

[54] **MAGNETICALLY-OPERATED LOCKING MECHANISMS**

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70/413

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

[58] Field of Search 70/134, 276, 339, 413

[56] **References Cited**

UNITED STATES PATENTS

3,552,159	1/1971	Craig	70/276
3,570,287	3/1971	Hallmann.....	70/276
3,584,484	6/1971	Hallmann.....	70/276
3,782,147	1/1974	Hallmann.....	70/276

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Attorney, Agent, or Firm—Beaman & Beaman

[57] **ABSTRACT**

Locking mechanisms include a rotatably mounted stop member movable by means of a magnetic key between a release position and a locking position. When the stop member is in the release position a control element can enter a recess in the stop member and release movement of a locking bolt is permitted. The locking bolt is movable transversely to the direction of movement of the control element and the control element includes a cam portion which cooperates with a cam surface so that, when the stop member is in its locking position, movement of the locking bolt is prevented by interaction of the cam portion and cam surface. When the stop member is moved into its release position so that the control element can enter the recess in the stop member, relative sliding movement of the cam portion and cam surface can be effected. In several forms an ancillary bolt is likewise controlled. The ancillary bolt may be released by remotely controlled means.

27 Claims, 17 Drawing Figures

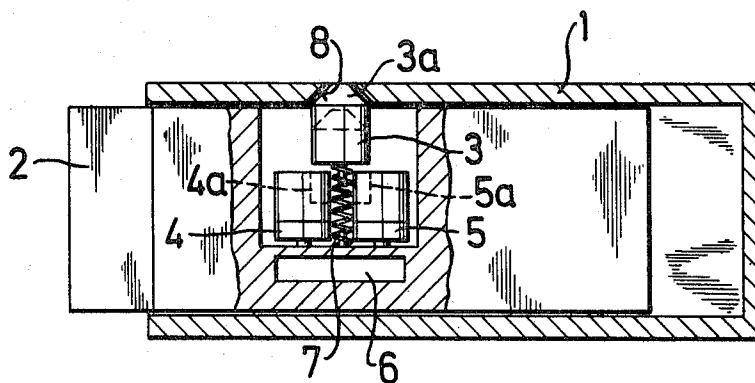


Fig. 1

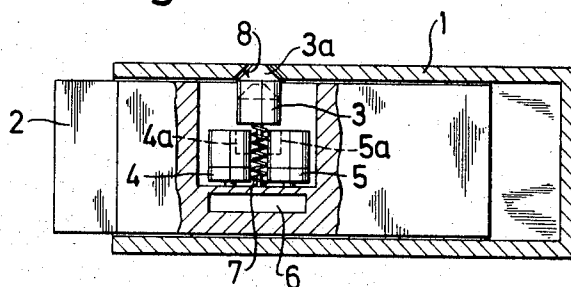


Fig. 2

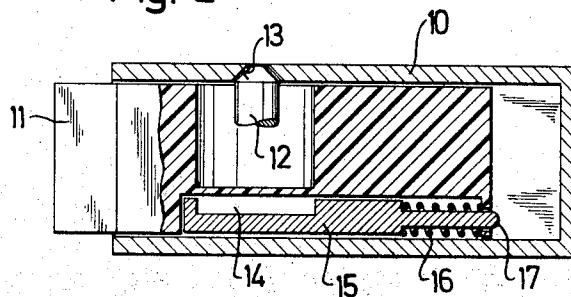


Fig. 3

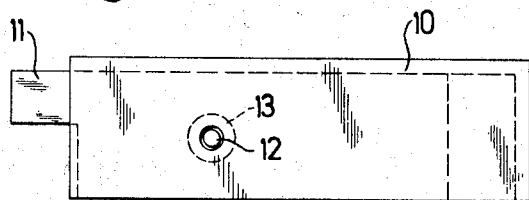


Fig. 4

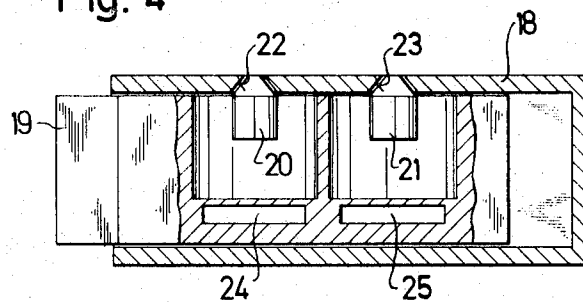


Fig. 5

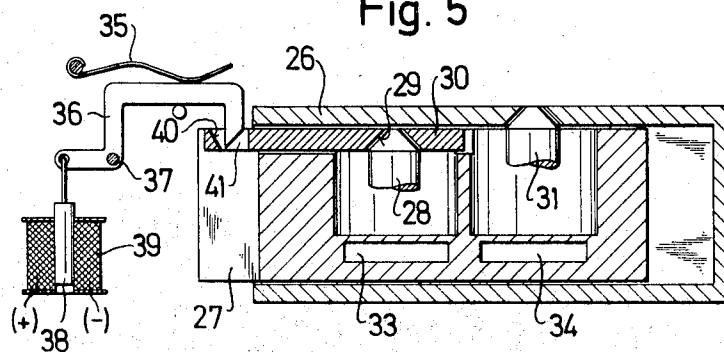


Fig. 6

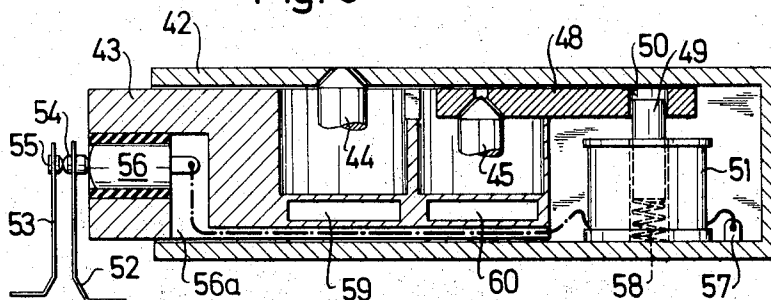


Fig. 7

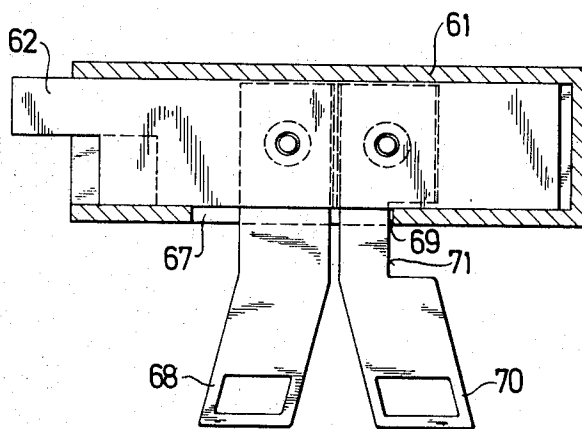
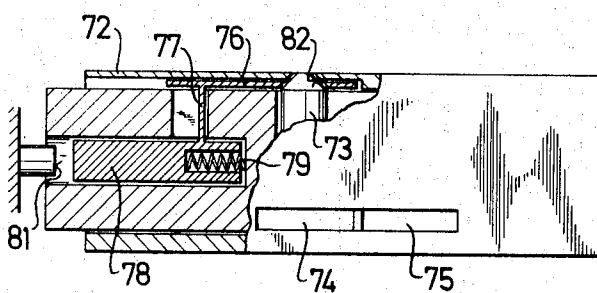


Fig. 8



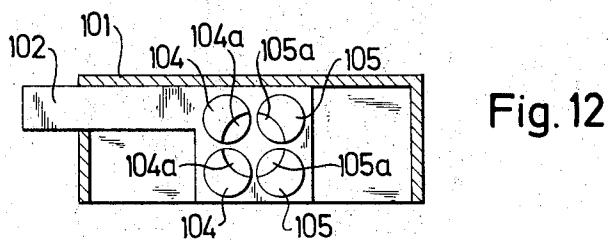
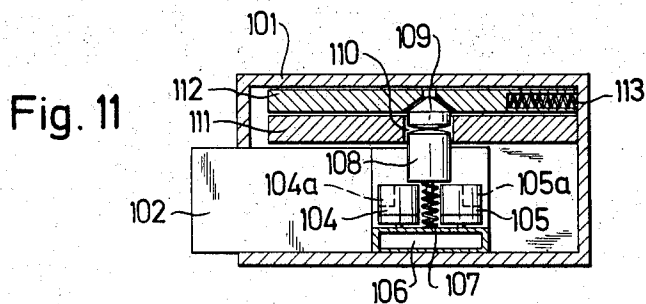
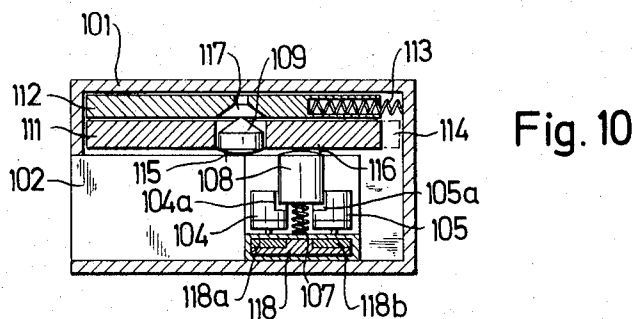
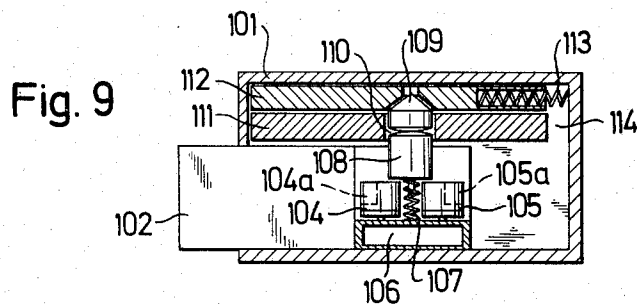


Fig. 13

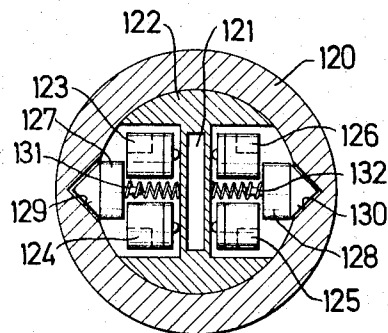


Fig. 14

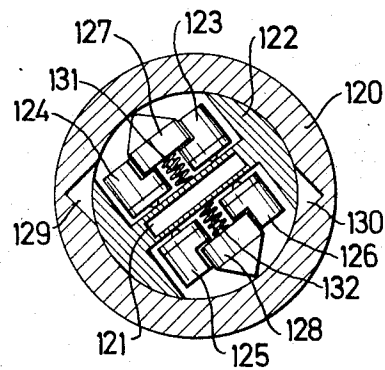


Fig. 15

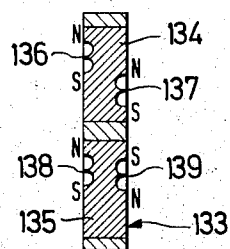


Fig. 16

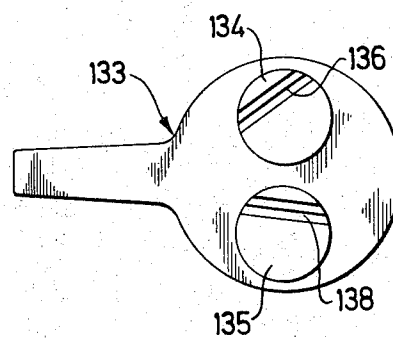
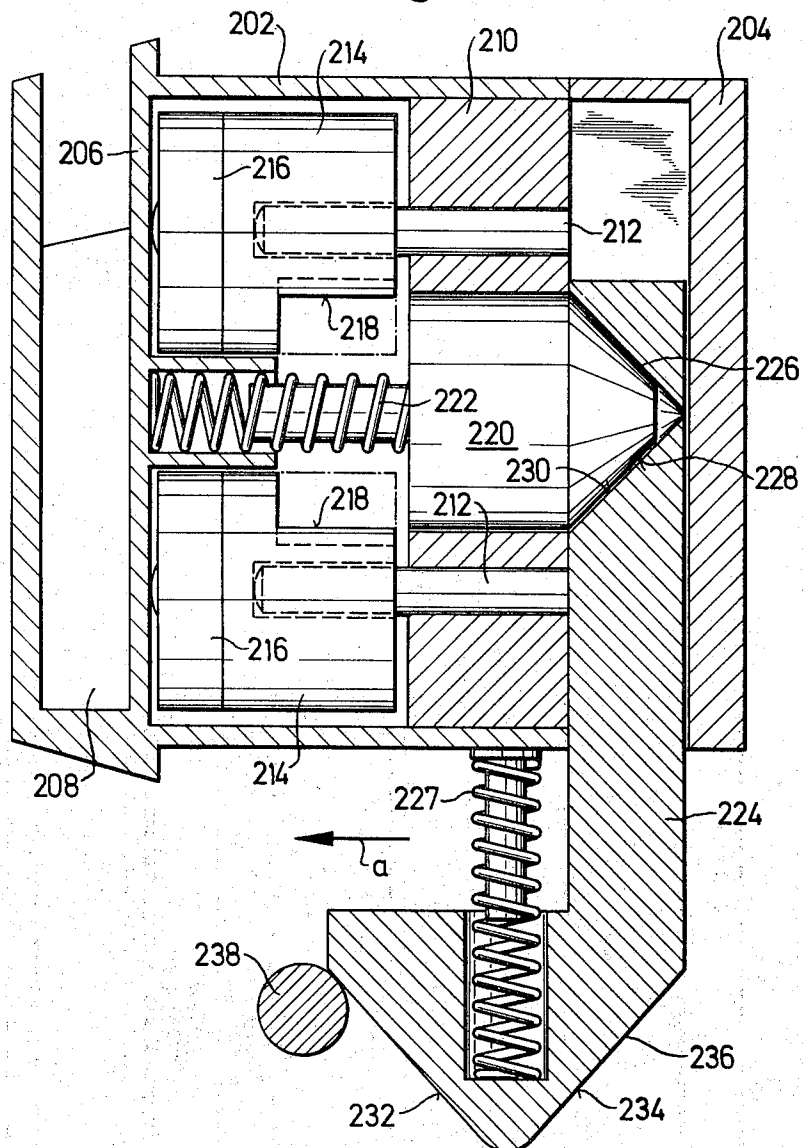


Fig. 17



MAGNETICALLY-OPERATED LOCKING MECHANISMS

FIELD OF THE INVENTION

This invention relates to magnetically-operated locking mechanisms of the kind which include at least one rotatably-mounted stop member which can be moved by means of a magnetic key into a release position from a locking position into which it is biased, and a control element which in the release position can enter a recess in the stop member by relative movement between the stop member and the control element in a direction parallel to the axis of rotation of the stop member, and is held against movement in said direction in the locking position of the stop member, so as to control movement of a locking bolt.

BACKGROUND OF THE INVENTION

In a known lock of the above kind (see FIGS. 3 to 5 of German Specification No. 2,123,168), one or more (for example four) magnetic stop members are arranged in a cylinder which is slidable in a lock casing, whilst the control element is in the form of a bolt secured in the lock casing. When a suitably coded magnetic key is applied to the front of the axially slidable cylinder, the stop members rotate into their release positions so that the cylinder can be pressed inwardly of the lock casing by pushing the magnetic key against the force of a spring, whereupon the control element enters into the recesses in the magnetic stop members. The bolt is linked to the cylinder so that, through axial sliding of the cylinder, the bolt is likewise slid in an axial direction, whereupon it exerts its control function.

With another known lock of this kind (see FIGS. 9 to 12 of German Specification No. 1,678,006), the stop member is rotatable but is arranged in the lock casing so as not to slide, whilst the control element is formed by a cylinder mounted in the casing so as to slide axially. The control element is provided with coupling dogs which engage with opposing dogs of a rotatably mounted locking bolt upon movement of the control element into the recess in the stop member. In this way, by use of the magnetic key, rotary movement can be transmitted to the locking bolt.

In both cases, operation of the lock requires a cylinder to be pressed inwardly against a resilient force with the aid of the magnetic key. On account of its unusualness, this method of operation is somewhat inconvenient. Furthermore, the resilient mounting of the cylinder necessitates a method of construction which increases the susceptibility to malfunction of the lock.

SUMMARY OF THE INVENTION

An object of the invention is to simplify assembly of the locking mechanism and to increase the serviceability of the locking mechanism.

According to the invention, the locking bolt is movable transversely to the direction of movement of the control element, and the control element includes a cam portion which cooperates with a cam surface so that, in the locking position of the stop member, movement of the locking bolt is prevented by interaction of the cam portion and cam surface and that, in the release position, movement of the locking bolt is permitted and the control element enters the recess in the

stop member upon relative sliding movement of the cam portion and cam surface.

With the lock according to the invention, pressing-in of a cylinder is no longer necessary to produce relative axial relative movement between the control element and stop member. The control element is itself displaced relative to the stop member as a result of the cam portion sliding relative to the cam surface when the locking bolt is moved. This increases reliability of the locking mechanism and simplifies assembly.

The control element may consist of a pin having a tapered end portion which provides the cam portion and enters a tapered recess of the wall of the lock casing. When the locking bolt is moved, the cam portion slides on the tapered surface, causing the pin to be moved at right angles to the direction of movement of the locking bolt. If the rotatable stop member is in its release position, the pin can enter the recess in the stop member. If, on the contrary, the stop member is not in its release position — which can, for example, happen when a wrong key or force is used — the pin is pushed by the cam action against the surface of the magnetic stop member. The magnetic stop member must then absorb the full force transmitted to the pin, which when force is used can lead to the stop member bearings and consequently the entire lock, being damaged.

In accordance, therefore, with another embodiment of the invention, the locking mechanism is designed in such a way that even when force is applied the magnetic stop member cannot be damaged. This is achieved by the use of a control element which includes two parts, the first part of which includes a cam portion whilst the second part enters into the recess in the stop member, and between the locking bolt and cam surface a guiding element is placed which can be moved at right angles to the direction of movement of the control element through a distance corresponding to the length of the cam surface. Said guiding element has a hole in which the two parts of the control element are located in such a way that, when the control element enters the recess in the stop member, the second part moves out of the hole and is separated from the first part which remains in the hole.

As a result of the division of the control element into two parts, and the use of the guiding element, in an attempt at forcible opening the force exerted on the locking bolt is transmitted through the guiding element to the casing, whereas the first part of the control element which includes the cam portion remains unloaded. The control element does not transmit any force acting at right angles to the direction of movement of the locking bolt, so that the magnetic stop member is not subjected to any load.

In another embodiment of the invention, the locking bolt is rotatable and the stop member and the control element are then arranged in a cylinder which is mounted for rotation with the locking bolt. The cam surface comprises a depression formed in the inner wall of the casing, and in which the control element engages when the stop member is in the locking position.

A locking mechanism can also be produced which is completely closed outwardly on the key side. The key support is then formed on a closed wall of the lock casing, the magnetic stop member is mounted so as not to slide and the control element, pre-stressed by a resilient force, is mounted slidably with respect to the lock casing. Between the control element and the locking bolt,

which is movable relative to it, a cam action is provided through which, in the locking position of the stop member, the control element prevents movement of the locking bolt relative to the control element and, in the release position, by entering the recess in the stop member, allows the locking bolt to move relative to the control element.

In this embodiment, in contrast to the known locks mentioned by way of introduction, the rotatable magnetic stop members are mounted, not in an axially slidable cylinder, but in the lock casing itself, whilst the control element can be slid relatively to the magnetic stop members towards the locking position by the resilient force, and towards the release position by the locking bolt, which can transmit a force to the control element through the cam action. In this way, it is possible to form the lock casing on the key side so that it is completely closed outwardly and thus the inside of the locking mechanism is completely protected against atmospheric influences. A further advantage is that no kind of mechanical force has to be exerted on the magnetic key to open the lock.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a magnetically-operated lock,

FIG. 2 shows a modified embodiment of the lock of FIG. 1,

FIG. 3 is a plan view of the lock shown in FIG. 2,

FIG. 4 is a sectional view of a lock for the operation of which two magnetic keys are required,

FIG. 5 shows a modified form of the lock of FIG. 4, in which one half of the lock can be operated by remote control,

FIG. 6 shows another form of lock which can be operated remotely,

FIG. 7 is a longitudinal section of a lock with two magnetic keys, corresponding to the lock shown in FIG. 4,

FIG. 8 shows a modified form of the lock shown in FIG. 7,

FIG. 9 is a longitudinal section of a further form of lock according to the invention in the locking position,

FIG. 10 is a view corresponding to FIG. 9 but showing the lock in the release position,

FIG. 11 is a view corresponding to FIGS. 9 and 10 of the lock during an attempt at forcible opening,

FIG. 12 is a schematic plan view of the arrangement of the locking bolt and the magnetic stops in the lock of FIGS. 9 to 11,

FIG. 13 is a cross-section of a rotating cylinder lock in the locking position,

FIG. 14 is a view corresponding to FIG. 13 of the lock in the release position,

FIG. 15 is a cross-sectional view of a magnetic key,

FIG. 16 is a plan view of the magnetic key shown in FIG. 15, and

FIG. 17 is a cross-sectional view of a further embodiment of lock according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The lock shown in FIG. 1, which is illustrated in the locked position, includes a lock casing 1 within which is mounted a locking bolt 2 so as to slide in a straight

line. In a boring in the locking bolt are arranged a number of stops 4 and 5 (two of which can be seen) provided with magnets. The magnetic stops 4, 5 are each mounted for rotation about an axis at right angles to the direction of movement of the locking bolt 2, and each is provided with a recess 4a, 5a. The locking bolt 2 also carries a control element 3 in the form of a pin, which is urged in an upwards direction by a spring 7.

The control element 3 can slide in a direction parallel to the axis of rotation of the magnetic stops 4, 5, i.e. at right angles to the direction of movement of the locking bolt 2, and engages in the position illustrated with a cam portion 3a provided by a conical head in a correspondingly conical opening 8 in the lock casing 1. The magnetic stops 4, 5 are normally biased by their magnets into locking positions in which the recesses 4a, 5a are not aligned with the control element 3. Control element 3 is thus held by the stops 4, 5 against axial sliding and locking bolt 2 is consequently prevented from sliding.

Locking bolt 2 is provided with a key support 6 in the form of a pocket which is located opposite the stops 4 and 5. When a correctly coded magnetic key (not shown) is inserted into the key pocket 6, the stops 4, 5 rotate into their release positions (shown in dotted lines), in which the recesses 4a, 5a are aligned with the control element 3. The locking bolt can now be slid to the right (as viewed in FIG. 1) by means of the magnetic key, whereupon cam 3a slides on the surface or opening 8 and control element 3 thus enters the recesses 4a, 5a of stops 4, 5. Locking bolt 2 can then be slid to the left relative to the lock casing 1 (the unbolting state). If the locking bolt 2 has to be held in this position it is merely necessary to provide another opening at this point in the casing 1 and corresponding to the opening 8.

The embodiments illustrated in the other figures have, as far as the arrangement of the stops is concerned, the same construction as the lock shown in FIG. 1; for the sake of clarity, therefore, the stops have been omitted from the other figures.

In its basic construction, the lock shown in FIG. 2 corresponds to the one shown in FIG. 1 and likewise has a lock casing 10, a locking bolt 11, a control element 12, and a conical opening 13. In contrast to the embodiment of FIG. 1, however, the key pocket 14 is not fixed relative to the locking bolt 11 but is formed in a movable sliding member 15. The sliding member 15, with an attached guiding tongue 17, can be slid parallel to the direction of movement of the locking bolt 11 and in the direction of opening against the action of a spring 16. The spring 16 is so dimensioned that, when the lock is operated normally with the correctly coded magnetic key, the spring is not compressed. The spring must, therefore, be relatively strong, so that the frictional forces which sometimes occur in practice with distorted doors can be overcome.

With the illustrated lock, if an attempt is made to forcibly slide the locking bolt 11 to the right with a wrong key or other tool, only the sliding member 15 is slid to the right with compression of spring 16, whilst the locking bolt 11 remains in the locked position. The force thereby exerted on the locking bolt 11 is transmitted to the control element 12, without it being possible for the magnetic stops to be damaged.

In this embodiment the locking bolt 11 can be made from a synthetic plastics material, it being possible for

the stressed side to be strengthened with a steel bolt cast into it. The lock housing 10 can be made from steel and this gives a cheap method of manufacture in relation to the security value of the lock.

In the lock shown in FIG. 4, in addition to the control element 20 interacting with the opening 22, the stops and the key pocket 24, a second control system, consisting of a control element 21 interacting with an opening 23, stops and a key pocket 25, is arranged in the locking bolt 19. Two magnetic keys (not shown) are therefore required to open the lock. Such a lock can be used, for example, as the lock for a bank safe box with a bank and a client's key, or anywhere else where for reasons of security it is desired that two keys should be used. Only when both magnetic keys are inserted into the key pockets 24 and 25 can the locking bolt 19 be slid to the right into its unlocked position. If one of the two magnetic keys is now withdrawn, locking can be carried out with one magnetic key, locking bolt 19 being pushed again to the left, whereupon both control elements 20 and 21 again engage in the openings 22 and 23.

With the lock shown in FIG. 5, which in its basic construction corresponds to the lock shown in FIG. 4, a device for remote operation of one control system (bank locking) is provided in addition. To this end, the conical opening 29 associated with the control element 28 is not formed in the lock casing 26 but in an ancillary bolt 30, which is arranged in the locking bolt 27 so as to slide in a direction parallel to the direction of movement of the locking bolt. The ancillary bolt 30 can, as desired, either be held in place by a magnetic operating device or released, so that it is either fixed in relation to the lock casing 26 or slidable relative thereto with the locking bolt 27. The magnetic operating device includes an electro-magnet 39 with an armature 38 arranged outside the lock casing. The armature 38 is linked with a locking lever 36, mounted so as to pivot about an axis 37, which is held by a spring 35 in its locking position. The locking lever 36 has a hook-shaped end which engages in an opening 41 of the ancillary bolt 30 causing the ancillary bolt 30 to be held in place.

When the remote control is operated, the electro-magnet 39 is energised, whereupon the armature 38 pivots the locking lever 36 about its axis 37, so that locking lever 36 lifts clear of the opening 41 of the ancillary bolt 30. As a result of this, the bank locking is cancelled and the lock can now be opened by insertion of the customer's key in the key pocket 34 and the consequent unlocking of the control element 31.

If, on the other hand, the lock is to be opened only by hand, the bank and customer keys must be inserted into the corresponding key pockets 33 and 34. Then, when the locking bolt is slid to the right, the control elements 28 and 31 can enter into the recesses in the appropriate stops. Locking bolt 27 then slides relative to ancillary bolt 30. Since, however, the ancillary bolt 30 can make only a limited movement with respect to the locking bolt 27, the locking bolt 27 is provided with a bevel 40 on which the hook-shaped end of locking lever 36 engages. Locking lever 36 can thereby be lifted out of the opening 41 of the ancillary bolt against the force of spring 35, whereupon the locking bolt 27, together with the ancillary bolt 30, can be moved beneath the locking lever 36.

FIG. 6 shows a modified version of a remotely controllable lock corresponding to the lock shown in FIG. 5. In the embodiment shown in FIG. 6, the electro-magnet 51 is arranged inside the lock casing 42. The armature 49 of the electro-magnet acts as a stop and can slide against the action of a spring 58 to engage in an opening 50 in an ancillary bolt 48, which corresponds to the ancillary bolt 30 shown in Fig. 5. One pole of the electro-magnet is earthed to the lock casing at 57, whilst the other pole is connected by a lead passing through a cable conduit 56a to a contact bolt insulated and inserted into the locking bolt 43 on its axis. In the closed position of the locking bolt 43, contact bolt 56 is connected with the contact points 54 and 55 of two contacts 52 and 53.

If the lock is to be opened only by hand, the two magnetic keys are inserted into the key pockets 59, 60, whereupon the control elements 44, 45 are unlocked, so that the locking bolt 43 can be moved to the right into its opening position. Contact bolt 56 is then released from rest contact 52, as the result of which a signal is sent to a central point indicating that the lock is open. However, if the lock is to be unbolted by the bank by remote control, the electromagnet 51 is excited through the contact 52 and contact bolt 56, causing the armature 49 to be withdrawn from the opening 50 of the ancillary bolt 48. The lock can now be unbolted by inserting the customer's key into the key pocket 59. Contacts 54 and 55 then open, whereupon a signal is sent to the bank's central point over a closed circuit. An electrical voltage is not necessary when bolting as the spring 58 itself returns the armature 49 into the opening 50 of the ancillary bolt 48.

The embodiment illustrated in FIG. 7 corresponds to the one shown in FIG. 4, but in FIG. 7 the bank key 68 and the customer's key 70 are inserted in the appropriate key pockets 67 and 69. The customer's key 70 is provided with a groove 71 which, in the opening position of the locking bolt 62, engages with the wall of the lock casing 61. When the lock is opened, therefore, the customer's key 70 cannot be withdrawn. This ensures that the lock is closed before the customer's key is withdrawn.

In order, however, to give the customer the possibility of withdrawing his key and operating the lock again without the aid of the bank official, in the embodiment shown in FIG. 8, a locking sliding member is provided consisting of a locking plate 76, a connecting rib 77 and a keying bolt 78. The locking sliding member is arranged in the locking bolt so as to slide in a direction parallel to the direction of movement of the locking bolt against the force of a spring 79. The keying bolt 78 has associated with it a counter-surface 81 located on the locking part. The two key pockets are designated 74 and 75.

If the locking bolt is slid to the right from the position shown in FIG. 8 into the unlocking position by the two magnetic keys, the keying bolt 78 lifts away from the fixed counter-surface 81 and the locking sliding member is pushed by the spring 79 to the left relative to the locking bolt. The locking plate 76 slides over the control element 73 which in the meantime has entered the recesses in its stops. The control element 73 thus no longer engages in the opening 82 of the locking plate 76.

The lock can now be operated with the customer's key alone as often as desired, as long as the locking bolt

is not slid over the counter-surface 81. Only when the door is again locked in the usual way, the keying bolt 78 being slid back into the position shown in FIG. 8 away from the counter-surface 81, does the control element 73 on the bank side again enter opening 82 of the locking plate 76 in the corresponding conical opening of the lock casing. The lock can now no longer be opened with one key only.

The magnetically operated lock illustrated in FIGS. 9 to 12 includes a casing 101, in which a locking bolt 102 can be slid in a straight line between a locking position (FIG. 9) and an unlocking position (FIG. 10). Four stops 104, 105, tipped with magnets, are mounted so as to rotate about an axis vertical to the direction of sliding of the locking bolt 102. The rotatable stops are each provided with a recess 104a, 105a which together form a cylinder in the release position of the rotating stops, (see FIG. 12).

The magnets, which are directed towards a key channel 106 running at right angles to the direction of sliding of the locking bolt, are placed on the surfaces of the stops facing away from the recesses. The magnetic key is provided with magnets 118a, 118b, corresponding to the magnets of the stops, whose magnetisation is so designed that they turn the stops into the release positions shown in FIG. 12.

A control element is associated with the stops, the control element consisting of two parts 108 and 109, which are separable at a point 110. Part 109 is provided with a cam shaped like a cone which, in the locking position of the stops, projects into a correspondingly conically shaped recess 117. In the locking position of the rotatable stops (FIG. 9), the two parts 108 and 109 of the control element are arranged in a hole in a guiding member 111, which can be slid through a predetermined distance in a direction parallel to the direction of sliding of the locking bolt 102 in the casing. The recess 117 (FIG. 10) is formed in a cam body 112 which can be slid in a straight line in the casing exactly like the guiding member 111, but it is tensioned by a spring 113 to the left as shown in the drawings. Both the guiding member 111 and the cam body 112 can only be slid through a limited distance 114, and their movements in both directions are limited by abutments formed by the wall of the casing. The two parts 108 and 109 of the control element have rounded surfaces 115, 116 which bear against each other.

The lock described above works in the following way. In the locked position, the movable parts of the lock are as shown in FIG. 9. To operate the lock, the magnetic key 118 is inserted into the key channel 106, whereupon the magnets 118a, 118b of the magnetic key 118 turn the magnetic stops into their release positions (FIG. 12). The locking bolt 102 is then slid to the right with the help of the magnetic key. In this sliding movement, the conical cam of part 109 slides on the conical surface of the recess 117 in the cam body 112, causing part 108 and part 109 of the control element to be pushed down (as viewed in FIG. 9) and to enter the recesses 104a and 105a of the stops 104, 105. At the same time, the guiding member 111 is pushed to the right by the distance 114, whilst the cam body 112 is held in its original position by the spring 113. When the junction 110 between the parts 108 and 109 of the control element reaches the level of the lower side of the guiding member 111 and the guiding member 111 bears against the right-hand end wall of the casing,

parts 108 and 109 are separated from one another. Part 108, together with the rotating stops, is pushed further to the right, whereupon part 108 is forced upwards by the spring 107 and slides along the lower surface of the guiding member 111, whilst part 109 slides freely on the bolt. The resulting release position of the locking bolt 102 is illustrated in FIG. 10.

If the locking bolt — with or without the magnetic key — is now pushed back towards the left into its locking position, part 109 of the control element springs back again into the hole in the guiding member 111 and thereby forces part 109 upwards into the recess 117. The lock then resumes its initial state shown in FIG. 9.

If the locking bolt is pushed, without or with a wrong key, forcibly to the right from the position shown in FIG. 9, the control element consisting of parts 108 and 109 sits on the upper surface of stops 104, 105, since the stops are in their locking positions. Parts 108, 109 are now "clamped" between the surface of recess 117 and the surfaces of the stops so that, when the locking bolt is slid to the right, said parts carry with them the cam body 112 as well as the guiding member 111 against the force of the spring 113. When the cam body 112 and guiding member 111 come into contact with the abutment formed by the wall of the casing, the locking bolt 102 can be slid no further. The force exerted on the locking bolt 102 is now directly transmitted to the wall of the casing through the part 108 and the guiding member 111, whilst the rotatable stops 104, 105 are completely relieved of load. Because of the separation of the two parts 108, 109 of the control element on the one hand, and the engagement of the guiding member 111 with the wall of the casing on the other hand, the cam of part 109 can no longer exert a vertically downwardly directed force on the part 108 and, consequently, on the rotatable stops. The lock cannot therefore be opened by forcibly pushing in the locking bolt 102.

In the embodiment illustrated in FIGS. 13 to 16, the locking bolt (not shown) is connected to a cylinder 122 which is mounted so as to rotate within a cylindrical housing 120. In the cylinder, four magnetic stops 123 to 126, which in principle are exactly like the stops of the preceding embodiment, are mounted symmetrically relative to a central key channel 121 so as to be able to rotate. With each pair of stops 123, 124 or 125, 126 is associated a one-part control element 127, 128 in the form of a pin which, in the locking position of the stops, as in the preceding embodiment, is pressed outwards by a spring 131, 132 to bear against a conical surface 129, 130. The surfaces 129, 130 are provided by recesses formed in the wall of the housing offset from one another by 180°. Cylinder 122 therefore has two locking positions offset from one another by 180°.

In principle, the locking and control mechanism described functions in the same way as in the preceding embodiment, bearing in mind that the control elements are of one-piece construction and the locking bolt is arranged to move not in a straight line but so as to rotate. This means that on insertion of the magnetic key 133 (FIGS. 15 and 16) into the key channel 121 and turning it, the magnetic stops are moved into their release positions and the control elements 127, 128 are pressed into the recesses in the stops by sliding over the surfaces 129, 130, in which recesses they are retained by further rotation of the cylinder by contact with the

inner surface of the cylindrical housing 120 (FIG. 14). If the magnetic key is withdrawn, the stops move again and a repeated turning with a tool or wrong key is not possible.

In order to achieve with the embodiment shown in FIGS. 13 and 14 the degree of security obtained with the preceding embodiment, the pin-like control elements 127, 128 must be duplicated. Furthermore, between the housing wall 120 and the cylinder 122, a guiding ring corresponding to the guiding member 111, as well as a resilient cam body, in the form of a ring and corresponding to the cam body 112, are provided.

The magnetic key 133 which operates the four stops includes two circular magnetic bodies 134, 135 which are magnetised on opposite sides in zones 136 to 139 corresponding to the coding of the stops. In order to obtain different angular positions of the magnetisations of the four magnetic codings, all four zones 136 to 139 must be magnetised simultaneously. Otherwise, the subsequent magnetisation of one side would reduce the magnetisation already accomplished of the other side. By magnetising simultaneously, on the contrary, a stabilised coding of all four magnets is obtained, which permits particularly cheap manufacture of the magnetic key.

The magnetically operated lock shown in FIG. 17 includes a lock casing which consists of a cylinder 202 and a cover 204 closing one end of the cylinder 202. The end of the cylinder 202 facing away from the cover 204 is closed by an end wall 206 integral with the cylinder 202. A key support in the shape of a key pocket 208 is formed in the end wall 206. A magnetic key (not shown) tipped with magnets can be inserted into the key pocket 208.

In the cylinder, and extending at right angles to the axis of the cylinder, is secured a mounting plate 210 on which a number (for example four) of magnetic stops 214 are rotatably mounted by means of mounting pins 212. The stops 214 are cylindrical rotors and are provided at their front ends with magnets 216, the magnets of different stops exerting a tensioning force on one another so that, when the magnetic key is withdrawn, the stops take up a predetermined position in relation to each other. If the correspondingly coded magnetic key is inserted into the key pocket 208, the magnets of the magnetic key turn the magnetic stops into a release position in which the recesses 218 formed in the stops assume a predetermined position in relation to a control element 220.

The control element 220 is mounted on the mounting plate 210 so as to slide in a direction parallel to the axis of the cylinder and is held by a spring 222 in its locking position (to the right in FIG. 17). The control element 220 is so arranged that it can enter the recesses 218 of the stops in the release position of the stops 214 (that is, when the magnetic key is inserted), whilst axial shifting of the control element in the locking position of the stops is prevented by the control element 220 bearing against the opposite end surfaces of the stops 214.

In the chamber formed between the mounting plate 210 and the front wall of the casing cover 204 there is mounted a locking bolt 224 which can be slid in a direction at right angles to the axis of the cylinder and thus normally to the direction of movement of the control element 220. The locking bolt 224 interacts with the control element 220 through a cam connection 226, which consists of oblique surfaces 228, 230 of the

control element 220 and locking bolt 224 which bear against one another. The locking bolt 224 is retained in its closed position by a spring 227, supported by the exterior of the lock casing, which acts on the end portion of the locking bolt 224 projecting from the lock casing. The projecting end portion of the locking bolt 224 has a cam 228 which interacts with a fixed stop pin 230. Cam 228 consists of two oblique surfaces 232, 234 which are arranged symmetrically relative to one another and in relation to the direction of movement *a* of the lock casing which can, for example, be moved together with a door.

The lock described above functions as follows: When the magnetic key is inserted in the key pocket 208, the magnetic stops 214, in dependence on the magnetic interaction between the magnets of the magnetic key and the magnets 216 of the stops, assume their release positions, in which the recesses 218 of the stops are aligned with the control element 220. If, when the magnetic key is inserted, the whole lock is pushed to the left (in the direction of the arrow *a*) relative to the fixed stop 230, the oblique surface 232 of cam 228 slides over the stop 230, causing the locking bolt 224 to be pushed inwardly into the lock casing. Locking bolt 224 thereby pushes the control element 220 to the left (in FIG. 17) by means of the cam connection 226, whereupon the control element 220 enters the recesses 218 of the stops 214. As soon as the lock has moved to the left beyond the stop 230, the spring 220 pushes the locking bolt 224 out of the lock casing again, whilst spring 222 moves the control element 220 to the right out of the recesses 218 of stops 214. When, in conjunction with this, the lock (with the magnetic key still inserted) is moved back again to the right, the oblique surface 234 slides over stop 230, whereupon the movable parts of the lock execute the same movement as when the lock is pushed to the left.

On the other hand, if an attempt is made to push the lock in the direction of arrow *a* without an inserted magnetic key (or with a wrong magnetic key), control element 220 bears against the end surfaces of the stops 214, which assume their locking position, so that the control element 220, by means of the cam connection 226, prevents displacement of the locking bolt 224. The locking bolt 224, through the cam interacting with the stop 230, thus prevents opening of the lock.

We claim:

1. In a magnetically-operated locking mechanism which includes at least one rotatably-mounted stop member which can be moved by means of a magnetic key into a release position from a locking position into which it is biased and a control element which in the release position can enter a recess in the stop member by relative movement between the stop member and the control element in a direction parallel to the axis of rotation of the stop member, the control element being held against movement in said direction in the locking position of the stop member, so as to control movement of a locking bolt,

the improvement wherein the locking bolt is movable transversely to the direction of movement of the control element and the control element includes a cam portion which cooperates with a cam surface so that, in the locking position of the stop member, movement of the locking bolt is prevented by interaction of the cam portion and cam surface and that, in the release position, movement of the lock-

ing bolt is permitted and the control element enters the recess in the stop member upon relative sliding movement of the cam portion and cam surface.

2. A locking mechanism according to claim 1, wherein the control element and the stop member are within the locking bolt and the cam surface is within the lock casing.

3. A locking mechanism according to claim 1, wherein a key support is formed in the locking bolt so that the locking bolt can be slid positively with the magnetic key.

4. A locking mechanism according to claim 1, wherein the cam portion comprises a conical head portion of the control element and the cam surface is provided by a correspondingly shaped recess in the wall of the casing.

5. A locking mechanism according to claim 3, wherein the key support is formed in a sliding member which is mounted in the locking bolt so as to slide against the action of a spring in a direction parallel to the direction of movement of the locking bolt.

6. A locking mechanism according to claim 3, wherein a second control element together with a stop member and key support associated therewith is provided so that two magnetic keys are required to operate the mechanism.

7. A locking mechanism according to claim 6, wherein the second control element is located in the locking bolt and the associated cam surface is formed in an ancillary bolt mounted so as to slide relative to the bolt in a direction parallel to the direction of movement of the bolt.

8. A locking mechanism according to claim 7, wherein means are provided whereby the ancillary bolt can be held in place by an electro-magnetic device to enable the lock to be operated remotely without use of the second magnetic key.

9. A locking mechanism according to claim 8, wherein the electro-magnet of the operating device is situated outside the lock casing, said operating device including a hook-shaped locking lever pivotal on energisation of the electro-magnet, which lever cooperates with a stop in the ancillary bolt when the locking mechanism is in its locked position.

10. A locking mechanism according to claim 9, wherein means are provided whereby the ancillary bolt can only be slid a limited distance relative to the locking bolt, which locking bolt is provided with a bevelled surface engaged by the locking lever upon relative sliding movement between the locking bolt and ancillary bolt.

11. A locking mechanism according to claim 8, wherein the electro-magnet of the operating device includes an armature for engagement in an opening of the ancillary bolt.

12. A locking mechanism according to claim 6, wherein one of the magnetic keys is provided with a groove for engagement with the wall of the lock casing to prevent withdrawal of the key when the locking mechanism is in its open condition.

13. A locking mechanism according to claim 6, wherein a locking sliding member is associated with the second control element and is retained by a spring in a position in which it prevents disengagement of the control element from the associated stop member, said locking sliding member being arranged so as to operate against a cooperative surface for movement thereof

into a release position in which the control element can disengage from the stop member by movement through an opening in the locking sliding member.

14. A locking mechanism according to claim 1, wherein an electrical signalling device is provided for transmission of a signal to a centre point upon movement of the locking bolt in the opening direction.

15. A locking mechanism according to claim 1, wherein the control element comprises two parts of which the first part includes the cam portion and the second part is arranged to enter the recess of the stop member.

16. A locking mechanism according to claim 15, wherein a guiding member is provided which is movable in a direction at right angles to the direction of movement of the control element, said guiding member being formed with a hole for reception of the two parts of the control element in such way that, when the said second part enters the recess in the stop member, the second part of the control element disengages from the hole in the guiding member and becomes separated from the first part which remains in the hole.

17. A locking mechanism according to claim 16, wherein a cam surface is formed in a cam body extending parallel to the guiding member, which cam body can be slid together with the guiding member in the locking position of the stop member into engagement with an abutment against the action of a spring.

18. A locking mechanism according to claim 17, wherein the guiding member and the cam body are movable in a direction parallel to the direction of movement of the locking bolt.

19. A locking mechanism according to claim 1, wherein the stop member and the control element are disposed in a cylinder which is mounted for rotation with the locking bolt, the cam surface being afforded by a surface of a recess formed in the wall of the cylindrical casing.

20. A locking mechanism according to claim 19, wherein at least two angularly spaced recesses are provided.

21. A locking mechanism according to claim 20, wherein two pairs of rotatable stop members are arranged symmetrically in a channel formed in the cylinder and a common control element is associated with each pair of stop members.

22. A locking mechanism according to claim 21, wherein the magnetic key includes two magnets which are magnetically coded by being magnetised on both sides simultaneously.

23. A locking mechanism according to claim 3, wherein the key support is formed in a closed wall of a lock casing and the control element is acted on by a spring so as to be movable relative to the lock casing.

24. A locking mechanism according to claim 23, wherein a common connection is provided between the control element and the locking bolt.

25. A locking mechanism according to claim 24, wherein the locking bolt includes a cam on an end portion thereof projecting from the lock casing, said cam being arranged to cooperate with a fixed stop by means of which the locking bolt is movable relative to the control element.

26. A locking mechanism according to claim 25, wherein the fixed stop comprises a pin.

27. A locking mechanism according to claim 3, wherein the key support comprises a pocket.

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