United States Patent [19]

Willach

[11] **3,757,551**

[45] **Sept. 11, 1973**

[54] **MAGNETIC LOCK WITH RELATIVELY SLIDABLE ELEMENTS**

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[73] Assignee: **Humwil-Werke Hugo Willach & Sohne,** Koln, Germany

[22] Filed: **Oct. 4, 1971**

[21] Appl. No.: **186,035**

[30] **Foreign Application Priority Data**

Nov. 12, 1970 Germany ..... P 20 55 550.4

[52] **U.S. Cl.** **70/276,** 70/290, 70/413

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

[58] **Field of Search** 70/276, 413

[56] **References Cited**

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Primary Examiner—Albert G. Craig, Jr.

Attorney—Flynn & Frishauf

[57] **ABSTRACT**

A first plate-like body has a predetermined number of chambers formed therein, of predetermined shape and location within the body; a second, plate-like body, relatively slidable with respect to the first is formed with chambers, the outlines of which, at least in part, match the chambers of the first body, and which further includes an additional chamber, and intercommunicating channels. Locking elements of magnetically responsive material, such as small balls, cylinders or the like are placed in the chambers to span both chambers. Upon application of a key having predetermined locations of zones of magnetization, the locking elements will assume the position in the chambers of the magnetization zones of the key. At those locations, one of the chambers is formed with interconnecting channels, permitting the locking elements to slide from one chamber into the next, and thus permit sliding movement of the plate-like bodies with respect to each other.

24 Claims, 12 Drawing Figures

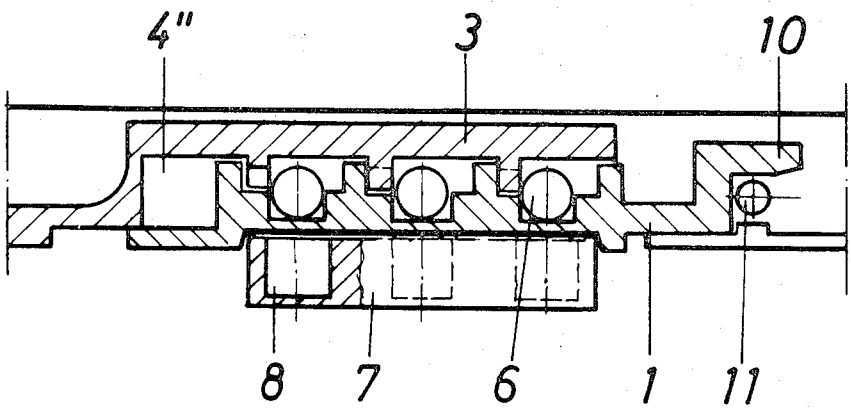


Fig. 9

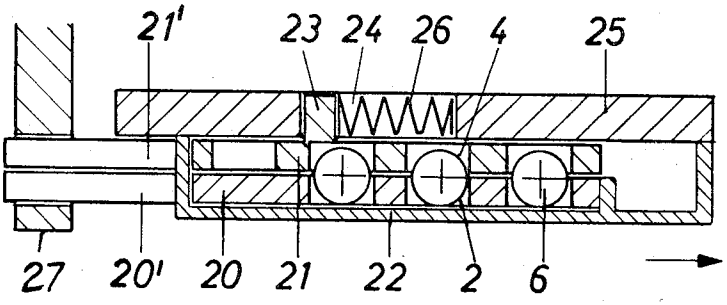


Fig. 10

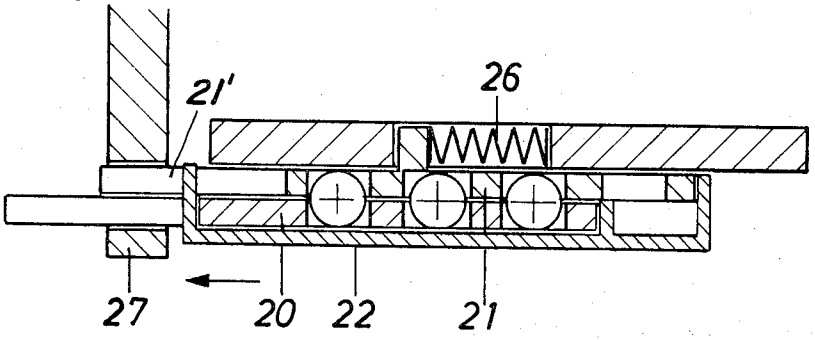


Fig. 11

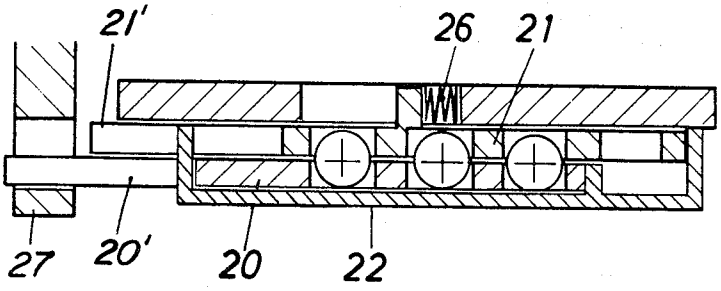


Fig. 4

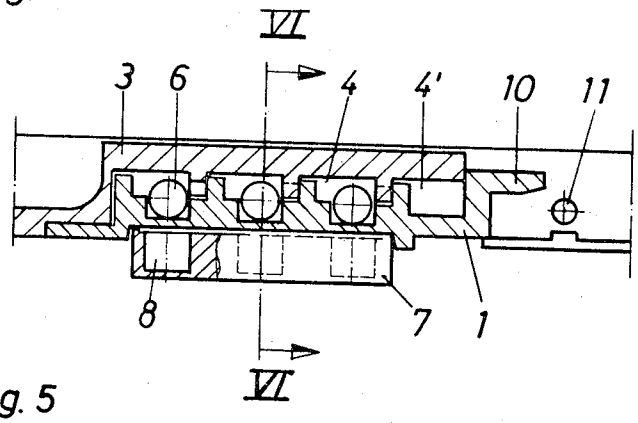


Fig. 5

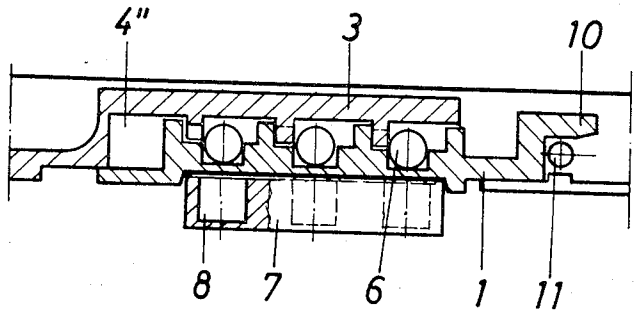


Fig. 6

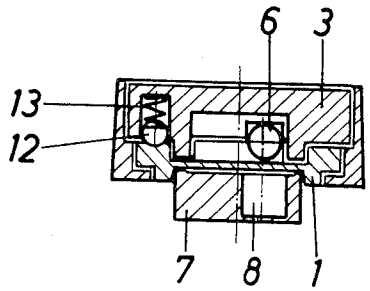


Fig. 7

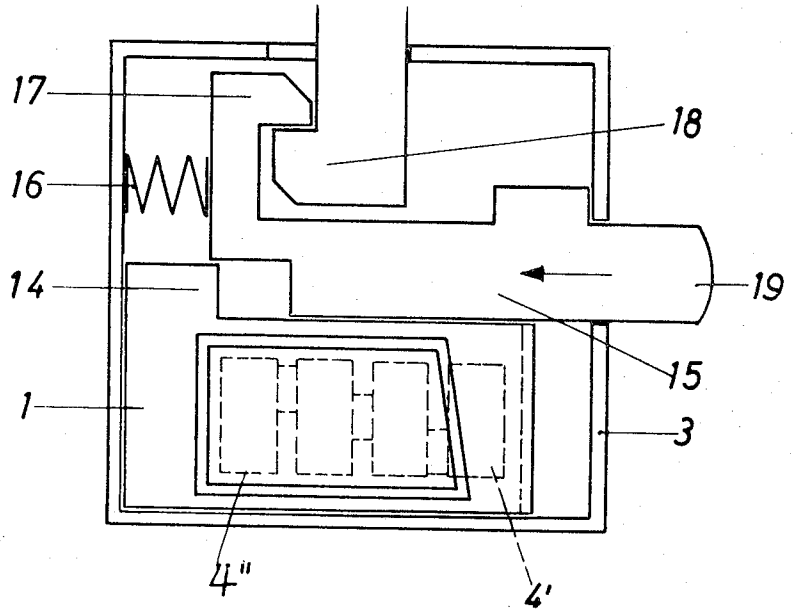


Fig. 8

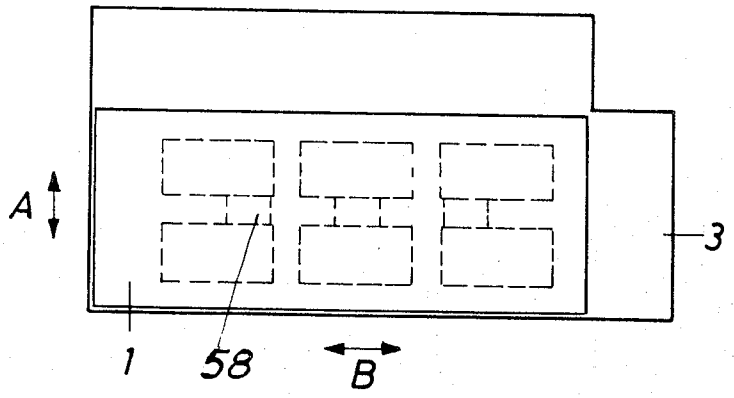


Fig. 12

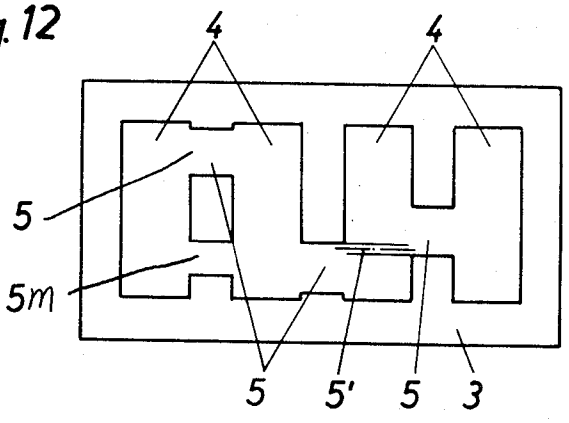


Fig. 9

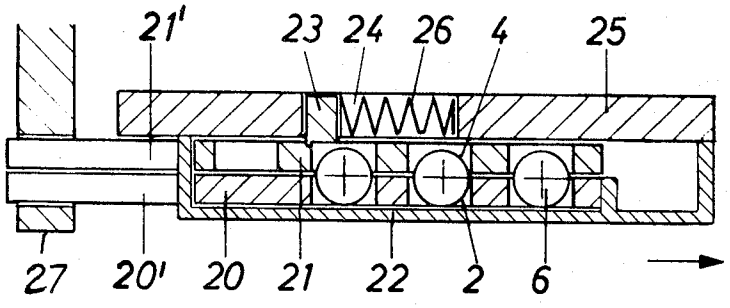


Fig. 10

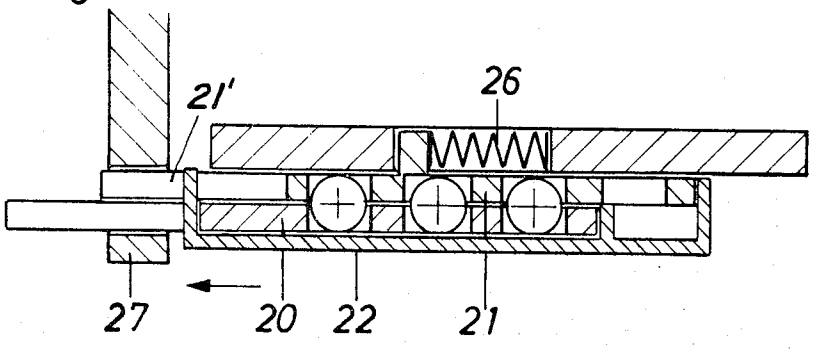
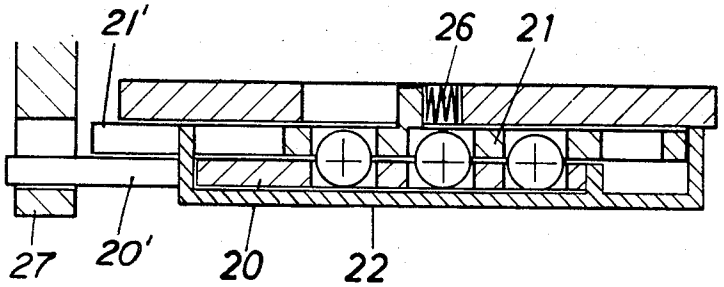


Fig. 11



MAGNETIC LOCK WITH RELATIVELY SLIDABLE ELEMENTS

The present invention relates to a magnetic locking mechanism which is adapted to cooperate with a key having magnets placed thereon in specifically predetermined, coded locations.

Various types of lock mechanisms utilizing magnetically coded keys have been proposed. It is an object of the present invention to provide a locking mechanism, particularly adapted for sliding operation, which utilizes a minimum of parts, is simple to assemble, can be made to be particularly flat, or of small diameter, and still provide for a substantial number of coded combinations.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, a pair of relatively slidable members are provided, preferably of plate-like form (although one can be a center cylinder and the other one a hollow surrounding tube), the two members being formed with chambers therein which have outlines which are essentially matching. One of the bodies has communicating channels between the chambers. An additional chamber is formed in one of the bodies, the communicating channels being located in predetermined positions on the members. Magnetically responsive material, such as small balls or cylinders capable of being magnetically attracted are located in the chambers. When a coded key is placed against the body members, and the key has magnets located therein which match the communicating channels of one of the bodies, the locking members or balls will move into the position of the communicating channels, permitting relative slidable movement of the two body members.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic representation, in top view, of a chamber system;

FIG. 2 is a bottom view of the chamber system of the matching opposed body;

FIG. 3 is a key adapted for the lock of FIGS. 1 and 2;

FIG. 4 is a schematic cross-sectional view of an actual lock mechanism utilizing the inventive concept, the lock being open;

FIG. 5 is a view similar to FIG. 4, the lock being closed, or locked;

FIG. 6 is a transverse cross-sectional view along lines IV—IV of FIG. 4;

FIG. 7 is a schematic top view, with housing removed, of a different embodiment of the invention;

FIG. 8 is a schematic top view, with housing removed, of yet another embodiment of the invention;

FIG. 9 is a transverse cross-sectional view of yet another embodiment of the invention, the lock being open, that is, in position to be operated (the key being omitted from the drawing);

FIG. 10 is a view similar to FIG. 9, the lock being closed;

FIG. 11 is a view similar to FIG. 10, illustrating the position of the elements when someone attempts to open the lock without the key; and

FIG. 12 is a schematic bottom view of the chamber system showing an embodiment permitting use of a master key.

The basic principle of the present invention is best illustrated in FIGS. 1 and 2, the key of FIG. 3 being shown to facilitate the understanding of the present invention. The upper or top body member 1 of FIG. 1 has three operating chambers 2. FIG. 2 illustrates the matching bottom member 3, which has four locking chambers 4. The locking chambers 4 are interconnected by communicating channels 5.

The locking chambers 2 of part 1 (FIG. 1) have locking elements 6 located therein. Locking elements 6 are of magnetically responsive material, such as small stainless steel balls, small cylinders or the like. The depth of chambers 2 corresponds approximately to half the diameter of one of the locking members 6. The other half of the locking member is received in the matching chambers 4, the chambers 2, 4 either being worked into the plates, or being punched out of thin plates with top and bottom cover plates preventing the locking elements 6 from falling out. These cover plates are not shown.

The upper body member 1 (FIG. 1) is placed above the bottom body member 3 (FIG. 2) so that the locking elements 6 are halfway in the chambers 2 and 4, respectively. As can be readily seen from a consideration of FIG. 2, the bottom member 3 can be moved with respect to the top member 1 in the direction of the arrows only when the locking elements 6 are in the position matching the communicating channels 5. To place the locking members 6 in such position, key 7 is formed with magnets 8, the magnets being located in positions corresponding to the location of the communicating channels 5. Applying the key 7 to upper member 1 causes magnets 8 to move the locking elements 6 into the position in which the upper member 1 can be moved relatively to the lower member 3, the locking elements 6 moving from one chamber 4 over the communicating channels 5 into the next adjacent counter chamber 4. Locking elements 6 respond to the magnets, the material of the top and bottom plate preferably being of non-magnetically responsive material, such as brass, plastic or the like. The key 7, except for the magnets located therein, likewise is of non-magnetic material such as plastic. Any suitable number of locking chambers 2 and counter chambers 4 can be arranged within the body members 1, 3, respectively, the number of counter chambers 4 in a row always being greater by at least 1 than the number of the chambers 2 in the body member 1. An additional chamber can be located at either side of the chambers 2 of body member 1, if it is desired to permit movement of member 3 from a center position either towards the right or to the left, with locking effect in each direction. The illustration merely shows three chambers for simplicity; the number of coded locking positions rises with the number of the chambers, the coded positions of course additionally being determined by the various height locations of the communicating channels. If the locking elements 6 are in a position other than the one which matches channels 5, then relative sliding movement of the members 1 and 3 is inhibited.

To prevent picking of the lock, and manipulating of the locking elements 6 and possible accidental location of the position permitting relative shifting motion of members 1 and 3, at least one of the chambers is formed internally with deflecting projections 9. These deflecting projections are formed as small rises within the chambers; they may be arranged towards the right

or to the left adjacent the communicating channels, preferably even with a line 5' (FIG. 2) to positively locate the locking elements 6 in a channel, or not. Different locations of the deflecting projections can be used, for example in line with the communicating channels 5, depending upon the shape and size of the locking elements 6.

As will be clear from considering FIGS. 1 to 3, relative sliding motion of body members 1 and 3 is possible only if key 7 locates the locking elements 6 in proper position.

The locking elements themselves may be placed normally at the bottom of the channels, for example by gravity, by small springs or, for example, by a weak magnetic plate or magnetic element located at any desired position within the lock, to attract the magnetically responsive locking elements 6 in a position out of alignment with the communicating channels. The magnets of the key then are strong enough to override such a small holding field, and to place the locking elements 6 in position. The magnets in the key may be formed as plug magnets, small horseshoe-type magnets or as zones of magnetization, impressed on a magnetically responsive material embedded within key 7.

FIGS. 4 to 6 illustrate an actual lock in accordance with the inventive concept. In the open position, FIG. 4, the locking elements 6 are in the left chambers 4 of the bottom portion 3, the right counter chamber 4' being empty. It is assumed that, by means of a key, the locking elements 6 are in line with communicating channels, so that the upper portion 1 can be shifted with respect to the lower portion 3 into the left position. The upper portion 1, at its far right end, is formed with a locking bail 10, releasing a locking pin 11, FIG. 4. FIG. 5 illustrates the locked position of the mechanism, the upper portion 1 being placed in the right position so that the left counter chamber 4'' is empty. The locking bail 10 reaches around the locking pin 11, preventing movement thereof in an up-down direction in this embodiment; if locking pin 11 is notched, inside-out movement (with respect to the plane of the drawing) can be equally prevented. The cross-sectional view of FIG. 6 illustrates the relatively slidable members 1 and 3; a spring positioning element including a spring 13 and a ball 12 matching into a detent provides positive seating at one of two positions, to locate the members 1, 3 in their relative end positions in which the locking elements 6 are freely movable in the chambers, but not in the intercommunicating channels, when the key is removed.

A different embodiment of the invention is illustrated in FIG. 7, which shows the open position of the lock. The locking elements 6 are removed from counter chamber 4'. The upper member 1 has a locking shoulder 14 which, in the illustrated open position permits a locking slider 15 to be operated. Slider 15 is loaded by spring 16 and holds, by means of interengaging catch elements 17, 18 the locking mechanism closed. Pushing the slider by means of pusher 19 in the direction of the arrow permits release of the catch member 18.

To lock the upper portion 1, so that the left counter chamber 4'' does not contain any locking elements 6, the key is applied and by placing the key correctly, the locking elements will follow through the communicating channels. Removing the locking elements 6 from the left counter chamber 4'' inhibits movement of element 15 towards the left, and the lock is secured.

FIG. 8 illustrates another embodiment of the present invention in which the locking chambers (both chambers 2 and 4) are located in a row above each other and in various rows adjacent each other. Relative movement of upper part 1 with respect to lower part 3 is possible in the direction of arrow A; operating movement when the lock is open, for example similar to the embodiment in accordance with FIG. 7, is in the direction of arrow B. The chambers, in each instance, are sufficiently elongated to permit the horizontal movement; the key itself is coded for the position of the communicating channels 58.

The embodiment of FIGS. 9 to 11 illustrates an arrangement in which the locking chambers 2 and counter chambers 4 are punched into plates 20, 21, respectively, made preferably of magnetically neutral material. Any other working method is suitable. Both plates 20, 21 are located within a housing 22 which is so arranged that plate 20 is held securely therein, whereas plate 21 can be slid horizontally to change the position of locking elements 6 from one counter chamber 4 in an adjacent counter chamber 4'. Plate 21 extends by means of a shoulder 23 into a groove 24 of base plate 25, the shoulder being loaded by spring 26.

FIG. 9 illustrates the open position of both plates 20, 21 with respect to their chambers 2 and 4. If the housing 22 is pushed in the direction of the arrow, both plates 20, 21 are carried along counter the pressure of spring 26. The ends of the locking bolts 20', 21' release a locking hook 27.

The position of both plates 20, 21 being locked is illustrated in FIG. 10. The housing 22 has moved plate 20 in the direction of the arrow. Relative sliding movement of the two plates 20, 21 is possible only if the proper key is applied. If the key is removed, plates 20 and 21 can be moved counter the pressure of the spring 26 only in the position in which they were previously placed, see FIG. 11. Since plates 20, 21 are in locked position, moving the housing 22 to the right does not cause relative shifting movement of the two plates 21, 22, so that the relative position will be maintained and the locking hook 27 is not released. In the illustration, the locking hook 27 has been moved far to the left to facilitate the drawing. Of course, the relative position and length of the elements, as well as the stroke can be changed so that hook 27 will be engaged by both ends 20', 21' at all times. Comparison of FIGS. 10 and 11 clearly shows that the relative position of plates 20, 21 has been retained in both instances.

Various changes can be made in applying the inventive concept. The plates need not be flat, but can be circular, one being, for example, formed as a solid cylinder having grooves worked therein extending partly or wholly around the circumference to form one of the chambers 2, 4, respectively, and a cylindrical housing placed thereover having likewise grooves or notches cut therein to form the counter chamber, with transverse communicating channels extending in axial direction. Locking elements 6, in this case preferably balls, would with key removed then all collect at the lowermost portion of the cylinder, assuming the cylinder to be installed horizontally, insertion of a key of proper configuration moving the balls into alignment with communicating channels permitting pushing, or other relative movement.

FIG. 12 is a schematic illustration, similar to FIG. 2, showing application of the present invention in which a master key can be used, or keys of two different codings employed with the lock. Rather than forming a single communicating channel 5, as illustrated in FIG. 2, additional channels 5*m* are located in the plate 3, the locations of channels 5m corresponding, for example, to the location of magnetic elements on master keys. For individual locking of a series of locks, the location of channels 5 can shift, the location of channels 5*m*, however, of all series being alike so that the same master key can operate all of them.

The depth of the intercommunicating channels 5, or 5m, respectively, should be deep enough to be able to accomodate the locking elements 6. It is, of course, also possible to work the communicating channels into both facing plates 1, 3, of essentially the same depth as the grooves forming the chambers, to permit the locking elements to move between the chambers when the interconnecting channels are lined up. The choice of location of the communicating channels, the depth of the grooves forming the chambers, and of the communicating channels, and the relative location can be selected in accordance with best design and manufacturing requirements, considering the size of the lock, machinery available and the like.

I claim:

1. Magnetic lock adapted for cooperation with a key having zones of magnetization thereon in predetermined locations with respect to the outline of the key, said lock comprising

a first body (1) having a plurality of first chambers (2) formed therein of predetermined shape and location within the body;

a second body (3) having a plurality of second chambers (4) formed therein which, at least in part, match the outlines of the chambers (2) in said first body, said second body being additionally formed with at least one additional chamber;

said chambers (2, 4) in both said bodies forming locking chambers and being of essentially rectangular outline, the plurality of chambers being placed adjacent each other in a plurality of rows of chambers located in columnar arrangement adjacent, and above each other;

locking elements (6) of magnetically responsive material located in matching chambers and spanning said chambers in the first and second bodies;

at least one of said bodies (3) being additionally formed with interconnecting channels (5), at predetermined locations, interconnecting the chambers in said body, the location of said interconnecting channels (5) matching the location of the zones of magnetization of the key for the lock so that, when the proper key is placed against said bodies, the locking elements will line up with the interconnecting channels and permit relative movement of said first and second bodies and shifting of the locking elements from the matching chambers of said second body into those chambers which are still matching the first body, and into the additional chamber.

2. Lock according to claim 1, wherein one additional chamber in the second body is located adjacent the terminal chamber in the row of chambers.

3. Lock according to claim 1, wherein the chambers are formed as grooves in the thickness of the bodies, the grooves being approximately half as deep as the thickness of the magnetically responsive locking elements.

4. Lock according to claim 1, wherein one of the bodies (1) is formed with a locking shoulder (FIG. 7: 14) and the other body (3) is formed with an engaging portion (15), the shoulder (14) and engaging portion (15) being relatively located for relative sliding motion of said bodies, when a key is present, so that the locking elements are aligned with the interconnecting channels (5) effecting unlocking of said engaging member and, in the absence of a key,

the shoulder (14) formed on said one body engaging the engagement portion (15) of the other body and blocking relative sliding motion of said bodies.

5. Lock according to claim 1, wherein one of said bodies is formed as a locking bail operating member.

6. Lock according to claim 5, wherein said one body is the one having only said predetermined number of chambers.

7. Lock according to claim 1, in combination with a key having zones of magnetization thereon in predetermined location with respect to an edge thereof, the zones of magnetization being placed to be juxtaposed to the intersection of the interconnecting channels with the chambers.

8. Lock according to claim 1, wherein adjacent chambers in the second body are interconnected by one interconnecting channel only.

9. Lock according to claim 1, wherein adjacent chambers in said second body are interconnected by more than one channel to provide operation of the lock with the key specific to one channel or with another key specific to the location of another channel.

10. Lock according to claim 1, including means locating the magnetically responsive elements at an extremity of the chambers.

11. Magnetic lock adapted for cooperation with a key having zones of magnetization thereon in predetermined locations with respect to the outline of the key, said lock comprising

a first body (1) having first chambers (2) formed therein of predetermined shape and location within the body;

a second body (3) having second chambers (4) formed therein which, at least in part, match the outlines of the chambers (2) in said first body, said second body being additionally formed with at least one additional chamber;

said first and second bodies being platelike elements (20, 21) having the chambers (2, 4, 4') formed therein;

said chambers (2, 4) in both said bodies forming locking chambers;

locking elements (6) of magnetically responsive material located in matching chambers and spanning said chambers in the first and second bodies;

at least one of said bodies (3) being additionally formed with interconnecting channels (5), at predetermined locations, interconnecting the chambers in said body, the location of said interconnecting channels (5) matching the location of the zones of magnetization of the key for the lock so that, when the proper key is placed against said bodies, the locking elements will line up with the interconnecting channels and permit relative movement of said first and second bodies and shifting of the

locking elements from the matching chambers of said second body into those chambers which are still matching the first body, and into the additional chamber; and means (22, 25) retaining said bodies together.

12. Lock according to claim 11, including locking means engageable by one of said plate-like elements, locking and unlocking being effected by relative motion between said plates.

13. Lock according to claim 11, wherein the means retaining the bodies together comprises a housing; the lock including locking means engageable by one of said plate-like elements, locking and unlocking being effected by relative motion between said plate-like elements and the housing.

14. Lock according to claim 11, wherein one of said bodies is formed as a locking bail operating member.

15. Lock according to claim 11, in combination with a key having zones of magnetization thereon in predetermined location with respect to an edge thereof, the zones of magnetization being placed to be juxtaposed to the intersection of the interconnecting channels with the chambers.

16. Lock according to claim 11, wherein adjacent chambers in said second body are interconnected by more than one channel to provide operation of the lock with the key specific to one channel or with another key specific to the location of another channel.

17. Lock according to claim 11, including means locating the magnetically responsive elements at an extremity of the chambers.

18. Magnetic lock adapted for cooperation with a key having zones of magnetization thereon in predetermined locations with respect to the outline of the key, said lock comprising

a first body (1) having first chambers (2) formed therein of predetermined shape and location within the body;

a second body (3) having second chambers (4) formed therein which, at least in part, match the outlines of the chambers (2) in said first body, said second body being additionally formed with at least one additional chamber;

said chamber (2, 4) in both said bodies forming locking chambers;

locking elements (6) of magnetically responsive material located in matching chambers and spanning said chambers in the first and second bodies;

at least one of said bodies (3) being additionally formed with interconnecting channels (5), at predetermined locations, interconnecting the chambers in said body, the location of said interconnecting channels (5) matching the location of the zones of magnetization of the key for the lock so that, when the proper key is placed against said bodies, the locking elements will line up with the interconnecting channels and permit relative movement of said first and second bodies and shifting of the locking elements from the matching chambers of said second body into those chambers which are still matching the first body, and into the additional chamber;

the locking chambers in at least one of the bodies are profiled to provide locating portions (9) engageable with the locking elements to assist in positioning the locking elements in predetermined locations within the chambers and tend to inhibit placement of the locking elements in positions other than the predetermined location.

19. Lock according to claim 18, wherein the locating portions are formed as projections extending inwardly of the chambers directed towards prohibited positions of the locking elements.

20. Lock according to claim 18, wherein one of said bodies is formed as a locking bail operating member.

21. Lock according to claim 18, in combination with a key having zones of magnetization thereon in predetermined location with respect to an edge thereof, the zones of magnetization being placed to be juxtaposed to the intersection of the interconnecting channels with the chambers.

22. Lock according to claim 18, wherein adjacent chambers in said second body are interconnected by more than one channel to provide operation of the lock with the key specific to one channel or with another key specific to the location of another channel.

23. Lock according to claim 18, including means locating the magnetically responsive elements at an extremity of the chambers.

24. In a magnetic lock, a first plate-like body having a plurality of grooves formed therein;

a second plate-like body having a like plurality of grooves at matching locations formed therein, said plate-like bodies being placed against each other so that the grooves will, together, form chambers;

interconnecting channels formed at predetermined locations interconnecting the grooves in at least one of the bodies;

at least one additional groove formed in one of said plate-like members and located with respect to the other grooves in the plates to form a chamber with the grooves in the other plate when the plates are shifted relative to each other;

an interconnecting channel connecting said additional groove to the next adjacent groove;

and magnetically responsive elements in said chambers.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,757,551 Dated September 11, 1973

Inventor(s) Horst WILLACH

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

In the heading of the patent, change the Assignment data to read:

--Huwil-Werke Hugo Willach & Söhne
5207 Ruppichteroth/Bezirk
Köln, Germany--

In the drawings, strike sheet 1 containing Figs. 9, 10, 11, and substitute therefor the attached sheet 1 containing Figs. 1, 2, 3.

Signed and sealed this 10th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

ORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

Patent No. 3,757,551 September 11, 1973

Fig. 1

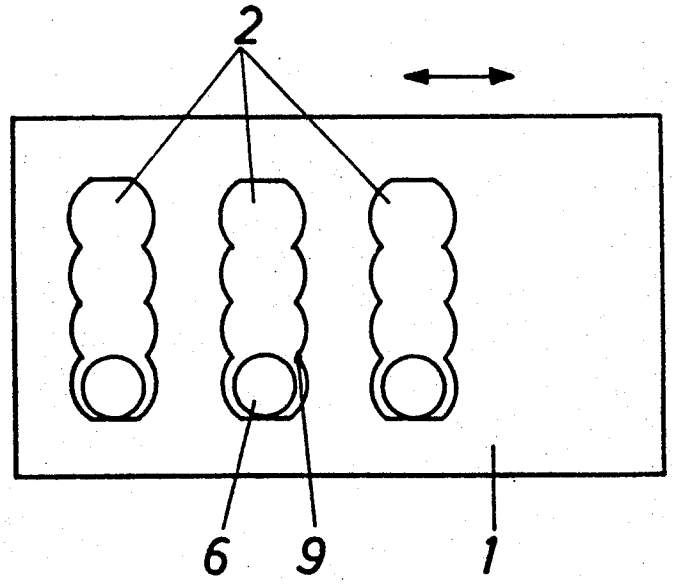


Fig. 2

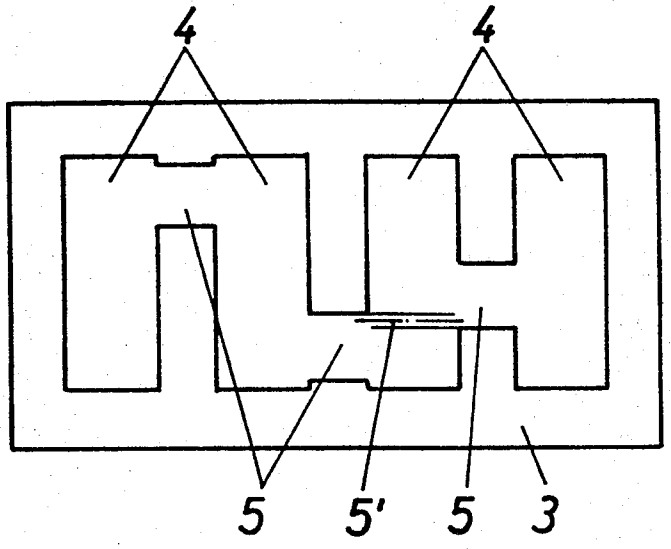


Fig. 3

