United States Patent [19]

Schipper

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[54] **PERMUTATION LOCK**

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[52] **U.S. Cl.** **70/299,** 70/138, 70/323, 74/25

[51] **Int. Cl.** **E05b 37/00**

[58] **Field of Search** 70/288, 299, 306, 311, 329; 74/25

[56] **References Cited**

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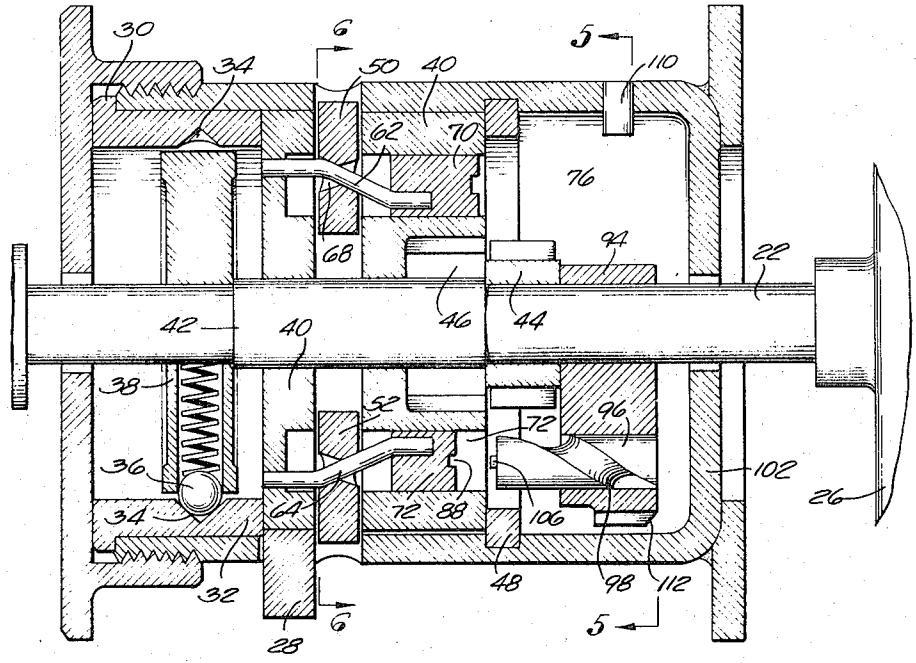
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Primary Examiner—Albert G. Craig, Jr.
Attorney, Agent, or Firm—Wheeler, Morsell, House & Wheeler

[57] **ABSTRACT**

Lock handles and spindle have rotative and axial movements, without any exposed dial which might become polished to indicate the combination, one such movement making cam selection and the other effecting cam actuation, selection being made when the actuating parts are completely disengaged to eliminate any possibility of betraying the combination to a person having a sensitive touch. Tumblers readily interchangeable to vary the combination are entirely out of sight. Tumbler actuating cams are operated by an actuator selectively engageable therewith and which shortens progressively in each step of operation to determine its proper sequential functioning. In the instant device the cam heads successively engaged by the actuator are of successively increased length so that in proper functioning the combined length of the actuator and the cam head is always the same. Engagement with an incorrect cam will preclude correct operation and make it necessary for the operator to return to the starting point. Three tumblers are shown; any number within the physical capacity of the device may be used.

20 Claims, 15 Drawing Figures



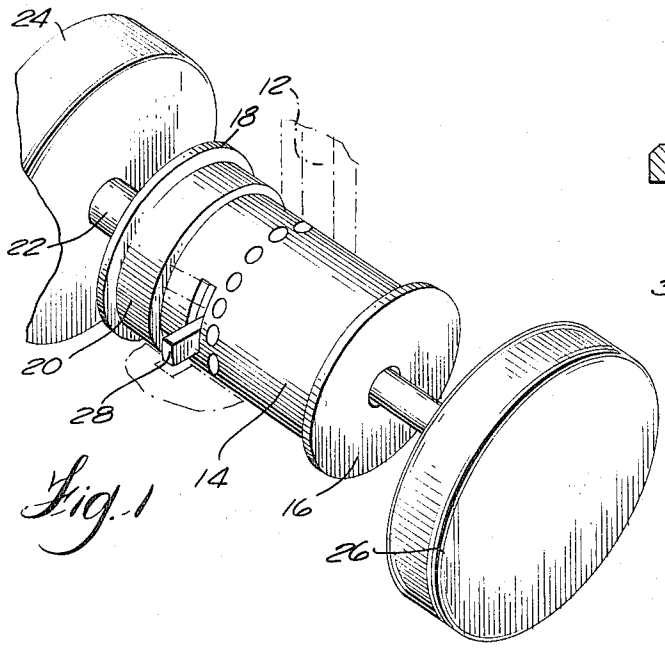


Fig. 1

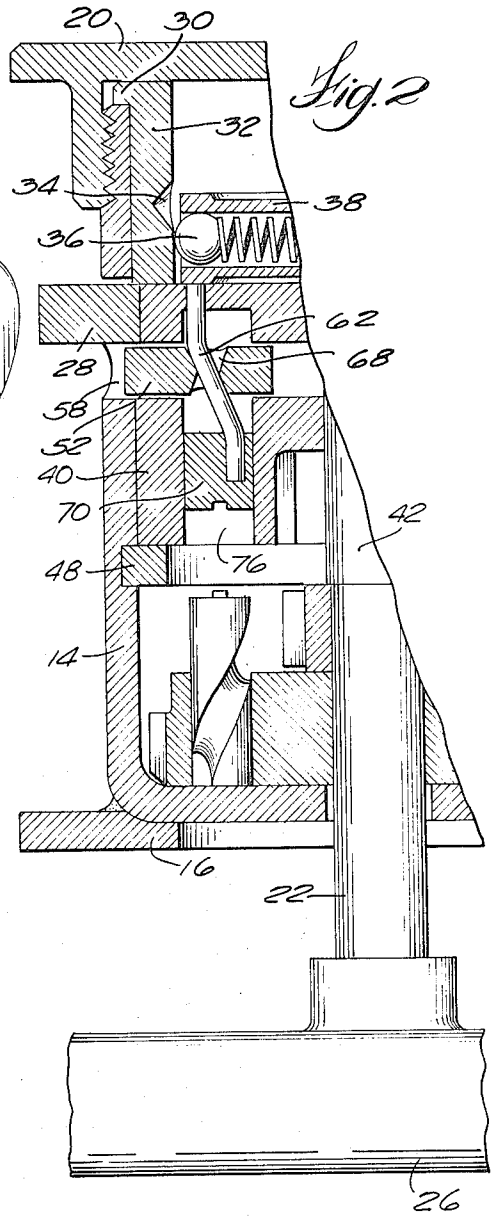


Fig. 2

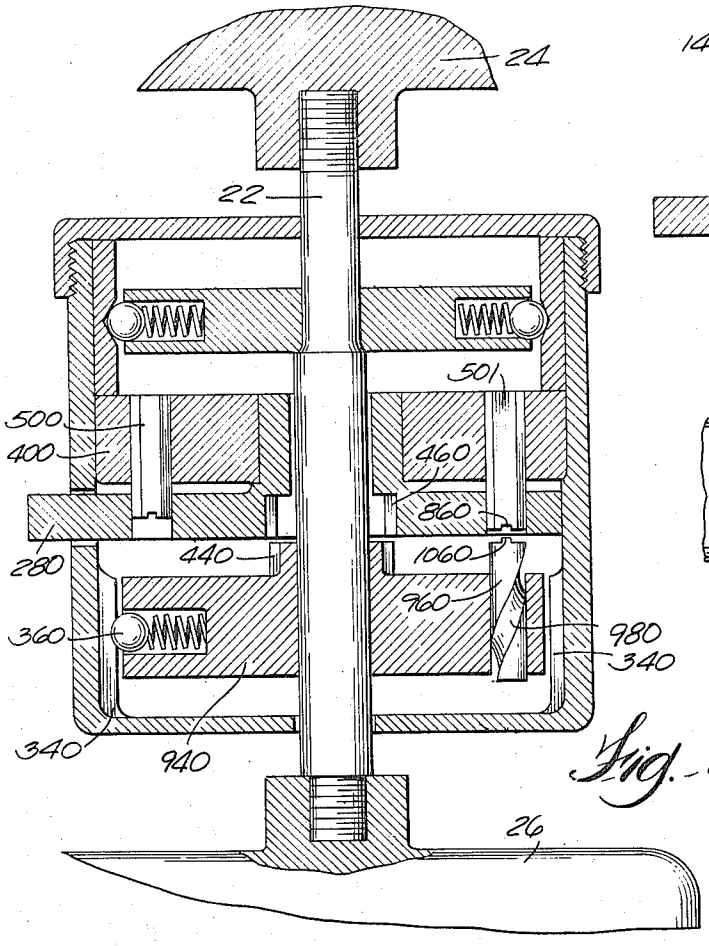
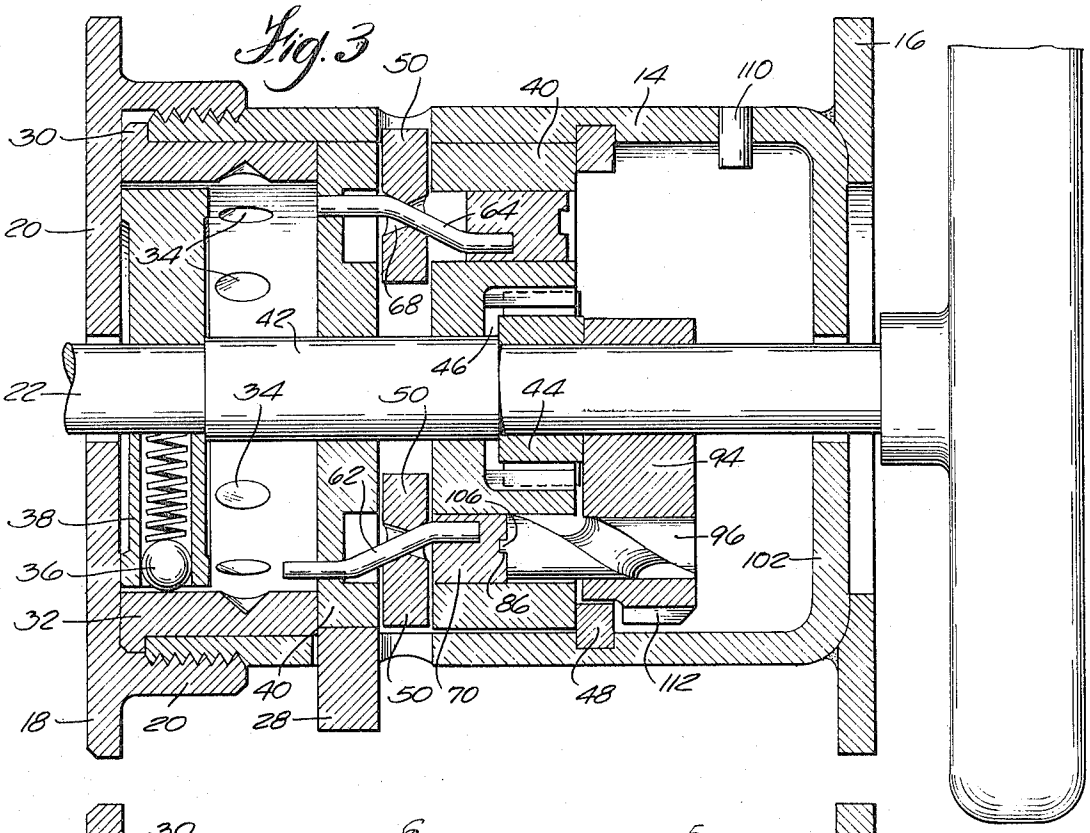


Fig. 11

Fig. 3


16
50
40
14
110
30
64
20
34
68
42
46
22
34
50
44
94
62
106
38
96
102
36
86
32
40
50
70
48
112
18
20
28

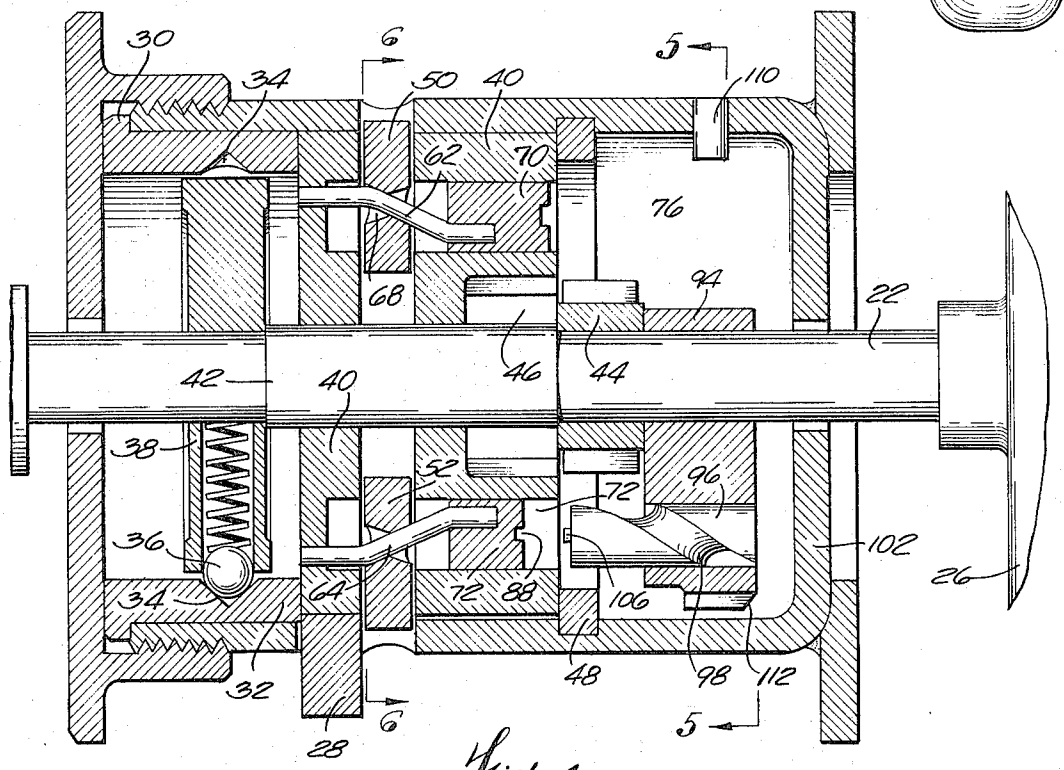

30
6
5
34
50
40
110
62
70
76
68
94
22
42
40
46
44
38
52
72
96
36
102
26
34
64
72
88
106
32
48
98
112
28
6
5

Fig. 4

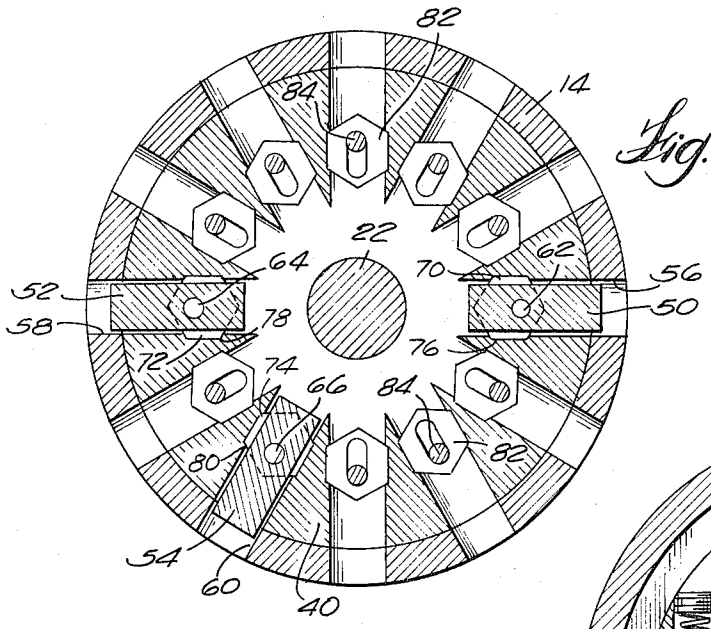


Fig. 6

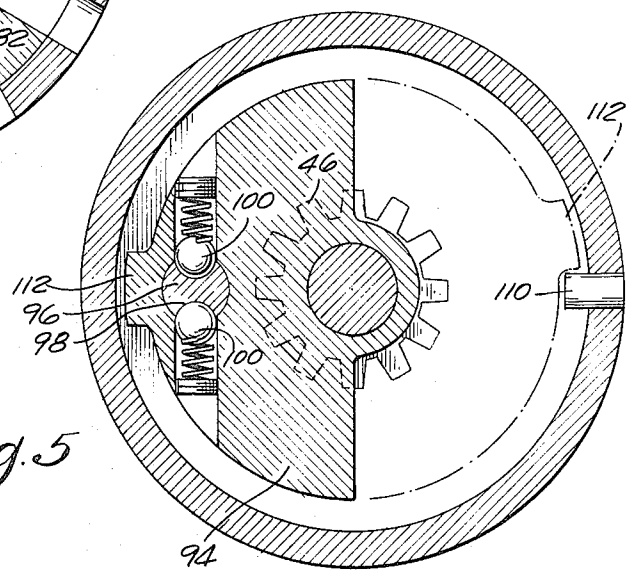


Fig. 5

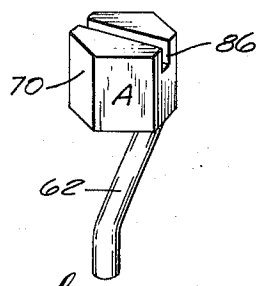


Fig. 7

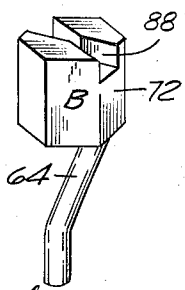


Fig. 8

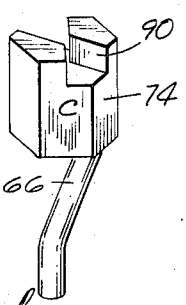


Fig. 9

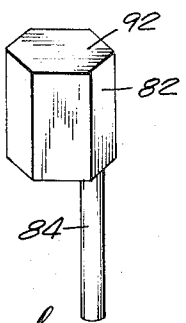


Fig. 10

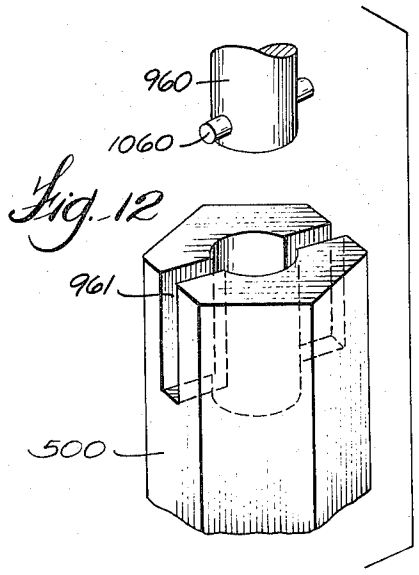


Fig. 12

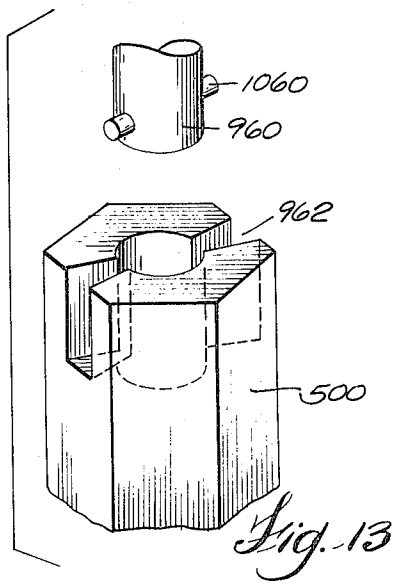


Fig. 13

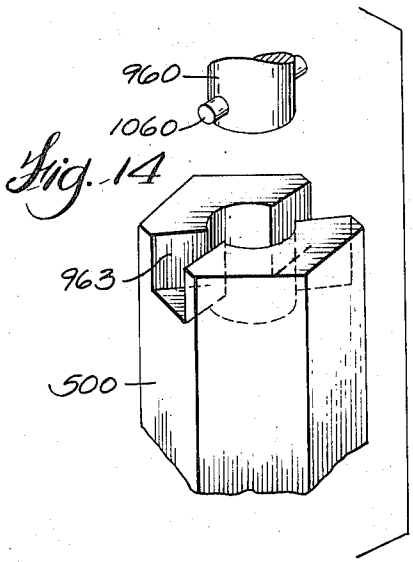


Fig. 14

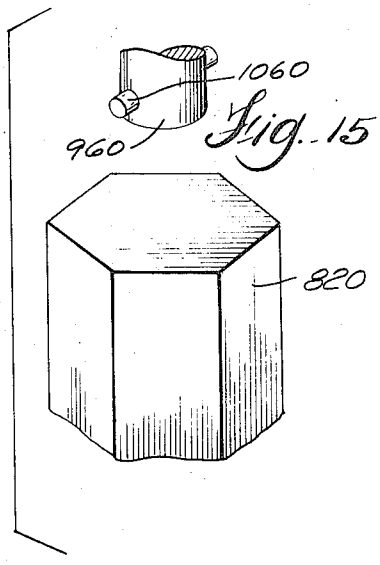


Fig. 15

PERMUTATION LOCK

BACKGROUND OF INVENTION

In the case of an ordinary permutation lock, a skilled operator can easily determine the combination either by his sense of sight or his sensitive touch. If the lock is of a construction using push buttons to be actuated in predetermined sequence, these buttons become polished and the only remaining problem is to determine the proper sequence. Thus picking the lock by a skilled person involves little difficulty. In the case of the ordinary tumbler lock which is rotated alternately in opposite directions, there is usually a perceptible metallic click when the proper tumbler is engaged. Again a skilled operator can readily determine the combination in such cases.

SUMMARY OF INVENTION

The object of the present invention is to provide a pick-proof keyless lock having unlimited and readily interchangeable combinations including a rotatable and axially movable spindle.

The principal features include a helically grooved actuator engageable in each of its operative positions with a tumbler retracting cam. The cam and the actuator have interengageable clutches which limit rotation of the actuator in its bracket, thereby retaining its projection from the bracket to an amount which is appropriate for the particular projection required in that position of the spindle. Unless preliminary manipulation of the spindle registers the actuator clutch with the clutch of the appropriate cam and unless such registration is achieved prior to the advance of the actuator, and without physical contact, the clutch will not control the actuator properly. The actuator slides back out of operative position unless keyed to the proper cams in proper sequence. The cams have actuator-engaging heads which are of progressively increasing length to compensate for the progressive decrease in projection of the actuator in the course of sequential operations.

The operating handle is initially set to a position from which an impositive detent permits ready adjustment in successive steps. Each reciprocation of the handle must occur prior to engagement of the actuator with a cam in the next step. There being no preliminary contact between the parts, there is no perceptible means of determining which is the correct rotative position for operation of the handle.

Once progression of the actuator is shortened beyond the point at which it should be at a given stage in normal operation, it can be restored to proper length of projection only by withdrawing the handle back to the starting point and thereby restoring the actuator to the desired length of initial projection. This will restore to locking position all of the tumblers previously withdrawn with the cams. A new start must then be made.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a perspective view of a lock casing for incorporation in a door or elsewhere for actuation of the mechanism by a handle or handles mounted on the spindle.

FIG. 2 is a fragmentary view in section showing on an enlarged scale a spindle retracted to starting position to place the threaded actuator at its maximum projection and to place all of the locking tumblers into the locking position which is their starting point.

FIG. 3 is a view in axial section showing the spindle advanced to engage the actuator with the first cam of the sequence, thereby retracting the tumbler controlled by that cam.

FIG. 4 is a view similar to FIG. 3 showing the spindle partially withdrawn to its selecting position and in readiness for rotation to register the actuator for engagement properly with another cam.

FIG. 5 is a view in transverse section on line 5—5 of FIG. 4.

FIG. 6 is a view in transverse section on the line 6—6 of FIG. 4.

FIG. 7 is a detail view in perspective showing the first cam requiring operation.

FIG. 8 is a view in perspective showing the second cam requiring operation.

FIG. 9 is a view in perspective showing the third cam requiring operation.

FIG. 10 is a view in perspective showing a dummy rod which does not actuate a cam.

FIG. 11 is a view comparable to FIG. 2 showing a modified embodiment.

FIGS. 12 – 15 inclusive are diagrammatic fragmentary views in perspective showing parts of a further modification of the FIG. 11 embodiment in positions generally corresponding to those shown in FIGS. 7 – 10 in the previous embodiments.

DETAILED DESCRIPTION

FIGS. 1 – 10

Extending through the door 12, and clamped thereto, is a lock casing 14 which is a shell to which disk 16 is welded at its closed end to abut the face of the door. The flange 18 on the closure 20 screwthreaded to the opposite end of the casing engages the opposite face of the door. This particular embodiment is intended for use as a door lock although the locks embodying the invention may be used for a wide variety of purposes. In the case of a door lock, I provide in this casing a spindle 22 which projects at both sides of the door and carries handles 24 and 26. The spindle is both rotatable and axially movable and when properly manipulated it serves to actuate the latch-actuating tongue 28 by means of which the door is releasably locked. The latch mechanism is not illustrated. Clamped by closure 20 at the end of barrel 14 is an annular flange 30 of the sleeve 32. The sleeve has a row of peripherally spaced pockets 34 with which a spring-pressed ball or balls 36 may be registered to define rotative positions impositively.

In the position of the spindle shown in FIG. 2, the back plate 38 is axially out of register with the series of pockets 34. The ball or balls 36, therefore, are pressed against the unpocketed inner cylindrical surface of sleeve 32.

In the position of the spindle shown in FIG. 3, the back plate 38 is at the other side of the pockets 34, whereby each impositive detent ball 36 is out of registry with the pocket in this position, also. Only in the position of axial adjustment of spindle 22 which is shown in FIG. 4 does an impositive detent ball or balls 36 register axially with the series of pockets 34.

The lock cylinder 40 is rotatably mounted on the hub portion 42 of the spindle 22. The spindle turns freely within it when the parts are in the position shown in

FIG. 4 but may be keyed to the cylinder when the spindle is in the position of FIG. 3. In this latter position, a splined hub 44 is in the socket 46, whereas in the position of the parts shown in FIG. 4, the splined hub is outside of the socket. The cylinder is anchored against axial displacement by means of the lock ring 48. Parenthetically it may be remarked that when the combination has been operated successfully the interlocking engagement between the spline 44 and the complementary opening 46 of the cylinder 40 will communicate torsion from the handle 24 or 26 through the spindle to the cylinder to rotate the cylinder within the casing and thereby to oscillate the latch or bolt operating tongue 28 to released position.

Until the combination has been operated successfully, the cylinder is restrained against rotation within the casing by virtue of radial engagement of the several tumblers 50, 52 and 54 in the corresponding openings 56, 58 and 60 of the casing 14 shown in FIGS. 2 and 4.

For moving the several tumblers in and out in their respective bores in the cylinder 40, I provide by way of example bent axially acting cams or camming pins 62, 64 and 66, respectively. These extend through the respective openings 68 in the respective tumblers as shown in each of FIGS. 2, 3 and 4. The leads or offsets of the cams operate radially on the tumblers because the cams are precluded from rotation by interlock with cylinder 40. For example, the respective heads 70, 72 and 74 may be hexagonal in cross section operating in corresponding openings 76, 78 and 80 in cylinder 40.

The lock cylinder may have any desired number of cams and also any number of dummy pins and dummy heads therefor, which perform no camming function. A number of the dummy heads 82 are shown in FIG. 6. These have the same cross section as the heads 70, 72 and 74, being readily interchangeable therewith. However, the dummy heads 82 may have straight pins 84 instead of the camming pins 62, 64 or 66. They may also differ in length, the dummy head 82 shown in FIG. 10 being longer than any of the cam heads 70, 72 and 74. Compare FIGS. 7, 8, 9 and 10. Whatever shape the cam or rod 84 takes, no tumbler is provided at the position of a dummy head 82, as best shown in FIG. 6.

It will be noted that the head 70 with which camming pin 62 is provided has a straight and narrow transverse clutch slot at 86. The head 72 of cam 64 has its clutch slot 88 widened at both ends. The head 74 of cam 66 has its clutch slot 90 still more widely angled as shown in FIG. 9. The form of the slot permits limited rotative movement of the actuator 96, notwithstanding its being clutched against more than limited rotative movement. The dummy head 82 of the straight rod 84 of FIG. 10 has no clutch slot whatever, having a flat face 92.

In reality I have shown two separate means of accomplishing my purpose of requiring actuation of the cams in predetermined order or sequence. One such means is the result of using the progressively widened clutch slots as above described. The other means consists in the fact that the heads progressively increase in length throughout the series in the order in which successive actuation is required.

Mounted on spindle 22 behind the splined hub 44 is a bracket 94 in which the actuator 96 is slidably and rotatably mounted. It has a helical groove or grooves at 98 which constitutes a thread or threads engaged by detents, shown here as balls 100 as shown in FIG. 5.

When the spindle 22 and bracket 94 are drawn rearwardly against the wall 102 of the casing 14, the engagement of the rear end of the actuator 19 with the casing will move the actuator forwardly in the bracket 94 to the position shown in FIGS. 2, 3 and 4. When the spindle 22 is moved forwardly from its retracted position, it will carry its actuator with it, without effecting rotation of the actuator unless or until the actuator encounters resistance at a time when it is free to rotate. If, at the time the spindle is moved forwardly, the actuator is in a position in which its key 106 registers with the groove of one of the camming heads, there will be a locking interengagement of these parts to control the rotation, and extent of rotation (and thus the extent of axial yield) of the actuator 96, depending upon the width or form of the key slot with which the key engages. Thus in FIG. 3 the key 106 is positioned to register with the groove 86 in the head 70 (FIG. 7) so that the non-rotatable head 70 will prevent the actuator from rotating at all and hence will constrain the actuator to remain fixed in the thread engaging detent provided by the balls 100. Under these conditions, the actuator and the bracket of the spindle have been unitarily locked against axial movement respecting bracket 94 as well as against rotative movement. Thus actuator 96 moves with bracket 94 and spindle 22, and the advance of the spindle has caused the cam 62 to retract the tumbler 50.

If the spindle and bracket were then rotated to register the actuator key 106 with the key slot 88 of head 72 as shown in FIG. 4, the continued advance of the spindle 22 to the left will cause cam 64 to retract tumbler 52. In the process, the actuator 96 would be permitted to rotate somewhat due to the form of clutch slot 88, thus changing its axial position respecting bracket 94. In its new position the actuator could only be engaged properly with slot 90 of head 74 and hence could only be restrained in accordance with the requirements of cam 66 for retraction of tumbler 54.

For example, suppose the key 106 engages the flat top 92 of the dummy 82 (FIG. 10). Although the dummy has the same hexagonal cross sections as the other cam rods, and therefore will not rotate, it cannot communicate its non-rotative characteristic to the actuator 96 for lack of any cross slot with which the actuator key 106 can engage. Hence contact of the actuator key with the dummy head 82 will leave the actuator free to rotate under axial pressure of such engagement and this rotation of the actuator will cause it to be screwed rearwardly by the detents or balls 100 (FIG. 5). The same would be true in any other position of the actuator in which its clutch key spans one of the clutch slots instead of entering into registering engagement therein.

In addition, whenever a position in the correct sequence is skipped by the operator, the actuator clutch will engage correctly with the next clutch slot, either immediately or after some preliminary rotation, but the rotation permitted to it will be excessive due to any preliminary rotation and to the angularly increased width of that slot; hence the actuator clutch will not thereafter properly engage the clutch of the cam in the skipped position, both because the key 106 will be in an incorrect rotative position for the skipped cam, and because actuator 96 will be in an incorrect axial position respecting bracket 94 to push the head of the cam in the skipped position far enough to retract its asso-

ciated tumbler. Actuation of that cam is irretrievably lost until the actuator is again restored to its initial or starting position, all previously operated tumblers being thus restored into engagement. The least axial movement of the parts beyond that intended to be accommodated by the clutch key and groove would permit the actuator to be retracted beyond the point at which the cam pin connected therewith would properly retract the associated tumbler. In such a case, it would be necessary for the operator to withdraw the spindle **22** as far as it would go to the right, whereby the end of the actuator projecting from the bracket **94** would become engaged with the rear surface **102** of the casing **14.** This would re-locate the actuator in the bracket as shown in FIG. **2** and simultaneously re-set the cams and tumblers because disc **38** moves with spindle **22,** and the operator would have to start over again to manipulate the spindle by means of its connected handles. Only when the spindle is so operated as to engage the actuator in proper sequence with the several cam heads will it be possible to manipulate the combination to release the lock.

As above explained, the proper location of the actuator with reference to successive cam carrying heads is not determinable by the senses of the operator. Manipulating the actuator to different positions in proper sequence can be done only when the actuator is out of contact with the cam-connected heads **70, 72** and **74.** When the spindle is advanced to the left as viewed in FIGS. **3** and **4,** the actuator is always engaged in one of the openings in which the cam heads reciprocate. These openings are disposed in the cylinder. The cylinder is restrained by the several tumblers until the manipulation has been successfully completed. Hence no rotation is possible.

In the opposite position of the spindle (at the right as viewed in FIGS. **3** and **4**) the actuator is completely out of contact with the camming parts and any movement of the spindle to this extreme will cause the actuator to engage the rear wall **102** of the casing, thereby destroying the intended sequence of operation and requiring that the operator start over since all tumblers have now been automatically pushed into locked position.

Only when the spindle is in its intermediate position in which the impositive detent ball or balls **36** is in the plane of the several sockets **34** (FIG. **4**) is it possible to turn the spindle for registration of the actuator **96** toward the next cam head in the intended sequence. In this axially intermediate position of the spindle, each ball **36** will register with successive pockets **34** in a manner apparent to the operator. Thus, if he knowns the intended permutation sequence the operator can count the number of steps to the right or the left to achieve registration of the actuator with the next cam head in such sequence.

The casing **14** is provided with a stop at **110** (FIG. **3** and FIG. **4**). A complementary lug **112** on the bracket **94** is engageable with the stop **110** to define the starting point. When the spindle is turned to the right as viewed in FIG. **5** until the lug **112** engages the stop pin **110,** the operator will then be aware of a starting position from which he can rotate the spindle to the left until the actuator **96** registers with the first cam head **72** in the selected sequence. As will be apparent, this might be any number of steps as measured sequentially by engagement of a ball detent **36** in successive pockets **34,** since whatever the number of cam heads that function in the operation of the lock, these may be arranged in any desired order with reference to each other and with reference to the dummy heads such as that shown at **82** (FIG. **10**). In any event, there is no contact between the spindle-connected parts and the tumbler-connected parts during the rotative movements required for selection. Only after the operator reaches the point believed to be correct for his next step in selection does he advance the spindle to the left as viewed in FIGS. **3** or **4,** thereby retracting the tumbler if his selection was correct, or destroying his whole sequence up to that point, if it was incorrect.

TYPICAL OPERATION

With the spindle and lock parts assumed to be at rest in the angular position shown in FIG. **5** and the axis position shown in FIG. **2,** the first step will involve clockwise rotation of the spindle to a starting point which is determined when the lug **112** on spindle bracket **94** engages stop **110** when it reaches the position **112** of FIG. **5.** The assumed code calls for spindle rotation clockwise five steps as indicated by successive impositive engagements of a ball or balls **36** in successive sockets **34.** The actuator **96** then registers with cam head **70** of cam **62** (FIG. **3**).

The next operation in the code requires the operator to move the spindle **22** axially to engage the key **106** of the actuator in the key slot **86** of the head **70** of cam **62.** Even light back pressure would cause the actuator **96** to cam itself rearwardly were it not precluded from so doing by engagement of its key in the slot **86** of the non-rotatable head **70.** Since it cannot rotate, the actuator must propel the cam **62** rearwardly. The offset or lead of the cam then draws the tumbler **52** inwardly as shown in FIG. **3.**

The next operation required is to draw the spindle axially rearwardly from its FIG. **3** position to a central position in which its impositive detent balls **36** are again in the plane of the series of recesses **34.** In this position of the parts, the spindle must now be rotated counterclockwise again for six steps impositively defined by engagement of a ball or balls **36** with successive sockets **34.** At this point, the key **106** on the actuator **96** will register with the angularly expanded slot **88** of head **72** of cam **64,** as shown in FIG. **4.**

The spindle must now be advanced once more axially to the left as viewed in FIG. **4,** thereby engaging key **106** in slot **88** to accommodate the control of rotative movement from the actuator when subjected to pressure against the head **72.** In the course of such axial and controlled rotative movement of the actuator, the cam **64** engages tumbler **52,** withdrawing it from engagement in casing **14.**

The spindle must now be retracted again to the right as viewed in FIG. **4** to withdraw the actuator **96** from bore **78** and from engagement with cam head **72.** When the spindle-connected back plate or disk **38** again registers with the annular series of pockets **34,** the operator rotates the spindle clockwise again for two steps defined by impositive engagement of a ball or balls **36** with two of the pockets **34.** At this time, the actuator **96** is in registry with the head **74** of the cam **66.** The slot **90** of head **74** is again an angularly widened slot adapted to accommodate the key **106** in the position of slightly increased angularity which the actuator was permitted to assume during engagement with the head **72.**

When the spindle is again moved to the left, as viewed in FIG. 4, the key 106 of the actuator 96 will be received into the angularly widened slot 90 (FIG. 9) and continued movement of the spindle will operate the cam 66 to withdraw the tumbler 54. All of the tumblers have now been withdrawn and, as in each previous advance of the spindle 22, the pinion 46 is engaged in the splined recess 46 of the lock cylinder, whereby rotation of the spindle can now cause rotation of the cylinder free of contact with the lock casing and thereby have the latch operating tongue 28 disengage the latch from its keeper.

It will be apparent that the successive clutches of cams 62, 64, 66 differ slightly in angularity, this being required because the actuator has slightly decreased projection from the bracket 94 each time it is permitted limited rotation in the bracket. It will likewise be apparent that if the actuator were permitted a greater or less degree of rotation than is required by the code and the mechanical construction of the parts, the lock could not be opened. Each of the heads from which the cams project must be engaged in proper sequence in order for the lock to function. The dummy rods are slightly longer than the longest cam rod. Consequently, any shortening of the actuator which occurs by contacting a dummy rod will always result in reducing its projection to a length which is too short to position even the longest cam rod, engagement of the correct heads in the wrong sequence will always result in incorrect adjustment of the axial projection and rotative position of the actuator 96 and key 106 so that the sequence cannot be completed, because each head 70, 72, 74 permits a different amount of rotation to actuator 96, and each requires a specific starting rotative and axial position of the actuator.

Resetting the lock either to correct an erroneous operation or to restore the latch to locked position is accomplished by pulling the spindle to its furthest outward position as viewed in FIG. 2. If the actuator is projecting from the bracket 94, it will be pushed back into the flush position in which it is illustrated in FIGS. 3 and 4. To the extent that any of the camming pins are projecting from the cylinder 40, as is the case in connection with camming pin 62 in FIG. 3, the back plate 38 will push it forward to the flush position of cam rod 64 in FIG. 3. This also will push all tumblers radially outward into locking position. Thus withdrawal of the spindle to the right as viewed in FIGS. 3 and 4, serves not only to retract the several camming pins but also to push the actuator to the proper starting position. Also, the pinion 44 will be disengaged from the spline 46 and latch actuating tongue 28 will be returned to locking position and the spindle and its handles will rotate freely, being disengaged completely.

FIGS. 11 – 15

The modified embodiment shown in these views is a simple construction in which locking is effected axially rather than radially. A cross rod 1060 (FIGS. 12–15, or bar as shown in FIG. 11) in the actuator 960 serves as a key and fits into slots 961 – 963 of progressively decreasing depth in successive hexrods. In the slot 961, no rotation is allowed. In the angularly wider slot 963, there is maximum clearance for angular movement of the pin 960 and, accordingly, maximum rotation may occur.

Rotation of the actuator 960, which causes actuator shortening, is compensated for by a shallower depth of slot. No reduction at all is provided in the dummy rod 820. Again as in the radial lock the effective length of actuator projection beyond the face of its bracket added to the length of the hex rods (measured from end of hex rod to bottom of slot) remains the same when the correct sequence is adhered to. If not manipulated in the correct sequence, this total length of actuator and hex rod becomes insufficient to actuate all of the hex rods in the skipped positions, either because the axial length of the actuator extending from the bracket would be insufficient due to excessive previous rotation, or because a mis-match between pin 1060 and the slot of the remaining hex rod would permit actuator 960 to rotate unduly as it is advanced, thus making it too short by the time pin 1060 drops into the slot of the head that was engaged in the incorrect order in the sequence, in the same manner as the device of FIGS. 1–10.

The mismatching of the cross pin 1060 with the slots also is a feature, similar to mismatching of the clutches in the radial lock.

As in the previous construction, the actuator 960 has a helical groove or grooves 980 of high pitch threaded in the bracket member 940. In the same manner as already described, the actuator decreases in projection each time it engages a fixed object which does not restrain it from turning. When it is to be restrained from turning, its transverse pin or key 1060 engages in the transverse channel 961, 962 or 963 in the end of a tumbler 500 which is non-rotatable but is axially slideable in the cylinder 400. The tumblers prevent manipulation of the bolt 280 whenever they are engaged therein as shown in FIG. 11. When the operator manipulates the spindle to advance the actuator 960 into engagement with one of the tumblers, starting with the shortest one as, for example, tumbler 500 in FIG. 11, he is able to push that tumbler free of the bolt or bolt actuating tongue 280. Thereupon the movement of the detent ball or balls 360 in the axial channels 340 will permit the actuator to be withdrawn.from the bolt and moved to the next position defined by the code. The operator will then again advance the spindle, the actuator being, for example, in registry with tumbler 501.

The foregoing description will make it apparent that in these embodiments there is no actual camming, the operation depending on the progressive increase actual length of the tumblers (FIG. 11) or in the effective length of the tumblers (FIGS. 12–15) caused by a progressively shallower depth of slot. This progressive increase allows the actuator to displace from the bolt all tumblers which become successively longer in the successive positions defined by the code, while the actuator projection becomes successively shorter in successive positions, due to successive increments of rotation permitted by the respective slots before the actuator 96 or 960 is clutched to a non-rotatable part to disengage a tumbler by cam action or by direct action.

I claim:

1. In a lock having a plurality of retractable locking tumblers, an actuator having support means supporting it for tumbler selecting movement and for tumbler retracting movement in different directions, engaging means engageable between said actuator and each said tumbler to perform tumbler retracting movements, said engaging means being engageable only in predeter-

mined sequence as a prerequisite for actuation of all of said plurality of tumblers.

2. A lock according to claim 1 in which the actuator is rotatable with respect to said support means, a handle connected to move said actuator manually in selecting directions and tumbler retracting directions, said engaging means including a tumbler retracting head normally disengaged from the actuator and complementary interengageable means on said head and said actuator which prevent rotation of said actuator in only one preselected position, said head and said actuator being interlockingly engaged in said preselected position when the actuator is moved in tumbler retracting direction in the course of said predetermined sequence of tumbler retracting movements, said means for requiring movements in predetermined sequence including means for simultaneously rotating and axially moving said actuator in response to axial pressure.

3. A lock comprising a cylinder member, a relatively rotatable barrel member, a plurality of retractable tumblers mounted in one of said members and for which the other of said members provides sockets into which respective tumblers are receivable to preclude relative rotation by said members, means operable only in predetermined sequence for retracting tumblers successively entirely into said one of said members to free said members for relative rotation, said means including a manually operable spindle mounted for axial and rotative movement, and a lock actuating member movable only in response to relative motion between said cylinder and said barrel, said means operable only in predetermined sequence including a handle mounted for movement in at least a tumbler moving direction and a tumbler selecting direction and means mounted for movement with said handle in said tumbler moving direction to move said tumblers and to preclude movement of said handle in the other direction.

4. A lock comprising the combination with a cylinder member and a barrel member, tumblers movably mounted in one of said members and movable to and from engagement in openings with which the other of said members is provided, a spindle having means supporting it for rotative and axial movements, an actuator for displacing at least one of said tumblers from a position of engagement with both of said members to a position of engagement with but one of said members, means for transmitting motion from said spindle to said actuator, motion of said actuator in response to one direction of movement of the spindle determining registration of said actuator with one of said tumblers, means for transmitting movement of the spindle in another direction for movement of the tumbler with which said actuator is in registry, and means for requiring a predetermined sequence of movements of said spindle to engage said actuator with successive tumblers as a prerequisite to the release of said lock, said last means including means to move said actuator to a position from which said sequence cannot be completed upon engagement of said actuator with any tumbler other than the tumbler next to be engaged in said sequence.

5. A lock according to claim 4 in which means is provided for precluding movement of the spindle in a direction to determine the particular tumbler with which said actuator is to be placed in registration unless said spindle and actuator are out of contact with the tumbler at the time the adjustment is made.

6. A lock comprising the combination with a cylinder member and a barrel member, of tumblers movable mounted in one of said members and movable to and from engagement with openings with which the other of said members is provided, cams individual to respective tumblers and constituting means for pushing said tumblers in a direction to retract respective tumblers from the last mentioned openings, an actuator rotatably mounted with respect to one of said members for selective engagement with respective cams for the pushing thereof in tumbler retractive movement, a spindle rotatably mounted with respect to said barrel member and upon which said actuator is carried for rotation to registration with a selected cam, means for precluding such movement to registration except when the actuator is out of contact with the respective cams, and means to move said actuator to a position from which it cannot move all said tumblers to retracted positions upon engagement with a cam which is not next in a predetermined order of cam engagement.

7. A lock according to claim 6 wherein said last mentioned means include a key on said actuator and said cam has a complementary slot in which said key is engageable, the cam being non-rotatable and the actuator having screw means in which it is mounted for axial and rotative movement respecting said spindle upon axial pressure on said actuator.

8. A lock comprising a combination with a cylinder member and a barrel member, of tumblers movably mounted in one of said members movable to and retractable from engagement in openings with which the other of said members is provided, cam means for individually retracting each of said tumblers, each of said cam means having a head axially reciprocable in said cylinder member and provided with a transverse slot, a spindle provided with means mounting it for rotation in the cylinder member and provided with a bracket projecting laterally, an actuator mounted for movement rotatably and axially in the bracket in a position offset from said spindle, screwthreaded means for potentially causing rotation of the actuator when subject to thrust axially of the bracket and not restrained from rotation, and a key on said actuator engageable in the slot to connect the actuator non-rotatably to a said head with which the actuator is aligned.

9. In a lock having relatively movable parts, bolt actuating means movable in response to relative movement between said parts, and tumbler means arrayed along a path and each movable from locked positions extending into both said parts to unlocked positions wholly in one of said parts, the combination comprising:

tumbler actuating means movable in a first direction to move a tumbler to unlocking position and movable along a path in a second direction parallel to the array of tumbler means only when said actuating means is out of contact with said tumbler means,

and means to disable said tumbler actuating means from moving all of said tumbler means to unlocked positions upon contact with a tumbler means which is not next in a predetermined sequence of tumbler means.

10. The device of claim 9 wherein said tumbler means includes a cam engageable by said tumbler actuating means.

11. The device of claim 9 wherein said array of tumbler means is circular.

12. The device of claim 9 wherein each tumbler means includes a tumbler movable radially along its own axis between locked position and unlocked position.

13. The device of claim 9 wherein each tumbler means includes a non-rotatable tumbler movable on its own axis between locked and unlocked position.

14. The device of claim 13 wherein said disabling means includes means mounting said tumbler actuating means for rotative and axial movement, and

clutch means engageable to prevent said rotative and axial movement during contact between said tumbler means and said tumbler actuating means.

15. The device of claim 14 in which said clutch means rotates a predetermined amount when said tumbler actuating means is engaged with a tumbler means which is next in the predetermined sequence and rotates a greater amount when engaged with any other tumbler means, the parts of said clutch being shaped to require a specific orientation of said tumbler actuating means at a specific tumbler means for movement of all tumblers to unlocked position.

16. The device of claim 15 in which said tumbler actuating means is a rod having a thread of high pitch around it, said rod being mounted on a bracket, detents in the bracket engaged with the thread, and a manually controlled spindle rotatable to move the tumbler actuating means along said path and reciprocable to engage said tumbler actuating means with a tumbler means, said clutch comprising a linear diametric projection from said rod and a mating groove in said tumbler means.

17. The device of claim 16 in which said mating groove is circumferentially widened at its ends to permit said predetermined rotation of said clutch.

18. The device of claim 16 in which said groove is oriented to premit said predetermined rotation of said clutch.

19. The device of claim 15 in which resetting means is mounted for movement with said bracket, and said rod may be restored to an operative position in said bracket only by a movement of said resetting means to a position that forces said tumbler means to locked position.

20. The device of claim 9 in which resetting means is mounted for movement with said bracket, and said rod may be restored to an operative position in said bracket only by a movement of said resetting means to a position thatforces said tumbler means to locked position.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,789,637 Dated February 5, 1974

Inventor(s) Pieter W. Schipper

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

Column 4, Line 3, "19" Should read --- 96 ----

Column 5, Line 51, "knowns" Should read --- knows ----

Column 6, Line 16, "axis" should read --- axial ---

Signed and sealed this 1st day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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