ONE-AT-A-TIME ALTERNATE DISPENSING METHOD

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Abstract

A web roll having a pair of plies equipped with transverse perforations of a specified character which are offset in the different plies so as to provide a source for dispensing through a force-developing nip whereby web segments issue sequentially and alternately.

2 Claims, 6 Drawing Figures
ONE-AT-A-TIME ALTERNATE DISPENSING METHOD

BACKGROUND AND SUMMARY OF INVENTION

Heretofore sequential alternate dispensing of web segments has only been achieved through interfold ing. That is to say, the web segments are partially interleaved so that as one is extracted from a position suitable for manual grasping, its trailing end portion in sure that the leading edge portion of a succeeding interfolded segment comes into the aforementioned grasping position. Illustrative of the product and a means and method for achieving this prior art operat ing is Sabee U.S. Pat. No. 2,626,145. Further illustra tive of the involved expedients employed for providing interfolded web segments is U.S. Pat. to Greiner et al. No. 3,066,932. Even though it would be most desirable to provide a web segment source which would achieve this type of dispensing without the elaborate machinery needed for manufacture and the involved interlining, no one has been able to do so.

An ideal form of the source of web segments is a roll which can be manufactured at high speed and with a minimum of complicated equipment. The idea of a sequential, alternate web segment dispensing roll has been known for many years but without avail—see, for example, Hicks U.S. Pat. No. 400,913 granted Apr. 9, 1889.

According to our invention, there is provided a unique method for developing a much improved roll of the Hicks type and wherein the roll is oriented for dispensing in a novel method to achieve simple, foolproof, sequential alternate dispensing of web segments.

An important feature of the invention is to provide the double web roll with transverse perforations in each web which have slit type perforations with two to 10 inter vening bonds per linear transverse inch and with each bond having a width of the order of 0.01 to about 0.05 inches. The roll made up of the thus specified webs is developed by winding the two webs simulta neously after the same have been perforated incident to the unwinding of the same from parent rolls. In the dispensing of the web segments, the leading edge portion of the web plies is passed through a pressure applying nip which causes the webs to adhere together intermediate the lines of perforation but restricts such con joint movement when a line of perforation of one web enters the aforementioned nip.

The invention is described in conjunction with an illustrative embodiment in the accompanying drawing, in which

FIG. 1 is a fragmentary perspective view of a two web roll incorporating teachings of this invention;
FIG. 2 is a side elevational view, partially schematic, of equipment illustrating the procedure for making the roll of FIG. 1;
FIG. 3 is a side elevational view, partially in section of equipment employed in the method of dispensing the roll of FIG. 1;
FIG. 4 is a schematic side elevational view of the equipment and roll of FIG. 3 shown in one phase of the dispensing operation;
FIG. 5 is a view similar to FIG. 4 but showing the web roll in a different phase of operation; and
FIG. 6 is a schematic side elevational view corresponding essentially to FIG. 4 but which shows certain symbols applied thereto for the purpose of further explaining the technology of the invention.

In the illustration given and with reference to FIG. 1 the numeral 10 designates generally a web roll which includes two webs 11 and 12. It will be appreciated that each web may consist of one or more plies but in the simplest version will have only one ply. Each web may be constructed of a variety of flexible material such as tissue, paper, toweling, etc. Each web is relatively elon gated and the two webs are convoluted wound to form the roll 10—advantageously around a core 13 which normally is constructed of paperboard.

Each web is equipped with equally spaced apart transverse lines of perforation. For example, the web 11 has a first line of perforation 14 and a second line of perforation 15. The web 12 has a first line of perforation 16 and a second line of perforation 17. Thus, the line of perforation 15 in the web 11 falls intermediate the line of perforations 16 and 17 in the web 12. This offset arrangement continues throughout the length of the roll. Advantageously, the line of perforation in one web is very close to the middle of the lines of perforations in the other web and this spaced relationship persists throughout the entire length of the web roll 10.

For the purpose of developing the roll 10 of FIG. 1, the arrangement and procedure depicted in FIG. 2 may be used to advantage. First, it will be appreciated from a consideration of FIG. 1 that by virtue of the two webs 11 and 12 being would convolutely, simultaneously, there will necessarily result an inner web and an outer web. In FIG. 1, the web 11 is the inner web and the outer web is designated 12. In the specific arrangement seen in FIG. 2 the outer web 12 is indicated at the right hand portion of the figure and is provided by a parent roll (not shown). Normally, such a parent roll is provided on an unwind stand, the structure and operation of which can be appreciated from a consideration of Kwitek and Nystrand, U.S. Pat. No. 2,769,600. The inner web 11 is designated in the upper left hand portion of FIG. 2 and is provided from a similar parent roll—unwind stand arrangement.

Following the travel of the web 12 it passes (in mov ing toward the left) between draw rolls 18 and 19. Al though these rolls are depicted schematically, it will be understood that such rolls are suitably journaled within side frames and serve to exert a drawing force or tension on the web 12 so as to unwind it from the parent roll. Thereafter, the web travels with and upon (for a portion of the periphery) a perforating bedroll 20. Each of the rolls depicted in FIG. 2 is suitably journaled for rotation about its own axis. Fixed to the frame (not shown) is a perforating head or knife bar 21 which co acts with the perforating bedroll 20 to develop the transverse perforations 16, 17, etc. Exemplary of apparatus suitable for this perforation is that shown in Kwitek U.S. Pat. No. 2,870,840.

As the web 12 departs from the perforating bedroll 20, it is united with the already perforated web 11. The web 11 meanwhile has passed through the same sequence of operations, i.e., being drawn from its associated parent roll by the action of draw rolls 22 and 23. A guide roll 24 may be advantageously employed to change the direction of travel of the web 11 where the parent roll providing the web 11 is physically associated closely with the parent roll providing the web 12. Frequently double roll unwind stands are employed so that the web 11 must cross over the equipment seen in
FIG. 2. The web 11 travels with and on a perforating bedroll 25 which is equipped with its own knife bar or perforating head 26. After partially traversing the periphery of the perforating bedroll 25, the web 11 passes around a peel-off roll 27 which is arranged so as to detour or delay the web 11 sufficiently to position the perforations therein (as at 14 and 15) intermediate the perforations in the web 12 (as at 16 and 17).

The webs 11 and 12 are united for travel around a portion of the periphery of a slitter bedroll 28. Such a roll is equipped with circumferential grooves in which slitting wheels 29 project so that the combined webs are now separated into a plurality of longitudinally spaced, side by side ribbon-like segments. The width of the ribbons or streamers depends upon the intended use. For example, with toilet tissue, the roll width is 4 1/2 inches so that this then would be the spacing of the slitter wheels 29. Normally, the parent roll will have a width which is a multiple of the width of the individual retail sized rolls 10. Alternatively, in some instances, it may be advantageous to dispense with the slitting function performed by the elements 28 and 29 and perform the separation subsequently as by the use of an orbital saw such as can be seen in Nystrand and Bradley U.S. Pat. No. 3,292,470.

The joined webs 11 and 12 are thereafter caused to pass around the main bedroll 30 which advantageously can take the form of the apparatus seen in Nystrand et al. U.S. Pat. No. 3,179,348. During the travel of the joined webs 11 and 12 on the main bedroll 30, a transverse cut is performed by virtue of a chopper roll 31 after which the webs are wound into retail sized rolls on a mandrel-equipped turret generally designated 32. Details of the turret 32 can be seen in the above identified U.S. Pat. No. 2,769,600.

In some instances, it may be advantageous to perform the perforation of the webs 11 and 12 simultaneously. In that instance, the perforating head or knife bar 26 may be used in conjunction with the bedroll 25. Thereafter the webs 11 and 12 are separated with the web 12 being designated 12' in the central upper portion of FIG. 2 and seen passing around a guide roll 27'. This permits the webs to be maintained in an out of phase relationship relative to the transverse perforations.

With the achievement of a roll of the character seen in FIG. 1, dispensing is advantageously achieved through the arrangement and procedure indicated in FIGS. 3–6.

Exemplary of an advantageous arrangement for dispensing the web segments 33, 34, etc. (being drafted between the transverse lines of perforation 14–15 and 16–17, respectively), is the showing of FIG. 3. There an enclosure 35 is seen to be equipped with a support portion 36 for rotatably supporting roll 10 and an output aperture 35'. In FIG. 3, the combined webs are seen to pass between rolls 37 and 38 which define a nip 39 therebetween. What occurs in this procedure can be more readily appreciated from a consideration of FIGS. 4 and 5. In FIG. 4 the inner web segment 33 is more than half way through the nip 39. On the other hand, the outer web segment 34 just slightly projects beyond the nip 39. In FIG. 5, the roll 10 has been unwound somewhat more than what it was in FIG. 4 and now the line of perforation 15 between the segments 33 and 40 in the web 11 is in the nip 39. Because of the pressure tending to constrict the webs 11 and 12 exerted by the elements 37 and 38, further longitudinal pulling or tension on the web 11 (by virtue of grasping the leading edge of the web segment 33) causes the same to be snapped off, thereby providing a discrete web segment. However, by this time, the web 12 has been advanced so that now the web segment 34 is in position for grasping. Upon the exertion of a longitudinal force, i.e., a pulling force on the web segment 34, the webs 11 and 12 are advanced further through the nip until the line of perforation 17 in the web 12 enters the nip whereupon the segment 34 is detached. It will be appreciated that by the time that this happens a subsequent web length 40 in the web 11 will be available for grasping — this subsequent web segment in the web 11 being the one at the trailing edge of the previously detached web segment 33. Thus, we provide an alternate sequential dispensing of one-at-a-time web segments from a roll which is made up of two webs would convoluted with the perforations staggered or offset relative to each other. It will be appreciated that for optimum operation the offset should be as close to halfway in between as is achievable commercially because then the same amount of graspable web segment will project from the nip 39 each time.

The physical principle employed in the dispensing just described can be appreciated from a consideration of FIG. 6. FIG. 6 corresponds to the stage of dispensing essentially to that seen and described in conjunction with FIG. 5. In FIG. 6 certain symbols are applied and it will be appreciated that the symbol $T_r$ corresponds to the longitudinal pulling force exerted by a person desiring a web segment. In contrast to dispersion from web rolls in the past, the force $T_r$ may be close to being completely longitudinally extending as is possible. It is not necessary to have any lateral component. In the past when dispensing from toilet tissue rolls has occurred, for example, a substantial lateral component has existed in the pulling-off force.

Arranged in opposition to the force $T_r$, is the force equivalent to the resistance of the roll to unwinding, here designated $T_u$. The force $T_u$ can be further broken down into the component forces $T_i$ relative to the web 11 and $T_o$ relative to the web 12.

Not only must the force $T_u$ overcome the resistance to unwinding $T_u$ but in addition must overcome the frictional forces $f_1$ and $f_2$ which result from the application of the force $F$ transverse to the longitudinally extending forces $T_i$ and $T_o$. In the illustration given, the force $F$ is that existing in the nip 39 defined by rolls 37 and 38. It can be developed in a number of ways and one means represented schematically in FIG. 3 is spring or biasing means 41. By spring loading the roll 38, a predetermined nip pressure can be developed on the webs 11 and 12.

The frictional forces $f_1$ and $f_2$ are characterized by the following equations:

$$f_1 = \mu_1 F$$

$$f_2 = \mu_2 F$$

In the above equations the symbols $\mu_1$ and $\mu_2$ are respectively the coefficient of friction between the surfaces of the webs 11 and 12 and the surfaces of the nip-providing elements 39 and 38. Also designated in FIG.
3,770,172

6 is the force \( f_w \). This is defined by the following relationship:

\[
f_w = \mu_a F
\]

The symbol \( \mu_a \) represents the coefficient of friction between the web 11 and 12.

For the phase of the dispensing procedure illustrated in FIG. 6, it will be appreciated that both \( \mu_a \) and \( F \) are significant. \( f_w \) must be large enough to prevent relative movement between the webs 11 and 12. For quite smooth-surfaced webs, to avoid such relative movement where the coefficient \( \mu_a \) will be relatively low, it is necessary to correspondingly increase the force \( F \), i.e., develop greater pressure on the combined webs in the nip 39. However, we ordinarily provide the nip-defining elements 38 and 39 with suitably smooth surfaces so that the frictional forces \( f_1 \) and \( f_2 \) are smaller than \( f_w \). It will be appreciated that \( F_n \), the frictional force between the webs 11 and 12, must be greater than either of the frictional forces \( F_1 \) and \( F_2 \) between the webs and the confronting surfaces of the nip-providing elements 28 and 29. Advantageously this is achieved by providing the nip-defining elements 38 and 39 as rollers which are freely journaled within the enclosure 35 with one or both of the rollers 38 and 39 being spring loaded to develop the appropriate constricting force \( F \). However, the nip-defining element 38 and 39 may be stationary elements and the invention here contemplated the use of either or both of the elements 38 and 39 as rollers or stationary elements.

Thus, with the frictional force \( f_w \) greater than either of the forces \( f_1 \) and \( f_2 \). The equation representing the phase illustrated in FIG. 4 is:

\[
T_n = T_w + f_1 + f_2
\]

(4)

In equation (4) above, \( f_2 \) does not figure because it is counterbalanced by an equal and opposite force since there is no relative movement between the webs. Further, inasmuch as \( T_n \) is relatively low — no resistance being added to the unwinding of the roll 10, the controlling factors are the frictional forces \( f_1 \) and \( f_2 \). As pointed out above, the coefficients of friction making up the forces \( f_1 \) and \( f_2 \) are also by choice quite low, the controlling factor for unwinding is the constricting force \( F \). However, the force \( F \) must not be so great as to cause the combined resistance to dispensing to exceed the strength of the web between perforations, viz.,

\[
S_p > T_n + F (\mu_1 + \mu_2)
\]

(5)

In the above equation, \( S_p \) is the dispensing strength of the unperforated web showing the necessary condition for removing webs from the container 35. However, the value of the constricting force \( F \) must be sufficiently great as to ensure severance at a perforation downstream (after) the nip 39. This is represented by the following equation:

\[
S_p < T_n + F (\mu_1 + \mu_2)
\]

(6)

Combining equations 5 and 6 we have:

\[
S_p < T_n + F (\mu_1 + \mu_2) < S_n
\]

(7)

which describes the condition necessary for the perforation on the pulled web to break and dispense one segment.

An important factor in the foregoing equation is the strength \( S_n \) which corresponds to the strength of the perforated web at the perforation and we find that optimum results are obtained in a cellulose web wherein the perforation 14–17 are of a slit of lineal type so as to provide from about two to about 10 bonds per inch with each bond having a width of about 0.01 to about 0.06 inches. By bonds, we refer to the narrow neck-like or isthmus-like portions B (see FIG. 1) which extend between adjacent perforations P. Where the bonds are too weak, there is the risk that the resistance to unwinding, corresponding to the total tension force \( T_n \) required to unwind the product will be of insufficient magnitude as to cause web separation upstream of the nip 39. Where the bond arrangement is such as to provide a cumulative strength greater than that which is effectively controlled by the force \( F \), detachment of web segments at the nip 39 may not occur.

Although the method of preparing the roll 10 tends to cause the webs 11 and 12 to adhere together somewhat (by virtue of their conjoint movement over the slitter bedroll 28 and the main bedroll 30), such does not insure that the inner web 11 will always travel with the outer web 12 during unwinding — in the absence of the inventive dispensing procedure. For example, a significant drawback of the offset perforated rolls used alone was that they worked only part of the time. When the inner sheet 11 was grasped the outer web 12 followed. However, when the outer web 12 was grasped the inner web 11 sometimes followed but sometimes would itself around the roll 10, i.e., followed the contour of the roll 10 rather than the outer web 12. By virtue of providing the nip 39 this signal drawback is obviated.

Testing of various webs such as facial tissue and industrial embossed towing where the width of the webs was nine inches and the normal force \( F \) two pounds, the force required to unwind the roll was only 0.2 pounds. Since the pulling force is localized between the thumb and forefinger, the separating force at perforation is transmitted longitudinally to just a few bonds. These few bonds break first, followed by complete separation. Thus the total strength of all the bonds may be twice or several times greater than the pulling force required for separation.

On three different facial tissues with different bond patterns, the total bond strengths were 1.3, 1.7, and 2.5 pounds respectively, and the pulling force required was between 0.8 and 1.0 pounds. In all three cases the coefficient of friction between the plies or webs was 0.5.

On the industrial embossed towing, the coefficient of friction between the plies or webs was 0.6 and the total bond strength 12.6 pounds, with a pulling force required for separation of 2.0 pounds.

We claim:

1. A method of providing discrete, substantially identical web segments for one-at-a-time sequential alternate dispensing comprising the steps of
perforating a pair of elongated webs at a plurality of equally longitudinally spaced apart transversely extending lines, superposing said webs and convolute winding said webs while spacing the lines of perforations of one web intermediate the lines of perforations of the other web to provide a web roll having a tail wherein one web projects beyond the other, and exerting an unwinding force on the tail of said one web while subjecting the superposed webs to a second force generally normal to the first mentioned force and which second force tends to adhere said webs together.

2. A method of sequential delivery of web segments alternately from a double wound web roll comprising providing a web roll having a pair of substantially identical elongated webs each being perforated at a plurality of equally longitudinally spaced apart transversely extending lines with the lines of perforation of one web being intermediate the lines of perforation of the other web, exerting an unwinding force on one web while subjecting the superposed webs to a second force generally normal to the first mentioned force and which second force tends to adhere said webs together, advancing the first web until a line of perforation therein is aligned with said second force, said second force being of a magnitude sufficient to cause said pulling force to detach a segment from said first web, and thereafter applying a pulling force to said second web.

* * * * *
CERTIFICATE OF CORRECTION

Patent No. 3,770,172  Dated November 6, 1973

Inventor(s) Ernst Daniel Nystrand and Archie S. Krueger

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

Page 1 of the printed matter, Item [75], the name of the second inventor should be Archie S. Krueger.

Signed and sealed this 14th day of May 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.  C. MARSHALL DANN
Attesting Officer  Commissioner of Patents