

United States Patent

Sanders et al.

[15] 3,705,507

[45] Dec. 12, 1972

[54] **LOCK CONTROLLED ELECTRIC
SWITCH MECHANISMS**

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[22] Filed: **May 14, 1971**

[21] Appl. No.: **143,439**

[52] U.S. Cl. **70/364 R, 70/434**

[51] Int. Cl. **E05b 29/00, E05b 39/04**

[58] Field of Search **70/364 R, 431, 432, 433, 434;
200/42 R, 44**

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[57] **ABSTRACT**

An electric switch lock mechanism having a hollow housing with several electric switches and a number of switch actuating elements operated by cams actuated by a lock assembly rotatable in the housing, the lock assembly including several moveable wafer-like elements transversely moveable in the assembly biased some into engagement with abutments in the housing and the remainder into engagement with the cam elements, the wafer-like elements having slots in alignment axially of the assembly but of different lengths for engagement by a key of varying contour inserted therethrough axially of the assembly, the key when inserted moving the wafer-like elements to free them from the housing and enabling the key to rotate the assembly and actuate the switches through the cams and switch actuating elements.

6 Claims, 10 Drawing Figures

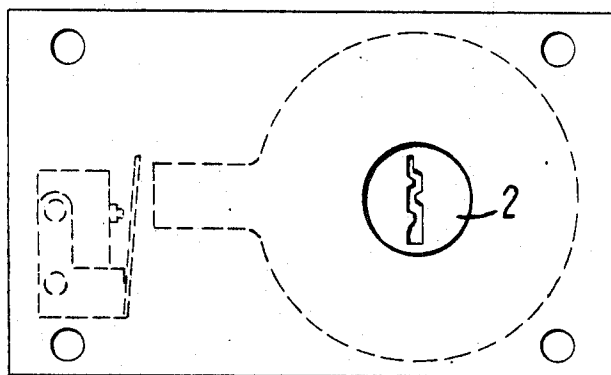


Fig. 1.

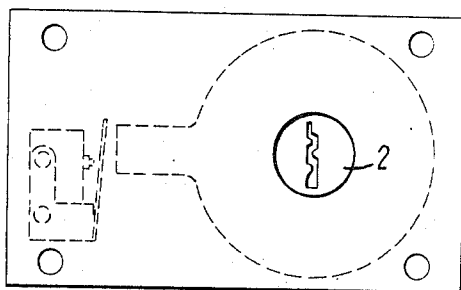


Fig. 2.

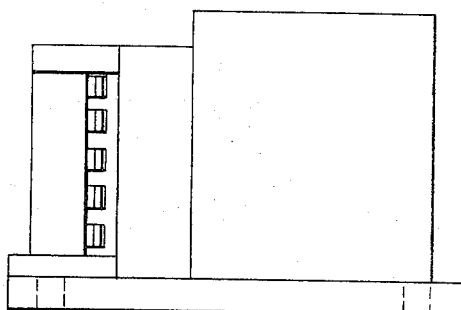
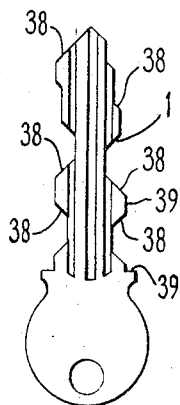
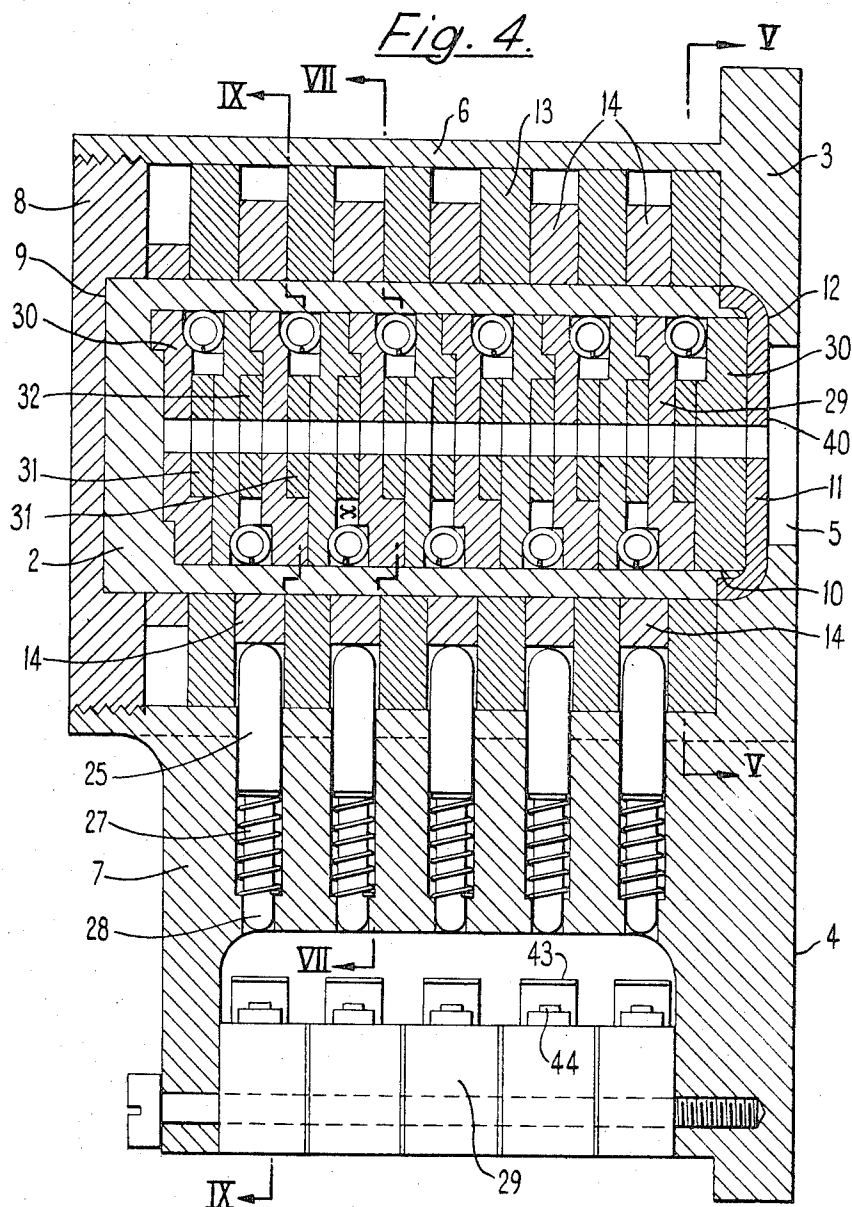


Fig. 3.



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Fig. 5.

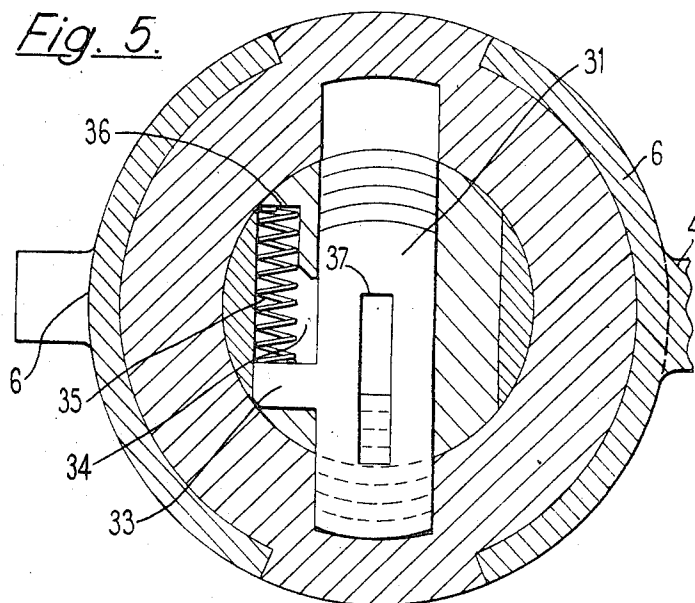
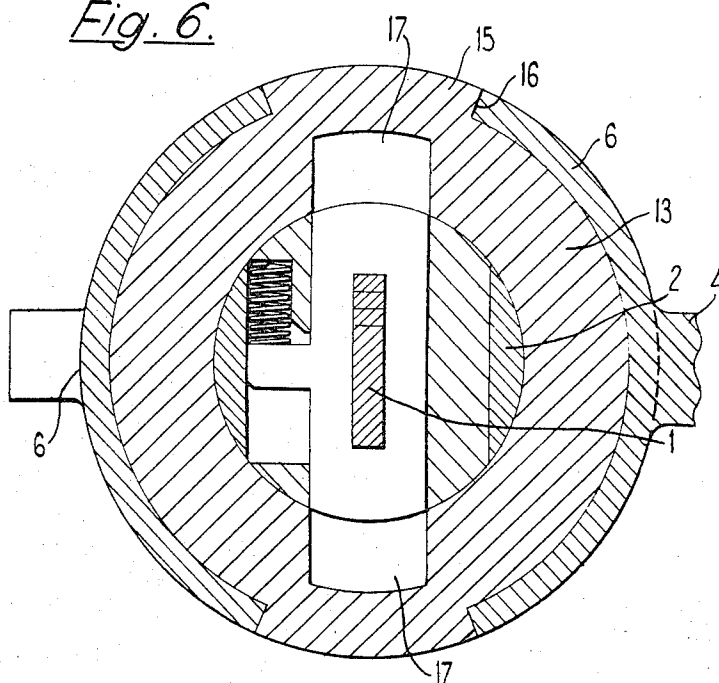
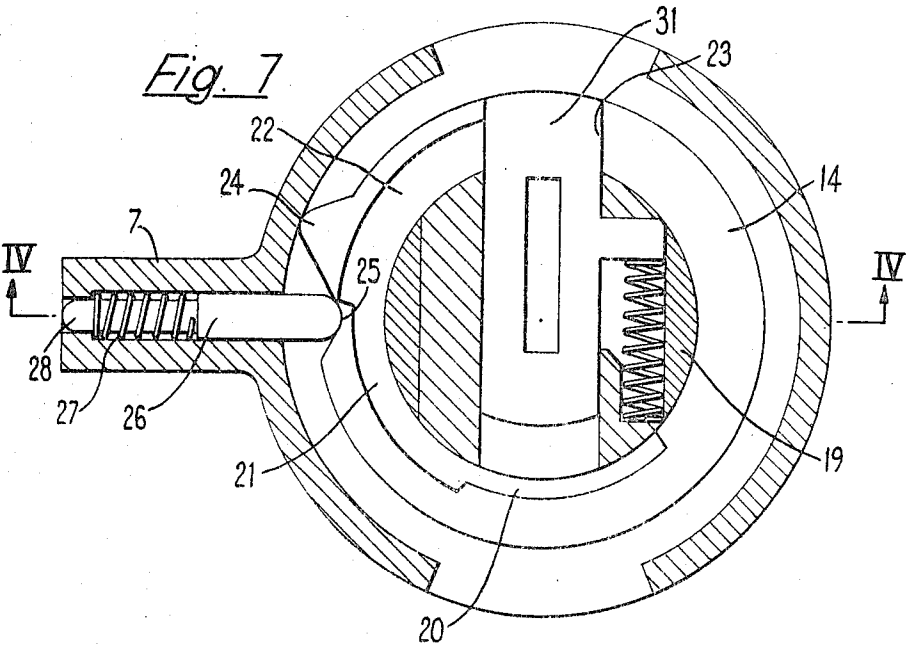
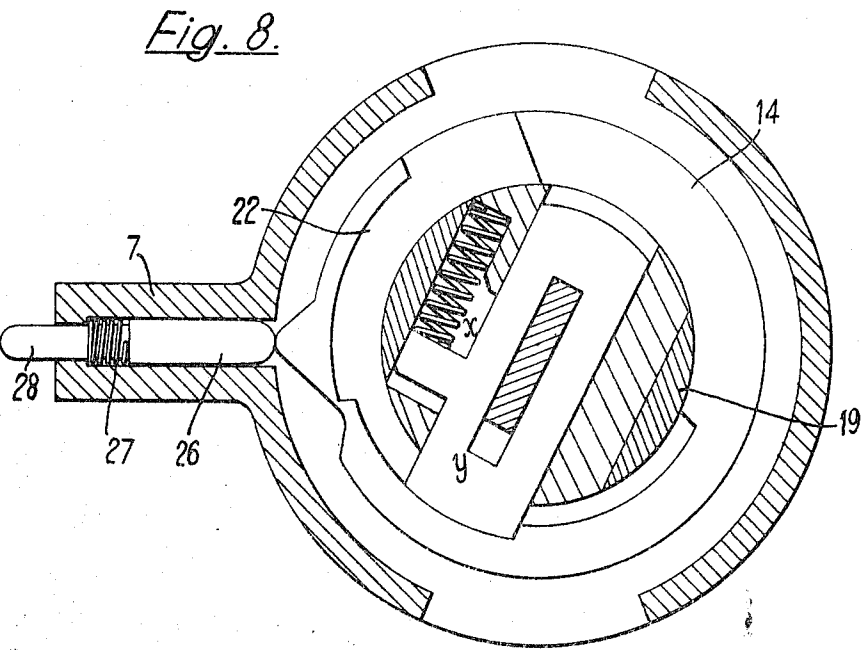


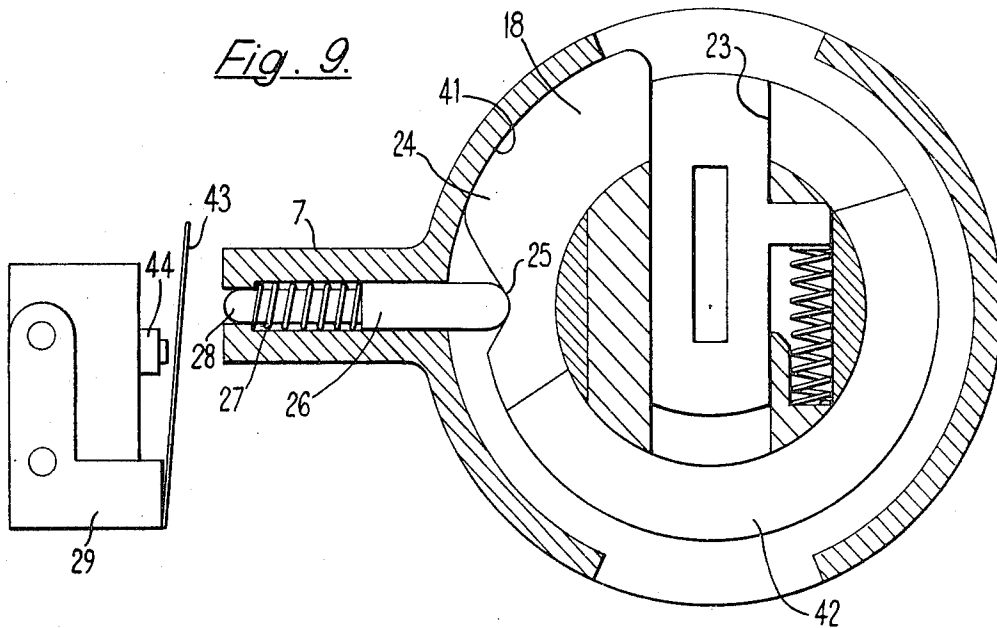
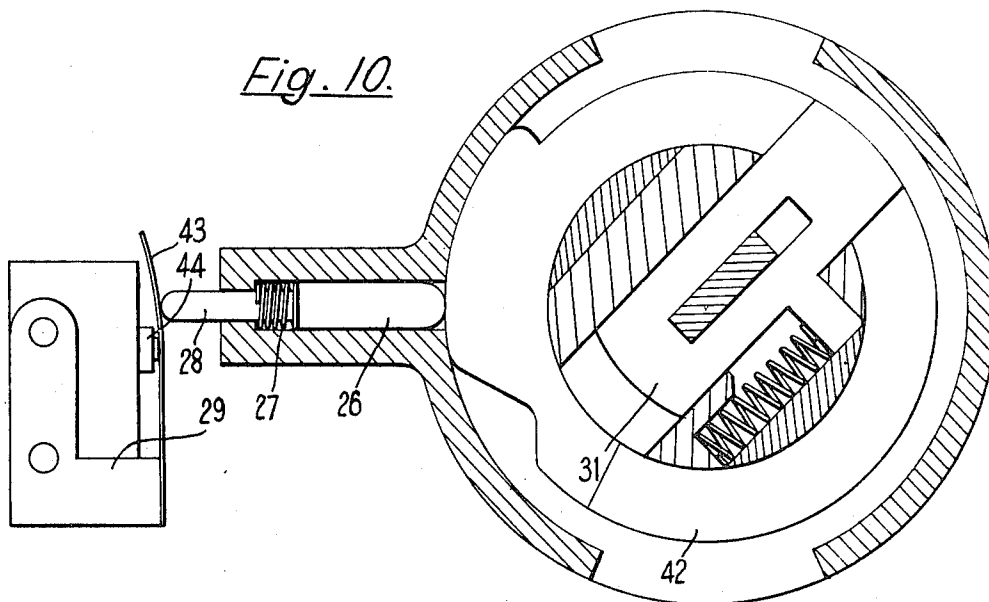
Fig. 6.



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LOCK CONTROLLED ELECTRIC SWITCH MECHANISMS

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a lock and electric switch mechanism having one or more switches, e.g., micro-switches of an electric circuit, which are actuated when a locking device is disposed in a predetermined position for each switch, the locking device being operated by an appropriately designed key.

Such lock controlled switch mechanisms have many uses, for example, for use in unlocking a pump such as a petrol pump so that operation of the pump and thus unauthorized extraction of petrol from a tank by the pump can be guarded against by making it essential to employ the correct key to operate the lock and set the switch or switches to energize the pump control circuit or circuits.

In large plants or installations, different parts can be set for a particular operation condition by use of the appropriate key and the keys and locks can be associated with punched cards or like means, so that the controlling operation can by use of the punched cards select the necessary key or keys by which the integers of the plant can be set for operation.

The main object of the present invention is to provide an improved lock controlled switch mechanism.

SUMMARY

According to the present invention a lock and electric switch mechanism comprises a hollow housing, a number of electric switches secured to the housing a number of switch actuating elements moveably mounted in the housing to make and break the switches, a rotatable lock assembly mounted for rotation in and in spaced relation to the housing wall, a number of cam elements rotatably mounted in the housing around the lock assembly with cam surfaces engageable by the switch actuating elements and operable to cause the elements to move to actuate the switches, and a number of moveable elements disposed for movement in the lock assembly transversely of the axis of rotation of the assembly and based to move at least some for engagement with abutments in the housing and to move the rest for engagement with abutments in the cam elements, the transversely moveable lock assembly elements having slots in axial alignment and of different lengths for engagement by a key of varying contour inserted therethrough, whereby when the key is disposed in the operating position in the slots in said slotted elements these elements are moved in the lock assembly to free them from the housing to permit the assembly to rotate and rotate the cam elements to actuate the switches through the switch actuating elements in a predetermined sequence.

Preferably the cams are in the form of rings rotatable round the plug and each in radial register with one of the locking elements and axially separated by spacer elements fast with the housing, each ring being in radial alignment with one of the switch actuating elements.

Each cam ring may have a radial cam surface extending radially outwards of the ring and a radial recess, whereby on rotation each ring allows the switch actuating element to engage the recess or the cam surface moves the switch actuating element radially outwards.

Each switch actuating element preferably comprises a plunger slidable in a guide in the housing towards or away from its switch contact elements and is biased to engage the cam.

While a single key is preferred to operate the whole mechanism, a number of keys may be provided all of which have to be employed to free the mechanism and cause the moving parts to become located in the switching position.

The mechanism may be operated where a number of switches are employed to actuate all the switches at the same time or in a predetermined sequence. Alternately different keys may be provided having a shaped portion for each slotted element to unlock the lock, and having different shaped portions for actuating the switch actuating elements in different sequences of switch operation.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more fully understood an embodiment in accordance therewith will now be described by way of example with reference to the accompanying drawings, in which;

FIG. 1 is a front view of a lock;

FIG. 2 is a plan view of the lock in FIG. 1;

FIG. 3 is a side view of the key for use in the lock of FIGS. 1 and 2;

FIG. 4 is a cross section on an enlarged scale of the lock in FIGS. 1 and 2;

FIG. 5 is a cross section through the lock of FIG. 4 taken along the line V — V looking in the direction of the arrows and showing the locking wafer with the key withdrawn;

FIG. 6 is a cross section similar to FIG. 5 with the key inserted in the lock;

FIG. 7 is a cross section along the line VII — VII looking in the direction of the arrows in FIG. 4 showing the operation of the contact rings and spring wafers;

FIG. 8 is a view similar to FIG. 7 with the key inserted in the position to actuate the micro switch;

FIG. 9 is a view similar to FIG. 7 showing the operation of the energizing ring, key withdrawn; and,

FIG. 10 is a similar cross section to FIG. 9 with the key inserted showing the actuation of the micro switch.

In the drawings the same references are used to designate the same parts.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the drawings, the lock shown in FIGS. 1 and 2 and in more detail in FIG. 4 with the cross sections of FIGS. 5 to 10, employs a key 1 engageable in a rotary barrel or plug 2 in the lock body 3.

The lock body has a front plate 4 with an aperture 5 through which the key is inserted into the slots in the members in the rotating plug as will be described. The plate 4 has a rearwardly tubular barrel 6 at one side of which is an extension 7 containing a microswitch mechanism to be described and the back of the barrel 6 is closed by a threaded plate 8 screwed into the interiorly threaded end of the barrel 6.

Within the barrel 6 the plate 8 has a recess 9 which is annular and in which the rotary barrel 2 is slidably engaged at its inner end, the front end of the barrel 10 being engaged in a plate 11 in a recess 12 in the front plate 4. Thus the barrel is free to be rotated as will be described within the barrel 6.

Within the barrel 6 and surrounding the plug 2 are a number of separator plates 13 spaced along the length of the plug and between these are rotatable rings 14 to be described the thickness of the plates 13 and rings 14 being such that when the closure plate 8 is screwed home into the barrel it not only locates the plug 2 so as to be freely rotatable in the barrel and within apertures in the plates 13 and rings 14, but also compresses all the rings and plates axially within the barrel so that they are accurately placed.

The plates 13 as seen in FIGS. 5 and 6 have lugs 15 which engage in slots 16 in the barrel 6 to prevent them rotating within the barrel 6 which remains stationary. The plates 13 have diametrically opposed slots 17 for the wafers to be described.

The rings 14 called contact rings shown as in FIGS. 7 and 8 and other rings 18 called energizing rings are shown in FIGS. 9 and 10.

The rings 14 FIGS. 7 and 8 have on one side an interior circular surface 19 with which the circular barrel slidably engages for rotation thereagainst. The remainder of the interior surface of the ring 14 has stepped recesses 20, 21 and 22 and a slot 23 while the outside of the rings 14 have a cam 24 and a recess 25.

Within an extension 7 of the barrel 6 are slidably arranged plungers 26 urged by springs 27 to engage the outer surface of the ring 14, their other ends 28, when the plungers 26 are moved to the left in FIG. 7 as seen in FIG. 8 engaging microswitches 29 in the portion 7 of the barrel 6.

In FIGS. 9 and 10 the rings 18 are similar in construction to the rings 14 but they do not have the interior recesses 20, 21 and 22 and the cam 24 is differently shaped: they do, however, have the recesses 23 and 25.

Inside the plug 2 are a number of separating rings 29 and end rings 30 between which are sandwiched alternately wafers or sliders 31, 32, 31 being cam operating wafers and 32 being locking wafers. The number of wafers 31 or 32 does not materially matter although in the drawings the wafers are shown as alternately locking and spring wafers. All the wafers at one end of the plug could be locking wafers and the others at the other end could be wafers 31 for example.

Each wafer is seen more clearly in FIGS. 5 to 10 and each has a projection 33 extending into a slot 34 formed between the plates 29. Within the slot 34 is an initially compressed spring 35 one end of which is engaged against a face 36 in a plate 29 and the other end of which is engaged against the lug 33. Thus the springs tend to force the wafers in one direction in a transverse slot 34 which extends across the plug and in one position as seen in FIGS. 5, 6, 7 and 9 engages the slot 23 in the ring 14 or ring 18 or the slot 17 in the plate 13. Each of the wafers has a central slot 37 through which the key passes, the blade of the key being wider than the depth of the slot 37 lengthwise of the wafer. The slots 37 are so disposed in the different wafers that when the key is inserted into the apertures 5 and goes through the center of the plug its chamfered faces 38 will act as cams on the top and/or bottom of each slot 37 in its respective wafer and move that wafer across the slot in the plug to the appropriate position. Where the key has not got right home in the plug the wafers will be in various positions depending on what parts 38 of the key engage them and thus some of them will be in the slots 17 in the plates 13 or in the slots 23 of the

rings 14 and 18. When the key has been fully driven home in the plug so that its face 39 engages the end 40 of the plug all the faces 38 and the crests 39 between them will be in engagement with one end of the slot 37 in each of the wafers 31, 32.

In the position where the key is fully within the plug as already described the wafers 32 are all disposed within the plug as seen in FIG. 6 so that as far as the locking wafers 32 are concerned the plug can be rotated within the plates 13 and in the barrel 6. During this rotary movement there is no effect on the rings 14. At the same time the wafers 31 are projected from the plug by the action of the key to engage in the slots 23 in the rings 14 and 18 which are rotated thereby, the cams 24 then engaging the plungers 26 and forcing them outwardly along the member 7 to actuate the switch mechanism 29. If the recess 25 in a ring 14 is brought into contact with the inner end of a plunger 26 that plunger is not depressed whereas of course if the cam 24 engages the inner end of the plunger 26 that is depressed. Similarly in FIGS. 9 and 10 the cam 24 and the recess 25 function as in FIG. 7 but the cam 24 has a longer circumferential face 41 so that for a substantial arc of rotation of the plug the plungers 26 are forced into engagement with the microswitch mechanism 29.

It will be understood that rings 18 and/or 14 can have a variety of cams 24 and/or plunger recesses 25 enabling a number of positions of the lock on rotation to actuate the microswitches in a predetermined sequence established by the shapes of the cam 24 and the positions of the recesses 25. In some positions of the wafers 31 their ends projecting from the plug 2 may engage in one of the recesses 20, 21 or 22 rather than in the recess 23 and this means that the ring 14 will be rotated at the appropriate moment in the rotation of the plug and since there may be an angular movement of the wafer 31 within the slot 22 or 21 or 20 there will be a lost motion before the ring 14 rotated by the wafer. Similar cut away portions may be provided if desired in the rings 18 but in FIG. 9 for example there is a cut away part 42 whereas in FIG. 8 there is no such cut away part.

It will be understood that when the key is withdrawn from the plug 2 all the springs 35 reassert themselves so that all the locking wafers 32 and the wafers 31 are moved eccentrically of the plug which is thereby prevented from rotating in the barrel 6 and the rings 14, 18 are similarly prevented from rotating. The whole is then locked against unauthorized movement.

Turning now to FIG. 4 and FIGS. 8 and 9 the microswitch mechanism 29 has a number of switches 43 shown as leaf springs with contacts 44 so that when the plungers 25 are forced by the cams 24 out of the portion 7 of the casing they close the switches 43, 44 or some of them and thereby complete an electric circuit for the particular use required. There is a different switch for each of the plungers 25 and any number of plungers with rings 14, 18 with their attendant switches 43, 44 may be employed.

In operation it will be seen that by rotating the key through different angular distances, the microswitches can be operated in a sequence dictated by the shape of the wafers and rings.

Means may be incorporated to prevent withdrawal of the key 1 from the plug until the key and plug 2 with as-

sociated parts have been rotated to the original or inoperative or locked position. Such means may comprise a pin or projection on the lock case so positioned to form a block against which the key will abut after completion of the desired rotation to complete an electric circuit through the switch mechanism 29.

During the reverse rotation of the key and plug each wafer 31, 32 will in turn abut against a straight step 50 FIG. 10 on the corresponding ring 14, 18 thereby also reversing rotation of the rings to the original position in which the plungers 25 will be spring pressed to re-engage the recess 25 in the associated ring thereby disconnecting the other end of the pin from contact with the micro-switch 43, 44. On withdrawal of the key from the plug the wafers will be spring pressed outwards from the plug so that one end of each wafer projects to the position of greatest radius on each of the rings or engages in the corresponding slot 17, in the plates 13 thereby securing the plug and associated parts against rotation.

Appropriate arrangement of the recesses 20-23 FIGS. 7 and 8 may enable the key to be withdrawn after less than a full revolution. The aperture 5 in the front of the plate 4 for passage of the key is then extended in the form of two outward slots positioned at each position for key entry and withdrawal and the key is correspondingly formed with a projection to pass through the two slots.

As an alternative to the holes or recesses in the lock case into which the detainers extend to lock the mechanism, nonrotating rings may be used said rings having the necessary apertures to receive the end of each detainer. When said locking rings are used it is preferred they shall be spaced within the depth of the lock case alternately with the rings for the sliders in which case the detainers and sliders in the plug will be correspondingly arranged.

The lock controlled switch mechanism of this invention may be associated with a mechanism to control the speed of rotation of the key and plug and wafer ring assembly. Such an arrangement may comprise a plunger or piston slidably arranged in a fluid controlled cylinder made as part of or fitted to the lock barrel 2, the plunger being actuated by a cam, formed on the rear end of the plug to the left in FIG. 4, and spring pressed towards the cam. Control of the plunger and corresponding speed of key rotation may be effected by opening or closing a valve in the cylinder for example in the form of a screw having a tapered slot along its length.

The invention has so far been described for use with a key of the flat type such as is normally used for lock mechanism of the cylinder or barrel type. The lock may however be constructed for operation by a pin type key having a bit in which steps are provided for operation of the mechanism. In this case the lock body or housing has a keyhole for the entry and withdrawal of a pin type key, a series of discs assembled for rotation in the housing, each disc having means to prevent rotation except when a correct key is inserted and rotated: such discs are formed with an aperture radially of the keyhole and having a form in which the radius is reduced at predetermined positions to produce a series of steps for contact by the bit of the key. Each ring is provided with a notch to receive a key pin and, on rotation, to slide

the pin from the notch to the periphery of the ring. Each pin is held under pressure of a spring at one end in contact with the corresponding ring, the other end of each pin projecting from the housing for contact with the corresponding operating arm of an electric switch and in particular a microswitch. The key for this mechanism is of the pin type having steps of varying depth for operation of the wafers and further steps of varying depths for operation of the rings.

In the locked position the pins are located in the notch of the relative rings which are prevented from rotation by tumblers or wafers slidably mounted in a channel in each ring and in the locked position projected by springs at one end from the ring into a recess in the housing. On the insertion and rotation of a correct key the tumblers or wafers are moved by the corresponding recess in the bit of the key to a position wherein they are aligned to the periphery of the ring which is then free to rotate. Further rotation of the key will bring the step of greatest radius on the key bit in contact with the first step of the radial form in the ring which with its wafer rotates with the key to bring the step of second greatest radius on the bit of the key in contact with the second step of the radial form in the ring and this series of movements will continue until all rings have been rotated to a step which on the housing prevents further rotation of the key. When the key contacts each step of the corresponding ring the ring rotates and its recess causes the key pin to contact the operating arm of the switch thereby making or breaking the switch circuit. The key having reached its stop cannot be removed from the mechanism and must therefore be rotated in the reverse direction. The tumblers or wafers may be of the pivotless-lever type guided in an arcuate groove or channel in each ring, or they may be levers pivoted on a pin attached to or integral with the disc and may have a projection at each side for locking engagement in slots or recesses in the lock housing. A further type of pivoted levers having a slot at a predetermined position on the periphery may be used in conjunction with a talon slidably guided on or through each ring one end of each talon being formed to engage a recess in the lock housing the other end of said talon being shaped for entry into the slot in each lever. On insertion and rotation of a correct key the levers are lifted by the respective recesses in the key to a position where each lever recess is aligned to form a channel which the other end of the talon enters the slots in the levers and further rotation ensures the rotation of the rings and lock mechanism. In a further construction the talon may be of the pivoted type, the pivot being arranged in, for example, plates or discs at each end of the rings.

We claim:

1. A lock and electric switch mechanism comprising a hollow housing, a number of electric switches secured to the housing, a number of switch actuating elements moveably mounted in the housing to make and break the switches, a rotatable lock assembly mounted for rotation in and in spaced relation to the housing wall, a number of cam elements rotatably mounted in the housing around the lock assembly with cam surfaces engageable by the switch actuating elements and operable to cause the elements to move to actuate the switches, and a number of moveable elements disposed

for movement in the lock assembly transversely of the axis of rotation of the assembly and biased to move at least some for engagement with abutments in the housing and to move the rest for engagement with abutments in the cam elements, the transversely moveable lock assembly elements having slots in axial alignment and of different lengths for engagement by a key of varying contour inserted therethrough, whereby when the key is disposed in the operating position in the slots in said slotted elements these elements are moved in the lock assembly to free them from the housing to permit the assembly to rotate and rotate the cam elements to actuate the switches through the switch actuating elements in a predetermined sequence.

2. A mechanism according to claim 1 wherein the housing is barrel shaped and the lock assembly comprises a cylindrical plug engageable in circular recesses at each end of the barrel, and the barrel at one end of the plug has an aperture through which a key is inserted and moved axially through the slotted elements to an actuating position therein.

3. A mechanism according to claim 1 wherein the cams are in the form of rings rotatable round the plug and each in radial register with one of the locking elements and axially separated by spacer elements fast with the housing, each ring being in radial alignment with one of the switch actuating elements.

4. A mechanism according to claim 3 wherein each cam ring has a radial cam surface extending radially outwards of the ring and a radial recess, whereby on rotation each ring allows the switch actuating element to engage the recess or the cam surface moves the switch actuating element radially outwards.

5. A mechanism according to claim 1 wherein each switch actuating element comprises a plunger slidable in a guide in the housing with respect to its switch contact elements and is biased to engage the cam.

6. A mechanism according to claim 1 wherein the slotted elements are shaped for operation with a number of keys all of which have to be employed in the operating position for actuating of the lock.

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