(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 354 974 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.10.2003 Bulletin 2003/43

(51) Int Cl.[7]: **C22C 38/00**, C22C 38/58

(21) Application number: **03251879.7**

(22) Date of filing: **25.03.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **25.03.2002 JP 2002083048**

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(54) Non-magnetic stainless steel, slide fastener and buttons suitable for use with needle detector

(57) A stainless steel suitable for use with a needle detector, that has a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 kOe. The steel comprises, in mass%, 0.01 to 0.15% of C, 0.1 to 5% of Si, 1 to 10% of Mn, 8 to 25% of Ni, 14 to 30% of Cr, 0.01 to 0.25% of N, and the remainder Fe and impurities, wherein an Ni equivalent, which is defined as Ni equivalent = $Ni + 0.6Mn + 9.69(C+N) + 0.18Cr - 0.11Si^2$, has a value of 19 or more, and may further contain at least one selected from among a) 0.5 to 3% of Cu, b) 0.05 to 0.5% of at least one element selected from Nb, W and V, and c) 0.1 to 2% of Mo. The stainless steel enables reliable detection of whether broken needles have got into clothing or the like during sewing, and there can be a slide fastener and buttons that satisfy required properties and can be used with needle detectors due to constituent components thereof being manufactured using the stainless steel.

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a stainless steel suitable for use with a needle detector that does not cause needle detectors to malfunction, and a slide fastener and buttons that are mounted on clothing, footwear or the like and are suitable for coping with needle detectors.

2. Description of the Prior Art

[0002] Conventionally, as this kind of stainless steel, the stainless steels disclosed in Japanese Patent Publication No. 6-4905B and Japanese Patent Publication No. 6-41624B are known. In the former patent publication a non-magnetic stainless steel having excellent spring characteristics is disclosed, and in the latter patent publication a work-hardened non-magnetic stainless steel that remains non-magnetic after having been work-hardened through cold working is disclosed. However, although the stainless steels of the above patent publications are non-magnetic to the extent that it is disclosed that the magnetic permeability is 1.01 or less, the extent of magnetism is still greater than that of other alloys, i.e. copper alloys and aluminum alloys, and hence there is a problem that because broken needles during sewing are rather small and thus have a small magnetism, the stainless steels of the above patent publications are insufficient in terms of coping with needle detectors that detect whether broken needles or the segments thereof remain in clothing or the like. On the other hand, the alloy disclosed in Japanese Patent Publication No. 2000-256813A is known as an alloy for personal ornamental use that does not cause needle detectors to malfunction. That patent application discloses that the alloy can be used in various personal ornaments such as buttons, slide fasteners, key-rings, earrings, tie-pins, brooches and pendants, and constituent components of such personal ornaments. However, the alloy disclosed in that patent application is an alloy having Zr and/or Ti as a principal component thereof, and hence is a special alloy from the viewpoint of alloys used hitherto, and moreover has a problem of not being able to be manufactured easily since the alloy structure must be controlled. Furthermore, in the case that a slide fastener or button is manufactured using only this alloy, sufficient ability to cope with needle detectors can be attained, but slide fasteners and buttons are constituted from many different components, and each component is manufactured in accordance with the required properties thereof. In the case that all of the many different components of a slide fastener or button are manufactured from this alloy, some of the components may lack the required capabilities. In particular, in the case of components that must have springiness, use of the above alloy is problematic, and hence a conventional stainless steel or the like must be used; it thus becomes impossible to adequately carry out detection of whether broken needles have got into clothing or the like during sewing.

SUMMARY OF THE INVENTION

[0003] It is thus an object of the present invention to provide a stainless steel that enables detection of whether broken needles have got into clothing or the like during sewing to be carried out adequately, and a slide fastener and buttons that satisfy properties required of slide fasteners and buttons and can cope with needle detectors due to the slide fastener and buttons or constituent components thereof being manufactured using the above stainless steel. Note that the stainless steel according to the present invention can be used not only in slide fasteners and buttons suitable for use with a needle detector, but also in uses in which non-magnetism is required, for example in members such as gun parts and magnetic sensor cases.

[0004] The present invention is constituted as follows.

[0005] (1) A stainless steel suitable for use with a needle detector, having a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 kOe.

[0006] (2) The stainless steel suitable for use with a needle detector according to (1) above, further exhibiting a needle-detecting performance of 1.2 mm-diameter iron ball or less.

[0007] (3) The stainless steel suitable for use with a needle detector according to (1) above, further exhibiting a needle-detecting performance of 0.8 mm-diameter iron ball or less.

[0008] (4) The stainless steel suitable for use with a needle detector according to any of (1), (2) and (3) above, comprising, in mass%, 0.01 to 0.15% of C, 0.1 to 5% of Si, 1 to 10% of Mn, 8 to 25% of Ni, 14 to 30% of Cr, 0.01 to 0.25% of N, and the remainder Fe and impurities, wherein an Ni equivalent, which is defined as Ni equivalent = Ni + 0.6Mn + 9.69(C+N) + 0.18Cr - 0.11Si^2, has a value of 19 or more. In the definition for Ni equivalent, Ni, Mn, C, N, Cr and Si represent the numerical values of their contents represented by mass% unless otherwise specified.

[0009] (5) The stainless steel suitable for use with a needle detector according to (4) above, further containing, in

mass%, at least one element selected from the group consisting of a) 0.5 to 3% of Cu, b) 0.05 to 0.5% of at least one element selected from the group consisting of Nb, W and V, and c) 0.1 to 2% of Mo.

[0010] (6) The stainless steel suitable for use with a needle detector according to any of (1) through (5) above, wherein the needle-detecting performance is maintained after cold rolling at a reduction ratio of 60% has been carried out.

[0011] (7) A slide fastener suitable for use with a needle detector, comprising elements mounted on mutually facing edge parts of a pair of fastener tapes, stops mounted at both ends of the elements, and a slider that opens and closes the elements, wherein at least one member selected from the group consisting of the elements, stops and slider, and constituent components thereof is formed from a stainless steel suitable for use with a needle detector, having a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 kOe.

[0012] (8) The slide fastener suitable for use with a needle detector according to (7) above, exhibiting a needle-detecting performance of 1.2 mm-diameter iron ball or less.

[0013] (9) The slide fastener suitable for use with a needle detector according to (7) above, exhibiting a needle-detecting performance of 0.8 mm-diameter iron ball or less.

[0014] (10) The slide fastener suitable for use with a needle detector according to any of (7) through (9) above, wherein the slider for slide fastener comprises a slider body, a pull-tab disposed on the slider body, and a latching pawl that is swingable through operation of the pull-tab and is pushed by urging means that applies force toward the slider body side, and at least the urging means is formed from the stainless steel suitable for use with a needle detector.

[0015] (11) The slide fastener suitable for use with a needle detector according to (10) above, wherein the urging means of the slider is a spring that possesses the latching pawl or a spring that is disposed on the latching pawl.

[0016] (12) A button suitable for use with a needle detector, which comprises a front surface member disposed on a front surface of cloth, and a base member disposed on a reverse surface of the cloth, and is attached to the cloth by engaging the front surface member and base member together, wherein at least one member selected from the group consisting of the front surface member and base member, and constituent components thereof is formed a stainless steel suitable for use with a needle detector, having a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 kOe.

[0017] (13) The button suitable for use with a needle detector according to (12) above, exhibiting a needle-detecting performance of 1.2 mm-diameter iron ball or less.

[0018] (14) The button suitable for use with a needle detector according to (12) above, exhibiting a needle-detecting performance of 0.8 mm-diameter iron ball or less.

[0019] (15) A button suitable for use with a needle detector comprising a pair of buttons comprising a male button that is fixed to cloth and has on a surface thereof a bulging head part that projects out, and a female button that is fixed to cloth and has a recessed part that separates from and engages with the bulging head part of the male button, wherein at least one member selected from the group consisting of the male button and female button, and constituent components thereof is formed from a stainless steel suitable for use with a needle detector, having a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 kOe.

[0020] Throughout the specification, all the contents of the respective elements constituting the stainless steel are represented by mass% based on the total of the stainless steel, unless otherwise specified.

DESCRIPTION OF THE DRAWINGS

[0021] Fig. 1 is a conceptual illustration of a slide fastener.

[0022] Fig. 2 is a perspective view of a slider to which the present invention is applied.

[0023] Fig. 3 is a sectional view of the slider to which the present invention is applied.

[0024] Fig. 4 is a perspective view of another example of a slider.

[0025] Fig. 5 is an exploded perspective view of the other example of a slider.

[0026] Fig. 6 is a longitudinal sectional view along a central line in the longitudinal direction of the slider.

[0027] Fig. 7 is a sectional view of an ornamental button that is mounted at the edge of a jeans pocket or the like.

[0028] Fig. 8 is a sectional view of another example of an ornamental button.

[0029] Fig. 9 is a sectional view of an ornamental button that is used on a jacket or the like.

[0030] Fig. 10 is a sectional view of a fastening button that is used on clothing or the like.

[0031] Fig. 11 is a sectional view of a snap button.

[0032] Fig. 12 is a sectional view of another example of a snap button.

[0033] Fig. 13 is a sectional view of another example of a snap button.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0034] Following is a description of the stainless steel of the present invention.

[0035] The stainless steel of the present invention must have a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 kOe, this being to make the stainless steel able to cope with needle detectors, which is an object of the present invention. Through these conditions being satisfied, it is possible to provide products, components and materials suitable for use with a needle detector which allow needle detectors to operate accurately in search of broken needles or their segments, which have got into clothing or the like during sewing, and do not cause malfunction of the needle detectors even when the stainless steel is used in products for personal ornamental use or constituent components of products for personal ornamental use, i.e. slide fasteners and buttons. Furthermore, if the magnetic permeability in a 1 kOe magnetic field is 1.003 or less, and the magnetization in an 18 kOe magnetic field is 440 memu/g or less, then the above effects can be further expected.

[0036] Regarding the needle-detecting performance, for a static magnetic field type needle detector that measures the amount of change in the magnetic flux density arising when metal is passed through magnetic flux at a constant speed, the amount of change in the magnetic flux density corresponding to a 0.8 mm-diameter iron ball is set to a reference value (indicative value) of 100 to 120, the value upon carrying out measurement on the article undergoing measurement is taken as the needle-detecting value, and evaluation is carried out based on the value relative to the reference value. Specifically, if the needle-detecting value for the article undergoing measurement is equivalent to the reference value or less, then the needle-detecting performance is represented as "0.8 mm-diameter iron ball or less", and if the needle-detecting value for the article undergoing measurement is equivalent to the needle-detecting value for a 1.2 mm-diameter iron ball or less, then the needle-detecting performance is represented as "1.2 mm-diameter iron ball or less". In such a manner, needle-detecting performance is represented as being one of 0.8-, 1.2- or 1.5 mm-diameter iron ball or less; in the case that the needle-detecting performance is 0.8 mm-diameter iron ball or less, this means that even a broken needle of the smallest special size used in sewing can be detected, and in the case that the needle-detecting performance is 1.2 mm-diameter iron ball or less, this means that a broken needle of an ordinarily used size can be detected accurately. In the present invention, the needle-detecting performance is preferably 1.2 mm-diameter iron ball or less, most preferably 0.8 mm-diameter iron ball or less. In the present invention, in the case of the alloy, the article undergoing measurement is a piece of the alloy of size 15mm×15mm×0.4mm, and the needle-detecting value for the article undergoing measurement is the result obtained upon passing the article undergoing measurement through perpendicular to the magnetic flux. Moreover, in the case of a slide fastener or button as described later, the article undergoing measurement is the product or component, and the needle-detecting value for the article undergoing measurement is the result obtained upon passing the article undergoing measurement through perpendicular to the magnetic flux.

[0037] The following composition is preferable for the stainless steel used. That is, a stainless steel that comprises, in mass%, 0.01 to 0.15% of C, 0.1 to 5% of Si, 1 to 10% of Mn, 8 to 25% of Ni, 14 to 30% of Cr, 0.01 to 0.25% of N, and the remainder Fe and impurities, wherein the Ni equivalent, which is defined as Ni equivalent = Ni + 0.6Mn + 9.69 (C+N) + 0.18Cr - 0.11Si^2, has a value of 19 or more, is effective.

[0038] C, like N, is a potent austenitic phase stabilizing element, and moreover is an element effective for improving the spring characteristics, and hence the lower limit of the C content is made to be 0.01%. However, C is an element that brings about a drop in the corrosion resistance, and moreover if solid solution of C occurs excessively then the workability of the stainless steel is marred due to hardening caused by the increase in the amount of C in solid solution, and hence in consideration of this the upper limit of the C content is made to be 0.15%.

[0039] Si is an effective element for achieving high strength, and hence it is preferable for the Si content to be at least 0.1%. However, as the Si content increases, the magnetic permeability after cold working increases dramatically and thus it become impossible to maintain the non-magnetism, and hence the upper limit of the Si content is made to be 5%.

[0040] Mn, like Ni, is an austenitic phase stabilizing element, and hence suppresses increase in the magnetic permeability upon cold working. Moreover, Mn is an element that increases the solid solubility of N. For these capabilities to be exhibited, the Mn content must be at least 1%, and moreover the Mn content must be adjusted along with the Ni content to maintain the non-magnetism after cold working; however, if more than 10% of Mn is contained then effects commensurate with this will not be observed, and hence the upper limit of the Mn content is set to 10%.

[0041] Ni is a fundamental component of austenitic stainless steel, and is an effective element for contributing to stabilization of the austenitic phase. To maintain the non-magnetism after cold working the Ni content must be at least 8%, and moreover the Ni content must be adjusted along with the Mn content in accordance with the Si content. However, Ni brings about a drop in the spring characteristics after cold working, and hence the upper limit of the Ni content is made to be 25%.

[0042] Cr is a fundamental component of stainless steel, and to obtain excellent corrosion resistance the Cr content must be at least 14%; however, if a large amount of Cr is contained, then a large amount of delta ferrite will be produced

and hence it will no longer be possible to secure the non-magnetism; the upper limit of the Cr content is thus made to be 30%.

[0043] N is an element that is effective for maintaining the non-magnetism, which is a main characteristic feature of the stainless steel of the present invention, and for improving the strength and obtaining excellent spring characteristics; the lower limit of the N content is thus made to be 0.01%. However, if the N content exceeds 0.25%, then as with C, the workability of the stainless steel will be marred due to hardening caused by an increase in the amount of N in solid solution. Moreover, the castability will be marred and hence it will not be possible to obtain a sound steel ingot; the upper limit of the N content is thus made to be 0.25%. In particular, in the case that workability, for example shape fixability, is required and it is required to make the lifetime of a press die long, and hence the stainless steel must be made soft, it is preferable to make the upper limit of the N content be less than 0.06%.

[0044] Cu is an austenitic phase stabilizing element, and is an effective element for conferring workability. To exhibit this effect, it is preferable to add at least 0.5% of Cu. However, if more than 3% of Cu is added then such an excess addition of Cu exceeding the solid solubility limit will impair the workability, and hence the upper limit of the Cu content is made to be 3%.

[0045] Nb, W and V are all elements that increase the work-hardening ability, and to exhibit this effect it is preferable to add at least 0.05% of Nb, W and V in total. However, if large amounts of Nb, W and V are added, then there will be a deterioration in the hot workability, and delta ferrite will be produced and hence it will no longer be possible to maintain the non-magnetism; the upper limit of the total content of Nb, W and V is thus made to be 0.5%.

[0046] Mo is an element that is effective for improving the corrosion resistance, and to exhibit this effect it is preferable to add at least 0.1% of Mo. However, if a large amount of Mo is added then the amount of delta ferrite produced will increase and hence it will no longer be possible to maintain the non-magnetism; the upper limit of the Mo content is thus made to be 2%.

[0047] Moreover, to obtain high strength it is necessary to confer working strain on the stainless steel of the present invention and thus work-harden the stainless steel through cold working. Cold working corresponding to a cold rolling reduction ratio of from 30% to 80% is thus necessary. In order to secure the non-magnetism even though such cold working is carried out, the value of the Ni equivalent stipulated as described earlier must be at least 19. The cold rolling reduction ratio is defined as the percentage of the change in the sheet thickness of the material upon cold rolling to the original sheet thickness. However, if the Ni and Mn contents become too high to raise the value of the Ni equivalent, then the work-hardening ability of the steel will drop, and hence the Ni and Mn contents are made to be as stipulated earlier.

[0048] Furthermore, a constituent component of a slide fastener or the like in which the stainless steel of the present invention is used is manufactured by cold rolling with a cold rolling reduction ratio as defined above of at least 60%, and hence it is necessary for the needle-detecting performance to be maintained after the 60% cold rolling reduction has been effected. As described above, for the stainless steel of the present invention, to obtain high strength, a cold rolling reduction ratio of 30 to 80% is necessary, and hence it is necessary for the needle-detecting performance to be maintained after at least 30% cold rolling reduction has been effected; depending on the product or component manufactured, it may be necessary to effect a 60% cold rolling reduction, and hence it is particularly preferable for the needle-detecting performance to be maintained after the 60% cold rolling reduction has been effected.

[0049] Following are descriptions, with reference to the drawings, of a slide fastener and buttons to which the present invention is applied.

[0050] First, a description will be given of a slide fastener F.

[0051] Fig. 1 is a conceptual drawing of the slide fastener; as shown in Fig. 1, the slide fastener F comprises a pair of fastener tapes 1 each of which has a core part 2 formed at an edge on one side thereof, elements 3 that are fixed (mounted) by caulking at prescribed intervals onto the core part 2 of each fastener tape 1, a top stop 4 and a bottom stop 5 that are fixed by caulking onto the core part 2 of each fastener tape 1 at the top and bottom ends respectively of the elements 3, and a slide fastener slider (hereinafter referred to as the "slider") S that is disposed between facing pairs of elements 3 and can be freely slid in an up/down direction to engage and separate (open and close) the elements 3. Note that, in the above, the article obtained by mounting elements 3 onto the core part 2 of the fastener tape 1 is a slide fastener chain 7. Also note that, although not shown in the drawing, the bottom stop 5 may be made to be a separable bottom stop assembly comprising an insertion pin, a box pin and a box body, whereby the pair of slide fastener chains 7 can be separated through the opening operation of the slider S. In the present invention, the stainless steel suitable for use with a needle detector described above can be used for the elements 3, the top stop 4, the bottom stop 5, the slider S, the separable bottom stop assembly, and so on if these are made of metal. Moreover, the stainless steel suitable for use with a needle detector can be used for constituent components of the slider S and the separable bottom stop assembly, for example the insertion pin, the box pin, the box body, and so on (for the slider S, the constituent components will be described later). Furthermore, the above description has been given based on a slide fastener that uses elements 3, a top stop 4 and a bottom stop 5 that are made of metal, but the present invention may also be applied to a slide fastener that uses elements 3, a top stop 4 and a bottom stop 5 that are formed from a resin, for example,

by injection, or from a resin filament (e.g. in a coil form), in which case the target of application of the present invention becomes other components and so on that are made of metal.

[0052] Following is a detailed description of the slider S.

[0053] Figs. 2 and 3 show the slider S to which the present invention is applied; Fig. 2 is an exploded perspective view that shows the relationship between the various components in exploded fashion, and Fig. 3 is a longitudinal sectional view along a central line in the longitudinal direction of the slider. 11 indicates a slider body, 12 indicates a pull-tab, and 13 indicates a latching pawl-possessing spring. In the latching pawl-possessing spring 13, a spring part 14 at the front and a latching pawl part 15 at the back are formed integrated together. As shown in Fig. 3, the slider S1 is constituted by disposing the pull-tab 12 on the slider body 11, and mounting the latching pawl-possessing spring 13 on a top part of the slider body 11. With such a slider S1, when not in use, as shown in Fig. 3, an end part of the latching pawl part 15 of the latching pawl-possessing spring 13 is pushed downward by application of force from the spring part 14 of the latching pawl-possessing spring 13 and hence bites in between elements, not shown, thus stopping downward movement of the slider S1. On the other hand, during use, the pull-tab 12 is operated upward against the force from the spring part 14, whereby the end part of the latching pawl part 15 moves upward, and thus the latching with the elements, not shown, is released, and hence downward movement of the slider S1 becomes possible.

[0054] Figs. 4, 5 and 6 show another example of the slider S; Fig. 4 is a perspective view of the slider S2, Fig. 5 is an exploded perspective view that shows the relationship between the various components in exploded fashion, and Fig. 6 is a longitudinal sectional view along a central line in the longitudinal direction of the slider. As before, 11 indicates a slider body, and 12 indicates a pull-tab; 16 indicates a latching pawl, 17 indicates a plate spring, and 18 indicates a cover. As shown in Figs. 5 and 6, the slider S2 is constituted by disposing the pull-tab 12 and the latching pawl 16 on the slider body 11, fixing the plate spring 17 onto a top part of the slider body 11, and fixing the cover 18 onto the top part of the slider body 11. With such a slider S2, when not in use, as shown in Fig. 6, an end part of the latching pawl 16 is pushed downward by application of force from the plate spring 17 and hence bites in between elements, not shown, thus stopping downward movement of the slider S2. On the other hand, during use, the pull-tab 12 is operated upward against the force from the plate spring 17, whereby the end part of the latching pawl 16 moves upward, and thus the latching with the elements, not shown, is released, and hence downward movement of the slider S2 becomes possible.

[0055] With the sliders described above, the latching pawl-possessing spring 13 of the slider S1, and at least the plate spring 17 of the slider S2, are made of the stainless steel suitable for use with a needle detector of the present invention. Furthermore, in the above, the latching pawl 16 and the cover 18, and also the pull-tab 12 and the slider body 11, may be made of the stainless steel suitable for use with a needle detector of the present invention, and moreover sliders suitable for use with a needle detector of the present invention can also be provided by making the latching pawl-possessing spring 13 and the plate spring 17 be made of the stainless steel suitable for use with a needle detector, and manufacturing the slider body 11, the latching pawl 16, the cover 18 and the pull-tab 12 from brass, red brass or the like. Furthermore, a slide fastener suitable for use with a needle detector of the present invention can be provided by making the slider have a constitution as described above, and making the elements 3, the top stop 4 and the bottom stop 5 be made of the stainless steel suitable for use with a needle detector, or else brass, red brass or the like.

[0056] Next, a description will be given of buttons B. In the present invention "buttons B" is used with a meaning that includes ornamental buttons B1 to B3 shown in Figs. 7 to 9, a fastening button B4 shown in Fig. 10, and snap buttons SB1, 2 and 3 shown in Figs. 11 to 13 Moreover, "front surface member" means a member that is generally disposed on the outer surface side of cloth, and "base member" means a member that is generally disposed on the reverse surface side of cloth.

[0057] Following are detailed descriptions of each type of button B.

[0058] Fig. 7 shows an ornamental button B1 that is mounted, for example, at the edge of a jeans pocket. As shown in the sectional view of Fig. 7, the ornamental button B1 comprises a connecting member 21, a covering member 22, and an attaching member 23. The button B1 is mounted on cloth 20 by fixing the covering member 22 to a base part of the connecting member 21 (the connecting member 21 and the covering member 22 together constitute a base member), piercing a shaft of the connecting member 21 through the cloth 20, and further passing the shaft of the connecting member 21 through the attaching member 23 (front surface member), and then expanding the tip of the shaft of the connecting member 21.

[0059] An ornamental button B2 of Fig. 8 differs from the ornamental button B1 of Fig. 7 in that the shaft of the connecting member 21 is expanded inside the attaching member 23, and is concealed. Other than this, the ornamental button B2 of Fig. 8 is like the ornamental button B1 of Fig. 7.

[0060] With the ornamental buttons B1 and B2 described above, the attaching member 23, which is generally exposed to the outer surface side, is made of the stainless steel suitable for use with a needle detector of the present invention, considering that the attaching member 23 must be able to deform for fixing by caulking and insusceptible to discoloration, degeneration and corrosion. Furthermore, in the above, the covering member 22 and the connecting member

21 may be made of the stainless steel suitable for use with a needle detector of the present invention, and moreover ornamental buttons suitable for use with a needle detector can also be provided by manufacturing the covering member 22 and the connecting member 21 from brass, red brass or the like.

[0061] Fig. 9 shows an ornamental button B3 that is used on a jacket or the like. As shown in the sectional view of Fig. 9, the ornamental button B3 comprises an attaching member 23 (front surface member) and a base part member 24 (base member). The button B3 is mounted on cloth 20 by disposing the base member 24 on the reverse surface of the cloth 20, piercing the attaching member 23 through the cloth 20, passing the attaching member 23 through the rear surface of the base part member 24, and fixing the attaching member 23 to the base part member 24 by caulking.

[0062] With the ornamental button B3, the attaching member 23, which is generally exposed to the outer surface side, is made of the stainless steel suitable for use with a needle detector of the present invention, considering that the attaching member 23 must be deformed for fixing by caulking and insusceptible to discoloration, degeneration and corrosion. Furthermore, in the above, the base member 24 may be made of the stainless steel suitable for use with a needle detector of the present invention, and moreover a ornamental button suitable for use with a needle detector can also be provided by manufacturing the base part member 24 from brass, red brass or the like.

[0063] Fig. 10 shows a fastening button B4 that is used on clothing or the like and that is fastened by passing a top part, where the button is enlarged, through an attaching hole formed in cloth 20 on the other side. As shown in the sectional view of Fig. 10, the fastening button B4 comprises a connecting member 21, a covering member 22, an attaching member 23, an ornamental member 25, and a supporting member 26. The button B4 is mounted on the cloth by fixing the covering member 22 to a base part of the connecting member 21 (the connecting member 21 and the covering member 22 together constitute a base member), piercing a shaft of the connecting member 21 through the cloth 20, passing the shaft of the connecting member 21 through the attaching member 23, and expanding the shaft of the connecting member 21, thus engaging the attaching member 23, which has the supporting member 26 therein and fixed inside, and the ornamental member 25 (the attaching member 23, the ornamental member 25 and the supporting member 26 together constitute a front surface member).

[0064] With the fastening button B4, the attaching member 23, which is exposed to the outer surface side, is made of the stainless steel suitable for use with a needle detector of the present invention, considering that the attaching member 23 must be able to deform for the attachment and insusceptible to discoloration, degeneration and corrosion, and/or the ornamental member 25, which is generally exposed to the outer surface side, is made of the stainless steel suitable for use with a needle detector of the present invention, considering that the ornamental member 25 must be able to deform for the attachment and insusceptible to discoloration, degeneration and corrosion. Furthermore, in the above, the connecting member 21, the covering member 22, and the supporting member 26 may be made of the stainless steel suitable for use with a needle detector of the present invention, and moreover a fastening button suitable for use with a needle detector can also be provided by manufacturing the connecting member 21, the covering member 22, and the supporting member 26 from brass, red brass or the like.

[0065] Fig. 11 is a sectional view showing a snap button SB1 out of the snap buttons SB to which the present invention is applied; the snap button SB1 comprises a female button 31 and a male button 32. The female button 31 comprises a female member 33 (base member) in which is formed a recessed part 33a having on the inner peripheral surface thereof an elastic part with which the male button 32, described below, engages, and a female fixing member 35 (front surface member) that is pierced through cloth 20, thus fixing the female member 33. The male button 32 comprises a male member 34 (front surface member) having a bulging head part 34a that engages with the elastic part of the female member 33, and a male fixing member 36 (base member) that is pierced through cloth 20, thus fixing the male member 34.

[0066] Fig. 12 is a sectional view showing another example of a snap button SB; as with the snap button SB1 described above, the snap button SB2 comprises a female button 31 and a male button 32. The female button 31 comprises a covering member 37, a female fixing member 35 that is fitted into the covering member 37, thus preventing deformation of the covering member 37, and is pierced through cloth 20, thus fixing the covering member 37 and a female member 33, described below, together via the cloth 20 (the covering member 37 and the female fixing member 35 together constitute a front surface member), the female member 33 in which is formed a recessed part 33a inside which the male button 32, described below, is housed, and an elastic spring 38 that is disposed inside the recessed part 33a of the female member 33 and engages with the male button 32, described below (the female member 33 and the spring 38 together constitute a base member). The male button 32 comprises a male member 34 (front surface member) having a bulging head part 34a that engages with the elastic spring 38 disposed inside the recessed part 33a of the female member 33, and a male fixing member 36 (base member) that is pierced through cloth 20, thus fixing the male member 34.

[0067] Fig. 13 is a sectional view showing yet another example of a snap button SB; as with the snap buttons SB1 and SB2 described above, the snap button SB3 comprises a female button 31 and a male button 32. The female button 31 differs from that of the snap button SB2 in that, whereas the spring 38 of the snap button SB2 has a partially cut out ring shape, the snap button SB3 uses a spring 38 of the form shown in Fig. 13 and the female member 33 has a

form matching this, but is otherwise similar to that of the snap button SB2. Moreover, the male button 32 is similar to that of the snap button SB1.

[0068] Regarding the snap buttons SB described above, in the snap buttons SB1, SB2 and SB3, at least the female member 33 is made of the stainless steel suitable for use with a needle detector of the present invention. Furthermore, in the above, the male member 34, the female and male fixing members 35 and 36, and the covering member 37 may be made of the stainless steel suitable for use with a needle detector of the present invention, and moreover snap buttons suitable for use with a needle detector of the present invention can also be provided by making the female member 33 be made of the stainless steel suitable for use with a needle detector of the present invention, and manufacturing the male member 34, the female and male fixing members 35 and 36, and the covering member 37 from brass, red brass or the like. Furthermore, in consideration of discoloration, degeneration and corrosion, it is preferable for the female fixing member 35 of the snap button SB1, and the covering member 37 of the snap buttons SB2 and SB3, to be made of the stainless steel suitable for use with a needle detector of the present invention.

Examples:

[0069] Following is a concrete description of the present invention through examples, but the present invention is of course not limited to the following examples.

Table 1

	Composition (mass%) balance: Fe										Ni equivalent
	C	Si	Mn	Ni	Cr	N	Mo	Cu	W	Nb	V	
Example 1	0.131	2.3	9.6	13.8	26.5	0.23	–	–	–	–	–	27.2
Example 2	0.065	0.6	3.8	13.0	20.3	0.04	–	–	–	–		19.9
Example 3	0.095	1.5	7.7	17.3	22.3	0.20	–	–				28.5
Example 4	0.065	1.1	6.0	20.2	23.6	0.08	–	–				29.3
Example 5	0.065	1.4	3.6	12.5	19.5	0.05	–	–				19.1
Example 6	0.093	0.8	5.1	13.6	17.7	0.06	–	–				21.3
Example 7	0.072	0.2	8.3	12.1	15.3	0.03	–	–				20.8
Example 8	0.062	0.6	5.1	13.6	19.5	0.04	–	–				21.1
Example 9	0.059	0.6	4.3	13.2	20.1	0.03	–	–				20.2
Example 10	0.066	0.7	3.8	12.8	20.4	0.03	–	–				19.7
Example 11	0.066	0.7	3.8	12.8	20.4	0.12	–	–				20.5
Example 12	0.070	0.3	6.5	10.3	20.0	0.10	–	–				19.4
Example 13	0.072	0.3	3.0	12.3	19.0	0.15	–	–				19.7
Example 14	0.063	0.6	1.5	14.8	22.3	0.02	–	–				20.5
Example 15	0.051	0.5	1.5	19.1	24.7	0.03	0.30	–				25.2
Example 16	0.073	0.6	3.0	12.2	18.9	0.13	1.50	–				19.3
Example 17	0.077	0.6	3.2	12.4	18.9	0.17	–	2.20				20.1
Example 18	0.067	0.5	3.1	12.0	19.3	0.12	–	–	0.30			19.1
Example 19	0.059	0.6	3.2	12.3	18.9	0.11	–	–		0.33		19.2
Example 20	0.072	0.7	3.0	12.2	19.2	0.14	–	–			0.35	19.5
Comparative Example 1	0.041	0.7	0.6	7.8	18.1	0.04	–	–				12.1
Comparative Example 2	0.052	0.6	3.2	10.0	18.9	0.03	–	–				16.1
Comparative Example 3	0.040	0.8	2.0	12.0	17.8	0.03	–	–				17.0
Comparative Example 4	0.041	0.3	1.0	13.0	22.0	0.03						18.2
Comparative Example 5	0.055	0.6	0.8	8.1	18.3	0.03						12.6
Comparative Example 6	0.072	0.4	0.7	8.1	18.3	0.03						12.8

[0070] Test materials (Examples 1 to 20) made of stainless steels of the present invention as shown in Table 1 were manufactured as follows. Moreover, test materials of comparative examples were also manufactured in the same way.

[0071] Each of the prescribed compositions shown in Table 1 was weighed out. 30 kg of each composition was melted in an ordinary manner using a high-frequency induction melting furnace, and cast into an ingot having a thickness of 10 mm and a width of 120 mm. Then, each ingot was subjected to solution treatment, cold rolling to 3 mm in thickness,

intermediate annealing, cold rolling to 1.5 mm in thickness and final annealing. The thus obtained material had a size of 120mm×300mm. Cold rolling was then further carried out to effect a rolling reduction ratio of 60%, and the material thus obtained was taken as the test material.

[0072] For each of the test materials obtained, the magnetic permeability was measured in a 1 kOe magnetic field using a magnetic balance Shimadzu MB-3. The results are shown in Table 2. From Table 2, it can be seen that for the test materials of the present invention, the magnetic permeability is extremely (not more than 1.005).

[0073] Moreover, for each of the test materials obtained, the magnetization was measured. The magnetization was measured for each test material using an alternating gradient force magnetometer (AGFM; model AFGM 2900-04C); a prescribed amount of the test sample was placed in the magnetic field of the electromagnet, a magnetic field of 18 kOe was generated from the electromagnet, and the magnetization was measured by changing the magnetic field. The measurement was carried out at a measurement speed of 50 msec/point. As can be seen from the results in Table 2, for the test materials of the present invention, the magnetization is extremely low at 550 memu/g or less even in a strong magnetic field of 18 kOe.

Table 2

	Magnetic permeability	Magnetization memu/g at 18kOe	Needle-detecting value	No. buttons at which needle detection is possible	
				0.8 mm-diameter iron ball	1.2mm-diameter iron ball
Example 1	1.003	412	65	3	10
Example 2	1.002	422	67	3	10
Example 3	1.002	409	64	3	10
Example 4	1.003	403	60	3	10
Example 5	1.004	432	78	3	10
Example 6	1.003	415	68	3	10
Example 7	1.002	419	69	3	10
Example 8	1.003	414	68	3	10
Example 9	1.003	420	69	3	10
Example 10	1.002	431	72	3	10
Example 11	1.003	423	71	3	10
Example 12	1.002	435	79	3	10
Example 13	1.003	435	75	3	10
Example 14	1.003	428	73	3	10
Example 15	1.003	416	68	3	10
Example 16	1.003	545	86	3	10
Example 17	1.003	524	83	3	10
Example 18	1.003	490	82	3	10
Example 19	1.003	515	84	3	10
Example 20	1.004	528	84	3	10
Comparative Example 1	1.21	8920	604	0	0
Comparative Example 2	1.03	937	133	0	2
Comparative Example 3	1.02	647	97	1	4

Table 2 (continued)

	Magnetic permeability	Magnetization memu/g at 18kOe	Needle-detecting value	No. buttons at which needle detection is possible	
				0.8 mm-diameter iron ball	1.2mm-diameter iron ball
Comparative Example 4	1.008	574	84	2	5
Comparative Example 5	1.14	5029	398	0	1
Comparative Example 6	1.12	5830	430	0	0

[0074] Furthermore, a 15mm×15mm×0.4mm piece of each test material was taken, and the needle-detecting value was measured. Regarding the needle-detecting value, for a static magnetic field type needle detector that measures the amount of change in the magnetic flux density arising when metal is passed through magnetic flux at a constant speed, the amount of change in the magnetic flux density corresponding to a 0.8 mm-diameter iron ball was set to a reference value (indicative value) of 100 to 120, and the value upon carrying out measurement on each test material undergoing measurement was taken as the needle-detecting value. The results of the measurements based on the above are shown in Table 2. The values shown in Table 2 are values relative to the above-mentioned reference value. As can be seen from the results in Table 2, the test materials of the present invention have an extremely low needle-detecting value of 86 or less.

[0075] Moreover, female members 33, female fixing members 35 and covering members 37 were manufactured from each of the test materials obtained, and female buttons 31 of the snap button SB2 shown in Fig. 12 were manufactured. Note that rolling was carried out as described earlier such that the reduction ratio was 60% before manufacturing the female buttons 31 of the snap button SB2. The female buttons 31 manufactured were fed into a needle detector, and a study was carried out into the number of female buttons 31 in the presence of which specified broken needles could be detected. The value of 0.8 mm-diameter iron ball in Table 2 is the number of female buttons 31 in the presence of which a broken needle equivalent to a 0.8 mm-diameter iron ball could be detected, and the value of 1.2 mm-diameter iron ball in Table 2 is similarly the number of female buttons 31 in the presence of which a broken needle equivalent to a 1.2 mm-diameter iron ball could be detected. From Table 2, it can be seen that for the female buttons 31 made of each of the test materials of the present invention, a broken needle equivalent to a 0.8 mm-diameter iron ball can be detected even in the presence of 3 of the female buttons 31, and when detecting a broken needle equivalent to a 1.2 mm-diameter iron ball, the broken needle can be detected even in the presence of 10 of the female buttons 31. These results mean that detection of broken needles can be carried out not only if clothing is fed into a needle detector such that snap buttons attached to the clothing pass through the needle detector one at a time, but even if 3 to 10 snap buttons pass through the needle detector simultaneously.

[0076] Next, a study was carried out into the relationship between the working ratio (reduction ratio), and the hardness, the magnetization and the needle-detecting value. Test materials were prepared for which the rolling reduction ratio was 60% by manufacturing as described earlier, and for which cold rolling was not carried out after the final annealing and hence the rolling reduction ratio was 0%. The hardness was measured in Vickers hardness with a load of 20kg, and the magnetization and the needle-detecting value were measured as described earlier. The results are shown in Table 3.

Table 3

	Hardness		Magnetization memu/g at 18k0e		Needle-detecting value	
	0%	60%	0%	60%	0%	60%
Example 1	176	422	401	412	61	65
Example 2	145	360	403	422	65	67
Example 3	172	409	398	409	63	64
Example 4	149	366	390	403	59	60
Example 5	144	363	428	432	73	78

Table 3 (continued)

	Hardness		Magnetization memu/g at 18k0e		Needle-detecting value	
	0%	60%	0%	60%	0%	60%
Example 6	139	368	411	415	65	68
Example 7	140	367	408	419	65	69
Example 8	127	366	402	414	66	68
Example 9	132	370	497	420	67	69
Example 10	145	387	428	431	68	72
Example 11	173	408	417	423	68	71
Example 12	171	404	427	435	72	79
Example 13	177	420	428	435	73	75
Example 14	145	389	419	428	68	73
Example 15	143	380	406	416	64	68
Example 16	155	390	511	545	78	86
Example 17	165	419	495	524	75	83
Example 18	162	404	477	490	77	82
Example 19	164	405	492	515	78	84
Example 20	168	413	519	528	80	84
Comparative Example 1	141	382	821	8920	129	604
Comparative Example 2	138	378	640	937	91	133
Comparative Example 3	139	381	503	647	88	97
Comparative Example 4	137	370	469	574	79	84
Comparative Example 5	140	383	793	5029	107	398
Comparative Example 6	138	379	713	5830	94	430

[0077] From Table 3, it can be seen that the hardness becomes higher when the rolling reduction ratio is larger, and that the test materials of the examples of the present invention have a higher hardness than the test materials of the comparative examples regardless of the rolling reduction ratio. Moreover, it can be seen that whereas the magnetization becomes larger for the test materials of the comparative examples upon increasing the rolling reduction ratio, for the test materials of the examples of the present invention the magnetization is not affected by the rolling reduction ratio, and it can be seen that the magnetization is lower for the test materials of the examples of the present invention than for the test materials of the comparative examples regardless of the rolling reduction ratio. Furthermore, it can be seen that whereas the needle-detecting value increases dramatically upon increasing the rolling reduction ratio for the materials of the comparative examples, the needle-detecting value is not affected by the rolling reduction ratio for the test materials of the examples of the present invention.

[0078] According to the stainless steel suitable for use with a needle detector of the present invention, detection of whether broken needles have got into clothing or the like during sewing can be carried out adequately. Moreover, according to the slide fastener and buttons of the present invention, there can be provided a slide fastener and buttons that satisfy properties required for the uses thereof, and that can cope with needle detectors in that detection of whether broken needles have got into clothing or the like during sewing can be carried out adequately.

Claims

1. A stainless steel suitable for use with a needle detector, having a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 kOe.

2. The stainless steel suitable for use with a needle detector according to claim 1, further exhibiting a needle-detecting performance of 1.2 mm-diameter iron ball or less.

3. The stainless steel suitable for use with a needle detector according to claim 1, further exhibiting a needle-detecting performance of 0.8 mm-diameter iron ball or less.

4. The stainless steel suitable for use with a needle detector according to any of claims 1 to 3, comprising, in wt.%, 0.01 to 0.15% of C, 0.1 to 5% of Si, 1 to 10% of Mn, 8 to 25% of Ni, 14 to 30% of Cr, 0.01 to 0.25% of N, and the remainder Fe and impurities, wherein an Ni equivalent, which is defined as Ni equivalent = Ni + 0.6Mn + 9.69(C+N) + 0.18Cr - 0.11Si^2, has a value of 19 or more.

5. The stainless steel suitable for use with a needle detector according to claim 4, further containing, in wt.%, at least one additive element selected from the group consisting of a) 0.5 to 3% of Cu, b) 0.05 to 0.5% of at least one element selected from the group consisting of Nb, W and V, and c) 0.1 to 2% of Mo.

6. The stainless steel suitable for use with a needle detector according to any of claims 1 through 5, wherein the needle-detecting performance is maintained after cold rolling at a reduction ratio of 60% has been carried out.

7. A slide fastener suitable for use with a needle detector, comprising:

elements mounted on mutually facing edge parts of a pair of fastener tapes;
stops mounted at both ends of the elements; and
a slider that opens and closes said elements,

wherein at least one member selected from the group consisting of said elements, stops and slider, and constituent components thereof is formed from a stainless steel suitable for use with a needle detector, having a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 kOe.

8. The slide fastener suitable for use with a needle detector according to claim 7, exhibiting a needle-detecting performance of 1.2 mm-diameter iron ball or less.

9. The slide fastener suitable for use with a needle detector according to claim 7, exhibiting a needle-detecting performance of 0.8 mm-diameter iron ball or less.

10. The slide fastener suitable for use with a needle detector according to any of claims 7 through 9, wherein the slider for slide fastener comprises a slider body, a pull-tab disposed on the slider body, and a latching pawl that is swingable through operation of the pull-tab and is pushed by urging means that applies force toward the slider body side, and at least said urging means is formed from the stainless steel suitable for use with a needle detector.

11. The slide fastener suitable for use with a needle detector according to claim 10, wherein the urging means of the slider is a spring that possesses the latching pawl or a spring that is disposed on the latching pawl.

12. A button suitable for use with a needle detector, which comprises a front surface member disposed on a front surface of cloth, and a base member disposed on a reverse surface of the cloth, and is attached to the cloth by engaging said front surface member and base member together,

wherein at least one member selected from the group consisting of said front surface member and base member, and constituent components thereof is formed from a stainless steel suitable for use with a needle detector, having a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 koe.

13. The button suitable for use with a needle detector according to claim 12, exhibiting a needle-detecting performance of 1.2 mm-diameter iron ball or less.

14. The button suitable for use with a needle detector according to claim 12, exhibiting a needle-detecting performance of 0.8 mm-diameter iron ball or less.

15. A button suitable for use with a needle detector, comprising a pair of buttons consisting of a male button that is

fixed to cloth and has on a surface thereof a bulging head part that projects out, and a female button that is fixed to cloth and has a recessed part that separates from and engages with the bulging head part of said male button,

wherein at least one member selected from the group consisting of said male button and female button, and constituent components thereof is formed from a stainless steel suitable for use with a needle detector, having a magnetic permeability of 1.005 or less in a magnetic field of 1 kOe, and a magnetization of 550 memu/g or less in a magnetic field of 18 kOe.

FIG. 1

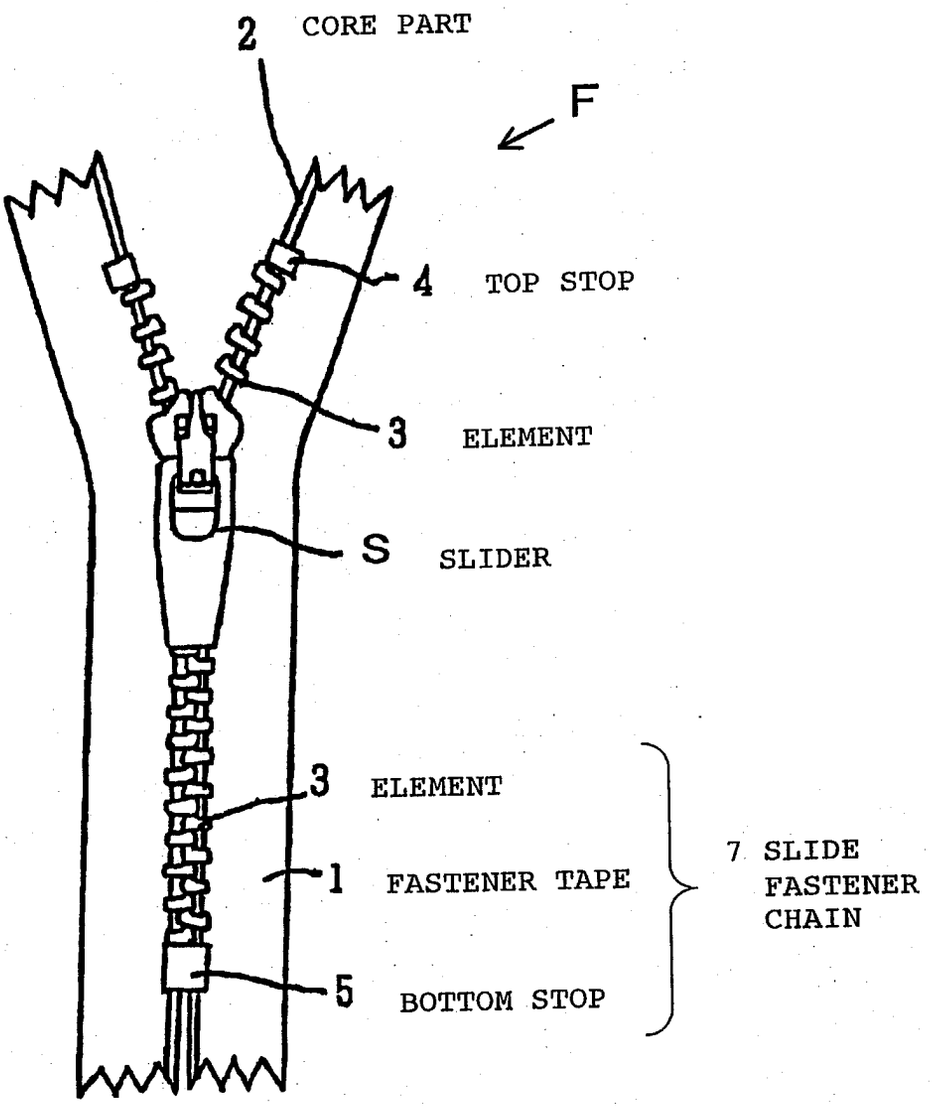

2 CORE PART
F
4 TOP STOP
3 ELEMENT
S SLIDER
3 ELEMENT
1 FASTENER TAPE
5 BOTTOM STOP
7 SLIDE FASTENER CHAIN

FIG. 2

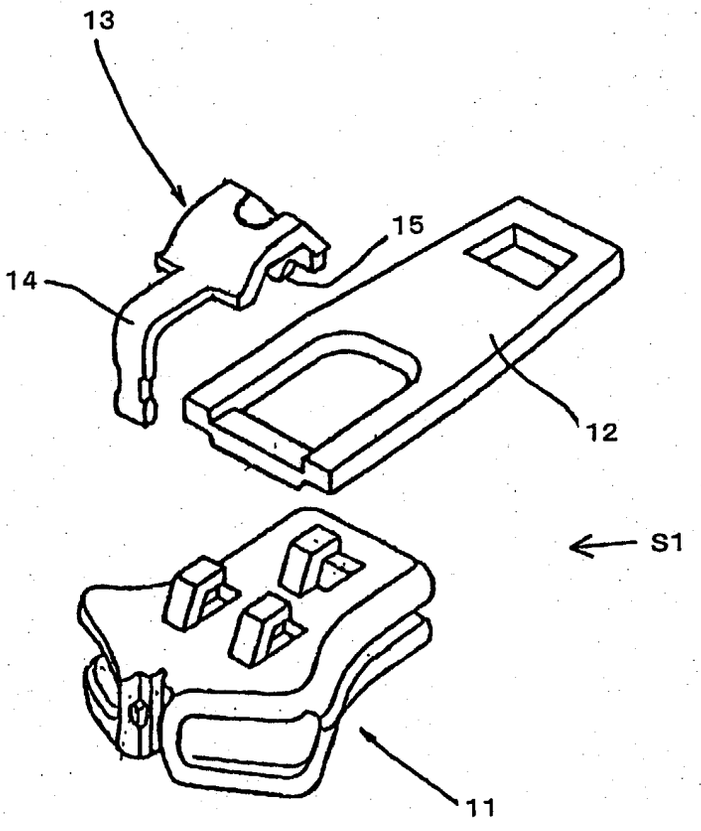


FIG. 3

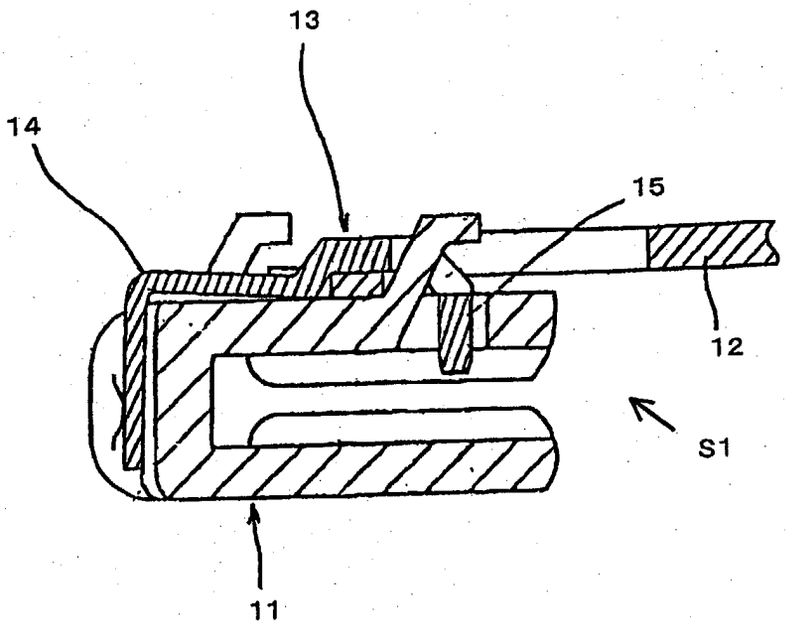


FIG. 4

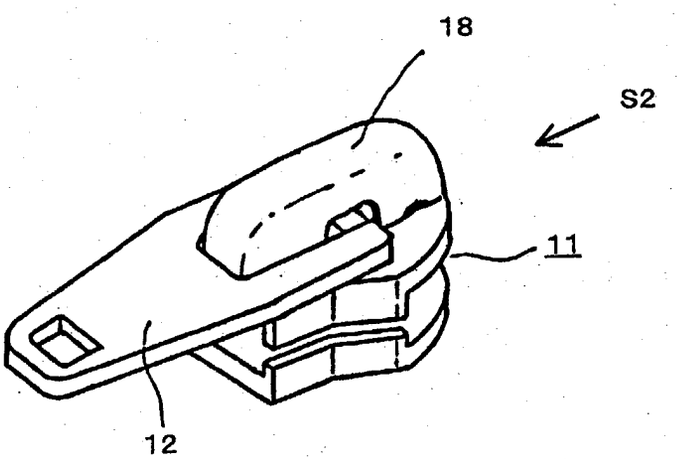


FIG. 5

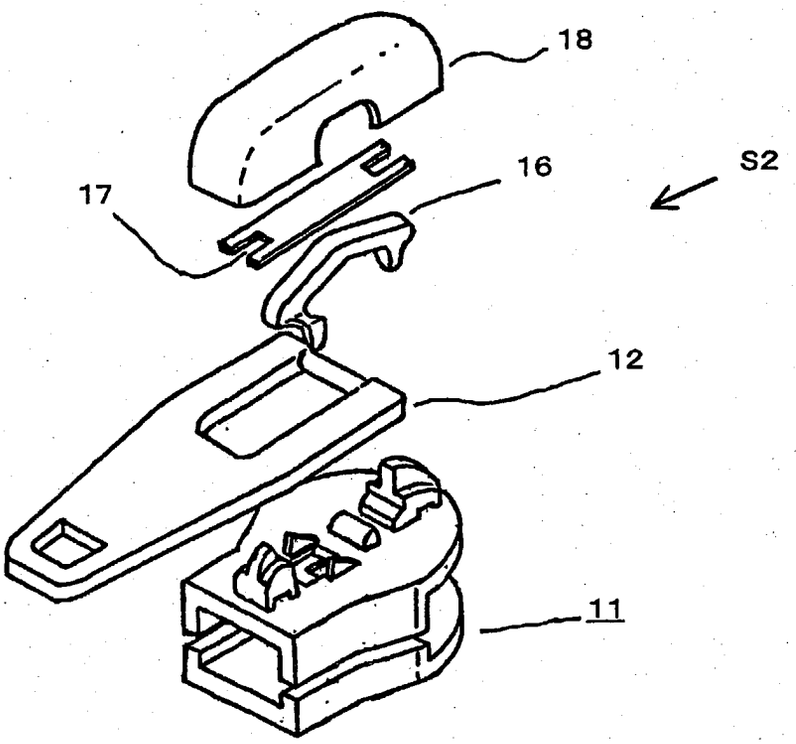


FIG. 6

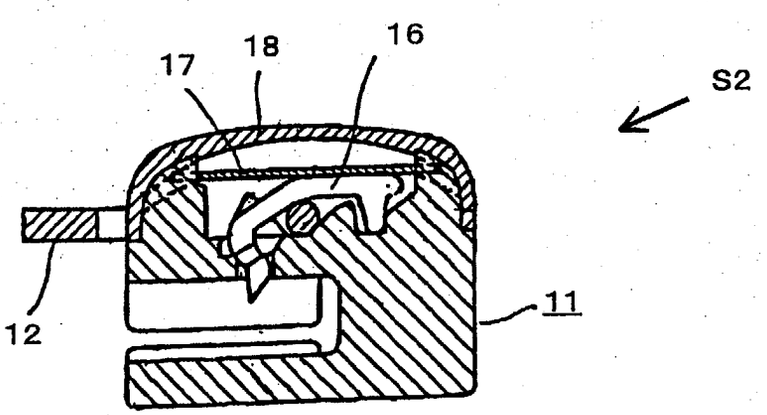


FIG. 7

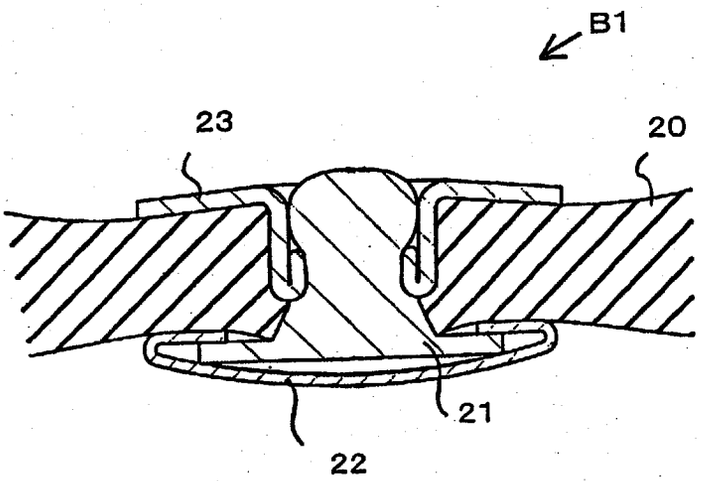


FIG. 8

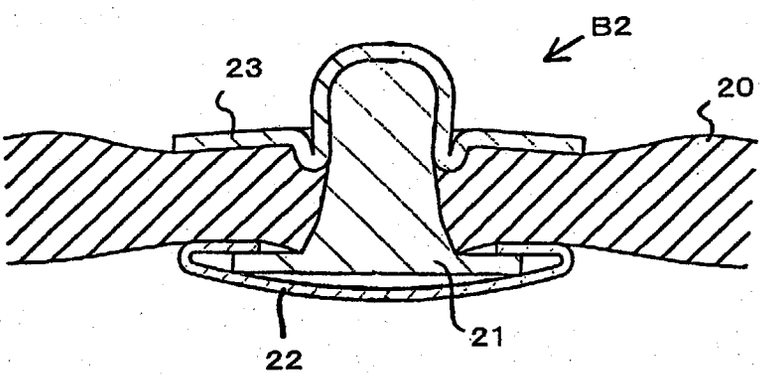


FIG. 9

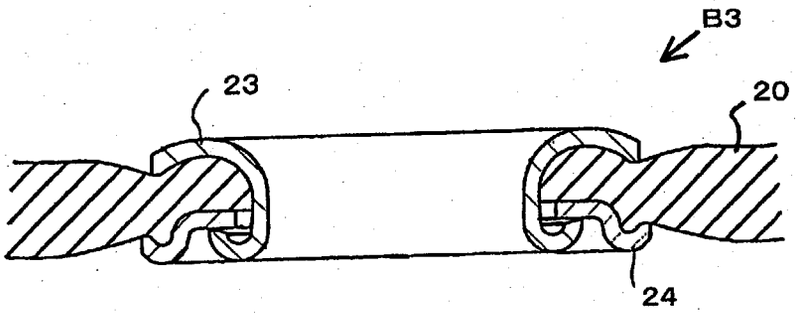


FIG. 10

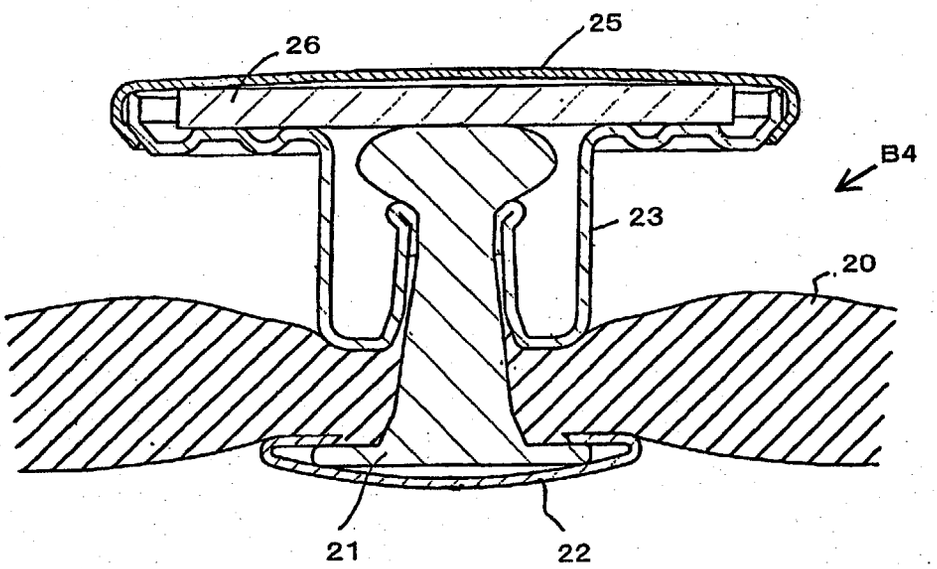


FIG. 11

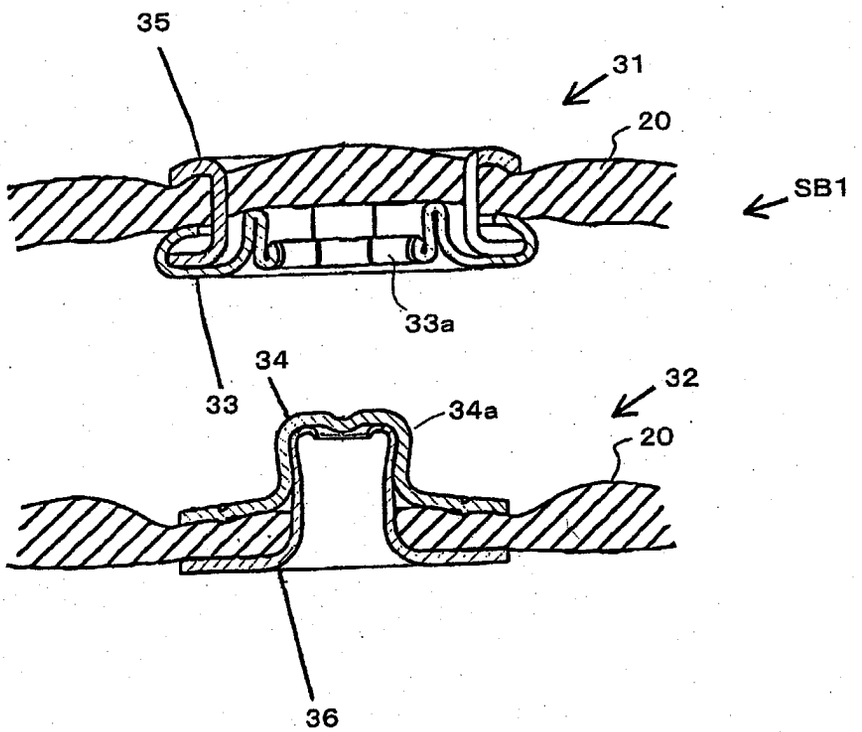


FIG. 12

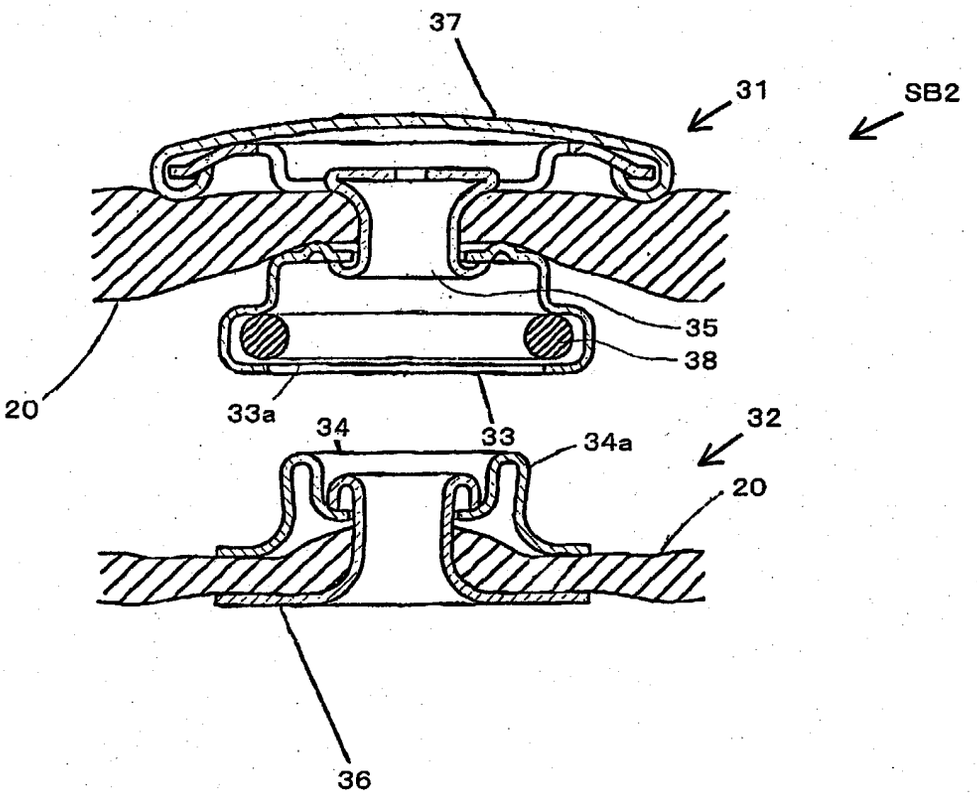
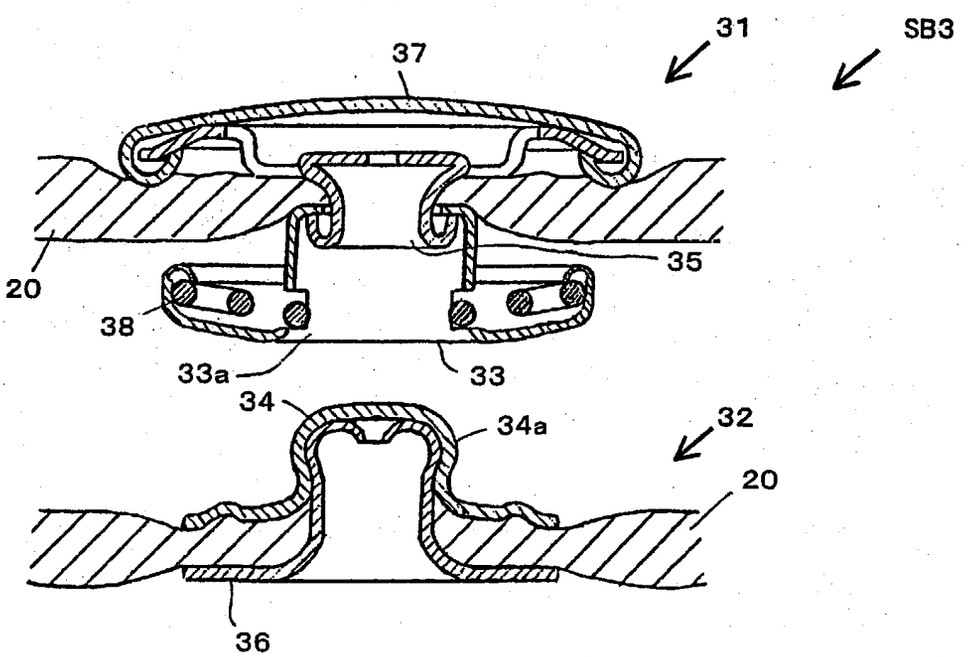

37
31
SB2
35
38
20
33a
34
33
34a
32
20
36

FIG. 13


31
SB3
37
35
20
38
33a
33
34
34a
32
20
36

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 25 1879

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 02, 28 February 1997 (1997-02-28) -& JP 08 269639 A (NISSHIN STEEL CO LTD), 15 October 1996 (1996-10-15)	1,4,5	C22C38/00 C22C38/58
Y	* abstract; tables 1,2 * * paragraphs [0001]-[0004] * ---	7-15	
X	PATENT ABSTRACTS OF JAPAN vol. 018, no. 052 (C-1158), 27 January 1994 (1994-01-27) -& JP 05 271768 A (NISSHIN STEEL CO LTD), 19 October 1993 (1993-10-19)	1,4-6	
A	* abstract; tables 1,2 * * paragraph [0010] * ---	7-15	
X,D	PATENT ABSTRACTS OF JAPAN vol. 011, no. 124 (C-416), 17 April 1987 (1987-04-17) -& JP 61 261463 A (NISSHIN STEEL CO LTD), 19 November 1986 (1986-11-19)	1,4-6	
A	* abstract; tables 1,2 * ---	7-15	TECHNICAL FIELDS SEARCHED (Int.Cl.7) C22C
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EP 03 25 1879

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