Method and apparatus for sheet transfer from one finished rewound roll of multi-ply sanitary tissue, paper towelling or the like to the core of another roll to be wound without interruption of the web unwinding process. By timing the transfer such that the sheet is broken at a tangent point on the finished roll, problems relating to ply separation are avoided. Also included are improved means for obtaining tail tacking.

9 Claims, 25 Drawing Figures
ROLL REWINDER TRANSFER APPARATUS AND METHOD

BRIEF SUMMARY OF THE INVENTION

The manufacture of consumer size rolls of products such as sanitary tissue, paper towelling, or the like customarily involves the rewinding of relatively short lengths from large rolls produced by paper machines onto cores which are slit into sizes convenient for home use. In the cases where the product is to comprise two or more plies or sheets, a corresponding number of paper machine (parent) rolls are simultaneously unwound so that the sheets are in a face to face position when rewound. If desired, the plies may be bonded together by the use of embossing, light adhesive application, or the like. In order for this operation to work efficiently, it must take place at high speeds and on a generally continuous basis. Thus, various apparatus have been devised to provide a continuous succession of cores in a manner such that the unwinding speed of the parent roll may be continuously maintained at speeds up to 1,800 feet per minute and even higher. In most cases the plies are unwound onto a transfer roll on which the circumferential wrap of the sheets is only partial. Adhesive is usually applied to an empty core, and the sheets transferred thereto by contact between the core and the sheets on the transfer roll. When the desired sheet length has been rewound, the sheets being fed from the parent roll are broken and transferred to the next empty core. At this point, especially at higher speeds, problems have developed due to the tendency of the plies to separate upon breaking and the tendency of the sheets to fly away or "tail" from the finished roll.

Accordingly, it is a primary object of this invention to provide an improved roll rewinder and method.

More particularly, it is an object of this invention to provide such an improved rewinder and method for winding multi-ply webs that substantially eliminate tail separation problems.

Other objects and advantages of this invention will become apparent upon reference to the drawings and to the detailed description below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates in partial perspective view an improved winder in accordance with the invention;

FIGS. 2 to 5 schematically illustrate in detail sequential operative steps in the preferred method of the invention;

FIGS. 6 to 8 schematically illustrate an alternative embodiment wherein a cutting knife is employed;

FIGS. 9 to 12 schematically illustrate an alternative embodiment including an adhesive applicator pad;

FIGS. 13 to 15 schematically illustrate another adhesive application technique that may be employed;

FIGS. 16 to 21 illustrate the preferred pad operation in detail; and

FIGS. 22 to 25 describe the invention as it may be employed in conjunction with known winding equipment.

DETAILED DESCRIPTION

Turning now to FIGS. 1 to 5, the operation of the invention will be described in detail. FIG. 1 illustrates in partial perspective a view of apparatus for one embodiment of the transfer operation of the invention. It will be understood that, while support and drive means have been substantially omitted from the drawings for purposes of clarity, any of the conventional arrangements known in this art for supporting and driving such apparatus may be utilized.

In the embodiment shown in FIG. 1, the transfer apparatus, generally indicated as 10, comprises transfer roll 12 supported by shaft 14 and including radially movable member 16. Rotatable shafts 18 support cores 20 which are rotated by pulley belt 22 driven around rolls 24 by means of shafts 26 connected to drive means (not shown). The cores 20 are moved into and out of position by means of chain 28 and in connection with an intermittent chain drive (FIG. 22). Sheet 32, previously slit along lines 34 if desired, is fed over transfer roll 12. Alternatively, when a log saw is used for subsequent cutting, the sheet would not be slit. The rotation of pulley belt 22 causes cores 20 to rotate and wind up the sheet 32 into consumer sized rolls of desired sheet lengths and roll diameters.

Turning now to schematic illustrations 2 through 8, the transfer step operation of this embodiment will be further described. In these figures, additional rolls are shown, and their purposes will become clear as the description progresses. Sheet 32 is passed over perforator roll 36 where transverse lines of perforation (P1, P2, etc.) are applied in a manner well known to this art. Then sheet 32 is passed under idler roll 38 which serves the usual purpose of adjusting length of travel between the perforation knife and the finished roll. From the idler roll 38 the sheet contacts transfer roll 12 and proceeds in partial wrapping engagement to be drawn off onto core 20. In FIG. 2 radially movable member 16 is in its extended position preparatory to engaging sheet 32, and finished roll 40 has been wound substantially to completion. Empty core 20 has been brought to a surface rotational speed approximating the rate of travel of sheet 32 by contact with pulley belt 22. FIG. 3 illustrates a subsequent position where member 16 has rotated to a location where it urges web 32 into contact with rotating empty core 20. The sheet is broken along a transverse perforation P1 as shown in FIGS. 3 and 4 and transferred to the new core 20. FIG. 5 illustrates the completion of the transfer cycle as member 16 is drawn back into drum 12 so that its circumferential surface is generally of uniform radius. The cores are then shifted in position by means which are known to this art (see FIGS. 22 to 25, for example) and a new empty core 20 put in position to receive the sheet 32.

In the case where the bond strength of the parting bond line or separation line at the surface of the finished roll is too high for a clean break, it may be desirable to use a knife or other curving means to reduce the force required to separate the web. An embodiment of this type is schematically illustrated in FIGS. 6 to 8 wherein a knife roll 42 has been added to the arrangement of FIGS. 1 to 5, and the transfer roll has been modified by including a second radially movable member 44. This embodiment operates essentially as previously described except that the line where it is desired to separate the web is weakened by contact with blade 46 of knife roll 42. As this line approaches knife roll 42 (FIG. 6), the second radially movable member 44 moves outward so as to displace web 32 at the desired separation line. Blade 46 need not be sharp and is only...
intended to reduce the detaching strength. In most cases it will not be continuous, and includes a number of "teeth" selected so as to produce the desired parting strength. It is necessary that the strength remaining in the combined webs be sufficient to carry the sheets to the core 20. This displacement of web 32 creates a nip between the blade and member 44 (FIG. 7) which results in the desired reduced bond strength. The second radially movable member 44 is then drawn into drum 12 (FIG. 8), and the sheet transfer proceeds as previously described with respect to FIGS. 1 to 5.

A common problem confronted in the rewinding of rolls of the type described in the tendency at higher speeds, for the "tail" or trailing portion of the finished roll to "fly away" or separate from the wound roll. A generally used solution to this problem has been "tail tacking" or applying a small amount of adhesive to the "tail" or end portion of the sheet constituting the finished roll portion. It is also customary to aid transfer to the empty cores by an application of adhesive to the cores before contact with the web.

The embodiment shown in FIGS. 9 to 12 schematically illustrates how such a system can be modified in accordance with the invention to provide for improved tail tacking. The knife roll 42 and second radially movable member 44 have been omitted for clarity, but it will be understood that, where it is desired to reduce the parting bond strength, they may be utilized with this embodiment as well. In the arrangement of FIGS. 9 to 12, a third radially movable member 48 is used to "rob" adhesive previously applied to the new core and apply it for "tail tacking" or releasable bonding to the finished roll. The positioning of this third radially movable member is such that, when activated, it will cause the sheet 32 to contact the empty core 20A which has an adhesive applied thereto (see FIGS. 22 to 25). Because the outward surface of member 48 consists of projections 50, the contact of web 32 with the adhesive core 20A takes place over a very limited surface and is insufficient to cause transfer of the sheet 32 to the core 20A. Adhesive transfer does, however, take place in these limited areas (see FIGS. 18 and 19) in sufficient amount for tail tacking purposes. It is important, of course, that the original adhesive application to the core by such that the amount remaining on the core is sufficient to cause subsequent sheet transfer. Adhesive application to the core may be accomplished in any desired manner, and apparatus for this purpose are well-known and have been omitted from these drawings for purposes of clarity (see FIGS. 22 to 25). In operation, radially movable member 48 having projections 50 is adapted to be activated outwardly along with radially movable member 16 and to be otherwise positioned in transfer roll 12 (FIG. 9). Immediately prior to desired contact with web 32 and with the activation of member 16, member 48 is extended from roll 12. Thus contact with the adhesive coated core 20A (FIG. 10) is made by the web 32 at a location just ahead of the desired line of separation. After this limited contact with the adhesive core 20A, member 16 causes the sheet 32 to contact the core 20A (FIGS. 11 and 12), and the remaining adhesive results in sheet transfer are previously described. Then member 48 is withdrawn (FIG. 9) and winding takes place on the new core.

FIGS. 13 to 15 schematically illustrate an alternative adhesive application embodiment for use where adhesive "robbing" as shown in FIGS. 9 to 12 may not be applicable. In this case the equipment illustrated in FIGS. 9 to 12 may be utilized along with tail seal roll 52, glue roll 54, glue applicator 56, and glue pan 58. Third radially movable member 48A forms a part of the surface of tail seal roll 52 instead of transfer roll 12 as in the previously described embodiment. The arrangement of FIGS. 13 to 15 operates by transfer of adhesive continuously from the conventional glue applicator 56 which may comprise an analog-type glue roll 54 which is kept moist with adhesive. When the desired separation line e.g. P2 of web 32 approaches transfer roll 12, the radially movable member 48A is activated outward (FIG. 14). It then rotates to a position in contact with moist glue roll 54 (FIG. 15) and projections 50A pick up adhesive. As roll 52 continues to rotate, member 48A contacts the web 32 immediately prior to the passing of the desired line of separation P2 over transfer roll 12. The member 48A is then retracted, and remaining steps take place as has been previously described. Roll 52 may also include blade 46 as described with respect to FIGS. 6 to 8 if desired in which case the relative spacing and timing of members 48A and blade 46 will be coordinated with second radially movable member 44 so as to place the adhesive in the desired positions on sheet 32.

FIGS. 16 to 21 illustrate in greater detail a preferred arrangement for simultaneously radially extending and retracting members such as 16, 44, and 48. While the choice of a particular mechanism is not critical and other devices may be used, it is important that the system selected be capable of very rapid movement. In many cases the web will be travelling at speeds of up to 1,800 linear feet per minute or even higher. Since the member must extend and retract generally within about two-thirds of a roll revolution, the time available is quite limited. For example, where the roll diameter is about 7 inches or circumference 22 inches, the time available would be about two-thirds of 0.055 second or about 0.037 second at such high speeds. For convenience all of the radially movable members are preferably operated in the same manner although different mechanisms may be used if desired.

In particular, FIGS. 16 to 21 illustrate transfer roll 12 in partial sectional view showing radially movable member 16 comprising pad 60, base plate 62, support plate 88, cam rod 90, barrel-shaped rocker cam 91 held by pin 93, rollers 92, pivot links 94, pivot pins 96, pistons 98, and radial support member 100. Pad 60 is preferably formed of rubber or other similarly resilient material and preferably has a circumferential length equal to the circumference of the core. For example, where the core has an outer diameter of 1-inch, the pad circumferential length would preferably be about 4.7 inches. The resiliency allows a wide nip in contact with the core and tolerates coreshaft misalignment and nonconcentricity. In operation, when it is desired to activate the members outward from positions shown in FIGS. 17, 19, and 21, cam rod 90 is urged axially outward within core shaft 102. This causes one set of rollers 92 to drop and another set of rollers 92 to move radially outward as they contact portions of increased diameter on cam rod 90. This pivots links 94 about pins 96 and causes pistons 98 to drop and opposing piston 98 to move radially outward against support plate 62 thus moving plate 88 and members 16 and 44. The second radially movable member 44 is preferably attached to member 48 for movement therewith as by welding.
or the like. Channel or conduit 102 is provided by machining plug 104 for guiding the piston shafts. Cover plate 108 held by screws 110 maintains snap ring 112 for bushing 114.

To return the radially movable members, the cam rod 90 is activated axially inward, and the reverse operation takes place. It will be understood that while one end of the roll has been illustrated, the other end is preferably also similarly equipped for balanced operation. Alternatively, similar provisions may be made at spaced intermediate locations for machines of greater width. Also, other means such as air diaphragms may be used in place of or in combination with the particular elements illustrated.

Turning now to FIGS. 22 and 23 the application of the invention to improve the operation of a conventional rewinder system will be described. In this arrangement the cores 20 are supplied by chain link 64 which is driven counterclockwise by sprockets 66 which are powered by a conventional source (not shown). There are nine core stations 68A to 68I for sequential operative steps. Cores 20 are provided at 68A, adhesive applied at 68E by a roller coaster consisting of dip pan 70 and roll 72. At sprocket step 68G sheet 32 contacts core 20 (FIG. 22) and is transferred from finished roll 40 by tuckers 106. Finished roll 40 proceeds to step 68I where it is removed, and the cycle repeated.

FIG. 23 illustrates a similar arrangement incorporating the improvements of an embodiment of the present invention. Tuckers 106 is not longer required, and radially movable member 16 provides for separation of the sheet 32 at the tangent point on finished roll 40.

FIGS. 24 and 25 illustrate the invention as it may be applied to a second conventional winding operation. In the illustrated arrangement web 32 travels from parent roll 74 around idler roll 76 and dancer roll 78, through the conventional tensioning arrangement indicated generally as 80 to transfer roll 12 and core 20. There are six core stations 82A to 82F for sequential operative steps. Cores 20 as provided at 82A, receive adhesive at 82B by means of a roll coaster comprising dip pan 84 and roll 86, contact transfer roll 12 and web 32 at step 82C, complete winding at step 82D, and the finished roll 40 is removed at either station 82E or 82F. Sheet transfer occurs in accordance with the invention as previously described; however, the overall operation of this type of arrangement as previously known is described in U.S. Pat. No. 2,769,600 to which reference may be had for further details.

Means for timing and activating the apparatus of the invention are known and will not be described. It is only necessary that controls be provided that are capable of quick response for maximum benefits to be derived from the present invention. However, the selection of any particular system is not critical and will depend upon the application involved.

Having described the improved method and apparatus for winding multi-ply webs or sheets in terms of preferred embodiments, the invention is not to be limited thereto except as such limitations are incorporated into the claims which conclude this disclosure.

What is claimed is:

1. In a device for winding a web having transverse lines of perforations of the type comprising a frame, a transfer roll rotatably supported by said frame to receive said web for rotation therewith in partial circumferential wrapping engagement, means for sequentially providing a plurality of cores adjacent said transfer roll for receiving said web, means in operative engagement with said transfer roll for periodically urging said web into contact with one of said sequentially provided cores, and means for severing said web into predetermined lengths on said cores to form finished rolls; the improvement wherein said periodically urging means includes a resilient pad having circumferential length about equal to the circumference of said core on said transfer roll, means for moving said pad radially so that said web is caused to sever at one of said transverse lines of perforations at a tangent point on said finished roll.

2. The device of claim 1 further including means for applying tail tacking adhesive comprising means for applying adhesive to each of said sequentially provided cores and a member adapted to move radially outward from said transfer roll and having projections which, when the member is in an outward position, contact said core, remove adhesion therefrom, and apply it to the web at a location adjacent the end of said predetermined length.

3. The device of claim 1 further including means for applying tail tacking adhesive comprising a roll disposed adjacent said transfer roll and having a radially movable member, means for providing adhesive to the surface of said radially movable member in limited areas, and means for urging said adhesive coated limited areas into contact with said web at a location adjacent the end of said predetermined length.

4. The device of claim 1 further including a radially movable knife member in combination with said transfer roll and adapted to reduce the force required to separate said web at the end of said predetermined length.

5. The device of claim 1 wherein an axial cam rod positioned within said transfer roll causes radial movement of said pad.

6. An improved method of rewinding multi-ply sheet products having transverse lines of perforation whereby tail separation problems are minimized comprising the steps of providing a source of said multi-ply sheet product having a length substantially greater than the predetermined length of said rewound product; passing said sheet in partial circumferential wrapping engagement with a transfer roll; providing a plurality of cores for receiving said sheet to form a rewound roll; applying adhesive to the circumferential surface of said plurality of cores in an amount at least sufficient to cause said sheet to transfer thereon; contacting said sheet while on said transfer roll with at least one of said cores having adhesive thereto to cause said sheet to transfer to the core; winding a predetermined length of said sheet onto the core; contacting a second core having adhesive applied thereto with said sheet on said transfer roll to cause said sheet to break and transfer to the second core; positioning said sheet so that the break caused by the transfer of the sheet to said second core occurs at one of said transverse lines of perforations at a tangent to the first rewound roll; and repeating the previous two steps until said originally provided sheet length has been rewound onto said cores.
7. The method of claim 6 further including the step of adding adhesive adjacent the break in said sheet to cause the end of said sheet to adhere to said rewound roll.

8. The method of claim 6 wherein said core contacting steps are accomplished by periodically displacing said sheet radially from said transfer roll to a position where it contacts said adhesive core.

9. The method of claim 6 further including the step of reducing the parting strength at the end of said predetermined length by contact with a knife member.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,791,602 Dated February 12, 1974

Inventor(s) Eric N. Isakson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 56, "curing" should read -- cutting --.
Column 3, line 45, "by" should read -- be --.
Column 3, line 62, "are" should read -- as --.
Column 5, line 23, "coaster" should read -- coater --.
Column 5, line 30, "not" should read -- no --.
Column 5, line 41, "coaster" should read -- coater --.
Claim 2, line 7, "siad" should read -- said --.

Signed and sealed this 9th day of July 1974.

(SEAL)
Attest:

McCoy M. Gibson, Jr. C. Marshall Dann
Attesting Officer Commissioner of Patents