

[54] **COMBINED MECHANICAL AND
PHOTOELECTRIC LOCK**

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250/219 D, 340/274**

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[58] Field of Search **70/277, 278, DIG. 51;
250/215, 219 D; 340/274**

[56] **References Cited**

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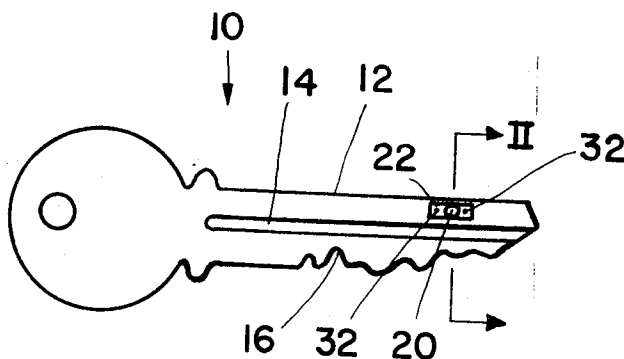
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[57] **ABSTRACT**

A combined mechanical and photoelectric lock. The mechanical lock is a conventional key operated tumbler lock. One portion of the key is provided either with a series of small holes or with an insert having a pattern of light and dark areas. A light beam is directed through the holes or the insert and is focused by an optical system on a photodetector which determines whether the projected pattern is valid or invalid.

9 Claims, 7 Drawing Figures



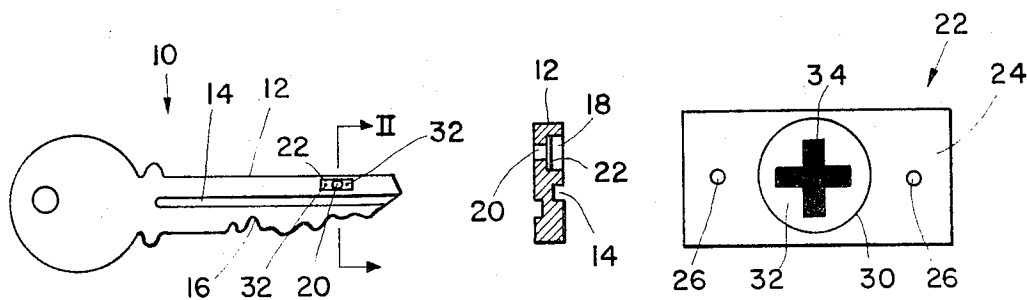


FIG. 1

FIG. 2

FIG. 3

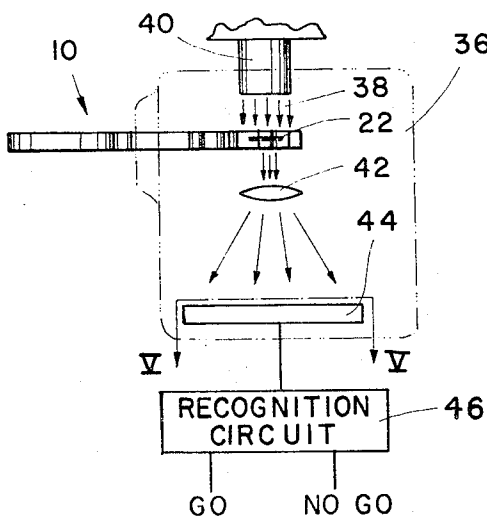


FIG. 4

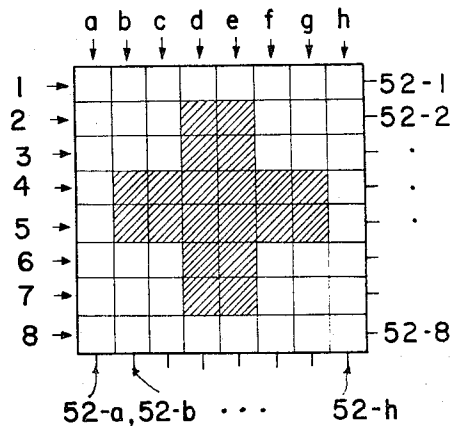


FIG. 5

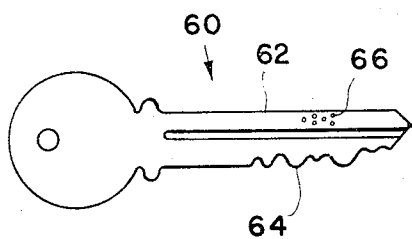


FIG. 6

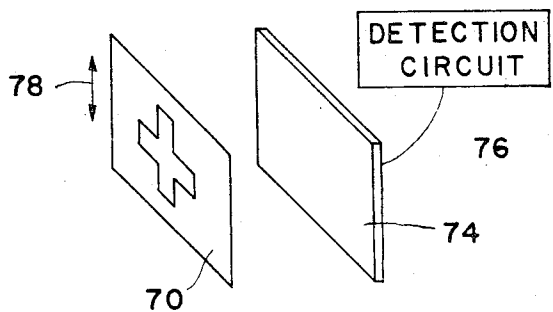


FIG. 7

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COMBINED MECHANICAL AND PHOTOELECTRIC LOCK

The present invention relates to a lock arrangement in which two distinct criteria must be met before the lock can be operated.

More particularly, the invention relates to a lock which has a first mechanically operated locking element and a second photoelectrically operated locking element.

The invention consists, essentially of the combination of a key operated mechanical lock and a photoelectric lock with the key including means to filter a light beam into a particular, unique pattern which may be recognized by a photodetector. The lock may be employed either as a two criteria security lock where both the mechanical and photoelectric combinations must be met simultaneously before the lock can be operated or, alternatively, as a two stage lock where the mechanical lock can be operated regardless of whether or not the photoelectric conditions are met, but where the photoelectric lock can operate only after the mechanical lock has operated. The reverse arrangement where meeting of the photoelectric lock criteria must be achieved prior to operation of the mechanical lock is also possible. The latter two arrangements may be used, for example, to provide different personal with different levels of access or freedom of operation. For example, the mechanical lock may permit access to a particular room while the photoelectric lock must be released before certain equipment within the room can be operated. In such a situation, a person having a key which operates the mechanical but not the photoelectric lock would be permitted to enter the room but not to operate the controlled equipment. Numerous other uses of the lock combination of the present invention are, of course, possible.

For a more complete understanding of my invention and the objects and advantages thereof reference should be had to the following detailed description and the accompanying drawing wherein there is shown a preferred embodiment of the invention.

In the drawing:

FIG. 1 is a side elevational view of a key having an identifying insert for use with the lock of the present invention;

FIG. 2 is a transverse sectional view taken along the line II—II of FIG. 1;

FIG. 3 is an enlarged elevational view of the identifying insert;

FIG. 4 is a schematic showing the mechanical and photoelectric lock of the present invention;

FIG. 5 is a fragmentary sectional view taken along the line V—V of FIG. 4;

FIG. 6 is a side elevational view of a second embodiment of the key used with the lock of the present invention; and

FIG. 7 is a schematic showing of a second detector circuit.

The invention comprises, essentially, a key which is notched in the conventional manner to operate the tumblers of a mechanical lock and which includes an insert having a unique pattern which, when the key is inserted into the lock, intersects a light beam to produce an identifying pattern. The light beam is projected onto a photosensitive target and suitable detection circuitry reads the projected image pattern to determine its authenticity.

Referring now to FIGS. 1-3, there is shown one embodiment of the key used in the lock of the present invention. The key, designated generally by the reference number 10, has a shank portion 12 provided with guiding grooves 14 notched along one edge, as indicated at 16, all in the conventional manner. The key is intended to co-operate with a tumbler type lock and the notches and intervening projections operate the tumblers of the lock. A recessed area 18 is provided on the shank portion 12 of the key 10 and a hole 20 extends through the key, with the hole 20 being centered with the recessed portion 18. Received within the recess 18 is an insert 22, which is shown on an enlarged scale in FIG. 3. The insert 22 has a body portion 24 which is, preferably, of the same configuration and dimensions as the recess 18 so as to have a tight fit and proper alignment within the recess. Holes 26 may be provided in the insert 22 for engaging small aligning pins 32 in the key, if desired. The center portion 30 of the insert which overlies the hole 20 through the key shank has a transparent region or regions 32 and an opaque region or regions 34. The regions 32 and 34 are arranged to provide a unique pattern serving to provide identifying data.

The manner in which the transparent regions 32 and the opaque regions 34 are formed on the insert 22 will depend upon the material from which the insert is formed. The invention contemplates that the insert 22 may be microfilm, in which event the regions 32 are transparent portions of the film while the regions 34 are opaque portions of the film. However, it is also possible to make the insert of an opaque material, in which case the regions 32 would consist of openings cut through the material. With this arrangement, of course, there is the limitation that the regions 32 must be so arranged so as to leave no isolated opaque regions 34.

As will be seen from FIG. 4, when the key 10 is inserted into a tumbler lock 36, the insert 22 intersects the path of a light beam 38 originating from a suitable source 40. The system includes a lens 42 for focusing the light beam 38 on a photoelectric sensitive target 44. A recognition circuit 46 compares the signal produced by the target 44 in response to the light beam 38 with a known signal to determine if the signal corresponding to the identifying pattern of the insert 22 is an authentic identifying signal. The output of the recognition system 46 may be used to control any action or device desired. Recognition circuits of the type employed here are well known in the art.

One form of target is shown in FIG. 5. In this embodiment, the target consists of an 8x8 matrix of photocells 48. For ease of description, the horizontal rows of the matrix are designated by numerals 1-8, respectively, and the vertical rows by letters a-h, respectively. Thus, the individual photocells can be identified as 48-1a, 48-1b, etc. Each of the photocells 48 is connected to a conductor 50 corresponding to the horizontal row in which the photocell is located and to a conductor 52 corresponding to the vertical row in which the photocell is located. With this arrangement, sequential scanning or reading of the conductors 50-1 to 50-8 and 50-a to 50-h permits the sensing of each individual photocell of the matrix.

When the image produced by the insert is projected onto the target 44 certain of the photocells 48 will be illuminated while others are not. The recognition circuit 46 senses the value of each photocell, that is the amount of illumination present at that photocell as

represented by the current output of the photocell in question, and compares this value with a known value to determine if the pattern projected on the matrix corresponds to an authentic or valid pattern. The scanning and recognition circuits are well known to those familiar with the data reading and identifying arts and are, therefore, not described or illustrated in detail herein. Any suitable scanning or reading circuits and recognition circuits capable of performing the comparison of the projected image with a known image may be employed.

FIG. 6 illustrates a second embodiment of the key of the present invention. In this embodiment, the key 60 which has a shank 62 notched along one edge, as indicated at 64, to operate the tumblers of a mechanical lock, is provided with a series of small diameter holes 66 in the shank portion of the key. The holes 66 are arranged to form a unique pattern, identifying the particular key. The key is used in a combined mechanical photoelectric lock similar to that shown in FIG. 4 with the holes 66 of the key intersecting the light beam to project the identifying image to a photoelectric target. Again the target is scanned or read to detect the projected image and the projected image is compared to a standard image to determine the validity of the projected image. Another form of the detector is illustrated in FIG. 7. This detector includes a mask 70 having an opening 72 corresponding to the desired configuration of the key insert 22. The mask 70 is located closely adjacent a photodetector 74. A detection circuit 76, which is essentially a threshold detector circuit, determines, from the signal produced by the photodetector 74 in response to the projected image, the validity of the projected image. The mask 70 is preferably movable, as indicated by the arrow 78, so that false detection is eliminated. For example, if a pattern other than a cross-shaped one is projected onto a mask which has a cross-shaped opening, the projected pattern may completely cover the opening of the mask 70 falsely indicating that a valid image has been projected. However, if the mask is shifted, there will be a sharp decline in the output signal of the detector 74 for a valid image but a less sharp decline if the projected image is an invalid one.

As was pointed out above, the detection of a valid identifying signal by the photoelectric detector may be used to control and/or authorize any desired function. If the detector arrangement is located so that the insert of the key intersects the light beam only when the key has been turned in the lock to an unlocked position, the system serves to provide two degrees of security since both the mechanical requirements of the lock, as represented by the notch pattern of the key, and the correct identifying insert, as detected by the photodetector, must be present to produce a validation signal. Conversely, with the key operating the photodetector when in the locked position, the photoelectric criteria must be met regardless of whether the mechanical criteria are also met. While the two locking criteria are interdependent, they may be used to control separate functions. Thus, the mechanical lock may be used to control access to a particular area while the photoelectric lock controls the operation of specific equipment within the area.

While the outline configuration of the key may be readily duplicated, duplication of the pattern contained on the insert is more difficult and, as a result, the likely-

hood of unauthorized persons obtaining duplicates of the keys is substantially reduced. Also, the insert may be readily changed and the stored pattern in the recognition circuit also changed when desired. This is of particular value where the key is used to operate a vending machine for purchases on credit as it permits periodic replacement of unauthorized keys to control credit losses. It is also contemplated that more than one insert or more than one series of holes may be provided and that the validating action can employ either all of the inserts to provide a larger number of possible combinations or a selected one of the inserts, making the duplication of the key more difficult. In the latter arrangement it is possible, by moving the light source and the photodetector, to use different ones of the insert at different times for validation.

It should be understood that while only the best known embodiments of the invention have been described and illustrated in detail herein, the invention is not so limited. Reference should therefore be had to the appended claims in determining the true scope of the invention.

I claim:

1. A combined mechanical and photoelectric lock comprising:
 - a key operated mechanical lock;
 - a key for operating the mechanical lock, the key having an opening extending therethrough;
 - an insert secured to the key, covering the opening, and having a plurality of light transmitting areas;
 - a light source projecting a beam of light onto the insert when the key is inserted into the lock to project an image of the light transmitting areas;
 - a photoelectric detector for receiving the projected image; and
 - circuit means responsive to the detector for determining if the projected image corresponds to a predetermined image.
2. The lock according to claim 1 further including a lens for focusing the image onto the detector.
3. The lock according to claim 1 wherein the insert is a piece of microfilm having transparent and opaque areas.
4. The lock according to claim 1 wherein the light source and the detector are so located that the key intersects the light beam so as to produce the image when the key is in its unlocked position in the mechanical lock.
5. The lock according to claim 1 wherein the light source and the detector are so located that the key intersects the light beam so as to produce the image when the key is in its locked position in the mechanical lock.
6. The lock according to claim 1 wherein the mechanical lock is a tumbler type lock.
7. A two criteria lock, comprising:
 - a key operated mechanical lock;
 - a key for operating the mechanical lock, the key having at least one hole extending therethrough;
 - an insert carried by the key and covering the hole, the insert having an identifying pattern of opaque and translucent areas;
 - means for projecting a beam of light onto the insert; and
 - photoelectric detector means located on the opposite side of the key from the light projecting means for receiving the portion of the light beam which passes through the insert, the detector means in-

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cluding means for comparing the projected portion of the light beam with a predetermined pattern to determine the authenticity of the projected portion.
8. The lock according to claim 7 wherein the key has

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a recess surrounding the hole, the insert being received within the recess.
9. The lock according to claim 8 wherein the insert is a piece of microfilm.
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