

SPECIFICATION

Magnetic lock and key

5 Description of Invention:

THIS INVENTION relates to a lock of the kind, hereinafter called the kind specified, having a plurality of locking elements movable from initial positions, into which they are biased, to
 10 respective releasing positions along respective channels by forces established by a magnetic field of a key when applied to the lock, each channel being defined partly by a first member and partly by a second member and the
 15 first member having an opening in a wall of the channel at the releasing position to receive a part of the associated locking element, whereby, when the key is absent, the locking elements do not occupy the releasing positions and they obstruct relative movement of
 20 the first and second members and, when the locking elements do occupy the releasing positions, limited relative movement of the first and second members is possible by relative
 25 movement of the locking elements into the associated openings. The invention also relates to a key for use with a lock of the kind specified.

Locks of the kind specified which have been
 30 proposed previously have one of two alternative arrangements. In the first of these arrangements, the respective channels of the lock extend parallel to an axis of the lock and are spaced apart around the axis, and in the
 35 second arrangement the channels are spaced apart along the axis and extend around the axis.

If the channels are spaced apart around the axis and the openings extend circumferentially, the relative movement of the first and second members which is possible only when the locking elements are in releasing positions is a rotation through the angle subtended by the openings at the axis of rotation. If one
 45 opening communicates with a plurality of channels, the security of the lock is reduced because the releasing positions of the locking elements in these channels are all adjacent to the same opening. Accordingly, either the
 50 angle through which relative movement of the first and second members can occur must be small or the number of locking elements must be small. There is a practical limit to the number of channels and locking elements
 55 which can be provided in a lock with this first arrangement.

Greater security can be achieved with a greater number of locking elements and, with the second arrangement hereinbefore mentioned, as many channels and locking elements as are needed to achieve the required degree of security can be provided. The disadvantage of this second arrangement is that the length of the lock must be increased if the
 60 number of locking elements is increased.

Locks of small size are desirable, partly because the amount of material used in the manufacture of the lock, and therefore one factor affecting cost, is increased if the size of
 70 the lock is increased and partly because in many situations where locks are required to be fitted, there is not sufficient space for a long lock.

According to a first aspect of the present
 75 invention, there is provided a lock of the kind specified wherein each locking element is movable along its respective channel in a direction around an axis of the lock and there is at least some overlapping of the elements
 80 along the axis.

With this arrangement, the security which results from the use of a plurality of locking elements can be achieved in a lock having the same length as a lock with only a single
 85 locking element. As compared with the second arrangement hereinbefore mentioned, the security can be increased without increasing the length of the lock.

The lock preferably comprises one or more
 90 pairs of locking elements, the elements of each pair overlapping entirely with each other along the axis.

The locking elements of each pair are preferably disposed in respective channels which
 95 are spaced apart around the axis but which overlap axially.

According to a second aspect of the invention, there is provided a key having an axis and comprising a magnetised portion extending about said axis and having first and second magnetic pole centres on the surface of
 100 said portion, the pole centres being spaced apart about the axis by an angle less than 180° and lying in a common plane which is perpendicular to the axis.

By a magnetic pole centre, we mean a point on the surface of the body at which the magnetic flux density reaches a maximum value.

110 The first and second pole centres are preferably spaced apart angularly about the axis by at least 30°.

There may be in a position diametrically opposite to each pole centre a further pole
 115 centre.

An example of a combination of lock and key which embodies both aspects of the invention will now be described with reference to the accompanying drawing wherein:—

120 *Figure 1* shows a side elevation of the lock with the key partly withdrawn therefrom, certain parts of the lock being shown in cross section in a plane containing a longitudinal axis of the key.

125 *Figure 2* shows a cross section of the lock without the key on the line II-II of *Fig. 1*, and *Figure 3* shows a cross section of the key in a plane corresponding to that of *Fig. 2*.

The lock comprises a hollow body 10
 130 which, when the lock is in use, would be

disposed within a housing of a device to be controlled by the lock. Within the body there are disposed three sleeves 11, 12 and 13 which overlap to some degree in a direction along an axis 14 of the body, a smaller diameter end portion of the sleeve 12 being received within a larger diameter portion of the sleeve 11 and a smaller diameter end portion of the sleeve 13 being received within a larger diameter portion of the sleeve 12.

There extends through the central openings of the sleeves a key-receiving member which is referred to herein as a barrel 15. The barrel has an elongate cylindrical slot centered on the axis 14 and open at an outer end of the lock, to receive a key 16. The barrel 15 and the sleeves 11, 12 and 13 are rotatable together within the body 10 by means of the key. Each of the sleeves has an internal spine 17 which engages in a longitudinal groove 18 formed in the barrel.

The key 16 comprises a cylindrical shank 19 and a handle 20 secured to one end of the shank. When the key is applied to the lock, the shank is inserted into the slot of the barrel to occupy those parts of the barrel which lie within the sleeves 11, 12 and 13. The handle remains outside the barrel. There projects laterally from the shank at a position near to the handle 20 a lug 21 which engages in a complementary formation in the barrel to enable torque to be transmitted from the key to the barrel. The lug also limits movement of the shank into the barrel and establishes a predetermined positional relation between the key and the barrel.

There is provided a cam mechanism for causing axial displacement of the sleeves 11, 12 and 13 relative to the barrel 15 when the barrel and sleeves are rotated from the single rotary position of the barrel in which the key 16 can be inserted and withdrawn. The cam mechanism is situated within the body adjacent to the outer end thereof and comprises a bush 22 which is constrained against movement relative to the body. An outer end portion 23 of the bush is of non-circular shape and is engaged in an opening of complementary shape defined by the body 10.

The outer end portion of the bush includes a part-annular flange defining the opening through which the key shank 19 is inserted and this flange prevents insertion or withdrawal of the key except when the lug 21 and the formation in the barrel which receives the lug are both aligned with a gap in the flange.

In the bush 22, there is provided at one side of the axis 14 a cam recess 24 which faces along the axis towards the sleeve 11. In this recess there engages the complementary cam formation 25 of a ring 26 mounted on the outside of the barrel 15 and having a key which engages in the spline 18 to cause the ring to rotate with the barrel. A face of the ring remote from the bush 22 abuts the

sleeve 11.

The sleeves 11, 12 and 13 and the ring 26 are urged towards the bush 22 by a coiled compression spring 27 acting between a washer which abuts the sleeve 13 and a clip 28 mounted on a part 29 of the barrel which protrudes from the inner end of the body 10. Displacement of the bush 22 outwardly from the body is prevented by engagement of the bush with shoulder 30 on the body.

The portion 29 of the barrel is drivably associated with the device (not shown) to be controlled by the lock. To operate the device, it is necessary to rotate the barrel from the position illustrated in the drawings. Such rotation drives the cam formation 25 out of the recess 24 and therefore can be accomplished only if the sleeves 11, 12 and 13 are free to move axially inwardly relative to the barrel and the body 10. The lock further comprises a plurality of locking elements for preventing axial displacement of sleeves relative to the barrel unless the proper key is present in the barrel. In the particular example illustrated, there are two of these locking elements associated with each of the sleeves 11, 12 and 13 and each of the locking elements is in the form of a cylindrical roller having flat end faces. Only the rollers associated with the sleeve 12 are shown in the drawing and these are indicated by the reference numerals 31 and 32.

Each of the rollers is disposed within a respective channel along which it can roll, the length of each channel extending around the axis 14 and each roller being arranged with its axis parallel to the axis 14. The channels 33 and 34 containing the rollers 31 and 32 respectively have the same width (that is the dimension measured along the axis 14) as each other and are situated at the same position along the axis 14 so that these channels overlap with each other along the axis and the rollers 31 and 32 are entirely overlapped with each other along the axis. These two channels are spaced apart around the axis so that the rollers 31 and 32 cannot approach closely to each other. Movement of the roller around the axis is limited by stops 35 and 36.

Each of the channels is defined partly by the barrel 15 and partly by one of the sleeve 11, 12 and 13. Thus, the barrel 15 is formed with a circumferentially extending groove 37 which lies within the sleeve 12 and respective circumferentially spaced parts of which constitute parts of the channels 33 and 34. The other parts of the channel 33 and 34 are defined by the sleeve 12, there being a first arcuate recess 38 in the sleeve between the stops 35 and 36 to form a part of the channel 33 and a second arcuate recess 39 between the stops to form a part of the channel 34.

Each of the rollers is biased by gravity towards the lowest point along its respective

channel. Thus, when the key is absent, the rollers occupy respective locking positions in which they are engaged between oppositely facing surfaces on the barrel 15 and associated sleeve respectively to prevent movement of the sleeves in the axial direction in which they are driven by the cam mechanism. It is envisaged that the lock mechanism will be so mounted in the housing of the controlled device that the lowest position which each roller can occupy along its channel will be defined by the stops 35 and 36. It will be noted that the length of the rollers 31 and 32 is only slightly less than the width of the grooves 37.

In an axially facing wall of the recess 38 there is formed an opening 40 which is sufficiently large to receive that part of the roller 31 which projects from the groove 37. A similar opening 41 is formed in an axially facing wall of the recess 39. If the rollers are moved to releasing positions in which the roller 31 is aligned with the opening 40 and the roller 32 is aligned with the opening 41, the sleeve 12 can be displaced axially by the cam mechanism, the rollers entering the openings 40 and 41.

The rollers associated with the sleeves 12 and 13 are arranged in a similar manner to the rollers 31 and 32 but the releasing positions of the various rollers about the axis 14 may differ.

If required, the two rollers associated with a sleeve may overlap which each other partly along the axis 14. Whilst we prefer to provide locking elements in the form of cylindrical rollers, locking elements of other forms, for example, spheres, could be used.

The shank of the key 16 is formed of or comprises material which can be permanently magnetised. The shank is magnetised to provide on its surface magnetic pole centers at positions corresponding to the releasing positions of the rollers. Thus, at a position along the shank corresponding to the groove 37, there are provided two magnetic pole centres spaced apart angularly about an axis of the key by an angle A which is the angular spacing of the openings 40 and 41. This angle is preferably at least 30° but less than 180°.

There may be associated with the sleeve 12 three channels, each containing a respective roller, provided that the angular extent of each channel is limited appropriately. The key would then be provided with three pole centres spaced apart angularly about the axis of the key and at the same position along the axis.

CLAIMS

1. A lock of the kind specified wherein each locking element is movable along its respective channel in a direction around an axis of the lock and there is at least some

overlapping of the elements along the axis.

2. A lock according to claim 1 comprising one or more pairs of locking elements, the elements of the or each pair overlapping entirely with each other along the axis.

3. A lock according to claim 2 wherein the locking elements of the or each pair are disposed in respective channels which are spaced apart around the axis but which overlap axially.

4. A lock according to any preceding claim wherein each channel extends in opposite directions from the releasing position of the associated locking element.

5. A lock according to any preceding claim wherein the locking elements are in the form of rollers having flat end faces.

6. A key having an axis and comprising a magnetised portion extending about said axis and having first and second magnetic pole centres on the surface of said portion, the pole centres being spaced apart about the axis by an angle less than 180° and lying in a common plane which is perpendicular to the axis.

7. A key according to claim 6 wherein the first and second pole centres are spaced apart angularly about the axis by at least 30°.

8. A lock substantially as herein described with reference to and as shown in the accompanying drawings.

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