In the following explanation, the electrical steel sheet constituting the laminated core (the rotor core and the stator core) is referred to as a first electrical steel sheet as necessary. In this embodiment, the first electrical steel sheet is an example of a first soft magnetic sheet. As described above, this embodiment explains, as an example, the case where an outer edge of the first electrical steel sheet is punched out by the third punch 111c and the third die 121c.

[0033] Fig. 2D is a view illustrating an example of a region to be punched out by the third punch 111c and the third die 121c after punching by the first punch 111a and the first die 121a and punching by the second punch 111b and the second die 121b are performed. This embodiment explains, as an example, the case where an electrical steel sheet having the planar shape illustrated in Fig. 2D and having the same thickness as the electrical steel sheet M is an example of the separating sheet used when manufacturing the rotor core. In the following explanation, the electrical steel sheet constituting the separating sheet is referred to as a second electrical steel sheet as necessary. In this embodiment, the second electrical steel sheet is an example of a second soft magnetic sheet. As described above, this embodiment explains, as an example, the case where an outer edge of the second electrical steel sheet is punched out by the third

punch 111c and the third die 121c.

laminated body 130d, 130e of a number of the first electrical steel sheets corresponding to the height of one stator core, and a laminated body 130e, 130f subsequent to the laminated body 130d, 130e within the lower die 120 (lamination space), are separated using the second electrical steel sheet. The laminated body subsequent to the laminated body 130d is the laminated body 130e. The laminated body subsequent to the laminated body 130e is the laminated body 130f. As above, "subsequent" refers to being the next in the sequence of the laminated bodies within the lower die 120 (lamination space) when counted from the bottom. Incidentally, in Fig. 1, reference numerals and symbols are not assigned to all the laminated bodies for convenience of notation.

[0044] Fig. 1 illustrates, as an example, the case where separating sheets 131a, 131b, 131c, and 131d are arranged at positions between the two laminated bodies 130a and 130b, between the two laminated bodies 130b and 130c, and between the two laminated bodies 130d and 130e and between the two laminated bodies 130e and 130f respectively, which are adjacent to each other in an arrangement order within the lower die 120 (lamination space). This embodiment explains, as an example, the case where a separating material arranging step and a separating material arranging means are implemented by using punching by the second punch 111b and the second die 121b and punching by the third punch 111c and the third die

121c. Incidentally, a plurality of separating sheets

[0079] For example, in Fig. 3, the shortest distance between the outer-peripheral-side end of the separating sheet 131b and the first heating device 140a is a straight-line distance between a position 1310a of the outer-peripheral-side end of the separating sheet 131b and a position 1400a of the first heating device 140a. Further, for example, in Fig. 3, the shortest distance between the outer-peripheral-side end of the laminated body 130b and the first heating device 140a is a straight-line distance between a position 1300a of the outer-peripheral-side end of the laminated body 130b and the position 1400a of the first heating device 140a. Similarly, in Fig. 3, the shortest distance between the outer-peripheral-side end of the separating sheet 131b and the first heating device 140b is a straight-line distance between a position 1310b of the outer-peripheral-side end of the separating sheet 131b and a position 1400b of the first heating device 140b. Further, for example, in Fig. 3, the shortest distance between the outer-peripheral-side end of the laminated body 130b and the first heating device 140b is a straight-line distance between a position 1300b of the outer-peripheral-side end of the laminated body 130b and the position 1400b of the first heating device 140b. Incidentally, the positions 1400a and 1400b of the first heating devices 140a and 140b may be, for example, positions (for example, positions of the center of gravity) within a region from which a

the circumferential length of the outer peripheral edge of the one cutout portion 210a or 210b may be 1/2 or more, 1/3 or more, or 1/4 or more of the outer diameter of the first electrical steel sheets constituting the laminated bodies 130a to 130f. Further, the circumferential length of the outer peripheral edge of the one cutout portion 210a or 210b may be, for example, 30 mm or more, or 50 mm or more. Here, the circumferential length of the outer peripheral edge of the one cutout portion 210a or 210b is the circumferential length of a portion corresponding to the one cutout portion 210a or 210b of the outer peripheral edge of the second electrical steel sheet, assuming that the cutout portion 210a or 210b is not formed. In Fig. 3, the circumferential length of the outer peripheral edge of the one cutout portion 210a or 210b is the length of an arc that is a part of a circle in contact with the contact portions 310a to 310h, and is the length of one of the two arcs illustrated in regions not indicated by oblique lines.

[0082] Further, the length in a radial direction of the one cutout portion 210a or 210b is not limited. For example, it may be 1/10 or more, 1/8 or more, or 1/6 or more of the radius of the first electrical steel sheets constituting the laminated bodies 130a to 130f. Further, for example, the radial length of the one cutout portion 210a or 210b may be 4/5 or less, 3/5 or less, or 2/5 or less. Further, the

position facing one of the cutout portions 210a and 210b of the plurality of cutout portions 210a to 210b with a gap therebetween, and the other of the first heating devices 140a and 140b is installed at a position facing the other of the cutout portions 210a and 210b with a gap therebetween. The state where the first heating devices 140a, 140b and the cutout portions 210a, 210b have a gap therebetween respectively corresponds to a state where the first heating devices 140a, 140b and an imaginary line indicating the outer-peripheral-side end of the second electrical steel sheet, assuming that the cutout portions 210a, 210b are not formed, have a gap therebetween.

[0085] In this embodiment, the first heating devices 140a to 140b locally heat the regions of the first electrical steel sheets located above and below the cutout portions 210a to 210b of the second electrical steel sheet. Therefore, the adhesion performance of the insulating material is partially exhibited in the heated regions. On the other hand, the cutout portions 210a to 210b are formed in the second electrical steel sheet, and further, the first heating devices 140a to 140b locally heat the regions where the cutout portions 210a to 210b of the second

and 410b in the case where the outputs of the first heating devices 140a and 140b are 80% and 70% of their rated outputs, respectively.

[0095] Ta is a target temperature of the first electrical steel sheet after the temporary adhesion. th is the duration from the measurement timing of the pre-temporary adhesion start temperature Ts to the timing at which the temporary adhesion is completed (in this case, 0 on the horizontal axis of Fig. 4 represents the measurement timing of the pre-temporary adhesion start temperature Ts).

[0096] An example of the method of setting heating conditions in the first heating devices 140a to 140b by using the graphs 410a to 410b and measured values of the thermometer 150a is explained below.

First, the pre-temporary adhesion start temperature Ts is measured by the thermometer 150a. Next, the measured value of the pre-temporary adhesion start temperature Ts is subtracted from the target temperature Ta of the first electrical steel sheet. In the following explanation, the value obtained by this subtraction (Ta - Ts) is referred to as a temperature increase amount. Further, the duration from the measurement timing of the pre-temporary adhesion start temperature Ts to the timing at which the temporary adhesion is completed is calculated as an example of the duration for which heating by the first heating devices 140a to 140b is performed. In the following explanation, this

the first heating devices 140a to 140b as described above and the control of the operation of the first heating devices 140a to 140b are implemented by the control device 200. For example, the control device 200 sets the heating conditions by calculating the output of the first heating devices 140a to 140b based on the temperatures measured by the thermometers 150a to 150b, the graphs 410a to 410b illustrated in Fig. 4, and the target temperature Ta of the first electrical steel sheet. The control device 200 operates the first heating devices 140a to 140b such that the output of the first heating devices 140a to 140b becomes the output calculated in this manner. Further, the control device 200 operates the first heating devices 140c to 140d in the same manner as the first heating devices 140a to 140b. Incidentally, the outputs of the first heating devices 140a to 140d may be updated. For example, the outputs of the first heating devices 140a to 140d may be updated when the attribute of the laminated bodies 130a to 130c changes. The attributes of the laminated body include, for example, at least one of the type of the first electrical steel sheet, the size of the first electrical steel sheet (for example, at least one of the outer diameter and the thickness), the type of the insulating material, and the thickness of the insulating material.

As described above, this embodiment explains, as an example, the case where a heating condition

do not have to be formed in the second soft magnetic sheet. For example, the planar shape of the second soft magnetic sheet may be the shape illustrated in Fig. 2E. Even when the second soft magnetic sheet illustrated in Fig. 2E is used as a separating sheet, the distances between the outer-peripheral-side ends of the separating sheet and the first heating devices 140a to 140b within the lamination space are longer than the distances between the outer-peripheral-side ends of the laminated body 130b and the first heating devices 140a to 140b.

[0102] Further, the separating sheet does not have to be the electrical steel sheet (second electrical steel sheet) punched out from the electrical steel sheet M being the base material. In this case, the insulating material that exhibits adhesion performance through heating does not have to be formed on the sheet surface of the separating sheet. In this case, an insulating material that does not exhibit adhesion performance at the temperature at which the insulating material formed on the electrical steel sheet M, which is the base material, exhibits adhesion performance may be formed on the sheet surface of the separating sheet. Further, the insulating material that exhibits adhesion performance through heating may be formed

130a to 130c (first electrical steel sheets) and the separating sheets 131a to 131b (second electrical steel sheets). That is, when viewed along the center line 0, the outer edge of the discharge space is set to be located outside the outer edge of the lamination space.

[0105] This explains, as an example, the case where each of the laminated bodies 130a to 130c and each of the laminated bodies 130d to 130f, on which the temporary adhesion has been completed, are discharged downward below the lower die 120 via such a discharge space and placed on receiving tables 160a and 160b respectively. At this time, the laminated bodies 130a to 130c and 130d to 130f may fall by their own weight, or may be taken out by being gripped by a robot arm or the like. The difference between the configuration after the laminated bodies 130a to 130c are discharged from the lower die 120 and the configuration after the laminated bodies 130d to 130f are discharged from the lower die 120 lies in the difference in the shape and size of the regions punched out from the electrical steel sheet M. Therefore, in the following, explanations of specific examples of the configuration after the laminated bodies 130d to 130f are discharged from the lower die 120 are omitted.

[0106] This embodiment explains, as an example, the case where, when the laminated bodies 130a to 130c are discharged, the separating sheets 131a and 131b

the first electrical steel sheets located on and under the separating sheet 131a is 0 (zero) or low, the worker can collect the separating sheet 131a so as to prevent the plurality of first electrical steel sheets constituting the laminated body 130a from separating (preferably to prevent positional displacement thereof). Further, when the laminated body 130a is discharged from the lower die 120, the separating sheet 131a on the laminated body 130a may separate therefrom spontaneously. In this case, the worker collects the separating sheet 131a that has separated from the laminated body 130a. Incidentally, the collection of the separating sheet 131a may be performed by an apparatus.

[0108] As described above, this embodiment explains, as an example, the case where a separating step and a separating means are implemented by causing the laminated bodies 130a to 130c and 130d to 130f to be discharged downward below the lower die 120 via the discharge space.

[0109] Fig. 5 is a view explaining an example of a step performed on the laminated body 130a discharged from the lower die 120.

In Fig. 5, this embodiment explains, as an example, the case where the laminated body 130a placed on the receiving table 160a is sent to a conveying device 520 by an extrusion device 510. In Fig. 5, the white arrow line attached beside the extrusion device 510 represents this. The conveying

exhibited by the insulating material formed on the sheet surfaces of the first electrical steel sheets during the temporary adhesion. This embodiment is configured as above, and thereby, separation of the laminated bodies 130a to 130c can be easily and reliably achieved. Incidentally, the fact that the separating material is not limited to the separating sheet will be described later in a third embodiment.

[0118] Further, in this embodiment, the distances between the first heating devices 140a to 140b and the outer-peripheral-side ends of the separating sheets 131a to 131b, which exhibit adhesion performance through heating, are longer than the distances between the first heating devices 140a to 140b and the outer-peripheral-side ends of the laminated bodies 130a to 130c. Therefore, it is possible to inhibit the separating sheets 131a to 131b from exhibiting adhesion performance through heating. Accordingly, the laminated bodies 130a to 130c can be reliably separated by the separating sheets 131a to 131b.

[0119] Further, in this embodiment, the separating sheets 131a to 131b are the second electrical steel sheets punched out from the electrical steel sheet M by the press apparatus 100. Further, in this embodiment, the second soft magnetic sheets (separating sheets 131a and 131b) are arranged at positions between the two laminated bodies 130a and 130b and between the two laminated bodies 130b and

130c within the lower die 120 respectively. Therefore, arranging the second soft magnetic sheets (separating sheets 131a and 131b) at the positions between the two laminated bodies 130a and 130b and between the two laminated bodies 130b and 130c respectively can be achieved with a simple configuration. Thus, it is preferable that the separating sheets 131a to 131b and the first electrical steel sheets should be punched out from the same base material (electrical steel sheet M in this embodiment). However, this embodiment is not necessarily required to be configured in this manner. For example, the separating sheet may be one that exhibits adhesion performance through heating, or may be one that does not exhibit adhesion performance regardless of the presence or absence of heating. In this case, a mechanism for arranging a separating sheet at positions between the two laminated bodies 130a and 130b and between the two laminated bodies 130b and 130c may be configured.

[0120] Further, in this embodiment, the plurality of cutout portions 210a to 210b are formed in the outer-peripheral-side ends of the second soft magnetic sheets (separating sheets 131a and 131b). Further, in this embodiment, the second soft magnetic sheet is arranged such that at least partial regions of the cutout portions 210a to 210b are located closer to the center line 0 side than the outer-peripheral-side ends of the two laminated bodies 130a and 130b or

130b and 130c arranged above and below the second soft magnetic sheet (separating sheet 131a, 131b) in which the cutout portions 210a to 210b are formed. Therefore, a space can be formed between the two laminated bodies 130a and 130b and between the two laminated bodies 130b and 130c. Accordingly, for example, by heating the regions above and below this space, it is possible to inhibit the insulating material formed on the sheet surfaces of the second soft magnetic sheets (separating sheets 131a and 131b) from exhibiting adhesion performance. Therefore, the separation of the laminated bodies 130a to 130c can be performed more reliably.

[0121] Further, in this embodiment, one of the plurality of first heating devices 140a to 140b is installed at a position facing one of the plurality of cutout portions 210a to 210b with a gap therebetween. Therefore, it is possible to more reliably inhibit the separating sheets 131a to 131b from exhibiting adhesion performance.

[0122] Further, in this embodiment, during the temporary adhesion, the temperature of at least a partial region of the regions located above and below the cutout portions 210a to 210b of the regions of the first electrical steel sheets is raised by 25°C or more relative to the minimum temperature of the regions of the first electrical steel sheets not located above and below the cutout portions 210a to 210b. Therefore, the adhesion strength in the former

positive direction side of the x-axis) than the region assumed as the supply region (injection region) of the volatile material by the nozzle 610. Further, the supply of the volatile material from the nozzle 610 may be stopped immediately after the volatile material supply target region moves further downstream than the region assumed as the supply region (injection region) of the volatile material by the nozzle 610.

[0130] This embodiment explains, as an example, the case where control of the operation of the nozzle 610 as described above is implemented by the control device 200. The control device 200 may control the operation of the nozzle 610, for example, based on a conveyance speed of the electrical steel sheet M and a punching pattern.

[0131] As described above, this embodiment explains, as an example, the case where the separating material is achieved by using the separating sheets 131a to 131d and volatile materials 620a to 620h. Further, this embodiment explains, as an example, the case where a separating material arranging step and the separating material arranging means are implemented by using punching by the second punch 111b and the second die 121b, punching by the third punch 111c and the third die 121c, and supply of the volatile material by the nozzle 610.

[0132] Incidentally, the volatile material may be supplied onto a region of the rear surface of the

for manufacturing the rotor core. Further, the fifth punch 111e and the fifth die 121e are used to manufacture the separating sheets 131c to 131d used for manufacturing the stator core. Therefore, this embodiment explains, as an example, the case where the separating sheets are not manufactured by the press apparatus 700.

[0138] This embodiment explains, as an example, the case where control of the operation of the press apparatus 700 as described above is implemented by the control device 200. The control device 200 selects, for example, a punch to operate from among the first punch 111a, the third punch 111c, the fourth punch 111d, and the sixth punch 111f based on a conveyance speed of the electrical steel sheet M and a punching pattern, and operates the selected punch.

[0139] Further, in Fig. 7, this embodiment explains, as an example, the case where the nozzle 610 is installed upstream of the press apparatus 700, similarly to the second embodiment. The nozzle 610 supplies a volatile material, which volatilizes by heating and does not react with an insulating material by heating, onto the sheet surface of the electrical steel sheet M that has not been punched out by the press apparatus 700. The volatile material may be the one explained in the second embodiment.

[0140] This embodiment explains, as an example, the

case where the separating material arranging step and the separating material arranging means are implemented by the supply of the volatile material by the nozzle 610.

[0142] Incidentally, the volatile material supply target region may be a region of the sheet surface of the electrical steel sheet M, including regions that constitute lower surfaces of the laminated bodies 130a to 130f. In this case, a nozzle that supplies the volatile material onto a region of the rear surface of the electrical steel sheet M is installed. Further, the volatile material supply target region may be both the regions constituting the upper surfaces of the laminated bodies 130a to 130f and the regions constituting the lower surfaces of the laminated bodies 130a to 130f.

[0143] Although it is necessary to install the nozzle 610 in this embodiment, the second die 121b and the fifth die 121e, and a configuration necessary for installing the second die 121b and the fifth die 121e are not required. Therefore, man-hours (process time) in the press apparatus 700 can be shortened. Further, the equipment cost can be reduced. Therefore, for example, when the priority is placed on these matters, the configuration of this embodiment may be adopted.

[0144] (Examples)

Next, examples are explained. Incidentally, the present disclosure is not limited to the following

examples. That is, various conditions described in

[0153] Whether or not temporary adhesion was performed was confirmed for the same number of laminated bodies as in the first example. As a result, it was confirmed that the temporary adhesion was performed in all of the laminated bodies. Further, whether or not permanent adhesion was performed was confirmed for the same number of laminated cores as in the first example. As a result, it was confirmed that the permanent adhesion was performed in all of the laminated cores.

[0154]

((Third example))

In this example, rotor cores and stator cores were manufactured by the method explained in the third embodiment. Incidentally, the method of the third embodiment is a method in which the volatile material is used as the separating material without using the separating sheet.

In this example, a press apparatus and a nozzle having functions similar to those of the press apparatus 700 and the nozzle 610 illustrated in Fig. 7 were used.

The same volatile material (press oil) as in the second example was supplied (injected) onto a region of the surface of the non-oriented electrical steel sheet, including the region that constitutes the upper surface of the laminated body.

[0155] Laminated cores for the rotor core and laminated cores for the stator core were each

manufactured under the same manufacturing conditions as in the first example, except that the punches and dies (the second punch, the fifth punch, the second die, and the fifth die) for manufacturing the separating sheet were not used.

[0156] Whether or not temporary adhesion was performed was confirmed for the same number of laminated bodies as in the first example. As a result, it was confirmed that the temporary adhesion was performed in all of the laminated bodies. Further, whether or not permanent adhesion was performed was confirmed for the same number of laminated cores as in the first example. As a result, it was confirmed that the permanent adhesion was performed in all of the laminated cores.

[0157] (Other embodiments)

Incidentally, the embodiments and the examples of the present disclosure explained above merely illustrate concrete examples of implementing the present disclosure, and the technical scope of the present disclosure is not to be construed in a restrictive manner by these embodiments. That is, the present disclosure may be implemented in various forms without departing from the technical spirit or main features thereof.

INDUSTRIAL APPLICABILITY

[0158] The present disclosure can be utilized for manufacturing a laminated core, for example.

CLAIMS

[Claim 1] A laminated core manufacturing method being a laminated core manufacturing method for manufacturing a laminated core for a rotary electric machine using a soft magnetic sheet as a base material, the method comprising:

a punching step of sequentially punching out first soft magnetic sheets from the base material using a die assembly;

a temporary adhesion step of heating a plurality of the first soft magnetic sheets punched out in the punching step within a lower die of the die assembly, thereby causing the plurality of first soft magnetic sheets to temporarily adhere to each other;

a separating step of separating a laminated body from a laminated body subsequent to the laminated body after the temporary adhesion step; and

a permanent adhesion step of heating the plurality of first soft magnetic sheets constituting the laminated body outside the die assembly, thereby causing the plurality of first soft magnetic sheets to permanently adhere to each other, wherein

an insulating material that exhibits adhesion performance through heating is formed on at least one of two sheet surfaces of the soft magnetic sheet,

within the lower die, the plurality of first soft magnetic sheets move downward in response to punching in the punching step while at least partial regions of outer-peripheral-side ends thereof are supported,

and

the laminated body is configured by laminating a number of the first soft magnetic sheets corresponding to a height of the one laminated core.

[Claim 2] The laminated core manufacturing method according to claim 1, further comprising:

a separating material arranging step of arranging a separating material at a position between the laminated body and the laminated body subsequent to the laminated body within the lower die before the temporary adhesion step, wherein

the separating material does not exhibit adhesion performance in the temporary adhesion step, or exhibits adhesion performance in the temporary adhesion step that is lower than adhesion performance exhibited by the insulating material in the temporary adhesion step.

[Claim 3] The laminated core manufacturing method according to claim 2, wherein

the separating material includes a separating sheet.

[Claim 4] The laminated core manufacturing method according to claim 3, wherein

the separating sheet exhibits adhesion performance through heating, and

a distance between an outer-peripheral-side end of the separating sheet and a first heating device used for heating in the temporary adhesion step is longer than a distance between an outer-peripheral-

side end of the laminated body and the first heating device.

[Claim 5] The laminated core manufacturing method according to claim 3 or 4, wherein

the separating sheet is a second soft magnetic sheet punched out from the base material by the die assembly, and

the separating material arranging step includes arranging the second soft magnetic sheet at a position between the two laminated bodies within the lower die.

[Claim 6] The laminated core manufacturing method according to claim 5, wherein

one or more cutout portions are formed in an outer-peripheral-side end of the second soft magnetic sheet, and

the separating material arranging step includes arranging the second soft magnetic sheet such that at least a partial region of the cutout portion is located closer to a center line side of the two laminated bodies than outer-peripheral-side ends of the two laminated bodies arranged above and below the second soft magnetic sheet in which the cutout portion is formed.

[Claim 7] The laminated core manufacturing method according to claim 6, wherein

there are a plurality of the cutout portions,

there are a plurality of first heating devices used for heating in the temporary adhesion step, and

one first heating device of the plurality of first heating devices is installed at a position facing one cutout portion of the plurality of cutout portions with a gap therebetween.

[Claim 8] The laminated core manufacturing method according to claim 6 or 7, wherein

in the temporary adhesion step, a temperature of at least a partial region of regions of the first soft magnetic sheets located above and below the cutout portion is raised by 25°C or more relative to a minimum temperature of the regions of the first soft magnetic sheets not located above and below the cutout portion.

[Claim 9] The laminated core manufacturing method according to any one of claims 6 to 8, wherein

there are a plurality of the cutout portions, and

when viewed along a center line of the second soft magnetic sheet, the plurality of cutout portions include two cutout portions formed at positions sandwiching the center line.

[Claim 10] The laminated core manufacturing method according to any one of claims 6 to 9, wherein

the separating material further includes a volatile material that volatilizes by heating and does not react with the insulating material by heating,

the separating material arranging step includes arranging the volatile material in a region of at least one of two sheet surfaces of the soft magnetic

sheet, and

the region where the volatile material is arranged is at least one of a region including a region to be punched out as the second soft magnetic sheet and a region including, out of a region to be punched out as the first soft magnetic sheet, a region facing the second soft magnetic sheet.

[Claim 11] The laminated core manufacturing method according to claim 10, wherein

the volatile material is oil.

[Claim 12] The laminated core manufacturing method according to claim 2, wherein

the separating material includes a volatile material that volatilizes by heating and does not react with the insulating material by heating,

the separating material arranging step includes arranging the volatile material in a region of at least one of two sheet surfaces of the soft magnetic sheet, and

the region where the volatile material is arranged is a region including a region that constitutes at least one of an upper surface and a lower surface of the laminated body, out of a region to be punched out as the first soft magnetic sheet.

[Claim 13] The laminated core manufacturing method according to claim 12, wherein

the volatile material is oil.

[Claim 14] The laminated core manufacturing method according to any one of claims 1 to 13, wherein

as a first heating device used for heating in the temporary adhesion step, at least two first heating devices installed at positions sandwiching the laminated body when viewed along a center line of the laminated body are included.

[Claim 15] The laminated core manufacturing method according to any one of claims 1 to 14, wherein

a first heating device used for heating in the temporary adhesion step includes a near-infrared heater.

[Claim 16] The laminated core manufacturing method according to claim 15, wherein

the near-infrared heater concentrates near-infrared rays linearly along a lamination direction of the laminated body.

[Claim 17] The laminated core manufacturing method according to any one of claims 1 to 16, further comprising:

a heating condition setting step of setting heating conditions in the temporary adhesion step based on a duration for which heating in the temporary adhesion step is performed, a target temperature of the laminated body after the temporary adhesion is completed, and a temperature of the first soft magnetic sheet before heating in the temporary adhesion step is completed.

[Claim 18] A laminated core manufacturing apparatus being a laminated core manufacturing apparatus that manufactures a laminated core for a rotary electric

machine using a soft magnetic sheet as a base material, the apparatus comprising:

a die assembly for sequentially punching out first soft magnetic sheets from the base material;

a first heating device for performing local heating to cause a plurality of the first soft magnetic sheets punched out by the die assembly to temporarily adhere to each other within a lower die of the die assembly;

a separating means for separating a laminated body from a laminated body subsequent to the laminated body after heating by the first heating device is performed; and

a second heating device for performing heating to cause the plurality of first soft magnetic sheets constituting the laminated body to permanently adhere to each other outside the die assembly, wherein

an insulating material that exhibits adhesion performance through heating is formed on at least one of two sheet surfaces of the soft magnetic sheet,

within the lower die, the plurality of first soft magnetic sheets move downward in response to punching by the die assembly while at least partial regions of outer-peripheral-side ends thereof are supported, and

the laminated body is configured by laminating a number of the first soft magnetic sheets corresponding to a height of the one laminated core.

[Claim 19] The laminated core manufacturing apparatus according to claim 18, further comprising:

a separating material arranging means for arranging a separating material at a position between the laminated body and the laminated body subsequent to the laminated body within the lower die before heating by the first heating device is performed, wherein

the separating material does not exhibit adhesion performance through local heating by the first heating device, or exhibits adhesion performance through local heating by the first heating device that is lower than adhesion performance exhibited by the insulating material through heating by the first heating device.

[Claim 20] The laminated core manufacturing apparatus according to claim 19, wherein

the separating material includes a separating sheet.

[Claim 21] The laminated core manufacturing apparatus according to claim 20, wherein

the separating sheet exhibits adhesion performance through heating, and

a distance between an outer-peripheral-side end of the separating sheet and the first heating device is longer than a distance between an outer-peripheral-side end of the laminated body and the first heating device.

[Claim 22] The laminated core manufacturing apparatus according to claim 20 or 21, wherein

the separating sheet is a second soft magnetic

sheet punched out from the base material by the die assembly, and

the separating material arranging means arranges the second soft magnetic sheet at a position between the two laminated bodies within the lower die.

[Claim 23] The laminated core manufacturing apparatus according to claim 22, wherein

one or more cutout portions are formed in an outer-peripheral-side end of the second soft magnetic sheet, and

the separating material arranging means arranges the second soft magnetic sheet such that at least a partial region of the cutout portion is located closer to a center line side of the two laminated bodies than outer-peripheral-side ends of the two laminated bodies arranged above and below the second soft magnetic sheet in which the cutout portion is formed.

[Claim 24] The laminated core manufacturing apparatus according to claim 23, wherein

there are a plurality of first heating devices as the first heating device,

there are a plurality of the cutout portions, and

one first heating device of the plurality of first heating devices is installed at a position facing one cutout portion of the plurality of cutout portions with a gap therebetween.

[Claim 25] The laminated core manufacturing apparatus according to claim 23 or 24, wherein

there are a plurality of the cutout portions, and

when viewed along a center line of the second soft magnetic sheet, the plurality of cutout portions include two cutout portions formed at positions sandwiching the center line.

[Claim 26] The laminated core manufacturing apparatus according to any one of claims 23 to 25, wherein

the separating material further includes a volatile material that volatilizes by heating and does not react with the insulating material by heating,

the separating material arranging means arranges the volatile material in a region of at least one of two sheet surfaces of the soft magnetic sheet, and

the region where the volatile material is arranged is at least one of a region including a region to be punched out as the second soft magnetic sheet and a region including, out of a region to be punched out as the first soft magnetic sheet, a region facing the second soft magnetic sheet.

[Claim 27] The laminated core manufacturing apparatus according to claim 26, wherein

the volatile material is oil.

[Claim 28] The laminated core manufacturing apparatus according to claim 19, wherein

the separating material includes a volatile material that volatilizes by heating and does not react with the insulating material by heating,

the separating material arranging means arranges the volatile material in a region of at least one of two sheet surfaces of the soft magnetic sheet, and

the region where the volatile material is arranged is a region including a region that constitutes at least one of an upper surface and a lower surface of the laminated body, out of a region to be punched out as the first soft magnetic sheet.

[Claim 29] The laminated core manufacturing apparatus according to claim 28, wherein

the volatile material is oil.

[Claim 30] The laminated core manufacturing apparatus according to any one of claims 18 to 29, further comprising:

as the first heating device, at least two first heating devices installed at positions sandwiching the laminated body when viewed along a center line of the laminated body.

[Claim 31] The laminated core manufacturing apparatus according to any one of claims 18 to 30, wherein

the first heating device includes a near-infrared heater.

[Claim 32] The laminated core manufacturing apparatus according to claim 31, wherein

the near-infrared heater concentrates near-infrared rays linearly along a lamination direction of the laminated body.

[Claim 33] The laminated core manufacturing

apparatus according to any one of claims 18 to 32, further comprising:

a heating condition setting means for setting heating conditions in the first heating device based on a speed at which the first soft magnetic sheet is moved downward within the lower die, a target temperature of the laminated body after the temporary adhesion is completed, and a temperature of the first soft magnetic sheet in a state where heating by the first heating device is not performed.