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Title: Paper winding apparatus

Specification

1. Title of Invention

PAPER WINDING APPARATUS

2. Claims

1. Paper winding apparatus, characterized by:

a plurality of winding belts disposed in front of a winding drum borne at a predetermined position, the plurality of winding belts being respectively set around every plurality of rolls borne at a predetermined position, and predetermined intervals are respectively provided between each belt, each belt being made to be aligned in parallel;

a gap formed between said winding drum and winding belts, where a core is brought into contact with said winding drum and winding belts and the core is enabled to pass through the gap;

a downward widened winding space formed at a position underneath said gap;

a core supply apparatus located above said gap;

an advanceable/retractable pushing roll displaceably supported by a bearing frame thereof, disposed from above towards the gap;

an advanceable/retractable first receiving roll displaceably supported by a bearing arm thereof in between said plurality of each of the winding belts, and disposed in a direction where the advanceable/retractable first receiving roll appears/retreats from each of the winding belt intervals, towards suitable places of said winding space;

an advanceable/retractable second receiving roll displaceably supported by a bearing frame thereof, at a location underneath said winding space from below towards said winding space;

an advanceably/retractably supported cutter device disposed such that a blade tip of a cutter passes through proximate to a circumferential surface of a winding drum from a position underneath a winding drum towards a winding space;

control means respectively disposed at a bearing frame of said pushing roll, bearing arm of first receiving roll and bearing frame of second receiving roll, where the control means is for coupling at least said winding drum and winding belt to a drive source made to rotate at the same circumferential speed, and in said downward widened winding space, the control means is for winding paper onto a core and first half thickening of a log by winding on a first receiving roll and for performing latter half thickening of a log by winding on a second receiving roll, and the control means is for releasing a log whose winding is completed from the top of the second receiving roll; and

a drive means made to selectively advance/retract a cutter and disposed at said cutter device.

2. The apparatus according to Claim 1, wherein said plurality of each of the winding belts are respectively set around one shared drive roll, and each pair of pulleys provided at each winding belt.

3. The apparatus according to Claim 1, wherein said core supply apparatus comprises an intermittently releasing mechanism of a core, opening and closing in synchrony with a rotation amount of the drum.

4. The apparatus according to Claim 1, wherein said bearing frame of the pushing roll is swingably supported by a shaft of a winding drum as a fulcrum.

5. The apparatus according to Claim 4, wherein said bearing frame is provided with width direction regulating plates blocking the positions at both sides of both said gap and winding space.

6. The apparatus according to Claim 4, wherein said pushing roll is interlockingly coupled to a winding drum via an interlock system made to rotate at the same circumferential speed as the winding drum.

7. The apparatus according to Claim 4, wherein an advancing/retracting control means for said pushing roll towards a winding space is a double action air cylinder coupled to said bearing frame.

8. The apparatus according to Claim 4 or 7, wherein an advancing/retracting control means for said pushing roll towards a winding space includes a stopper oppositely arranged to a bearing frame.

9. The apparatus according to Claim 1, wherein each bearing arm of said plurality of first receiving rolls is integrally coupled via a stay.

10. The apparatus according to Claim 9, wherein said plurality of bearing arms is swingably supported by one shaft.

11. The apparatus according to Claim 10, wherein said plurality of bearing arms is rotatably supported by one shaft, said shaft is rotatably borne at a machine frame and interlockingly coupled to said winding belt, and intervals between this shaft and each of first receiving rolls are respectively interlockingly coupled via an interlock system.

12. The apparatus according to Claim 11, wherein a receiving surface of said first receiving roll for a core is a surface of a belt set around between said receiving roll and a pulley fittably attached to said shaft.

13. The apparatus according to Claim 10, wherein an advancing/retracting control means for said first receiving roll towards a winding space comprises a rotational moment of a bearing arm due to its own weight with said shaft as a fulcrum, and a stopper to secure the moment to a fixed rotational position.

14. The apparatus according to Claim 1, wherein said bearing frame of the second receiving roll is swingably supported by a shaft rearward of said winding drum.

15. The apparatus according to Claim 14, wherein an advancing/retracting control means for said second receiving roll towards a winding space comprises a rotational moment of a bearing frame in an advancing direction due to its own weight with said shaft as a fulcrum, and an air cylinder coupled to a bearing frame.

16. The apparatus according to Claim 14, wherein said second receiving roll is interlockingly coupled to a winding drum via an interlock system made to rotate at the same circumferential speed as the winding drum.

17. The apparatus according to Claim 1, wherein said cutter device comprises a swing arm pivotally supporting a fulcrum of the swing arm at a location above and behind winding drum, and a plate-shaped cutter installed at a free end of said swing arm.

18. The apparatus according to Claim 17, wherein an air nozzle facing a blade tip of a cutter is mounted at a free end of said swing arm.

19. Paper winding apparatus, characterized by:

a plurality of winding belts disposed in front of a winding drum borne at a predetermined position, the plurality of winding belts being respectively set around every plurality of rolls borne at a predetermined position, and predetermined intervals are respectively provided between each belt, each belt being made to be aligned in parallel;

a gap formed between said winding drum and winding belts, where a core is brought into contact with said winding drum and winding belts and the core is enabled to pass through the gap;

a downward widened winding space formed at a position underneath said gap;

a core supply apparatus located above said gap;

an advanceable/retractable pushing roll displaceably supported by a bearing frame thereof, disposed from above towards the gap;

an advanceable/retractable first receiving roll displaceably supported by a bearing arm thereof in between said plurality of each of the winding belts, and disposed

in a direction where the advanceable/retractable first receiving roll appears/retreats from each of the winding belt intervals, towards suitable places of said winding space;

an advanceable/retractable second receiving roll displaceably supported by a bearing frame thereof, at a location underneath said winding space, from below towards said winding space;

an advanceably/retractably supported cutter device disposed such that a blade tip of a cutter passes through proximate to a circumferential surface of a winding drum, from a position underneath a winding drum towards a winding space;

control means respectively disposed at a bearing frame of said pushing roll, bearing arm of first receiving roll and bearing frame of second receiving roll, where the control means is for coupling at least said winding drum and winding belt to a drive source made to rotate at the same circumferential speed, and in said downward widened winding space, the control means is for performing winding of paper onto a core and first half thickening of a log by winding on a first receiving roll and for performing latter half thickening of a log by winding on a second receiving roll, and the control means is for releasing a log whose winding is completed from the top of second receiving roll; and

a drive means made to selectively advance/retract a cutter and disposed at said cutter device,

wherein a water supply means for a water-containing member is disposed in a retract position of the cutter device, said water-containing member being adhered to a lower surface of the cutter of the cutter device.

20. The apparatus according to Claim 19, wherein said water-containing member is plate-shaped felt.

21. Paper winding apparatus, characterized by:

a plurality of winding belts disposed in front of a winding drum borne at a predetermined position, the plurality of winding belts being respectively set around every plurality of rolls borne at a predetermined position, and predetermined intervals are respectively provided between each belt, each belt being made to be aligned in parallel;

a gap formed between said winding drum and winding belts, where a core is brought into contact with said winding drum and winding belts and the core is enabled to pass through the gap;

a downward widened winding space formed at a position underneath said gap;

a core supply apparatus located above said gap;

an advanceable/retractable pushing roll displaceably supported by a bearing frame thereof, disposed from above towards the gap;

an advanceable/retractable first receiving roll displaceably supported by a bearing arm thereof in between said plurality of each of the winding belts, and disposed in a direction where the advanceable/retractable first receiving roll appears/retreats from each of the winding belt intervals, towards suitable places of said winding space;

an advanceable/retractable second receiving roll displaceably supported by a bearing frame thereof, at a location underneath said winding space, from below towards said winding space;

an advanceably/retractably supported cutter device disposed such that a blade tip of a cutter passes through proximate to a circumferential surface of a winding drum, from a position underneath a winding drum towards a winding space;

control means respectively disposed at a bearing frame of said pushing roll, bearing arm of first receiving roll and bearing frame of second receiving roll, where the control means is for coupling at least said winding drum and winding belt to a drive source made to rotate at the same circumferential speed, and in said downward widened winding space, the control means is for performing winding of paper onto a

core and first half thickening of a log by winding on a first receiving roll and for performing latter half thickening of a log by winding on a second receiving roll, and the control means is for releasing a log whose winding is completed from the top of the second receiving roll; and

a drive means made to selectively advance/retract a cutter and disposed at said cutter device,

wherein a winding means of the cut end of the base paper side onto a core is disposed in between said plurality of belts.

22. The apparatus according to Claim 21, wherein said winding means onto a core is an air jet apparatus comprising an air nozzle in between each of the winding belts, the air nozzle being opened towards the upper surface of a core supplied in said winding space.

23. The apparatus according to Claim 21, wherein said winding means onto a core is a liquid spraying gun in between each of the winding belts, the liquid spraying gun being opened towards a surface of a core supplied in said winding space.

24. The apparatus according to Claim 21, wherein said winding means onto a core comprises both said air nozzle and liquid spraying gun.

25. The apparatus according to Claim 23 or 24, wherein said pushing roll has a wetness-removing groove.

3. Detailed Description of Invention

The present invention relates to a comparatively thin or flexible paper winding apparatus, such as for e.g. toilet paper or paper towels.

Apparatuses in which base paper, fed from a base paper roll with a large amount of base paper wound thereupon, is made to wind onto another core in fixed amount increments are already known. For example, JP Examined Patent Appl. Publ. No. S48-281 discloses an apparatus in which a core rod longer than a core is inserted therethrough, both ends of the core rod are supported by a suitable means, and base paper is made to wind onto many cores in sequentially fixed amount increments, by a drive conveying the core rod through which these cores were inserted. Alternatively, JP Examined Patent Appl. Publ. No. S48-13910 discloses an apparatus in which cores are supplied in between many autorotatably supported and cylindrically arrayed winding rollers with a rotating support body and without employing a core rod, such that cores are rotationally driven in the winding direction of base paper due to the autorotation of a winding roll, and cores are made to be conveyed by the revolution of a winding roll.

However, in the former disclosure, a core rod is inserted through cores at a pre-stage of a winding step of thick paper, and the core rod must be extracted from a log wound with base paper at a post-stage. Thus, in addition to the substantial core winding step, extra steps as well as apparatuses such as for the aforementioned stages are required, which resulted in very large-scale apparatuses as well as high cost. Moreover, the latter disclosure has been devised so as to require no core rod. However, in this apparatus, cores are supported at one of many small-diameter wavy valleys of a winding roll, and cores are made to thicken by paper winding at the wavy valley. During thickening by winding and at the completion of winding, a winding roll is made to revolve. Hence, there were disadvantages such as cores needing to be intermittently revolved during winding, and the contacting surface of a winding roll brought into contact with paper being small.

Therefore, the present invention intends to provide a paper winding apparatus that is made to support a core without the use of a core rod, and that gradually moves during winding as a core is thickened by winding, which is also devised so that winding

action onto paper takes place via a large contacting surface onto paper, so as to smoothly cut paper.

Moreover, another object of the present invention is to provide a paper winding apparatus where a cut end of paper of the completed winding side in a log wound at a core is automatically made to be adhered by means of a simple apparatus without wasting paper. It is also a further object of the present invention to provide a paper winding apparatus where a cut end of paper of the starting winding side to a core, in a log wound at a core, is automatically made to be very smoothly wound without generating creases etc.

An Example will be explained as follows with reference to the drawings. (1) is a winding drum with a knurled finish on its outer circumferential surface, with a support shaft (3) thereof rotatably borne by machine frame (2); (4) is a plurality of winding belts disposed in front of the drum (1), where these winding belts (4) are wound by the following winding means. Namely, (5) is a support shaft suspended over both sides of machine frames (2)(2) and fixed thereto; (6) are bearing plates fittably supported by performing key stop (7) of a boss portions (6)a of the bearing plates, at regular intervals on this support shaft (5). Rolls (8) are respectively rotatably supported (9) at the front edges of each bearing plate (6). A required number of rolls (10) are also respectively rotatably supported at this support shaft (5), at a side of bearing plates (6).

Moreover, a shaft (12) of one roll (11) is rotatably borne (13)(13) in between both sides of machine frames (2)(2). Endless bands (4) are respectively set around, between this roll (11) and the rolls (8)(10), and the winding belts (4) are configured by these endless bands (4).

Thereby, in between the plurality of winding belts (4) disposed in front of winding drum (1), and winding drum (1), gap α (minimum interval portion) where core (15) is brought into contact with both (1)(4) and ultimately is able to pass through, is formed. Moreover, a downward widened winding space β positioned below the gap α ,

is formed. In the apparatus of the present invention, a core supply apparatus (supply hopper) (16) is disposed above the gap α , in order to supply a core (15) made to pass through, and head below, the gap α . This supply apparatus (16) has a guide chute (18) at the bottom of hopper (17), where the guide chute (18) has a width for core (15) to be able to align, roll and drop down by increments of one at a time. Moreover, at a base end of the bottom of this hopper (17), a core stirring arm (20) consisting of a bent plate body pivotally supported (19) at hopper (17) is provided. By swinging this stirring arm (20) in hopper (17), many cores (15)(15) ... in hopper (17) align above the guide chute (18) so as to roll and drop down. A rotary stopper (21) with jaw pieces (21)a (21)b is provided at the exit of the guide chute (18). By reciprocatably and rotationally displacing this rotary stopper (21) intermittently at a constant rate, a core (15) in above guide chute (18) is made to be able to fall down and be supplied in increments of one at a time.

Then, as core (15) is supplied from the hopper (17) towards the direction of gap α between winding drum (1) and winding belts (4), a first receiving roll (22) for catching this core (15) at the upper position inside a downward widened winding space β , is appearably/retreatably provided, from a clearance γ between each of the winding belts (4), towards winding space β . Namely, this first receiving roll (22) is rotatably borne (23) between both sides of machine frames (2)(2). In front of winding drum (1), a shaft (25) is provided in front of the winding belts (4) (top rightward in Fig. 1). A required number of bearing arms (27) rotatably supported (26) at suitable places at regular intervals on this shaft (25) are respectively pivotally supported (28) at a free end position of the bearing arms (27). A drive belt (30) is set around between pulleys (29) fittably attached (key stop) to the shaft (25) at the side of bearing arms (27). A shaft (25) is interlockingly coupled to a drive source of the drum (1) via an interlock system (not shown). A receiving surface of a first receiving roll (22), where the receiving surface is brought into contact with core (15) (surface of belt (30) in this Example), is rotationally driven clockwise as seen in Fig. 1 at the same circumferential speed as the surface of drum (1).

Moreover, the plurality of bearing arms (27)(27) ... integrally fix and couple to suitable places opposite the side where first receiving rolls (22) are respectively pivotally supported (28), by means of a stay (31). These plurality of first receiving rolls (22)(22) ... are configured to be appearable/retreatable, from underneath winding space β towards the winding space β , by a support shaft (28) thereof being kept on the same line and by a plurality of bearing arms (27) integrally and swingably supported with the shaft (25) as a fulcrum.

Moreover, first receiving roll (22) receives upward-facing rotational moment in the A($\uparrow$) direction as indicated by the arrow symbol in Fig. 1, by the own weight of entirety (33) comprising bearing arms (27), stay (31) and balance weight (32) etc. at this first receiving roll (22), which is a support means of this first receiving roll (22). By the rotational moment, first receiving roll (22) is urged towards the direction of projecting towards a winding space. The urging is regulated to the projecting position by stopper (34), as shown in Fig. 1.

The aforementioned Example shows an example where first receiving roll (22) is urged towards winding space β by means of the rotational moment of bearing arms (27). However, in another Example, instead of rotational moment, a piston rod (not shown in the figures) or spring of an air cylinder is coupled to these bearing arms (27). Also, bearing arms (27) may be urged towards the aforementioned direction by means of fixed air pressure or spring pressure.

In any case, in this Example, a core (15) supplied by falling from the aforementioned hopper (17), after having passed through the narrowest gap α position formed by winding drum (1) and winding belts (4), is made to be caught at the upper position of downward widened winding space β by means of first receiving roll (22), via the surface of belt (30) set around receiving roll (22) (Fig. 1). A base paper roll (35) supported by a shaft thereof (not shown in the figures) by a suitable means, after having passed through guide roll (36), is wound towards winding drum (1). This base paper roll

(35)a, after having passed through between winding drum (1) and core (15), is made to be wound in the upper position of winding space β , onto core (15) in the anti-clockwise direction as seen in Fig. 1.

In order to easily wind paper (35) towards this direction, a shaft (37) suspended over both sides of machine frames (2)(2), an arm (38) rotatably pivotally supported by the shaft (37), and a feed roll (39) borne at a free end of this arm (38) are provided at a position above and behind winding drum (1). Arm (38) is selectively lowered from the position shown by the solid line towards the position shown by the chain line in Fig. 1. When winding drum (1) is made to rotate, the front edge of paper (35) is fed towards the direction of core (15). Arm (38) of feed roll (39) is brought towards the position shown by the chain line only at the start of this apparatus. During continuous operation once winding has begun, this arm (38) is fixed and held in the position shown by the solid line in the drawing (fixing apparatus is not shown in the figures).

Core (15) heads towards the lower portion of the under gap α portion, in other words, is made to pass through the gap α , where core (15) is reliably positioned towards the downward widened winding space β . Thus, in order for a core to be positioned at the downward widened winding space β , and in order for this core to automatically descend when it is thickened by winding, a pushing roll (40) is provided in front of and above winding drum (1), as follows.

Namely, the winding drum (1) is further rotatably supported (42) at shaft (3) rotatably borne (41) at machine frames (2)(2). A gear (43) with the same diameter as drum (1) is fixed to a side surface of drum (1). The base end of a pair of rotating frames (45) is fixed (key stop) at both ends of shaft (3). At a free end side of this rotating frame (45), the pushing roll (40) is positioned proximate to the circumferential surface of drum (1). A small gear (47) is fittably attached at the edge of shaft (46) of this pushing roll (40). This small gear (47) is enmeshed with another idler gear (48) which is meshed with gear (43) which is integrally fixed to the drum (1). Namely, idler gear (48) is rotatably and

pivotaly supported at bearing frame (45). Moreover, in Fig. 3, (49) is a drive gear of winding drum (1) integrally fixed to the gear (43). The driving power for rotating winding drum (1) towards the B(∇) direction indicated by the arrow symbol in Fig. 1 is input to this gear (49). When winding drum (1) rotates, pushing roll (40) is made to rotate towards the C($\wedge$) direction indicated by the arrow symbol in Fig. 1, via an interlock system consisting of an idler gear (48) and gear (47) interlocked to winding drum (1). The pushing roll (40) of this Example is configured as in the aforementioned. A balance weight (50) is installed at the bearing frame (45) of pushing roll (40). The pushing roll (40) is normally urged by the own weight moment of pushing roll (40) and bearing frame (45) thereof, towards the clockwise direction as seen in Fig. 1. Also, at the shaft (3) to which this bearing frame (45) is fixed, arm (51) is protrudingly installed at the outer side of machine frame (2). A piston rod (52)a of a double action air cylinder (52) is coupled to this arm (51). When piston rod (52)a of air cylinder (52) contracts, bearing frame (45) is kept in the position shown by the solid line in Fig. 1. When piston rod (52)a elongates, bearing frame (45) is rotated clockwise. Pushing roll (40) pushes core (15) to pass through the narrowest gap α , core (15) is supplied onto first receiving roll (22) of the edge of bearing arms (27) whose rotational moment was secured by stopper (34). Core (15) is maintained in a pressure-contacted state with the first receiving roll (22) (refer to Fig. 6). (53) is a stopper attached to machine frame (2) for reliably securing bearing frame (45) to the position as shown in Fig. 6. By providing such a stopper (53), bearing frame (45) may also be urged clockwise, as a single action air cylinder (52), by means of the moment of bearing frame (45) *per se*.

A width direction regulating plate (45)b is extendingly installed at the free end (45)a of the bearing frame (45), extending from the free end towards underneath the rotating direction of bearing frame (45). In this apparatus, the side surfaces of winding space β where the core (15) is supplied are regulated to a fixed position and blocked by means of a left and right pair of width direction regulating plates (45)b (45)b. (40)b is a

water removing groove formed at suitable places on the outer circumference of pushing roll (40).

A second receiving roll (55) provided by advanceable/retractable urging, so as to project from underneath winding space β towards winding space β , is explained as follows. The base end of a bearing frame (57) pivotally supported (56) at the front edge of this receiving roll (55) is fittably attached (key stop) to a rotatably borne (58) shaft (59) at both sides of machine frame (2)(2), rearward of winding drum (1). At this shaft (59), two mutually coupled pulleys (60)(61) are supported with a loose fit. Two mutually coupled pulleys (62)(63) are also rotatably pivotally supported at an intermediate position of bearing frame (57) bent into an L-shape. A belt (64) is set around the second receiving roll (55) and pulley (63), and a belt (65) is set around pulley (62) and pulley (61). Moreover, by coupling pulley (60) with a drive source thereof (not shown in the figures), second receiving roll (55) synchronizes with drum (1) and winding belts (4) so as to be made to rotate at the same circumferential speed.

Moreover, a balance weight (66) is installed at this bearing frame (57). The bearing frame (57), by its own weight moment, is urged towards the direction (anti-clockwise direction) where second receiving roll (55) normally projects towards winding space β . At shaft (59), to which this bearing frame (57) is fixed, an arm (67) is protrudingly installed at the outer side of machine frame (2). A piston rod (69) of air cylinder (68) is coupled to this arm (67). If an air supply to air cylinder (68) is neutral, bearing frame (57) becomes free, and second receiving roll (55) is made to project towards the winding space β . When air cylinder (68) is operated, this second receiving roll (55) is made to be retracted to the stand-by position shown by the solid line in Fig. 6.

Before a cutter device (70) oppositely arranged to the paper winding apparatus of the present invention is explained, the winding action of paper (35) wound up at core (15) as configured in the above is explained as follows. By the action of feed roll (39)

having temporarily been brought towards the chain line position of Fig. 1, paper (35) is manually wound onto core (15), where the core (15) was supplied by dropping from hopper (17) towards the top of first receiving roll (22). A core (15) is brought into contact with both winding drum (1) and winding belts (4), and the lower side of core (15) is supported by first receiving roll (22) urged to the uppermost position, and the upward side of core (15) is pushed by pushing roll (40). Also, the winding drum (1), winding belts (4), first receiving roll (22) and pushing roll (40) all rotate the contacting surface with respect to core (15) with the same circumferential speed in the same direction. Hence, as seen in the situation in Fig. 6, paper (35) is progressively thickened by winding at the winding space β under this gap portion α . As this paper (35) thickens by winding, it heads lower towards the downward widened winding space β , and winding progresses whilst pushing down on first receiving roll (22), and this paper (35) thus progressively descends. As the winding amount of paper (35) wound at core (15) attains a fixed amount, a log (71) wound up until an intermediate amount of paper (35) plunges first receiving roll (22) towards clearance γ between the plurality of winding belts (4), and this log (71) is made to fall downward. Prior to this, when bearing frame (57) supporting second receiving roll (55) is made to be free, in other words, when put into an upward-facing urged state, this second receiving roll (55) is in the downward widened winding space β between winding drum (1) and winding belts (4), in rolling contact with a lower surface of log (71) in a half-rolled state. A circumferential surface of log (71) is made to be in pressure-contact with winding drum (1) and winding belts (4) from underneath thereof. Thus, the log (71) is supported by means of three points on the circumference of this log (71).

Thus, by the winding drum (1), winding belts (4) and second receiving roll (55) brought into contact at the circumferential surface of log (71) in a tandem rotating direction, log (71) is progressively thickened by winding.

At the second receiving roll (55), when this log (71) attains a fixed winding amount, in other words, for example, at the point in time when this log (71) has been wound to a prescribed winding amount as detected by a counting apparatus (not shown) disposed in winding drum (1) (e.g. 50 to 60 m), air is supplied to air cylinder (68) and bearing frame (57) is made to rotate towards the clockwise direction, and log (71) thereby falls downward (refer to the chain line of Fig. 1). An unloading conveyor apparatus (72) is disposed underneath winding space β in order to receive this log (71).

A process can be understood by the above explanation, where a core (15) falls in winding space β from the upper part to the lower part thereof, as paper (35) is wound towards the core (15), which becomes a log (71) progressively thickened by winding. In such a winding process, log (71) is caught by second receiving roll (55) below and thickened by winding. Meanwhile, in the apparatus of this Example, bearing arms (27) supporting the first receiving roll (22) are made to return again by its own moment, towards the position in which the urging of A(1) direction of these bearing arms (27) has been stopped by stopper (34), as shown by the solid line in the drawings.

As mentioned above, before the wound-up log (71) falls, while it is still being wound, the next core (15) is supplied to the top of first receiving roll (22), idly spinning. This core (15) is idly spinning as paper (35) is interposed between the core (15) and winding drum (1).

A cutter device (70) for cutting paper (35), which operates instantaneously as the log (71) of which winding is completed falls after being released from the second receiving roll (55) as mentioned above, is explained as follows. The cutter device (70) in this Example consists of a swing arm (73) fittably attached (key stop) to a base end portion (73)a of the shaft (37) rotatably suspended over both sides of machine frame (2)(2) at a position above and behind the winding drum (1), a cutter holder (74) installed at the front edge of this swing arm (73), and a plate-shaped cutter (75) fastened to the cutter holder (74), where the blade tip of cutter (75) is formed in a saw-tooth shape.

Moreover, at the shaft (37) to which base end (73)a of this swing arm (73) is fittably attached, arm (76) is protrudingly installed at the outer side of machine frame (2). A piston rod (78) of a double action air cylinder (77) is coupled to one end of this arm (76). In this cutter device (70), when second receiving roll (55) is made to be retracted, namely, at the instant that second receiving roll (55) is to release log (71) whose winding is completed and retract to the vicinity of position shown by the chain line in Fig. 1, in other words, during the instant that a slight gap is formed between winding drum (1) and log (71) supported between second receiving roll (55) and winding belts (4), this cutter device (70) is instantaneously made to be rotated in the anti-clockwise direction by an amount of θ . Cutter (75) then passes through proximate to the circumferential surface of winding drum (1) and is made to project towards the position shown by the chain line in Fig. 1.

Thus, the cutter (75) breaks paper (35) so as to be able to cut the paper (35), in between the paper (35) wound on this winding drum (1) and the paper (35) wound on log (71).

Moreover, a plate-shaped soft water-containing member (76) such as felt is affixed at the lower part of plate-shaped cutter (75) of this cutter device (70). A water supply means (77) for the water-containing member (76) filled with a sponge (77)b in vessel (77)a is further disposed in the position in which soft water-containing member (76) can be brought into contact with cutter (75) when cutter device (70) is in the retract position shown by the solid line in Fig. 1. When cutter (75) projects towards the position shown by the chain line, this cutter device (70) cuts paper and is simultaneously able to impart wetting to the cut end of the log side at this time by means of water-containing member (76) being brought into contact with the cut end of paper (35) of the log (71) side.

Moreover, an air nozzle (78) of which air is jetted along the upper surface of cutter (75) is disposed at the free end (73)b of swing arm (73) of this cutter device (70).

The air nozzle (78) is coupled to a supply source (shut-off valve mediated) of compressed air, via a suitable flexible tube (not shown in the figures). At the instant that cutter (75) is projected towards the cutting action position, air is jetted from the air nozzle (78). The cut end of the base paper side which was cut by cutter (75) is positioned above the cutter (75) so as to be sprayed towards the surface of the rotating core (15). In this drawing, (79) is a balance weight for matching the center of gravity position of cutter device (70) with the shaft (37)-center position of cutter device (70).

Moreover, in the paper winding apparatus of this Example, in order to have smooth and good winding of the cut end of the base paper side onto core (15) supplied towards the top of first receiving roll (22) at winding space β between winding drum (1) and winding belts (4), the following apparatus is disposed between the plurality of winding belts (4).

Namely, (80) is a water spraying gun fixedly provided on each of the bearing arms (6). From the front edge (80)a of this gun (80), water is made to be sprayed facing towards the upper surface of core (15) in controlled fixed instants, in synchrony with the operation of cutter device (70). Moreover, in between the plurality of each of the winding belts (4), an air jet apparatus (81) is disposed facing towards gap α . In other words, a nozzle (81)a of the air jet apparatus (81) was made to be opened and face towards a core (15) caught towards the top of first receiving roll (22), and face towards the rolling contact portion of pushing roll (40) in rolling contact with this core (15). The cut end of the base paper side which was cut by the cutter device (70) is first fed by winding drum (1), and sprayed with air by nozzle (78) towards the direction of core (15). At the same time that the cut end of the base paper side is inserted between first receiving roll (22) and core (15), the edge portion thereof is affixed to core (15) by water sprayed from the water spraying gun (80). Immediately after this has passed through core (15) and winding belts (4), the cut end of the base paper is made to be smoothly and reliably wound onto core (15) without generating creases etc., by air jetted from

nozzle (81)a of the air jet apparatus (81), and by the cut end edge thereof being sprayed at the core (15) side.

Shown in the aforementioned Example are examples of an advancing/retracting control means of pushing roll (40) configured by means of an air cylinder (52) and stopper (53) coupled to bearing frame (45), and an advancing/retracting control means of first receiving roll (22) configured of a rotational moment of bearing frame (27) and stopper (34). However, these control means are not limited to the aforementioned Example. More preferable is a means according to a fixed program, which enables advancing/retracting control of a pushing roll (40) and first receiving roll (22) towards a winding space, with a predetermined speed and cycle. For example, by replacing the stoppers (53) and/or (34) with cams, and controlling the cams by suitable control mechanisms (not shown in the figures), pushing roll (40) may be made to be in rolling contact with log (71) thickened by winding in winding space β , until a position of fixed thickening by winding.

In an example in which pushing roll (40) is made to be advancingly/retractingly controlled as mentioned above, the action of the cutter device (70) etc. is explained as follows, referring to Figs. 6 to 8. In these drawings, Fig. 6 shows a winding state at start, Fig. 7 shows winding state during operation, and Fig. 8 shows a winding state at completion, respectively. It has already been explained that at the beginning of operation, feed roll (39) is positioned in the position shown by the chain line in Fig. 6. When base paper (35) is initially wound onto a core (15) and winding is started, the feed roll (39) is immediately returned towards the position shown by the solid line. The first receiving roll (22) and pushing roll (40) clamp core (15), are as seen in the Fig. 6 initial position shown by the solid line. The first receiving roll (22) and pushing roll (40) are made to rotate in the direction indicated by the arrow symbol, in other words, anticlockwise, in cooperation with winding drum (1) and winding belts (4). The core (15) thickens by winding of paper (35). At this time, pushing roll (40) pushes log (71)

thickened by winding and gradually advances downward. Thus, if core (15) is thickened by winding so as to become as shown by the solid line in Fig. 7, first receiving roll (22) is plunged once into clearance γ between winding belts (4) and is returned again to the position of Fig. 1 by its own moment, after allowing the half-rolled log (71) to pass through toward a lower position. At the same time, pushing roll (40) is retractably driven by the action of air cylinder (62), and returned to the position as shown in Fig. 1, so as to not obstruct the supply of a new core (15).

If the return operation of the pushing roll (40) and first receiving roll (22) to the aforementioned Fig. 1 position is detected by a detector (not shown), a rotary stopper (21) is made to operate by a signal of the detector, and one core (15) is supplied towards gap α .

At the beginning of the operation, a second receiving roll (55) is held in the position shown by a chain line in Fig. 6. When a log (71) thickening by paper winding is descending in a winding space β while pushing back a first receiving roll (22), a detector (unshown in figures) provided to a bearing arm (27) sends a signal to an air cylinder (68) to bleed air from the air cylinder (68), and the second receiving roll (55) is located in a position (cf. Fig. 7) where it can receive the log (71) instead of the first receiving roll (22). The second receiving roll (55) shifts backward as the log (71) is further thickening from the state shown in Fig. 7.

When the log (71) has completed winding a predetermined amount of paper (35) (cf. solid line in Fig. 8), the second receiving roll (55) is shifted backward to the position shown by a solid line in Fig. 8 due to the action of the air cylinder (68). During the shifting, the paper (35) is cut, and the sealed log (71) is released outside the apparatus, as described above.

As is clear from the above explanation, in the paper winding apparatus of the present invention, a core located in front of a winding drum and behind a winding belt is ultimately able to pass through a gap towards a downward widened winding space,

where the core is kept. At the start of winding, this core is sandwiched in front of the winding drum and behind the winding belt, and is kept above the pushing roll and below the first receiving roll. Winding is begun in this state. Moreover, this winding space is formed in a downward widened manner. Hence, as the core is thickened by winding, a log whose core diameter increases automatically descends and moves towards this downward widened winding space. When the log thickened by winding reaches a fixed amount, the log is shiftingly supported by all three of the second receiving roll, winding drum and winding belt. Furthermore, the log then descends and moves towards this downward widened winding space whilst being thickened by winding. Thereby, in the apparatus of the present invention, movement due to thickening by winding of a log is enabled without employing a core rod etc. Hence, the apparatus of the present invention provides advantages of not requiring an apparatus for inserting and extracting a core rod, and thereby a compact apparatus can be configured.

Moreover, in the winding apparatus of the present invention, there is absolutely no forcible conveyance step of a core in a winding process of a core (log), such as intermittently driving a winding roller on which a core (log) is mounted by revolution and forcibly conveying this, like that of the conventional apparatus. Also, winding action onto paper is made to take place by means of a large contacting surface with a winding drum and winding belt, etc. Hence, the winding apparatus of the present invention also has the advantages of a winding paper onto a core taking place very smoothly and well, and having absolutely no risk of unexpected breakage etc. of paper occurring during a winding step.

Moreover, in the winding apparatus of the present invention, a log catching means is configured by means of upper and lower two-tier receiving rolls of a first receiving roll and a second receiving roll intermittently appearing/rereating in a downward widened winding space. The winding action of paper is performed so as to gradually and steplessly have a core descend into this downward widened winding space.

Meanwhile, two receiving rolls are made to be alternated. Hence, while the log comparatively thickened by winding is caught at the lower side second receiving roll and wound, the next empty core to be wound is supported in an idling state at the upper side of first receiving roll. Thereby, when the winding amount of a log caught in a second receiving roll attains a predetermined amount and base paper is cut, the cut end of the base paper side can be immediately wound onto a core towards the upper side, during the aforementioned stand-by. Hence, there is no interruption of winding work, which can be performed completely continuously.

Moreover, if, in accordance with the present invention, a water-containing member is adhered to a lower surface of a cutter of a cutter device, and a water supply means is disposed to the aforementioned water-containing member at the retract position of the cutter device, the cutter is instantaneously projected to the gap between a paper wound onto a log having attained a predetermined winding amount and a paper wound onto a winding drum. Meanwhile, at the same time as the cutting action of the paper, the cut end of the paper at the log side is brought into contact with the aforementioned water-containing member and the cut end is automatically wetted. Hence, an excellent effect of the cut end being reliably adhered to a log whose winding is completed, is obtainable.

Moreover, if air nozzle (78) as in the Examples is disposed at a cutter device, a cut end of the base paper side is sprayed by air jetted from the air nozzle, towards the direction of a core rotating upward thereto whilst on stand-by. The front edge of the cut end of the base paper is made to be smoothly inserted towards the area between the core and the first receiving roll. If, according to the apparatus of the present invention, a further winding means of the cut end of the base paper side onto a core is disposed between a plurality of winding belts, a cut end of the base paper side made to pass through between a core and winding belt during stand-by can be made to more reliably wind onto a core.

Moreover, since the winding apparatus according to the present invention is configured as mentioned above, a means of winding a cut end of the base paper side onto a core between a plurality of winding belts, as shown in the Example, can be easily disposed. For example, an air nozzle (81)a can be easily disposed with a liquid spraying gun (80) etc. As in the Example, in the case where a liquid spraying gun and air nozzle are disposed between a plurality of winding belts, liquid is jetted from liquid spraying gun (80) and a portion of the core surface on stand-by is wetted. Air is jetted from air nozzle (81)a towards the winding drum direction along the upper surface of core. Hence, a cut end of the base paper side of which a front edge thereof is inserted between the core and first receiving roll has no occurrence of curling etc. at the core during stand-by, and winding is reliably adhered onto the core. Thereby, the cut end of the base paper side is wound onto the core, and rises upward from between the winding belts. By air jetted from air nozzle (81)a towards the winding drum direction, the front edge of the cut end of the base paper side is further reliably inserted between the pushing roll and the core.

Namely, according to the apparatus of the present invention, in the processing steps of the paper edge at the completion of winding and the paper edge at the start of winding, advantages such as trouble not easily occurring, beautiful finish, and absolutely no paper waste generated at the cut end, are obtainable.

4. Brief Description of Drawings

Fig. 1 is a partial cutaway side view showing an Example of a paper winding apparatus according to the present invention; Fig. 2 is a sectional view taken on the line II-II in Fig. 1; Fig. 3 is a sectional view taken on the line III-III in Fig. 1; Fig. 4 is a sectional view taken on the line IV-IV in Fig. 1; Fig. 5 is a sectional view taken on the line V-V in Fig. 1; and Figs. 6 to 8 are explanatory drawings which diagrammatically show the action of the main components of the winding apparatus according to the present invention.

(1) ... winding drum, (4) ... winding belt, (8)(10)(11) ... roll, (17) ... hopper, (18) ... guide chute, (22) ... first receiving roll, (27) ... bearing arm, (34) ... stopper, (40) ... pushing roll, (45) ... bearing frame, (52) ... air cylinder, (55) ... second receiving roll, (57) ... bearing frame, (68) ... air cylinder, (70) ... cutter device, (75) ... cutter, (76) ... water-containing member, (77) ... air cylinder, (80) ... water spraying gun, (81)a ... air nozzle, α ... gap, β ... winding space, γ ... clearance between winding belts