotally attached by a screw 65 to the disc 64 of the sensor unit S at a position spaced radially from the disc axis. The screw passes through a slot in the rod, as shown. It is evident that rotation of the disc 64 imparts longitudinal movement to the connector rod 239, and resultant pivotal movement to the latch key 212 about its pivot 213. From the earlier description, it will be recalled that in the absence of any force aiding the counterclockwise torque (in FIG. 4) of the release arm spring 87, the clockwise torque of the sensing slide actuator spring 17 will extend any sensing slide 22 whose tumblers 30 are all in go position and rotate, clockwise in FIG. 7, the sensor unit disc 64. As will appear presently, such clockwise rotation of the disc occurs from its position of FIG. 7, hereafter referred to as its normal position, to a position hereafter referred to as its actuated position. This rotation of the disc moves the connector rod 239 to the left in FIG. 6 and thereby pivots the latch key 212 from its latching position to its lateral unlatching position to permit rotation of the outer knob 201 to open door A.

Referring particularly to FIG. 7, it will be seen that the bias spring 223 for the slide 222 of the lock M urge the slide to the right to a position wherein the edge 222*d* of the slide opening or slot 222*b* presses against the latch key 212 to yieldably retain the key a against pivoting to its lateral unlatching position under the above-described action of the sensing slide actuating spring 17. In other words, the lock slide springs 223 oppose the sensing slide actuating springs and exert on the sensor unit disc 64 a counterclockwise force or torque aiding that of the release arm spring 87. According to the present invention the combined counterclockwise spring torque exerted on the disc 64 by the release arm and lock slide spring 87, 223 is greater than the combined clockwise spring force or torque exerted on the disc by the three sensing slide actuating springs 17. Accordingly, so long as the slide springs 223 exert their release arm aiding force or torque on the disc 64, the sensing slides 22 are retained in their upper retracted positions.

As best shown in FIG. 7, the latching slot 202*b* in the outside door knob spindle 202 is circumferentially enlarged relative to the thickness of the latch key detent 212*b*, such that the outside knob 201 can be rotated through a small angle when the latch key 212 is in latching position. This rotation is not sufficient to retract the latch member234*a* enough to open the door A. However, such knob rotation is sufficient to retract the lock slide 222 to the left in FIG. 7 to disengage the slide edge 222*d*, and hence remove the thrust of the slide springs 223, from the latch key and permit pivoting of latch key to its lateral unlatched position. In other words, the above limited rotation of the outer door knob 201 removes from the sensor unit disc 64 the release arm spring aiding force or torque of the lock slide springs 223. This conditions the latch key 212 for rotation to its lateral unlatching position in response to insertion into the sensor unit S of a key card C which is properly coded to place all the tumblers 30 for at least one sensing slide 22 in go position. Once the latch key is retracted to its unlatching position, the outer door knob 201 can be rotated through the full angle required to retract the latch member 234*a* and open the door.

As noted earlier, the sensor unit S is equipped with a night latch N (FIG. 5) for at least partially inactivating the unit against actuating the door lock M to unlocked condition in response to insertion of a properly coded key card into the sensor unit. The night latch may be arranged to totally deactivate the sensor unit against entry by all persons with properly coded key cards. However, in most cases, it is desirable that the night latch is set for partially deactivating the unit. For example, in the earlier described hotel application, it will be recalled that employees and the manager may be issued differently coded key cards C which provide the employees access to selected rooms or selected groups of rooms and the manager access to all rooms. The particular inventive embodiment illustrated is intended for such a controlled multiple access application and its night latch N is so arranged that when set, it bars access by all persons except those, such as a hotel manager, with a specially coded card.

To this end, the night latch N has a shaft 67 parallel to and laterally spaced to one side of the sensor unit shafts 15, 64*a* and having its axis in a plane passing between the reset slides 49*a*, 49*b* and the sensing slides 22*a*, 22*b*. Shaft 67 extends forwardly through aligned openings in the rear sensor housing plate 77, the lower sensor housing mounting boss 53, and plate 51. The front end of shaft 67 abuts the rear end of a shaft 19 which extends forwardly between reset slides 49*a*, 49*b*, through support plate 45, between sensing slides 22*a*, 22*b*, and through the front wall of sensor unit housing 11, its front cover 12 and the outer wall of the key card guide 13. The rear end of the rear shaft 67 is enlarged and internally threaded to receive a threaded stem 68 of the night latch push button 79. Fixed on shaft 67 is a retainer ring 69 for limiting rearward movement of the shaft. The rear end of shaft 19 is squared, and mounts a sensing slide stop 43 in the form of a bushing slidable on the shaft. Forward movement of the stop along the shaft 19 is limited by a retainer ring 20 on the shaft. Surrounding shaft 19 between the front cover 12 of the sensor housing 11 and the retainer ring 20 is a compression spring 21 for urging the shafts 19, 67 rearwardly. A second spring 44 surrounds the shaft 19 between the stop 43 and the support plate 45 for urging the stop forwardly against the retainer ring 20. Spring 21 exerts a greater force than spring 44 and is thus capable of moving the shaft 19 and stop 43 rearwardly against the action of the latter spring.

As may be best observed in FIG. 4 the adjacent vertical edges of the sensing slides 22*a*, 22*b* having rectangular notches 91 through which the forward night latch shaft 19 and its stop 43 extend. When the sensing slides

22*a*, 22*b* are in their upper retracted positions, these notches are aligned to form a rectangular opening. Stop **43** has a rear enlarged rectangular portion **43***a* whose cross-section is just slightly smaller than that of the slide opening formed by notches **91**. The front end **43***b* of the stop is reduced to a cross section whose dimension in the direction of movement of the sensing slides is substantially less than the corresponding dimension of the slide notches **91**. The squared portion of shaft **19** forwardly of retainer ring **69** passes through a square opening in the support plate **45** to support the shaft and restrain it against turning. Stop **43**, in turn, has a square opening slidably receiving the square shaft portion. Accordingly, the stop is retained in its angular position of FIG. **4**, wherein the sides of the stop parallel the edges of the slide notches **91**.

The night latch spring **21**, being stronger than spring **44**, tends to yieldably retain the shafts **19**, **67** in a rear retracted or inoperative position, wherein the reduced portion **43***b* of the stop **43** is located within the slide notches **91**. This reduced stop portion is sized to permit downward movement of the sensing slides **22***a*, **22***b* to their extended positions to actuate the lock M to unlocked condition. The night latch shafts **19**, **67** are depressable to their forward positions of FIG. **5** against the rearward thrust of spring **21**, by finger pressure on the rear or inner latch button **79**. In this position, the rear enlarged portion **43***a* of the stop **43** is located within the notches **91** in the sensing slides. This rear enlarged portion is sized to retain the latter slides in their upper retracted positions. Thus, the sensor unit S is inactivated against actuating the lock M to unlocked condition, even in response to insertion into the unit of a key card C with a proper code pattern **149***a* and/or **149***b*. However, the sensing slide **22***c* remains free to move to its extended position to place the lock M in unlocked condition in response to insertion of a key card with a proper code pattern **149***c*.

It is possible that the night latch may be pressed when either or both the sensing slides **22***a*, **22***b* are not in their fully retracted positions. In this event, the stop **43** may contact and damage the slide or slides if sufficient force is exerted on the night latch button **79**. This possibility of slide damage is avoided by the spring **44** which permits the stop **43** to yield in the event it encounter either or both sensing slides **22***a*, **22***b* when the button **79** is pressed to set the night latch.

Means are provided to releasably retain the night latch shafts **19**, **67** in their forward locking positions of FIG. **5**. This latch retaining means comprises a keeper or locking disc **59** rotatable on the protruding rear end of the sensor unit bushing **57**. Disc **59** is positioned axially on the bushing by a washer **58** and a retainer ring **62**. The disc has a circumferentially elongated notch **59***a* (FIG. **7**) through which extends the night latch shaft **67**. One end edge of this notch is bevelled to form a cam edge **59***b*. Locking disc **59** is urged in the clockwise direction in FIGS. **2** and **7**, to urge its cam edge **59**b against the night latch shaft **67**, by a spring **55**. This spring is secured by a shoulder screw **56** to the lower sensor housing mounting boss **53** and has one end bearing against a pin **54** on the boss and its other end bearing against a pin **60** on the locking disc **59**.

Formed on the night latch shaft **67** is a conical cam **67***a* having a rear locking shoulder **67***b*. When the shafts **19**, **67** are in the rear retracted or unlocking position, wherein the sensing slides **22***a*, **22***b* are free to extend and retract, the cam **67***a* is located rearwardly of the locking disc **59**. Forward depression of the shafts to their extended locking position of FIG. **5** by finger pressure on the night latch button **79** urges the cam against the beveled cam edge **59***b* of the locking disc **59**, thereby rotating the disc counterclockwise in FIG. **2** against the action of the disc spring **55** to permit the cam to move past the disc. Upon arrival of the night latch shafts in their forward locking position of FIG. **5** the edge **59***a* of the locking disc snaps behind the cam shoulder **67***b* to retain the shafts in locking position.

The night latch shafts **19**, **67** are released for spring return to their rear unlocking position by inward retraction of the door latch member **234***a* in FIGS. **6** and **7** either in response to closing the door A or turning the inside door knob **236**. To this end, a connecting rod **238** is rotatably attached at one end to the locking disc **59** by a means of a screw **61**. This connecting rod slides in the door lock bushing **237**. The opposite end of the rod extends into the housing **200** of the door lock M for contact with the lock slide **222** when the latter moves to the left in FIG. **6** either in response to turning the inner door knob **236** or inward retraction of the latch member **234***a* when the door A is closed. The slide moves the connecting rod **238** to the left in FIG. **7**, thereby rotating the locking disc **59** counterclockwise to release the night latch shafts **19**, **67** for spring return to their rear unlocking position.

The operation of the illustrated coded key card actuated door lock will now be described. The lock has three basic modes hereafter referred to as a "normal inoperative mode," a "programming mode," and a "-sensing mode." In the normal inoperative mode with the door A closed, the parts of the sensor unit S and lock mechanism M occupy their illustrated positions wherein the outer door knob **201** is locked against turning to open the door. The wave spring **50** then retains the reset slides in their upper locking positions wherein the tumbler positioning levers **48** and hence the tumblers **30** are locked in fixed angular positions on their rotation axes. One slot **33** or **34** in each tumbler is then oriented with its bottom wall parallel to the upper edge of the corresponding opening **42** in the respective sensing slide **22**. The release arm spring **87** of the sensor unit aided by the slide springs **223** of the lock mechanism M retains the sensor release arms **25** in their counterclockwise limiting position of FIG. **4** wherein they retain the sensing slides **22** by their upper retracted positions. The lock slide springs **223** retain the latch key **212** in its latch slot **202***b*, to lock the outer knob **201** against turning.

In the programming mode, the sensor unit S is programmed to release the lock mechanism M for operation to unlocked condition in response to insertion of a properly coded key card C into the unit. This programming operation is accomplished by inserting into the sensor unit in sequence one or more key cards with selected code patterns. The sensor tumblers **30** are thereby positioned axially in accordance with their respective card code pattern or patterns. The inside door knob **236** is now rotated to retract the lock slide **222** and thereby remove from the sensor unit the release spring aiding force of the slide springs **223**, and

a sensor unit lock **81** associated with the tumblers of a code group to be programmed are rotated with the proper key and in the proper direction to extend the respective sensing and reset slides **22, 49**. Reset slide extension releases the corresponding tumblers for rotation on their axes. Sensing slide extension rotates the corresponding tumblers, by the camming action described earlier, to the angular positions determined by the tumbler notches **33** and **34** then located in the plane of the sensing slides. Finally, the sensor lock is returned to its normal locking position and the inside door knob released to effect spring return of the sensing and reset slides to their retracted positions. The tumblers **30** are thereby locked in their programmed angular positions.

The sensing mode of the lock involves insertion into the sensor unit of a key card C with one or more of the code patterns **149***a*, **149***b*, **149***c*, and rotation of the outer door knob **201** through the angle permitted by the angular extent of the latch key notch **202***b* in the outer knob spindle. As noted earlier, this knob rotation removes from the sensor unit release arms **25** the aiding force or torque furnished by the lock slide springs **223**. Removal of this aiding torque, in turn, conditions any one of the sensing slide springs **17**, whose corresponding sensing slide **22** is free to extend or descend by virtue of its tumblers **30** all being placed in go position by the key card C currently inserted into the sensor unit, to rotate the sensor unit output disc **64** clockwise in FIG. **7** and thereby retract the latch key **212** of the locking mechanism M from its latching slots **202***b* in the outer door knob spindle **202**. The outside knob is then released for full rotation to retract the latch member **234**a and open the door A.

It is now evident that insertion into the sensor unit S of the key card C with a code pattern **149***a*, **149***b*, or **149***c* which matches the corresponding code pattern programmed into or stored in the sensor unit actuates the output member or disc **64** of the unit to release the lock mechanism M for operation to its unlocked condition by rotation of the outside door knob. This capability of the sensor unit to store three different code patterns adapts the unit for the multiple controlled entry applications, such as the hotel application, referred to earlier. In the hotel application, guests may be issued key cards with a code pattern **149***a* which is coded to permit them access to their own rooms only, employees may be issued cards with a code pattern **149***b* which is coded to permit them access to selected groups of rooms, and the manager may be issued a card with a code pattern **149***c* which is coded to permit them access to all rooms. If desired each sensor unit lock **81** may be designed to require one key for clockwise rotation and another key for counterclockwise rotation so that programming of the sensor unit requires separate keys to store in the unit each of the programming card code patterns **149***a*, **149***b*, **149***c*. It is significant to note here that the night latch N, when set in locking position, bars entry to the room even in response to insertion into the sensor unit S of a key card C with a proper code pattern **149***b* (employee card) or **149***a* (guest card). However, the door A may be opened by a key card with a proper code pattern **149***c* (manager card). In other applications of the lock, a key card for the sensor in FIG. **4** can have **14, 28, 42** or more magnets. For each door, only **14** magnets. For each door, only **14** magnets will be used. A key card with **42** magnets can open three doors, each door using a different code pattern. It is significant to recall here that the tumbler slots **33, 34** are separated by a shoulder **36**. These shoulders prevent unauthorized setting of the tumblers in go position without a valid key card by applying a powerful force, for example, that of a magnet, to the outer side of the sensor unit during the time the outer door knob is held in a rotated position to release the spring force of the slide springs **223** from the sensor unit S.

It will be recalled that the above discussed capability of the sensor unit S to store three separate code patterns and to release the locking mechanism M for operation to unlocked condition in response to a key card with any one of these code patterns results from the fact that the sensing slide actuating or camming pins **88** engage in notches **25***a* in the slide release arms **25** such that all three release arms **25** are free to rotate clockwise in FIG. **4** in response to release of only one of the sensing slides **22** for extension by placement of its tumblers **30** in go position. In some cases, it may be desirable to require a key card C to have all three properly coded patterns **149***a*, **149***b*, **149***c* to actuate the sensor unit S and release the locking mechanism M. This may be accomplished by providing the release arms **25** with closed slots rather than open notches to receive the sensing slides actuating or camming pins **88** such that all three sensing slides **22** must be released for extension by placement of their tumblers **30** in go position in order to enable clockwise rotation of the arms. Alternatively, of course, the same end may be accomplished by providing the sensor unit with a single sensing slide, reset slide, and release arm and the key card C with a single code pattern. In this case the sensor unit does not require spring **87** and may be designed to receive three separate key cards, as explained later.

Occasionally, it may be necessary to remove the rear plates **77, 80** from the sensor unit S or to remove the entire sensor unit from the door A for servicing, repair, or other reasons. As noted earlier, this requires operation of locks **81** to unlocking position by insertion and rotation of the proper lock keys. An important feature of the invention resides in the fact that this operation of the locks depresses the reset slides **49** to release the tumblers **30** for rotation under the action of gravity on the tumbler positioning levers **48** and/or other forces active on the tumblers. This feature, then, constitutes, in effect, a memory erase feature which prevents unauthorized observation or copying of the programmed sensor unit code patterns, i.e., programmed angular tumbler positions, when the sensor unit is removed.

It will not be understood that the sensor unit S is programmed for actuation, i.e., rotation, of its output member or disc **64**, in response to insertion into the unit of a key card C with one or more selected code patterns. Such actuation of the unit indicates, in effect, that the key card is authentic. Considering this basic operation of the sensor unit, it is evident that the latter may be employed for a wide variety of applications in addition to the door lock application described above and may embody a wide variety of modifications for accomplishing the various functions required for each application. A few of these many possible alternative uses and modifications will now be described.

FIG. 9, for example, illustrates a modification which may be embodied in the door lock of FIGS. 1–4, and 8 and also used for various other applications. In this case, the sensor unit S is identical to that described above. Associated with the unit is a push button actuator 260 which is installed in the sensor unit mounting support 276. In the particular inventive embodiment illustrated in FIGS. 1 – 8, this support may be the door A. In other applications, the support may be any supporting structure appropriate to the particular applications involved.

The illustrated actuator 260 has mounting plates 261, 275 which are secured to opposite sides of the support 276 in overlying relation to an opening 276*a* through the support and have flanges which project into the opening, as shown, to center the plates relative to the opening. The plates are attached to the support by screws 274 which pass through plate 275 and are threaded in posts 273 (only one shown) fixed to and extending from the inner side of the plate 261. Mounting plate 261 has a central, inwardly flanged opening slidably receiving a pushbutton 268. About the inner end of the pushbutton is a flange 268*a* which is engageable with the mounting plate flange 261*a* to limit outward movement of the pushbutton to its illustrated extended position. Mounted within the support opening 276*a*, by means of a bracket 270 attached to the mounting plate 261, is an electrical switch 271. This bracket has a plate portion 270*a* which extends across the inner end of the pushbutton 268 and to which switch 271 is secured by screws 272. A compression spring 269 acts between the pushbutton 268 and the bracket plate portion 270*a* to urge the pushbutton to its illustrated extended position.

Attached by a pivot 263 to a mounting bracket 262 secured to the inner side of mounting 261 adjacent one end of switch 271, is a bell crank 264. One arm 264*a* of this bell crank seats against the outer face of the pushbutton flange 268*a*. The other arm 264*b* of the bell crank seats against the switch plunger 281. Plunger 281 is urged outwardly against the bell crank arm 264*b* by a light spring (not shown) within the switch. The lever arm 264*b* is connected to the screw 65 on the output member or disc 64 of the sensor unit S by a connector rod 265 which is attached to the bell crank arm 264*b* by a pivot 266.

At this point, it is significant to recall that each sensing slide actuating spring 17 of the sensor units opposes and is stronger than the slide release arm spring 87 and tends to rotate the output disc 64 clockwise in FIGS. 2 and 7 against the action of the release arm spring. The push-button actuator 260 is connected by the rod 265 to the disc 64 in a manner such that the push-button spring 269 aids the sensor unit release arm spring 87 and the actuator switch spring aids the sensing slide actuating springs 17.

The combined forces of the release arm spring 87 and push-button spring 269 on the disc 64 are greater than those of the sensing slide springs 17 and switch spring and thus retain the disc in its normal position, the sensor unit sensing slides 22 in their upper retracted position, and the actuator bell crank 264 in its counterclockwise limiting position of FIG. 9. In this crank position, the switch plunger 281 is held in its illustrated retracted position in the switch housing against the action of the switch spring. The switch 271 is thereby retained in one operating condition.

Depression of the actuator push button 268 removes the thrust of the push button spring 269 from the bell crank 264 and thereby the aiding force of the spring from the sensor unit S. The spring of the actuator switch 271 then tends to extend the switch plunger 281 to place the switch in its other operating condition. However, such extension of the switch plunger is controlled by the sensor unit S. Thus, the switch plunger can extend only if the sensor unit disc 64 is rotated clockwise in FIGS. 2 and 7 in response to insertion of a properly coded key card C into the sensor unit, as explained earlier.

It is now evident that in the normal inoperative condition of the sensor unit S, the switch plunger 281 is retained in its retracted position of FIG. 9 even though the actuator push button 268 is depressed. On the other hand, if a properly coded or authentic key card C is inserted into the sensor unit, depression of the push button will permit rotation of the sensor unit output disc 64 by one of more of the sensing sliding springs 17 and resultant clockwise pivoting of the actuator bell crank 264 in FIG. 9 to enable extension of the actuator switch plunger 281. The actuator switch 271 may have either or both normally closed and normally open switch contacts depending upon the function or functions to be performed. For example, the arrangement of FIG. 9 might be embodied in the door lock of FIGS. 1 – 8 to operate a signal or alarm for indicating opening of the door. Alternatively, the arrangement of FIG. 9 might be used merely as a key card verification or authentication device by illuminating a light in response to insertion of an authentic card into the sensor unit; or as a safety device for controlling a machine to permit machine operation only by authorized personnel; or for numerous other control applications.

It will be evident that the number of sensor unit tumblers may be varied to suit a particular application. Also, as noted earlier, the number of sensing and reset slides and card code patterns may be varied, or the sensing slides of the illustrated sensor unit may be interlocked, in the manner explained earlier, to require extension of two or three slides for actuation the the sensor unit. A sensor unit of this kind may be arranged to receive simultaneously three separate key cards each containing one of the three code patterns 149*a*, 149*b*, 149*c*, respectively, such that three different authentic cards, issued to three different persons, are required at the same time to actuate the sensor unit. In this case, each key card would be one third the width of that shown in FIG. 8, and the sensor unit may have separate guides for receiving the cards. Moreover, initiation of the sensing mode of the sensor unit, i.e., removal of the aiding spring force from the output member 64 of the unit, may be accomplished otherwise than by door knob rotation or push button depression, as explained thus far. For example, the key card itself may operate a device for removing the aiding spring force to initiate the sensing mode when the card is inserted into the sensor unit S.

The various diverse applications and modifications of the invention may require different relative positions of the sensor unit and a device, such as the locking mechanism M or push button actuator 260, used with the unit. To this end, the output disc 64 of the sensor unit is provided with a number of spaced threaded holes into which the disc screw 65 may be inserted, as

shown in FIGS. 2 and 7. It will be evident, of course, that the device which is used in conjunction with the sensor unit may be connected to its output disc 64 by other than a pivoted connector rod, such as a cable, gear and rack or the like.

FIG. 10 illustrates a modified tumbler 38 and key card C' for the sensor unit S. The modified tumbler and card are identical to those described earlier except that the tumbler magnet 39*a* has its poles spaced laterally of the tumbler and the card magnets 39*b* have their poles spaced lengthwise of the card. The card magnets may be arranged to repel or attract their respective tumblers by arranging the like or unlike poles opposite one another.

The sensor unit and key card arrangements described to this point permit the storage and sensing of only two levels of code pattern information on the key card, that is to say, each code position on the key card may be coded to establish only two different axial positions of the corresponding sensor unit tumbler. FIGS. 11 and 12 illustrate a modification of the invention which permits the storage and sensing of three levels of code pattern information, i.e., each code pattern position on the key card (not shown) may be coded to establish any one of three different axial positions of the corresponding sensor tumbler. In FIGS. 11 and 12, the sensor unit S, is illustrated in fragmentary fashion since, except for the card code pattern, tumbler configuration, and reset slide construction, the key card and sensor unit are identical to those described earlier. The parts of the sensor unit S_1 which are identical to those of the earlier sensor unit S are designated by the same numerals.

Each tumbler 300 in FIG. 11 is similar to the tumblers 30 in the sensor unit S, but unlike the latter tumblers, contains three transverse sensing slide receiving slots 302, 304, 306. The bottom walls of these slots are angularly displaced, as shown. The tumbler is axially movable to locate any one of the slots in the plane of the corresponding sensing slide 22. Fixed within a recess in the wall of the tumbler receiving bore 11*a* of the sensor unit housing 11 is a magnetic shunt 308. The magnetic shunt 308 is located to attract the magnet 310 such that tumbler 300 is biased to a neutral position and tumbler slots 302, 304, and 306 are so arranged so that the center tumbler slot 304 is located in the plane of the sensing slide 22 when the tumbler is in neutral position. Each code pattern position on the key card (not shown) may contain a magnet with a north pole, a south pole, or a magnet which is demagnetized or missing adjacent the respective tumbler 300. In this regard, it should be noted that for reasons of production, it is preferable that all code positions contain magnets, some of which may be demagnetized. If a card magnet is demagnetized or neutral or the code position is without a magnet, the corresponding tumbler will assume its neutral position, wherein the center tumbler slot 304 is in the plane of the sensing slide 22, under the interaction of the tumbler magnet 310 and the sensor shunt 308. On the other hand, if a code position is magnetized, the respective tumbler will assure either a forward or rearward limiting position, wherein the corresponding tumbler slot 302 or 306 is located in the plane of the sensing slide, depending upon the polarities of the adjacent card and tumbler magnets. In this regard, it will be understood that the key card magnets are sufficiently strong to effect axial positioning of the tumblers against the opposing action of the sensor magnet 310 and the shunt 308.

Each tumbler 300 is rotatable to three different angular positions wherein the bottom walls of its slots 302, 304, 306 parallel the upper edges of the sensing slide openings 42. As shown in FIG. 12, each reset slide opening 312 is shaped to retain its respective tumbler positioning lever 48 in three different angular positions corresponding to the three angular tumbler positions.

The sensor unit S_1 is programmed for actuation in response to a selected key card code pattern or selected code patterns in much the same way as described earlier in connection with FIGS. 1 – 8 except that two programming steps are required to program the sensor unit S_1. The first programming step is carried out in the manner explained earlier but without a key card inserted into the sensor unit, whereby the tumblers 300 assume their neutral axial positions in which the center tumbler slots 304 are aligned with the sensing slides 22. Accordingly, when a set of sensing and reset slides 22, 314 are depressed or extended by rotation of a proper key in its assigned sensor unit lock 81, all tumblers of the affected code pattern are rotated to the same position wherein the bottom walls of their center slots parallel the upper edges of the sensing slide openings 42. The second sensor programming step involves the same procedure as the first programming step but with a selectively coded key card inserted in the sensor unit. Under these conditions, the tumblers 300 assume their neutral, forward, or rearward axial positions according to the card code pattern, and the tumblers are rotated to positions wherein the bottom walls of their slots 302, 304, or 306, then in the plane of the sensing slide 22, parallel the upper edges of the slide openings 42.

The modified sensor unit S_1 requires the above two step programming procedure in order to initially locate all the tumblers 300 in an angular position wherein the bottom walls of their center slots 304 parallel the upper edges of the sensing slide openings 42. This is necessary to enable programming rotation of the tumblers, by extension of the sensing slides 22, to any of their three angular positions, in accordance with the key card code pattern. Thus, if any of the tumblers occupied in an initial position with one of its end slots 302, 306 in the plane of the sensing slide and the bottom wall of its other end slot parallel to the upper edge of the sensing slide opening 42, the sensing slide could not be extended to rotate the tumbler to its programmed angular position.

The sensing mode of the modified sensor unit S_1 is the same as described earlier in connection with FIGS. 1 – 8. In the mode, however, each tumbler may assure any one of three axial positions in response to the key card code pattern, thus substantially increasing the number of possible tumbler position combinations and hence the security of the sensor unit.

In the sensor units described to this point the tumblers are slotted and rotatably positioned in the programming mode to store a selected code pattern in the units. The tumblers sensing elements, i.e., the upper edges of sensing slide openings 42 have a fixed angular position normal to the direction of slide extension. FIG.

13 illustrates a modified sensor unit S_2 wherein the tumbler sensing elements are slotted and rotatably positioned in the programming mode.

Referring to FIG. 13, the sensor unit S_2 has a vertically movable sensing slide or slides **316** (only one shown) located directly in front of the sensor unit reset slides **49** (only one shown). Slides **49**, **316** are supported for vertical movement in the same manner as the slides in the earlier described sensor units but are located in somewhat different positions along the support rods **14**, **15**, in front of the release arms **25**. Rotatably mounted on the front sides of the slides **316** are tumbler sensing elements **318** one shown) arranged in vertical columns and horizontal rows in the same manner as the tumbler guides in the earlier sensor units. Each sensing element has transverse angularly displaced slots **320**, **322** and a positioning lever **48** at the rear side of its sensing slide **316**. Levers **48** are located within the reset slide openings **89** and cooperate with the reset slides to releasably lock the sensing elements **318** in either of two angular positions, as before. In one angular position, the bottom walls of sensing slots **320** are normal to the direction line movement of the sensing slides **316**. In the other angular position, the bottom walls of slots **322** are normal to the direction line.

Axially movable within the bores **11a** in the front wall of the sensor unit housing **11** are magnetic tumblers **325** each containing a magnet **326** at its front end. At the rear end of each tumbler is a circular flange **328**. Tumblers **325** are positioned axially, in either a forward limiting position or a rearward limiting position in accordance with the magnetic code pattern or patterns on a key card inserted into the sensor unit in the same manner as the tumblers in the earlier described sensor units.

The tumbler sensing elements **318** and tumblers **325** are equal in number and are so arranged that when the sensing slides **316** are in their upper retracted positions, each tumbler flange **328** is located directly below its corresponding sensing element. In the forward axial position of each tumbler, it s rear flange **328** is located in the plane of its respective sensing slot **320**. In the rearward axial position of each tumbler, its flange is located in the plane of its respective rear sensing slot **322**. The remainder of the sensor unit S_2 is essentially identical to those described earlier.

It will now be understood that the operation of sensor unit S_2 is similar to that of the earlier described units except that in the programming mode of unit S_2, the sensing slides **316** are depressed or extended with the reset slides **49** to move the slotted tumbler sensing elements **318** relative to the tumblers **325** which are positioned axially in accordance with the code pattern on the key card inserted into the sensor unit. The reset slide extension cams **71** on the reset shafts **70** are dimensioned and located to extend or depress the reset slides a slightly greater distance than the sensing slides, against the upward bias of the reset slide return springs **50** which act between the slides, to release the sensing element positioning levers **48** for programming rotation of the elements. During this slide extension, the bottom walls of the sensing slots **320**, **322** aligned with the respective tumbler flange **328** are urged against the flanges to effect rotation of the sensing elements **318** to their programmed angular positions. The slides are then returned to their retracted positions to lock the sensing elements in their programmed angular positions.

In the sensing mode of the sensor unit S_2, the sensing slides **316** and reset slides **49** are urged downwardly in unison by the slide springs **17** when the aiding spring force on the sensor unit output disc (not shown) is removed, in any of the ways described earlier. Any sensing slide whose tumblers **325** are then all in go position relative to their respective sensing elements **318** is released for extension to permit rotation of the output disc by the corresponding slide spring **17**.

Programming of the sensor units to store a selected keycard code pattern or selected card code patterns in a unit may be accomplished in ways other than those described thus far. For example, some or all of the tumbler positioning levers **48** may have screwdriver slots **330** (FIGS. **3**, **4**) and the sensor unit may have rear openings (not shown) through which a screw driver may be inserted to rotate the levers and hence the tumblers by hand. When this method of tumbler rotation is employed, there must be sufficient frictional resistance to tumbler rotation to retain the tumblers in position after they have been rotated.

FIGS. **14 – 16** illustrate a modified sensor unit S_3 with another programming arrangement. Sensor unit S_3 is identical to the sensor unit S_1 except that the tumbler positioning levers **48** are magnetized. The rear side of the support plate **45** is provided with lever stop ribs **334**, and the reset slides are replaced by a magnet programming card **336** containing magnets **338** which are arranged in such a way as to magnetically urge the levers, and hence their respective tumblers **30**, to and retain the same in one or the other of their angular positions wherein the levers contact the ribs **334**, as shown. The programming card **336**, is inserted into a slot **337** in the sensor unit. The card may obviously be magnetically coded to place each lever and its tumbler in either of their angular positions and thereby program or store any selected key card code pattern or patterns in the sensor unit. In this type of sensor unit, it is desirable, if not essential, to have the tumbler slots **33**, **34** angularly displaced 90° or more to prevent rotation of any tumblers from No-Go to Go position by the sensing slides **22** in the sensing mode of the unit.

The sensor units described to this point have utilized magnetically coded key cards and magnetic action to position the tumblers in accordance with the key card code pattern. FIG. **17** illustrates a modified sensor unit S_4 and key card C_4 which accomplish positive mechanical positioning, rather than magnetic positioning of the sensor tumblers. Sensor unit S_4 is identical to sensor unit S described earlier except for its modified tumblers **340** and its key card receiving guide **342**. Each tumbler **340** is similar to the tumblers **30** of the sensor unit S except that tumbler **340** contains no magnet and is urged to its forward position by a compression spring **344** acting between a rear shoulder on the tumbler and the support plate **45**. Axially movable within a front cavity **346** in tumbler body is a pin **348** with a shoulder **350**. A compression spring **352** acting between this shoulder and the bottom of cavity **346** urges the pin **348** forwardly to its illustrated position. Tumbler pin **348** projects through the front cover **12** of the sensor housing.

The key card C_4 has holes **354** defining code patterns corresponding to the code patterns of the earlier described key card C. These patterns may be coded to provide in each code position either a hole **354** for receiving the corresponding tumbler pin **348** or a flat surface for seating the pin.

The key card guide **342** of sensor unit S_4 comprises a plate **356** pivotally attached by a lower hinge **358** to the front side of the sensor housing. Plate **356** is swingable between a closed position against the cover **12** of the sensor housing **11** and an open position spaced from the housing. The inner face of this plate is recessed to receive the key card C_4 in the position shown when the plate is in its open position. When the plate, with its contained card, is rotated to closed position, the code positions of the card code pattern are aligned with the tumbler pins **348**. The key card then positions the tumblers **340** axially in accordance with the card code pattern. In this regard, it will be seen that any tumbler aligned with a card hole **354** remains in its forward position. Any tumbler aligned with a flat surface region of the card is depressed rearwardly to its rear position by the card.

The front tumbler springs **352** are stronger than the rear tumbler springs **344**, such that the tumblers **340** may be depressed rearwardly by the key card, as explained. Springs **352**, however, are sufficiently resilient to enable the tumbler pins **348** to yield rearwardly in relation to the tumbler bodies in the event the tumblers are obstructed by the sensing slides **22** when the pins are depressed, thus to prevent damage to the slides.

The operation of sensor unit S_4 is identical to that of sensor unit S except for the manner in which the tumblers **340** are positioned axially by the key card C_4, accordingly, it is unnecessary to explain the operation of the modified sensor.

FIG. **18** illustrates a modified sensor unit S_5 and key card C_5 which are similar to those of FIG. **17** except that sensor unit S_5 and card C_5 are arranged to store and sense three levels of key card code pattern information. This is accomplished by providing the sensor tumblers **360** with three slots **362**, **364**, **366**, rather than two slots as in FIG. **17**, such that each tumbler has three axial positions, a forward position, a rearward position, and a center position. The key card C_5 has a code pattern each of whose code positions may comprise a flat surface region **368***a* for locating the corresponding tumbler **360** in its rearward position, a recess **368***b* for locating the tumbler in its center position, or a hole **368***c* for locating the plunger in its forward position. Obviously, the key card and sensor unit could be arranged to store and sense additional levels of card code pattern information by providing the tumblers with additional slots and the key card with additional code formations, such as raised portions and/or holes of different size or shape to receive the tumbler pins, which would then be sized or shaped to project to different positions in the holes. The operation of sensor S_5 is identical to that of sensor S_1 with the exception of the positioning of the tumblers.

Turning finally to FIG. **19**, there is illustrated a modified sensor unit S_6 actuated by a keyboard C_6. Except for the key board and the fact that the tumbler guides **47** are magnetized, the modified sensor unit is identical to sensor unit S. Keyboard C_6 comprises a mounting plate **370** secured to and spaced from the front cover **12** of the sensor housing **11**. Mounted in the plate **370** opposite each sensor plunger **30** is a depressible key **372** containing a magnet **374**. Each key is urged outwardly, i.e., away from the sensor unit, to a retracted position by a spring **376**. The keys are depressible inwardly to extended position by finger pressure. Releasable latch means **378** retain the keys in the extended position.

As shown, the tumbler and key magnets **32**, **374** have their unlike poles adjacent one another, such that the magnet fields urge the tumblers **30** to their forward positions. The tumbler guides **47** are magnetized to urge the tumblers to their rearward positions. The sensor unit is so arranged that when the key **372** for any tumbler **30** is in its retracted position the tumbler is moved to its rearward position by the magnetic attraction between the tumbler and its magnetic guide **47**. When the key is depressed to its extended position the magnetic attraction between the key and tumbler overcomes the magnetic action of the tumbler guide and shifts the tumbler to its forward position. Thus, the tumblers may be selectively axially positions in their forward and rearward positions by selective depression of the keys **372**. The keys which are depressed are latched in extended positions and are released for spring return to retracted position by releasing the latch means **378**. The particular latch means shown comprises a slide **380** with spring fingers **382** which are engageable with shoulders **384** on the keys **372** to retain the latter extended, the slide is cammed upwardly against the bias of a spring **386** to release the keys by depression of a latch releasing button **385**.

Operation of the sensor unit S_6 is essentially similar to that of the earlier described sensor unit S except that in both the programming and sensing modes, the tumblers **30** are positioned axially by the keys **372** rather than by a coded key card. Accordingly, no further description of the sensor unit is required.

In those sensor units of the invention which employ magnetic tumblers, such as the sensor unit of FIGS. **1 – 8**, the magnetic fields of the tumbler magnets produce attracting or repelling forces between neighboring tumblers, depending up the polarities of the adjacent poles of the magnets. Thus, a repelling force is produced if the tumblers are magnetized in the same direction and an attracting force is produced if the tumblers are magnetized in opposite directions. Between closely spaced magnets, these forces are quite large and will tend to resist positioning of the tumblers by the key card magnets. Very large card magnets would therefore be required to effectively position the tumblers.

According to a feature of the invention, the magnetic forces between neighboring tumblers are neutralized or eliminated by the introduction of counter-magnetic forces. Thus, repelling forces between neighboring tumblers are neutralized by placing between the neighboring tumblers magnetically permeable elements, such as the magnetically permeable pins **400** in FIG. **3**. The attracting forces between these pins and the tumblers counteract the repelling forces between the tumblers. If the neighboring tumblers attract one another, magnets **402** are placed between the tumblers with their poles arranged to produce repelling counter forces on the tumblers as shown in FIG. **3A**.

I claim:

1. A programmable sensor unit for use with a coded key which may be coded to define any one of a number of different code patterns, comprising:
a frame,
sensing means supported on said frame for movement along a direction line between retracted and extended positions and including a number of sensing elements,
coded key positioned tumbler elements supported on said frame for movement along parallel axes transverse to said direction line to a number of selected axial positions and adapted to be axially positioned in accordance with the key code pattern,
each tumbler element being located in the path of extension movement of a corresponding sensing element with said sensing means to provide a coacting element pair,
an element of each element pair being rotatably adjustable to selected angular positions equal in number to the axial positions of the corresponding tumbler element, and the coacting elements of each pair having coacting shapes such that in each angular position of the rotatable element, the coacting elements are engageable to block extension of said sensing means in all axial positions but one of the respective tumbler element, whereby said sensor unit may be programmed for release of said sensing means for movement to extended position in response to a selected key code pattern by presetting said rotatable element in selected angular positions,
means for releasably retaining said rotatable elements in their preset angular positions,
means for effecting extension and retraction movement of said sensing means, and
output means controlled by said sensing means upon movement of said sensing means to extended position.

2. A sensor unit according to claim 1 wherein:
said tumbler elements are rotatably adjustable.

3. A sensor unit according to claim 1 wherein:
said sensing elements are rotatably adjustable.

4. A sensor unit according to claim 1 wherein:
said sensing means comprising a sensing plate movable edgewise between said extended and retracted positions in a plane normal to said tumbler axes and having openings through which said tumbler elements extend,
said sensing elements comprise edges of said openings which face in the direction of extension movement of said plate, and
said tumbler elements are shaped in a manner such that in each selected axial position of each tumbler element the latter provides clearance for the respective plate sensing edge to permit sensing plate extension in one selected angular position of the respective tumbler element and the tumbler element is engageable by the respective edge to block plate extension in all other angular positions of the tumbler element.

5. A sensor unit according to claim 4 wherein:
each tumbler element has slots which are spaced axially along and angularly about the element to receive the respective sensing plate edge when the element is disposed to permit plate extension.

6. A sensor unit according to claim 1 wherein:
said sensing means comprises a sensing plate movable edgewise between said extended and retracted positions in a plane normal to said tumbler axes,
said tumbler elements have shoulders,
said sensing elements are shaped in a manner such that in each selected axial position of each tumbler element, the corresponding sensing element provides clearance for the respective tumbler shoulder to permit sensing plate extension in one selected angular position of the respective sensing element and the sensing element is engageable with the shoulder to block plate extension in all other angular positions of the sensing element.

7. A sensor unit according to claim 6 wherein:
each sensing element has slots which are spaced axially along and angularly about the element to receive the respective tumbler shoulder when the sensing element is disposed to permit plate extension.

8. A sensor unit according to claim 1 wherein:
engagement of said coacting elements by extension of said sensing means with said rotatable elements released for rotation and said tumbler elements located in selected axial positions by said coded key produces camming forces on said rotatable elements for rotating the latter elements to the angular positions wherein they permit movement of the sensing means to extended position, and
said sensor unit includes means for releasing said retaining means and permitting extension of said sensing means to program a selected key code pattern into said unit.

9. A sensor unit according to claim 8 wherein:
said programming means includes locking means for locking said programming means against operation to alter the programmed code pattern.

10. A sensor unit according to claim 8 wherein:
said programming locking means comprise key lock means for releasing said retaining means and permitting said sensing means to program a selected key code pattern into said sensor unit and then locking said programming means against operation to alter the programmed code pattern.

11. A sensor unit according to claim 1 wherein:
said sensor unit includes a means for releasably locking said sensing means against extension independently of said coacting elements.

12. A sensor unit according to claim 1 wherein:
said sensing means comprise a number of separate sensing members movable between retracted and extended positions,
extension of each sensing member is controlled by a group of said coacting elements, and
said output means is controlled by extension of at least one of said sensing members.

13. A sensor unit according to claim 12 wherein:
extension of a number of said sensing members controls said output means.

14. A sensor unit according to claim 13 including:
means for releasably locking certain of said sensing members against extension independently of said coacting elements.

15. A sensor unit according to claim 12 wherein:
actuation of said output means requires extension of a number of the sensing members.

16. A sensor unit according to claim 1 wherein:

said output means comprises a movable output member connected to said sensing means in a manner such that extension of said sensing means drives said output member in a given output motion, and

said means for effecting extension and retraction of said sensing means comprises first means for urging said sensing means to extended position, second means opposing said first means to retain said sensing means in retracted position, and means for reducing the opposing force of said second means to permit extension of said sensing means by said first means.

17. A sensor unit according to claim **1** including:

means connected to said output means for operation from one condition to another in response to control of said output means by extension of said sensing means.

18. A sensor unit according to claim **1** including:

a door lock connected to said output means for operation from a locked condition to an unlocked condition in response to control of said output means by extension of said sensing means.

19. A sensor unit according to claim **18** including:

a night latch for releasably locking certain of said sensing means against extension independently of said coacting elements.

20. A sensor unit according to claim **18** wherein:

said door lock comprises a handle, a latch member retractable by rotation of said handle to permit opening of the door, a latch key for normally locking said handle against turning to retract said latch member, and means connecting said output means and latch key for retraction of said latch key by control of said output means to release said handle for turning.

21. A sensor unit according to claim **1** wherein:

said retaining means comprises a locking slide engageable with said rotatable elements to positively lock the latter in their preset angular positions.

22. A sensor unit according to claim **1** wherein:

said retaining means comprises magnetic means for magnetically retaining said rotatable elements in their preset angular positions.

23. A sensor unit according to claim **1** including:

electrical means connected to said output means for operation from one condition to another in response to control of said output means by extension of said sensing means.

24. In combination:

a coded key which may be coded to define any one of a number of different code patterns,

a sensor unit comprising a frame, sensing means supported on said frame for movement along a direction line between retracted and extended positions and including a number of sensing elements, coded key positioned tumbler elements supported on said frame for movement along parallel axes transverse to said direction line to a number of selected axial positions and adapted to be axially positioned in accordance with the key code pattern, each tumbler element being located in the path of extension movement of a corresponding sensing element with said sensing means to provide a coacting element pair, an element of each element pair being rotatably adjustable to selected angular positions equal in number to the axial positions of the corresponding tumbler element, and the coacting elements of each pair having coacting shapes such that in each angular position of the rotatable element, the coacting elements are engageable to block extension of said sensing means in all axial positions but one of the respective tumbler element, whereby said sensor unit may be programmed for release of said sensing means for movement to extended position in response to a selected key code pattern by presetting said rotatable elements in selected angular positions, means for releasably retaining said rotatable elements in their preset angular positions, means for effecting extension and retraction movement of said sensing means, and output means actuated by said sensing means upon movement of said sensing means to extended position, and said key and tumbler elements comprising coacting means for axially positioning said tumbler elements in accordance with the key code pattern.

25. A sensor unit according to claim **24** wherein:

said coacting tumbler positioning means comprises magnetic means.

26. A sensor unit according to claim **24** wherein:

said coacting tumbler positioning means comprise formations on said key engageable with said tumblers.

27. A sensor unit according to claim **24** wherein:

said coacting tumbler positioning means comprise magnetic means and formations on said key engageable with said tumblers.

28. A sensor unit according to claim **24** wherein:

said coacting tumbler positioning means are adapted to establish any one of at least two different axial positions of each tumbler element.

29. A sensor unit according to claim **24** wherein:

said key comprises a coded key card and said sensor unit has a guideway for receiving said card.

30. A sensor unit according to claim **24** wherein:

said key comprises a key board mounted in said unit including depressible keys for axially positioning said tumbler elements.

31. A programmable sensor unit for use with a coded key which may be coded to define anyone of a number of different code patterns, comprising:

a frame having a wall,

a number of coded key positioned tumblers supported by said wall for movement along parallel axes and rotation about said axes,

sensing slide means supported by said frame adjacent said wall for movement in a plane normal to said axes between extended and retracted positions and having openings through which said tumblers extend, each opening having an edge facing in the direction of extension movement of said slide means,

said tumblers having transverse slots spaced axially along and angularly about the tumblers,

each tumbler being axially positionable in accordance with different key code patterns in predetermined axial positions such that in each axial position one slot is situated in said plane and each tumbler being rotatable in each axial position to a predetermined angular position wherein the

slot currently in said plane is oriented to receive the edge of the respective opening in said sensing slide means and thereby permit extension of said slide means, each tumbler when in any of said axial positions blocking extension of said slide means in every angular position other than the predetermined angular position corresponding to the current axial tumbler position whereby said sensor unit may be programmed for release of said sensing slide means for movement to extended position in response to a selected key code pattern by presetting said tumblers in selected predetermined angular positions,

programming means for presetting said tumblers selected predetermined angular positions,

means for releasably retaining said tumblers in their preset angular positions while permitting axial positioning of the tumblers,

means for effecting extension of said sensing slide means after axial positioning of said tumblers by a proper key code pattern,

a rotatable output member, and

means for connecting said sensing slide means and output member for rotation of said output member in response to extension of said slide means.

32. A sensor unit according to claim **31** wherein:

said tumbler retaining means comprise axially slotted tumbler positioning elements rotatably supported on said frame on the axes of said tumblers, axial tongues on said tumblers slidable within the slots in said positioning elements, locking slide means supported on said frame for locking said positioning elements and thereby said tumblers against rotation by movement of said locking slide means to retracted locking position and releasing said positioning elements and thereby said tumblers for rotation by movement of said locking slide means to extended releasing position and means for extending and retracting said locking slide means and retaining the latter slide means in locking position.

33. A sensor unit according to claim **32** wherein:

said programming means comprise lock actuated means for extending said locking slide means to release said positioning elements and tumblers for rotation, and means for rotating said tumblers to selected predetermined angular positions.

34. A sensor unit according to claim **33** wherein:

said tumbler rotating means comprise means connected to said lock actuated means for extending said sensing slide means with said locking slide means to urge said sensing slide means against said tumblers to rotate the tumblers to their corresponding predetermined angular positions.

35. A sensor unit according to claim **31** wherein:

said tumbler retaining means comprise a card to be inserted into said sensor unit adjacent said positioning elements, and coating magnetic means on said elements and cards for magnetically retaining said elements and thereby said tumblers in their corresponding predetermined angular positions.

36. A programmable sensor unit for use with a coded key which may be coded to define anyone of a number of different code patterns, comprising:

a frame having a wall,

a number of coded key positioned tumblers supported by said wall for movement along parallel axes,

sensing slide means supported by said frame adjacent said wall for movement in a plane normal to said axes between retracted and extended positions and including sensing elements equal in number to said tumblers, said sensing elements being rotatable on axes parallel to said tumbler axes and having transverse slots spaced axially along and angularly about the elements,

each tumbler having a transverse shoulder and being axially positionable in accordance with different key code patterns in predetermined axial positions wherein the tumbler shoulder is aligned with the slots in the corresponding sensing element, and each sensing element being rotatable in axial position of the corresponding tumbler to a predetermined angular position wherein the respective element slot is oriented to receive the tumbler shoulder and thereby permit extension of said slide means, each sensing element being located for engagement with the corresponding tumbler shoulder to block extension of said slide means in all angular positions other than the predetermined angular position corresponding to the current axial position of its respective tumbler, whereby said sensor unit may be programmed for release of said sensing slide means for movement to extended position in response to a selected key code pattern by presetting said tumblers in selected predetermined angular positions,

means for releasably retaining said sensing elements in their preset angular positions,

programming means for presetting said sensing elements to said selected angular positions,

means for effecting extension of said sensing slide means after axial positioning of said tumblers by a proper key code pattern,

a rotatable output member, and

means connecting said sensing plate means and output member for rotation of said output member in response to extension of said plate means.

37. A sensor unit according to claim **36** wherein:

said retaining means comprise locking slide means supported on said frame for locking said sensing elements against rotation by movement of said locking slide means to retracted locking position and releasing said sensing elements for rotation by movement of said locking slide means to extended releasing position, and means for extending and retracting said locking slide means and retaining the latter slide means in locking position.

38. A sensor unit according to claim **37** wherein:

said programming means comprise key lock actuated means for extending said locking slide means to release said sensing elements for rotation, and means for rotating said sensing elements to select predetermined angular positions.

39. A sensor unit according to claim **1** including:

means for normally concealing said rotatable elements and exposing said latter elements when desired, and

means for automatically releasing said retaining means and altering the settings of said rotatable

elements to erase the code pattern programmed into the sensor unit when said rotatable elements are exposed.

40. A sensor unit according to claim 20 wherein:

said latch key when in latching position permits slight rotation of said handle,

said output means comprises a movable output member connected to said sensing means in a manner such that extension of said sensing means drives said output member in a given output motion, and

said means for effecting extension and retraction of said sensing means comprises first means for urging said sensing means to extended position, said means opposing said first means to retain said sensing means in retracted position, and means operable by slight rotation of said handle for reducing the opposing force of said second means to permit extension of said sensing means by said first means.

41. A sensor unit according to claim 1 wherein:

said rotatable element of each element pair has relatively angularly displaced transverse slots for receiving the other element of the respective element pair to permit extension of said sensing means in selected angular positions of the respective rotatable element and axial positions of the respective tumbler element.

42. A sensor unit according to claim 41 wherein:

each rotatable element has a shoulder between its adjacent slots to block relative movement of the other element of the respective element pair from one slot to another.

43. A sensor unit according to claim 1 wherein:

said key code pattern is a magnetic code pattern,

said tumbler elements are magnetic elements which are magnetically positioned axially in accordance with said magnetic code pattern, and

said sensor unit includes means for producing magnetic forces on said tumbler elements opposing the magnetic forces between adjacent tumbler elements.

44. A sensor unit according to claim 43 wherein:

the magnetic forces between adjacent tumbler elements are repelling forces, and

said opposing force producing means comprise magnetically permeable elements between the adjacent tumbler elements.

45. A sensor unit according to claim 43 wherein:

the magnetic forces between adjacent tumbler elements are attracting forces, and

said opposing force producing means comprise magnets between the adjacent tumbler elements.

46. For use in a sensor unit of the character described:

a tumbler sensing element rotatably positionable about its longitudinal axis,

said element having at least a pair of axially spaced transverse slots selectively receiving a portion of a tumbler and separated by an intervening shoulder, and

said slots having bottom walls, respectively, which are angularly displaced about said longitudinal axis.

* * * * *

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,680,336 Dated August 1, 1972

Inventor(s) HERBERT M. SCHENDEL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 5, line 12, after "its" delete "locked"
and insert therefor --unlocked--.

Col. 9, line 11, after "their" delete "their"
(second occurrence).

Col. 15, line 35, after "detent" delete "212a"
and insert therefor --212b--.

Col. 20, line 12, after "edge" delete "59a"
and insert therefor --59b--.

Col. 22, line 55, after "will" delete "not"
and insert therefor --now--.

Col. 27, line 13, after "318" delete " one shown)"
and insert therefor
--(only one shown)--.

Signed and sealed this 15th day of May 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents