

SPECIFICATION

Key, method of producing same and process and apparatus for use in the method for magnetising the key

5 *Technical field*

A first aspect of this invention relates to a key which, after being permanently magnetised, is suitable for use in combination with a lock which has magnetic elements movable by magnetic force. A second aspect of the invention relates to a method of producing a key for use in such a lock. A third aspect of the invention relates to a process for magnetizing a magnetisable body, which process may be used in the method according to the second aspect to magnetise permanently the key. A fourth aspect of the invention relates to apparatus for use in the process according to the third aspect.

The background art

In known combinations of a lock and key wherein there is associated with the key a permanent magnetic field and the lock has one or more magnetic elements which must be moved by the field of the key to a predetermined releasing position before the lock can be operated, the key has one or more permanent magnets embedded in a body of non-magnetic material. The key will operate the lock only if the magnet or magnets occupy predetermined positions and have a predetermined orientation with respect to the body of the key. Once the components of a key have been assembled together, that key is specific to locks having a corresponding arrangement of releasing positions of the magnetic elements. Since the locks and the keys would normally be assembled by different persons at different places in a workshop, there arises the problem of ensuring that the appropriate key is associated with each lock before that lock is sold or despatched from the workshop. A further difficulty arises in the provision of additional keys which may be required after the lock has been sold and been used for some time. It would be necessary for each stock holder of duplicate keys to hold duplicates of each key which has been sold with locks. If the number of different keys which are available is large, this stock would be correspondingly large. Thus, the supply of duplicate magnetic keys is inconvenient and expensive, as compared with the supply of duplicate keys for known mechanical tumbler locks by stocking key blanks and cutting duplicate keys as and when required.

Summary of the invention

According to the first aspect of the present invention, there is provided for use, after being magnetised, in combination with a lock having one or more movable elements of magnetic material, a key comprising a body of unmagnetised magnetic material and a handle rigidly connected with the body.

From a stock of such unmagnetised keys, there

can be produced duplicates of a magnetised key by impressing upon the unmagnetised keys permanent magnetic poles.

The body of magnetic material is preferably cylindrical. The handle may be of non-magnetic material.

The key preferably further comprises a sheath of non-magnetic material enclosing the body.

According to a second aspect of the invention, there is provided a method of producing a key for use in combination with a lock having one or more movable elements of magnetic material, wherein a body of unmagnetised magnetic material is rigidly connected with handle and subsequently has impressed upon it a plurality of permanent magnetic poles.

Preferably, the body is enclosed in a sheath of non-magnetic material before the magnetic poles are impressed upon the body.

According to a further aspect of the invention, there is provided a process for magnetising a magnetisable body, the process including the steps of providing a first group of conductors comprising an electrical conductor and first and second magnetic conductors, arranging the conductors of the first group adjacent to a surface of the body with the electrical conductor extending at least a part of the way across said surface in a first direction, the magnetic conductors being spaced apart across said surface in a second direction perpendicular to said first direction and the magnetic conductors lying on opposite sides of the electrical conductor and then passing an electric current through the electrical conductor.

The surface of the body may be curved. Thus, said first direction or said second direction may extend around a centre or axis or curvature of the surface.

There is preferably provided a second group of conductors also comprising an electrical conductor and first and second magnetic conductors, the second group being spaced from the first group in said first direction and the conductors of the second group being arranged relative to each other and relative to the magnetisable body in the same manner as the conductors of the first group are arranged. An electric current may be passed through the electrical conductors of the first and second groups. Alternatively, respective electric currents may be passed through the conductors of the first and second group either concurrently or successively.

The or each group of conductors preferably comprises a second electrical conductor and a third magnetic conductor, the second electrical conductor being arranged alongside the first electrical conductor and spaced therefrom in the second direction with the second magnetic conductor lying between the electrical conductors and the third magnetic conductor adjacent to the side of the second electrical conductor remote from the first electrical conductor. An electric current may be passed in opposite directions

through the first and second electrical conductors or respective electric currents may be passed in opposite directions through these conductors.

After the electric current or currents have been passed through the electrical conductor or conductors, relative displacement of the or each group of conductors and the surface of the magnetisable body in the second direction may occur until the magnetic conductor at one end of the or each group at least partly overlies an area of said surface which was previously overlain by the magnetic conductor at the opposite end of that group and a further electric current or further electric currents may then be passed through the electrical conductor or conductors. During the interval between the passing of electric currents, relative displacement of the first and second groups of conductors in said first direction or relative displacement of the conductors and the surface of the body may be effected in the first direction.

According to a fourth aspect of the invention, there is provided apparatus for carrying out a process according to the third aspect of the invention, the apparatus comprising a carrier and a first group of conductors, the carrier being adapted to support a key with an axis of a magnetisable body of the key in coincidence with an axis of the carrier, the group of conductors comprising an electrical conductor and first and second magnetic conductors, each of said conductors being spaced from the axis of the carrier to lie adjacent to a surface of the body and the magnetic conductors being spaced apart by a gap in which the electrical conductor lies.

The electrical conductor and the magnetic conductors may each present towards the axis a substantially arcuate concave surface which has its axis of curvature on the axis of the carrier. The concave surface of the electrical conductor may subtend at the axis of the carrier an angle of at least 10° .

Brief description of the drawings.

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

FIGURE 1 shows diagrammatically a side elevation of apparatus for magnetising the body of a key, certain parts being broken away.

FIGURE 2 shows on an enlarged scale a plan view of one magnetising head of the apparatus shown in Figure 1, together with an adjacent key body which is shown in cross section,

FIGURE 3 is a side elevation of the parts shown in Figure 2, certain of these parts being shown in cross section on the line III—III of Figure 2, and

FIGURE 4 shows a perspective view of the key with certain parts broken away.

Detailed description

The apparatus illustrated in Figures 1, 2 and 3 of the accompanying drawings is intended for use in magnetising a magnetic body of a key which is

illustrated in Figure 4. The key comprises a cylindrical body 1 of magnetic material, for

example a sintered isotropic ferrite. The body is enclosed by a sheath in the form of a sleeve 2 of non-magnetic material, for example stainless steel or brass. One end of the sleeve is closed and an opposite end of the sleeve is embedded in a handle portion 3 of the key. The handle portion is formed by moulding plastics material around a core 6 of non-magnetic metal. One end portion of the core 6 engages in a diametral groove formed in an end face of the body 1. The core is formed with a laterally projecting lug 5 which extends through a slot formed in the sleeve 2 adjacent to the handle portion of the key. Adjacent to the lug 5 but spaced therefrom in a direction away from the closed end of the sleeve 2, the handle portion includes a boss 4 of plastics material. The key is produced by inserting the body 1, whilst in an unmagnetised condition, into the sleeve and then placing the core 6 and a free end portion of the sleeve in a mould cavity. Plastics material is then injected into the mould cavity to form the plastics portion of the key. The plastics material forces the body 1 against the closed end of the sleeve and fills the space in the sleeve around the core 6, so that the core, the sleeve and the body 1 are rigidly united with one another. Subsequently, the body 1 of the key is magnetised.

In use of the key the lug 5 engages in a complementary formation in a lock to establish a predetermined angular relation between the key body 1 and a key-receiving member of the lock. The end face of the boss 4 cooperates with the lock to establish a predetermined axial position of the body 1 relative to the key-receiving member of the lock. Because permanent magnetic poles are impressed on the body 1 after the body has been rigidly connected with the lug 5 and the boss 4, the positions of magnetic poles with respect to the lug and the boss can be controlled with a high degree of accuracy. Typically, the diameter of the body 1 is 4 mm and the thickness of the sleeve 2 is 0.1 mm. If the mechanical properties of the body of magnetic material are adequate, the sleeve may be omitted, the core 6 and the body 1 being modified to interfit in a more complex manner than shown in Figure 4.

The magnetising apparatus comprises a carrier 10 which is adapted to support the key for rotation relative to a base 11 of the apparatus about an axis 12 which co-incides with a longitudinal axis of the key body 1. The carrier is connected with the base by a bearing 13 and includes a platform 14 which is spaced from the bearing along the axis 12 by a gap 15. In the platform 14, there is formed an aperture through which the key body 1 and sleeve 2 extend and, surrounding the aperture at the upper side of the platform, a recess for receiving the boss 4 and lug 5. The recess includes a portion complementary to the lug 5 to establish a predetermined angular relation between the carrier 10 and the key body 1. On the carrier there is mounted a spring-loaded presser member 17 which, when engaged with

the handle portion 3 of a key as shown in Figure 1, ensures that the boss 4 is properly seated in the recess 16. In this way, the position of the key body 1 along the axis 12 relative to the carrier 10 is accurately controlled.

For subjecting the key body 1 to magnetic flux, there are provided two magnetising heads 18 and 19 which lie within the gap 15 and near to the axis 12 but spaced sufficiently far from the axis to permit the sleeve 2 of the key to extend between them.

Each magnetising head comprises an upper electrical conductor 20 and a lower electrical conductor 21. Each of these electrical conductors has a substantially truncated V shape, having an arcuate limb 22 which lies near to the axis and rectilinear limbs 23 and 24 which extend from opposite ends of the arcuate limb in directions away from the axis 12. The cross section of each of the limbs 22, 23 and 24 may be rectangular. The arcuate limb 22 presents towards the axis 12 a concave arcuate surface which, when the apparatus is in use, lies close to or even in contact with the sleeve 2 of the key in order that the arcuate surface of the electrical conductor should be as close as possible to the magnetic body 1 of the key. The electrical conductors 20 and 21 are formed of a material having a high electrical conductivity, for example platinum or silver.

The radius of curvature of the arcuate surface of each of the electrical conductors 20 and 21 which is presented towards the axis 12 may be substantially equal to the external radius of the sleeve 2. Each electrical conductor is then positioned with its centre of curvature lying on the axis 12 so that all parts of the arcuate surface lie at the same distance from the axis of the key body 1. If the radius of curvature of the arcuate surface differs substantially from that of the sleeve 2, then the centre of the arcuate surface would lie closer to the axis 12 than other parts of the arcuate surface. The angle α subtended at the axis 12 by the arcuate surface of each of the electrical conductors 20 and 21 is preferably at least 10° . More preferably this angle is approximately 60° . It will be noted that the dimension of each limb 22 which extends parallel to the axis 12 is smaller than the dimension of each limb 22 which extends around the axis 12. Thus, each arcuate surface presented by the electrical conductors 20 and 21 towards the axis 12 is elongate and its longitudinal centreline lies substantially in a plane perpendicular to the axis 12.

Each of the magnetising heads 18 and 19 further comprises upper, middle and lower magnetic conductors 25, 26 and 27 which are formed of material having a low resistance to magnetic flux, for example mild steel. The upper and middle magnetic conductors are spaced apart by a gap in which the upper electrical conductor 20 lies. The middle and lower magnetic conductors are spaced apart by a further gap in which the lower electrical conductor 21 lies. The electrical conductors 20 and 21 are insulated electrically from the magnetic conductors 25, 26

and 27 by layers 28 of electrically insulating material. The middle magnetic conductor 26 is in the form of a flat plate having a profile corresponding to that of the electrical conductors

20 and 21, that is the magnetic conductor has an arcuate edge lying directly between the arcuate surfaces of the electrical conductors which face towards the axis 12, rectilinear edges extending radially with respect to the axis 12 and lying

between the corresponding surfaces of the electrical conductors and a further rectilinear edge spaced further from the axis 12 than is the arcuate edge and coinciding with a tangent to a circle drawn around the axis 12. The upper and lower

magnetic conductors 25 and 26 have a shape similar to that of the middle conductor 26 but with the addition of flanges along the radially extending edges. The flanges of the upper magnetic conductor just touch the flanges of the lower

magnetic conductor. An aperture is formed centrally in each of the magnetic conductors and in each layer of electrical insulation adjacent to the magnetic conductors. The assembly of electrical conductors, magnetic conductors and layers of

electrical insulation are held together by a bolt 29 which extends through these apertures and is insulated electrically from both of the electrical conductors and from the magnetic conductor 26 by a sleeve of insulating material fitted around a shank of the bolt.

Means is provided for conducting an electric current to the electrical conductors 20 and 21 of each magnetising head and also for conducting a fluid coolant to the electrical conductors. This means comprises a series of metal and non-metal tubes connected end-to-end to provide a coolant duct through which a fluid coolant can be conveyed. Water is a suitable coolant and the apparatus may include a pump (not shown) for pumping water from a reservoir through the coolant duct.

The non-metal tubes of the coolant duct are electrically insulating. The metal tubes of the coolant duct are formed of copper or other good electrical conductor. The coolant duct comprises a metal tube 30 having at one end a union 31 by which the tube is connected with a flexible conduit 32. Adjacent to the union 31, there is provided on the tube 30 an electrical terminal 33. The tube 30 extends from the terminal 33 to the limb 23 of the upper electrical conductor 20 with which the tube is united by fusion. An end of the tube 30 remote from the union 31 is connected by a non-metal tube with an end of a metal tube 34 which is united by fusion with the limb 24 of the upper electrical conductor 20. The tube 34 extends away from the electrical conductor 20, around a bend 37 in a vertical plane and returns to the limb 24 of the lower electrical conductor 21, with which limb the tube is united by fusion. A lower end of the tube 34 is connected by a non-metal tube with a lower metal tube 35 similar to the tube 30. The tube 35 is united by fusion with the limb 23 of the lower electrical conductor 21 and has an electrical terminal 36 and a union 37. The

terminals 33 and 36 are connected by means of flexible electrical conductors (not shown) to a power pack (also not shown) capable of causing a large current pulse to flow through the circuit comprising the tube 30, the upper electrical conductor 20, the tube 34, the lower electrical conductor 21 and the tube 35. It will be noted that a current which flows in one direction through the upper electrical conductor flows in an opposite direction through the lower electrical conductor.

As shown in Figure 1, the magnetising heads 18 and 19 lie at the same position along the axis 12. These heads can be moved along the axis relative to the carrier 10 and the body 1 of the key. Furthermore, the head 18 can move about the axis 12 relative to the head 19 so that the angular relation between each head and the body 1 of the key can be adjusted independently. The assembly of magnetic and electrical conductors and the tubes which are comprised by the head 19 are supported on a support 40 which is constrained by a fixed pillar 55 against movement around the axis 12 but is adjustable along the axis. The support 40 is rotatable around a tube 41 which extends upwardly from the bearing 13 towards the platform 14. This tube is maintained by the bearing in coaxial relation with the body 1 of the key and is constrained against rotation about the axis 12 by a pin 42 engaging in a vertical slot formed in the tube.

The assembly of magnetic and electrical conductors and the coolant duct of the magnetising head 18 are supported on a support 47 which is mounted on the tube 41 for rotation relative thereto about the axis 12 and interfits with the support 40 in such a manner that the supports 40 and 47 move together along the axis. The tube 41 is constrained to move along the axis with the supports. For raising and lowering the tube 41 and supports 40 and 47, there is provided a handle 43 which is rigidly secured to a lever 44. One end of the lever is pivotally connected with the support 40 and the other end of the lever is pivotally connected with a post 45 which is rigid with the base 11.

Means is provided for establishing alternative positions of the support 40 along the axis 12. This means comprises two vertical rows of apertures or recesses 46 formed in the tube 41 at diametrically opposite positions between the bearing 13 and the support 40. On the base 11 there are provided detents (not shown) for engaging releasably in the apertures or recesses 46. Each such detent preferably comprises a ball which is urged towards the tube 41 by a spring-loaded position. In the particular example illustrated, there are five apertures or recesses 46 defining five alternative positions of the support 40 along the axis 12. In one extreme position, the magnetising head 19 is adjacent to the underside of the platform 14 and to a part of the body 1 of the key near to the lug 5. In the other extreme position, the head 19 is adjacent to an end portion of the body 1 remote from the lug 5.

For turning the support 47 about the axis 12

there is provided a handle 48. Alternative positions of the support about the axis are defined by detents 49 and 50 engageable in selected ones of recesses 51 formed in the support 40. These detents are urged towards the support 40 and when a detent is aligned with one of the recesses 51, that detent engages partly in the support 40 and partly in the support 47.

A further pair of detents 52 and 53 are provided on the base 11 to define alternative positions of the carrier 10 about the axis 12. The detents 49, 50, 52, 53 and the detents associated with the apertures 46 are all arranged in a similar manner which is illustrated in Figure 1.

When the body 1 of the key is to be magnetised, the presser member 17 is raised away from the platform 14 and the key is inserted into the carrier 10 with the body 1 and sleeve 2 of the key extending between the magnetising heads 18 and 19 and the boss 4 of the key seated in the recess 16 of the carrier. By means of the handle 43, the magnetising heads 18 and 19 are moved to their uppermost positions and are then retained in that position by engagement of a detent in one of the apertures or recesses 46. By means of a handle 54 the carrier 10 is turned about the axis 12 to establish the required angular relationship between the body 1 of the key and the magnetising head 19. By means of the handle 48, the magnetising head 18 is moved about the axis to establish the required angular relationship with the head 19. These angular positions are maintained by engagement of one of the detents 49 and 50 in an associated recess and one of the detents 52 and 53 in an associated recess. A pulse of electrical current is passed through the electrical conductors of the magnetising heads. The conductors of the head 18 may be connected in series with the conductors of the head 19, in which case a single pulse is passed through the conductors of both heads and the heads are energised concurrently. Alternatively, a current pulse may be passed through the conductors 20 and 21 of the head 18 and then a further current pulse passed through the electrical conductors of the head 19 to energise the heads successively. The flow of electric current through the conductors 20 and 21 of the head 18 establishes a magnetic flux which imprints magnetic poles on the body 1 of the key as illustrated in Figure 3. Like poles are established adjacent to the upper and lower magnetic conductors 25 and 27 whilst adjacent to the middle magnetic conductor 26 there is established an opposite magnetic pole. Since the magnetic conductors provide paths of low resistance for the magnetic flux, the magnetic poles do not extend significantly above the upper magnetic conductor or below the lower magnetic conductor.

After each of the magnetising heads 18 and 19 has been energised, the carrier 10 and support 47 may be turned about the axis 12 to establish a new angular relationship between the magnetising heads and the body 1 of the key. The magnetising heads may then be energised once

more to imprint on the body 1 further magnetic poles at the same position along the axis of the key but spaced angularly about that axis from the previously imprinted poles. The magnetising heads

- 5 18 and 19 may then be moved along the axis 12 relative to the key body 1 by means of the handle 43 to a second axial position, further required angular relations between the magnetising heads and key body established and the magnetising
10 heads then energised once more. In the second axial position of the magnetising head 18, the upper magnetic conductor 25 may occupy the same position along the axis 12 as is occupied by the lower magnetic conductor 27 in the first axial
15 position.

- Each magnetic pole imprinted on the body 10 of the key extends somewhat further around the axis of the key than do the arcuate surfaces of the electrical conductors 20 and 21, depending upon
20 the extent to which leakage of magnetic flux occurs in regions adjacent to the rectilinear edges of the magnetic conductors. Thus in a case where the electrical and magnetic conductors subtend at the axis of the key an angle of approximately 60°C ,
25 the magnetic poles imprinted on the key may subtend at the axis of the key an angle of approximately 90° . The angular extent of the magnetic poles and the flux density at different positions within those poles can be varied by
30 varying the leakage of magnetic flux from the magnetising head. The leakage of magnetic flux can be increased by partly or entirely omitting the flanges of the upper and lower magnetic conductors 25 and 27.

- 35 Whilst we prefer to employ two magnetising heads, it would be within the scope of the invention to provide in the apparatus a single magnetising head. This could be energised in four alternative positions around the axis of the key to
40 imprint on the body of the key four poles at the same position along the key axis.

- The arrangement of two electrical conductors and three magnetic conductors shown in Figure 3 and used in the manner hereinbefore described is
45 convenient, in that successive poles along the length of the key which correspond to the middle magnetic conductor 26 do not interfere with each other. Such interference is avoided by the presence of opposite poles between successive
50 poles corresponding to the middle magnetic conductor. However, the lower magnetic conductor 27 and lower electrical conductor 21 could be omitted from the or each magnetising head. Upon being energised by a single current
55 pulse, each magnetising head would then imprint on the body of the key only one pair of unlike magnetic poles.

- In a case where two electrical conductors are provided in each magnetising head, we prefer that
60 these electrical conductors should be connected in series with each other as shown. However, the pair of electrical conductors could be connected in parallel with each other or could be connected separately to the electrical power pack so as to be

- 65 energisable respectively by successive current pulses.

CLAIMS

1. For use, after being magnetised, in combination with a lock having one or more
70 movable elements of magnetic material, a key comprising a body (1) of unmagnetised magnetic material and a handle (3) rigidly connected with the body.
2. A key according to claim 1 wherein the
75 handle (3) is formed of non-magnetic material.
3. A key according to claim 1 or claim 2 wherein the body (1) is generally cylindrical.
4. A key according to any preceding claim further comprising a sheath (2) of non-magnetic
80 material enclosing the body (1).
5. A method of producing a key for use in combination with a lock having one or more movable elements of magnetic material, wherein a
85 body (1) of unmagnetised magnetic material is rigidly connected with a handle (3) and subsequently a plurality of permanent magnetic poles are impressed on the body.
6. A method according to claim 5 wherein the body (1) is enclosed in a sheath (2) of non-
90 magnetic material before the magnetic poles are impressed upon it.
7. A process for magnetising a magnetisable body of a key, the process including the steps of providing a first group (18) of conductors
95 comprising an electrical conductor (20) and first and second magnetic conductors (25, 26) arranging the conductors of the first group adjacent to a surface of the body (1) with the electrical conductor extending at least a part of
100 the way across said surface in a first direction, the magnetic conductors being spaced apart across said surface in a second direction perpendicular to said first direction and the magnetic conductors lying on opposite sides of the electrical conductor and then passing an electrical current through the
105 electrical conductor.
8. A process according to claim 7 wherein there is further provided in the first group of conductors a second electrical conductor (21) and a third
110 magnetic conductor (27), the second electrical conductor is arranged alongside the first mentioned electrical conductor (20) and spaced therefrom in said second direction with the second magnetic conductor (26) lying between the
115 electrical conductors, the third magnetic conductor (27) is arranged adjacent to the side of the second electrical conductor remote from the first electrical conductor and an electric current is or respective electric currents are passed in
120 opposite directions through the electrical conductors.
9. A process according to claim 7 wherein there is provided a second group (19) of conductors also
125 comprising an electric conductor and first and second magnetic conductors, the second group is spaced from the first group in said first direction, the conductors of the second group are arranged



more to imprint on the body 1 further magnetic poles at the same position along the axis of the key but spaced angularly about that axis from the previously imprinted poles. The magnetising heads 18 and 19 may then be moved along the axis 12 relative to the key body 1 by means of the handle 43 to a second axial position, further required angular relations between the magnetising heads and key body established and the magnetising heads then energised once more. In the second axial position of the magnetising head 18, the upper magnetic conductor 25 may occupy the same position along the axis 12 as is occupied by the lower magnetic conductor 27 in the first axial position.

Each magnetic pole imprinted on the body 10 of the key extends somewhat further around the axis of the key than do the arcuate surfaces of the electrical conductors 20 and 21, depending upon the extent to which leakage of magnetic flux occurs in regions adjacent to the rectilinear edges of the magnetic conductors. Thus in a case where the electrical and magnetic conductors subtend at the axis of the key an angle of approximately 60°, the magnetic poles imprinted on the key may subtend at the axis of the key an angle of approximately 90°. The angular extent of the magnetic poles and the flux density at different positions within those poles can be varied by varying the leakage of magnetic flux from the magnetising head. The leakage of magnetic flux can be increased by partly or entirely omitting the flanges of the upper and lower magnetic conductors 25 and 27.

Whilst we prefer to employ two magnetising heads, it would be within the scope of the invention to provide in the apparatus a single magnetising head. This could be energised in four alternative positions around the axis of the key to imprint on the body of the key four poles at the same position along the key axis.

The arrangement of two electrical conductors and three magnetic conductors shown in Figure 3 and used in the manner hereinbefore described is convenient, in that successive poles along the length of the key which correspond to the middle magnetic conductor 26 do not interfere with each other. Such interference is avoided by the presence of opposite poles between successive poles corresponding to the middle magnetic conductor. However, the lower magnetic conductor 27 and lower electrical conductor 21 could be omitted from the or each magnetising head. Upon being energised by a single current pulse, each magnetising head would then imprint on the body of the key only one pair of unlike magnetic poles.

In a case where two electrical conductors are provided in each magnetising head, we prefer that these electrical conductors should be connected in series with each other as shown. However, the pair of electrical conductors could be connected in parallel with each other or could be connected separately to the electrical power pack so as to be

energisable respectively by successive current pulses.

CLAIMS

1. For use, after being magnetised, in combination with a lock having one or more movable elements of magnetic material, a key comprising a body (1) of unmagnetised magnetic material and a handle (3) rigidly connected with the body.

2. A key according to claim 1 wherein the handle (3) is formed of non-magnetic material.

3. A key according to claim 1 or claim 2 wherein the body (1) is generally cylindrical.

4. A key according to any preceding claim further comprising a sheath (2) of non-magnetic material enclosing the body (1).

5. A method of producing a key for use in combination with a lock having one or more movable elements of magnetic material, wherein a body (1) of unmagnetised magnetic material is rigidly connected with a handle (3) and subsequently a plurality of permanent magnetic poles are impressed on the body.

6. A method according to claim 5 wherein the body (1) is enclosed in a sheath (2) of non-magnetic material before the magnetic poles are impressed upon it.

7. A process for magnetising a magnetisable body of a key, the process including the steps of providing a first group (18) of conductors comprising an electrical conductor (20) and first and second magnetic conductors (25, 26) arranging the conductors of the first group adjacent to a surface of the body (1) with the electrical conductor extending at least a part of the way across said surface in a first direction, the magnetic conductors being spaced apart across said surface in a second direction perpendicular to said first direction and the magnetic conductors lying on opposite sides of the electrical conductor and then passing an electrical current through the electrical conductor.

8. A process according to claim 7 wherein there is further provided in the first group of conductors a second electrical conductor (21) and a third magnetic conductor (27), the second electrical conductor is arranged alongside the first mentioned electrical conductor (20) and spaced therefrom in said second direction with the second magnetic conductor (26) lying between the electrical conductors, the third magnetic conductor (27) is arranged adjacent to the side of the second electrical conductor remote from the first electrical conductor and an electric current is or respective electric currents are passed in opposite directions through the electrical conductors.

9. A process according to claim 7 wherein there is provided a second group (19) of conductors also comprising an electric conductor and first and second magnetic conductors, the second group is spaced from the first group in said first direction, the conductors of the second group are arranged



relative to each other and relative to the magnetisable body in the same manner as the conductors of the first group are arranged and an electric current is or respective electric currents are passed through the electrical conductors of the first and second groups.

10. A process according to claim 8 wherein there is provided a second group (19) of conductors also comprising first and second electrical conductors and first, second and third magnetic conductors, the second group is spaced from the first group in said first direction, the conductors of said second group are arranged relative to each other and relative to the magnetisable body in the same manner as the conductors of the first group are arranged and an electric current is or electric currents are passed through the electrical conductors of the first and second groups.

11. A process according to any of claim 7 to 10 wherein, after passing the electric current or currents through the conductor or conductors, relative displacement of the or each group of conductors and the surface of the magnetisable body in the second direction occurs until the magnetic conductor (25) at one end of the group at least partly overlies an area of said surface which was previously overlain by the magnetic conductor (27) at the opposite end of the group and then a further electric current is or further currents are passed through the electrical conductor or conductors.

12. A process according to claim 11 as appendant to claim 9 or claim 10 wherein, during the interval between the passing of electric currents, in which interval the relative displacement in the second direction occurs, relative movement of the first (18) and second (19) groups in the first direction is effected.

13. Apparatus for carrying out the process of claim 7 and comprising a carrier (10) and a first group (18) of conductors, the carrier being adapted to support the key with an axis of the body in coincidence with an axis (12) of the carrier, the group of conductors comprising an electrical conductor (20) and first (25) and second (26) magnetic conductors, each of said conductors being spaced from the axis of the carrier to lie adjacent to a surface of the body (1)

and the magnetic conductors being spaced apart by a gap in which the electrical conductor lies.

14. Apparatus according to claim 13 wherein the electrical conductor (20) and magnetic conductors (25, 26) each present towards the axis (12) a substantially arcuate or other concave surface.

15. Apparatus according to claim 14 wherein the concave surface of the electrical conductor (20) subtends at the axis (12) an angle of at least 10°.

16. Apparatus according to claim 14 or claim 15 wherein the concave surface is arcuate and has an axis of curvature which coincides with the axis of the carrier.

17. Apparatus according to any one of claims 14 to 16 wherein the concave surface of the electrical conductor is elongated and its longitudinal centre line lies substantially in a plane perpendicular to the axis of the carrier.

18. Apparatus according to any one of claims 13 to 17 wherein said first group of conductors further comprises a second electrical conductor (21) arranged alongside the first mentioned electrical conductor (20) and spaced therefrom in a direction along the axis (12) of the carrier and a third magnetic conductor (27) situated at the side of the second electrical conductor remote from the first electrical conductor (25).

19. Apparatus according to any one of claims 13 to 18 comprising a second group of conductors (19) which is adjustable relative to the first group (10) angularly about the axis (12) of the carrier (10) and comprises substantially the same arrangement of conductors as does the first group.

20. Apparatus according to any one of claims 13 to 19 wherein the carrier (10) includes a locating formation (16) to co-operate with a locating element (5) of the key to establish a predetermined angular position of the key relative to the carrier about the axis (12) of the carrier.

21. Apparatus according to any one of claims 13 to 20 including means (43) for adjusting the relative positions of the carrier (10) on the one hand and of the conductors on the other hand in a direction along the axis (12) of the carrier, there being provided means (46) for maintaining a selected relative axial position.

ERRATA

SPECIFICATION NO 2036444B

Front page, Heading (31) *for* 656878 *read* 6568/78

Heading (56) Documents cited *below* cited *insert* GB 14.18268

THE PATENT OFFICE
8 April 1983

Bas 250619/7

10

ERRATUM

Slip No 2

SPECIFICATION NO 2036444B

Front page, Heading (43), *for* Date of issue *read* Application published

THE PATENT OFFICE
3 June 1983

Bas 251621/6

(2)