feeder 40 unwinds and feeds out the strip-shaped steel sheet M from a wound hoop material F. More specifically, the feeder 40 includes a hoop feeding device 42. The strip-shaped steel sheet M is unwound and fed out from the hoop material F by this hoop feeding device 42. The hoop feeding device 42 is provided, for example, with a pair of clamping rolls 44. The strip-shaped steel sheet M is fed out while being gripped from both sides by the pair of clamping rolls 44. Further, the strip-shaped steel sheet M is fed from the feeder 40 to the oil application part 50, the pressing part 60, the adhesive application part 70, and the lamination part 80. The direction in which this strip-shaped steel sheet M is fed out is called the feeding direction, and is indicated by the symbol C in the drawing. Here, in the following, "downstream" and "downstream side" refer to downstream and the downstream side in the feeding direction of the strip-shaped steel sheet M. Further, when reference is made to "upstream" or an "upstream side", this indicates upstream or the upstream side in the feeding direction of the strip-shaped steel sheet M.

[0014] The strip-shaped steel sheet M is, for example, an electromagnetic steel sheet. As the electromagnetic steel sheet, a known electromagnetic steel sheet may be used. For example, a non-oriented electromagnetic steel sheet may be used, or a grain-oriented electromagnetic steel sheet may be used, as the electromagnetic steel sheet. As the non-oriented electromagnetic steel sheet, the non-oriented electrical steel strip of JIS C2552:2014 may be used. As the grain-oriented electromagnetic steel sheet, the grain-oriented electrical steel strip of JIS C2553:2012 may be used. Further, both sides of the strip-shaped steel sheet M may be covered with an insulation coating.

[0015] The oil application part 50 is the portion of the manufacturing apparatus 30 that applies oil to the strip-shaped steel sheet M that will be the material for the core sheets 22. The oil application part 50 is provided, for example, with plural nozzles 52 that apply oil by spraying the oil toward one surface of the strip-shaped steel sheet M. Oil is supplied to each nozzle 52 from an oil supply source (not shown). Here, in the oil application part 50 of the present embodiment, processing oil for pressing is applied to the strip-shaped steel sheet M. Further, in the present embodiment, each nozzle 52 applies the oil in a downward orientation. Therefore, oil is applied to the upper surface of the strip-shaped steel sheet M. Furthermore, the oil is applied across the entire width of the strip-shaped steel sheet M.

[0016] The pressing part 60 is the portion of the manufacturing apparatus 30 that performs punch processing on the strip-shaped steel sheet M. This pressing part 60 is provided with a first-stage punching part 62 and a second-stage punching part 64.

[0017] The first-stage punching part 62 is located downstream of the oil application part 50

withdrawn from the female die 64b, and the strip-shaped steel sheet M is fed downstream.

[0025] Plural stator tooth parts 26 are formed at the strip-shaped steel sheet M by the first-stage punching part 62 and the second-stage punching part 64. Here, the plural tooth parts 26 are portions at which windings configuring the stator are formed as concentrated windings or distributed windings.

[0026] The adhesive application part 70 is a portion of the manufacturing apparatus 30 that has the function of applying an adhesive to one surface (lower surface) of the strip-shaped steel sheet M. The adhesive application part 70 is provided with an adhesive supply device 72, a supply channel 74, an application head 76, a steel sheet holder 71, and a discharge mechanism 110.

[0027] The adhesive supply device 72 is a device that supplies adhesive from an adhesive container (not shown) that stores adhesive, to the application head 76. For example, an anaerobic adhesive is used as the adhesive that bonds together the core sheets 22. As an anaerobic adhesive, for example, "ARONTITE" (registered trademark) manufactured by Toagosei Co., Ltd. may be used. Further, the adhesive supply device 72 may be attached to the fixed mold 90, or it may be installed in a separate location from the fixed mold 90. Similarly, the adhesive container may be attached to the fixed mold 90, or it may be installed in a separate location from the fixed mold 90.

[0028] The supply channel 74 is a flow path for supplying adhesive from the adhesive container to the application head 76. The member configuring the supply channel 74 is configured, for example, by a non-metallic material. Specifically, the supply channel 74 is a pipe configured by a resin material; that is, a resin pipe.

[0029] The application head 76 is attached to the leading end of the supply channel 74 and is the portion that applies the adhesive to the lower surface of the strip-shaped steel sheet M. The application head 76 is accommodated in a housing part 91 provided on the upper surface of the fixed mold 90, in a state in which movement thereof in a direction intersecting a mold opening and closing direction is restricted. Specifically, an outer peripheral surface 76a of the application head 76 contacts a side wall surface 91a configuring the housing part 91, thereby restricting movement of the application head 76 in a direction intersecting the mold opening and closing direction. The housing part 91 is an inner portion of a bottomed cylindrical holder 100. The holder 100 is fitted into a recess part 102 of an elevated part 94 provided on the upper surface of the fixed mold 90. The application head 76 is fitted into the holder 100, and its outer peripheral surface 76a contacts the inner wall surface of the holder 100 (the side wall surface 91a of the housing part 91). Further, the application head 76 is supported by a support

part (not shown) provided at the holder 100. Here, the application head 76 of the present embodiment is an example of an application part in the present disclosure. Further, in Figs. 5 and 6, the arrow A indicates the flow of the adhesive.

[0030] As shown in Fig. 3, the application head 76 has plural discharge ports 77 for dispensing adhesive. As shown in Fig. 4, each discharge port 77 faces upward. That is, each discharge port 77 faces the lower surface of the strip-shaped steel sheet M at a time of manufacturing the laminated core 20.

[0031] Further, as shown in Fig. 5, the application head 76 has a storage part 78 for storing adhesive supplied from an external source. Specifically, the resin pipe configuring the supply channel 74 is connected to a connection port of the application head 76, and the supply channel 74 is communicated with the storage part 78. The storage part 78 is communicated with each discharge port 77. Therefore, the adhesive sent through the supply channel 74 is discharged from each discharge port 77 via the storage part 78.

[0032] Further, since the storage part 78 is the portion that stores the adhesive, it is formed solely with a portion having a larger diameter than the discharge port 77.

[0033] The application head 76 of the present embodiment has an annular protrusion 79 on its surface (the top surface in Fig. 4) that protrudes from the surface. This protrusion 79 has, for example, an annular shape. The plural discharge ports 77 are formed on the top surface 79a of this protrusion 79, spaced apart in the circumferential direction of the protrusion 79.

[0034] Further, in the present embodiment, the entire application head 76 is configured by a non-metallic material.

[0035] The non-metallic material configuring the application head 76 is, for example, a resin material. Specifically, it is an organic resin material. Further, in this disclosure, the punching process is performed continuously. Therefore, the application head 76 is required to have sufficient heat resistance to avoid deformation at 120°C in order to obtain adequate mechanical strength. As such resin materials, it is preferable to use polyacetal resin, polyethylene resin, polypropylene resin, polyether ether ketone resin, or polytetrafluoroethylene resin.

[0036] The discharge mechanism 110, as shown in Fig. 7, is a mechanism that discharges adhesive that is surplus to application—that is, excess adhesive (indicated by the dashed arrows in Fig. 7)—from the application head 76. This discharge mechanism 110 includes a first discharge channel 112 and a second discharge channel 114.

[0037] The first discharge channel 112 is a flow path that discharges excess adhesive from the application head 76. The first discharge channel 112 is provided at the application head

periphery punching female die 84, core sheets 22 with their outer periphery punched out are obtained from the strip-shaped steel sheet M.

[0048] The core sheets 22 punched out from the strip-shaped steel sheet M are laminated onto the upper surface of other core sheets 22 that have been punched out previously and laminated and bonded inside the outer periphery punching female die 84. Further, pressure from the outer periphery punching male die 82 and heat from the heater 88 are applied. At this time, the pressure applied to the core sheet 22 from the outer periphery punching male die 82 is maintained at a constant level by the biasing force of the spring 86. Furthermore, the spring 86 may be omitted by appropriately setting the height position of the male die 82.

[0049] As a result, the core sheet 22 currently punched out is bonded to the upper surface of the core sheet 22 previously punched out. By repeating these respective processes of periphery punching, pressurizing, and heating a number of times equal to the number of layers of the respective core sheets 22, a laminated core 20 is formed inside the outer periphery punching female die 84. A fixed laminated core 20 is transferred to the lower side of the mold through a through hole (not shown in Fig. 2) formed in the fixed mold 90 and ejected from the mold.

[0050] As shown in Fig. 2, the female die 62b, the female die 64b, the application head 76, the outer periphery punching female die 84, and the heater 88 are fixed on the fixed mold 90.

[0051] The male die 62a, the male die 64a, the steel sheet holder 71, and the outer periphery punching male die 82 are fixed to the lower surface of the movable mold 92.

[0052] When the strip-shaped steel sheet M is fed toward the downstream side and paused, the movable mold 92 is brought closer to the fixed mold 90—that is, lowered—whereby punching out of the outer periphery of the core sheet 22, lamination and bonding, applying adhesive to the position of the core sheet 22 that will next have its outer periphery punched out at the strip-shaped steel sheet M, the second punching process at the position at which the adhesive will be applied next at the strip-shaped steel sheet M, and the first punching process at the position at which the second punching operation will be performed next at the strip-shaped steel sheet M, are performed simultaneously.

[0053] Next, the movable mold 92 is raised and stowed above the strip-shaped steel sheet M, after which the strip-shaped steel sheet M is fed only a predetermined distance toward the downstream side again and then paused again. In this state, the movable mold 92 is lowered, and processing continues at each position. In this way, the laminated core 20 is manufactured by repeatedly feeding the strip-shaped steel sheet M intermittently and moving the movable mold 92 up and down during pauses.

application part using a discharge mechanism provided at the lower mold; and

laminating a core, which has been punched out from the strip-shaped steel sheet by pressing by the upper mold and the lower mold, while bonding the core sheet with the adhesive.

[0088] Further, the disclosure of Japanese Patent Application No. 2023-195402 filed on November 16, 2023, is incorporated herein by reference in its entirety.

[0089] All publications, patent applications and technical standards mentioned herein are incorporated herein by reference to the same extent as if each individual publication, patent application and technical standard were specifically and individually indicated to be incorporated by reference.

Description of Reference Numerals

[0090]

20	LAMINATED CORE
22	CORE SHEET
30	MANUFACTURING APPARATUS
40	FEEDER
50	OIL APPLICATION PART
60	PRESSING PART
62	FIRST-STAGE PUNCHING PART
64	SECOND-STAGE PUNCHING PART
70	ADHESIVE APPLICATION PART
72	ADHESIVE SUPPLY DEVICE
74	SUPPLY CHANNEL
76	APPLICATION HEAD
80	LAMINATION PART
90	FIXED MOLD
92	MOVABLE MOLD
91	HOUSING PART
110	DISCHARGE MECHANISM
112	FIRST DISCHARGE CHANNEL
114	SECOND DISCHARGE CHANNEL
F	HOOP MATERIAL
M	STRIP-SHAPED STEEL SHEET

CLAIMS

Claim 1. A laminated core manufacturing apparatus, comprising:

an upper mold and a lower mold that press and punch out a core sheet from a strip-shaped steel sheet that is fed downstream;

a lamination part that is provided at the lower mold and that laminates the punched-out core;

an application part that is provided further toward an upstream side of the lower mold than the lamination part in a feeding direction of the strip-shaped steel sheet, that applies an adhesive to a lower surface of the strip-shaped steel sheet, that contacts a restriction part provided at the lower mold, and that is restricted from movement in a direction intersecting a mold opening and closing direction; and

a discharge mechanism that is provided at the lower mold and that discharges adhesive surplus to application from the application part.

Claim 2. The laminated core manufacturing apparatus of claim 1, wherein the discharge mechanism comprises a first discharge channel that is provided at the application part and discharges the adhesive surplus to application from the application part, and a second discharge channel that is provided at the lower mold, that is communicated with the first discharge channel and that discharges the adhesive surplus to application to an external part.

Claim 3. The laminated core manufacturing apparatus of claim 2, wherein:

the application part has an application head accommodated in a housing part provided at the lower mold, and

the restriction part includes a side wall surface of the housing part that contacts an outer peripheral surface of the application head.

Claim 4. The laminated core manufacturing apparatus of claim 3, wherein the second discharge channel extends from a bottom surface of the housing part to an exterior of the lower mold.

Claim 5. The laminated core manufacturing apparatus of any one of claim 2 to claim 4, wherein a portion configuring the first discharge channel in the application part is configured by a non-metallic material.

Claim 6. The laminated core manufacturing apparatus of any one of claim 2 to claim 5, wherein a member configuring the second discharge channel is configured by a non-metallic material.

Claim 7. The laminated core manufacturing apparatus of any one of claim 3, claim 4, claim 5 as dependent from claim 3, and claim 6 as dependent from claim 3, wherein an entirety of the application head is configured by a non-metallic material.

Claim 8. The laminated core manufacturing apparatus of claim 5 or claim 6, wherein the non-metallic material is a resin material.

Claim 9. The laminated core manufacturing apparatus of claim 8, wherein the resin material is polyacetal resin, polyethylene resin, polypropylene resin, polyether ether ketone resin, or polytetrafluoroethylene resin.

Claim 10. The laminated core manufacturing apparatus of claim 2, wherein a portion configuring the first discharge channel in the application part is configured by a metal material.

Claim 11. A method of manufacturing a laminated core, the method comprising:

feeding a strip-shaped steel sheet toward an upper mold and a lower mold that press the strip-shaped steel sheet and punch out a core sheet;

while applying an adhesive to a lower surface of the strip-shaped steel sheet from an application part that is provided at the lower mold, that contacts a restriction part provided at the lower mold, and that is restricted from movement in a direction intersecting a mold opening and closing direction, discharging adhesive surplus to application from the application part using a discharge mechanism provided at the lower mold; and

laminating the core sheet, which has been punched out from the strip-shaped steel sheet by pressing by the upper mold and the lower mold, while bonding the core sheet with the adhesive.