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Bradley

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[54] **METHOD AND APPARATUS FOR TRANSVERSE FOLDING OF WEBS**

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[73] Assignee: **Paper Converting Machine Company**, Green Bay, Wis.

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[52] **U.S. Cl.** ..... **270/68 R**, 270/69, 270/72

[51] **Int. Cl.** **B65h 45/14**

[58] **Field of Search** ..... 270/66, 69, 71–72, 270/68 R; 93/84 R, 84 FF

[56] **References Cited**

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Attorney, Agent, or Firm—Dawson, Tilton, Fallon & Lungmus

[57] **ABSTRACT**

A method and apparatus for transverse folding of webs of discrete length to provide napkins, hankies, or the like, in which a first folding roll is equipped with a pair of vacuum ports selectively actuatable to provide a double transverse fold.

1 Claim, 6 Drawing Figures

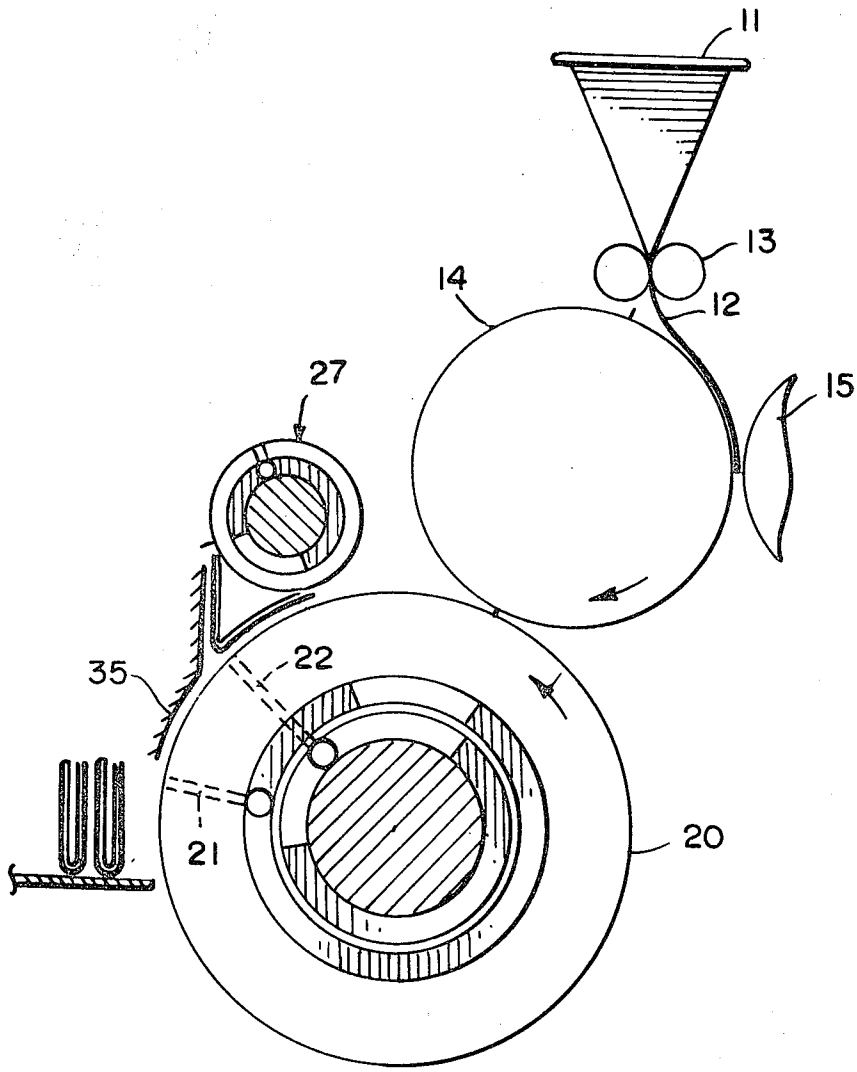


FIG. 1

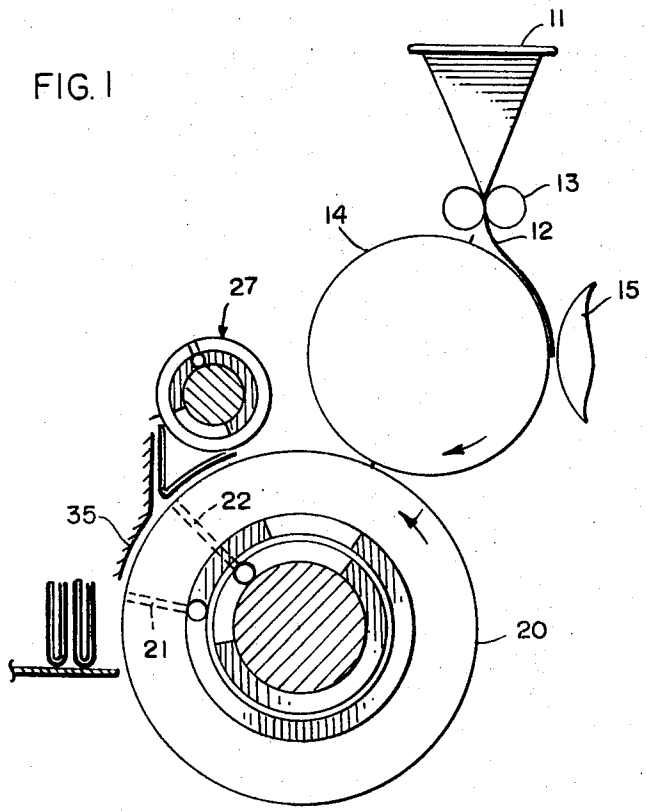


FIG. 2

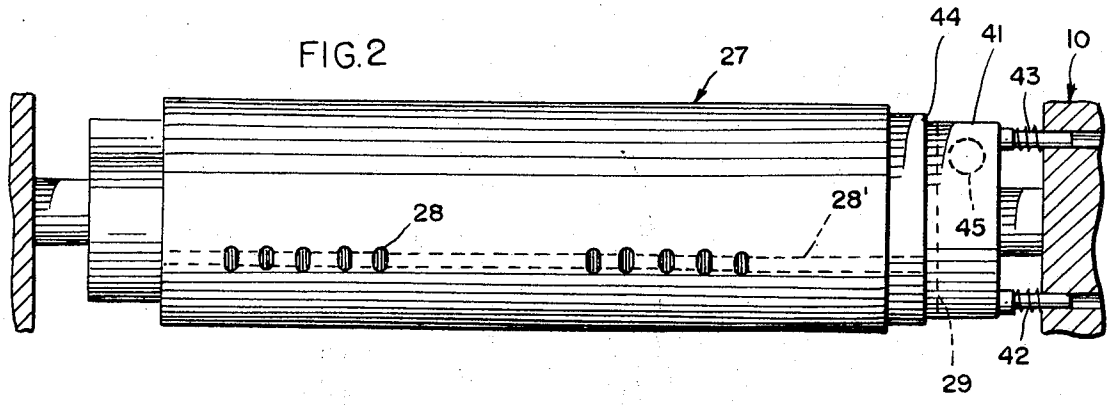


FIG. 3

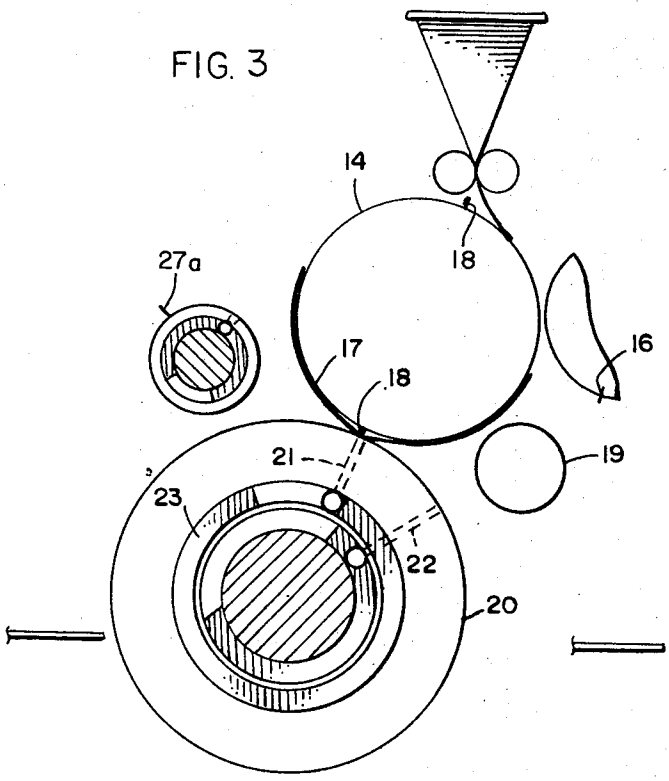


FIG. 4

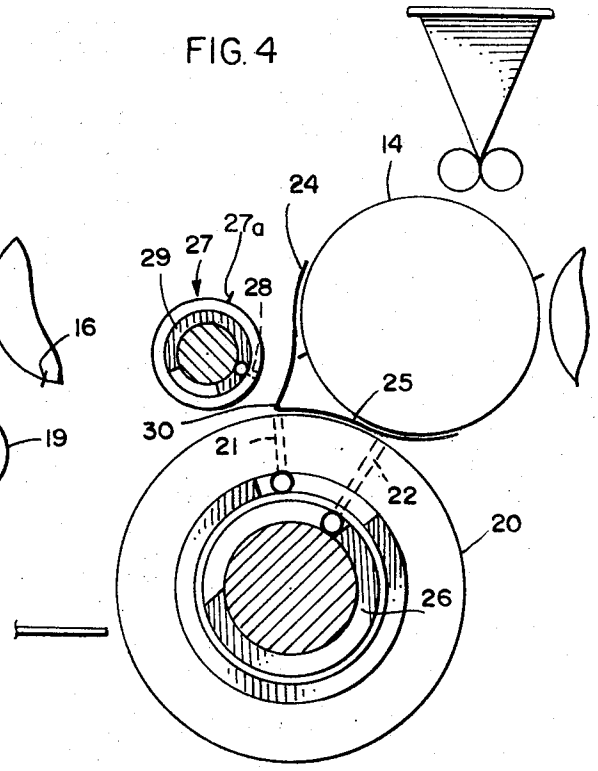


FIG. 5

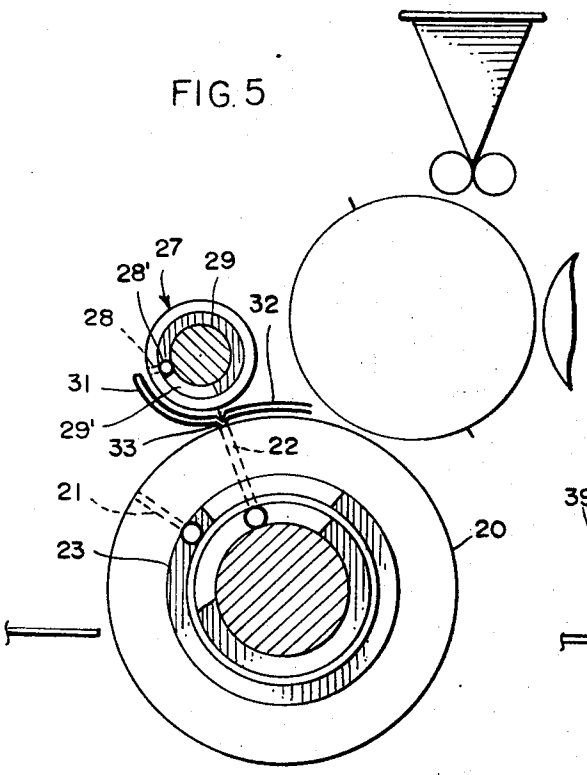
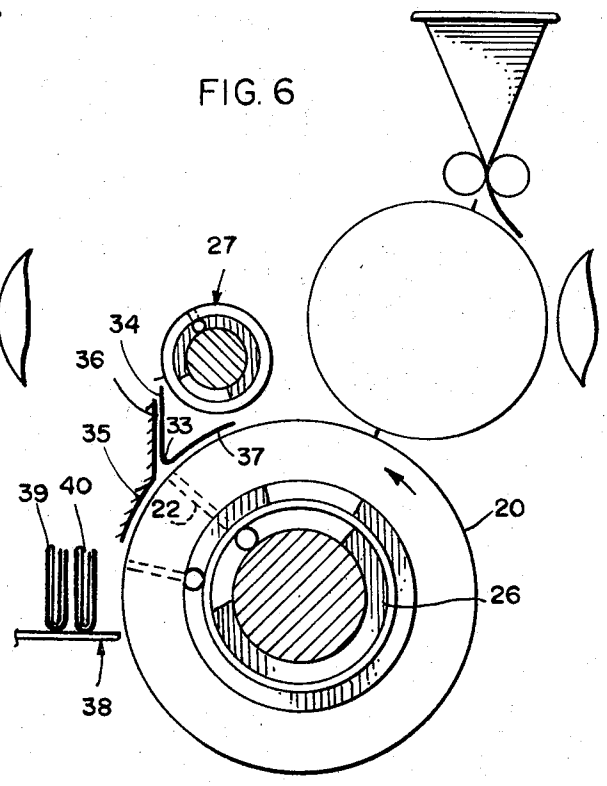


FIG. 6



METHOD AND APPARATUS FOR TRANSVERSE FOLDING OF WEBS

BACKGROUND AND SUMMARY OF INVENTION

This invention is an improvement over prior art machines such as can be seen in co-owned U.S. Pat. Nos. 1,566,079 and 3,689,061. Historically, the machinery employed for double transverse folding included a cutoff and carrier roll mechanism for separating the continuous web into discrete lengths. The carrier roll had vacuum ports so as to temporarily maintain each severed segment in general wrapping engagement. This much of the prior art is utilized in the instant invention. However, according to the prior art, the discrete segment was removed by a first folding roll which was adapted to apply a withdrawal force (as by vacuum) to the midlength portion of the segment temporarily supported on the carrier roll and perform only the first transverse fold. Thereafter, a second folding roll picks off (again as by vacuum) the midlength portion of the already once folded segment to develop the second transverse fold. This geometry, in operation, was subect to definite speed limitations, and I have determined that the limiting factor stems from the structure and relationship of the first and second folding rolls.

According to the invention, an entirely new form of folding arrangement is provided wherein the first folding roll maintains control over the segment during both transverse folds, and, for this purpose, is equipped with a pair of circumferentially spaced vacuum ports. Through this arrangement, the speed limitation of the prior art is overcome. Other advantages and objects of the invention may be seen in the details of construction and operation set down in the ensuing specification.

DETAILED DESCRIPTION

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

FIG. **1** is a side elevational view in essentially schematic form of the preferred embodiment of the invention;

FIG. **2** is an end elevational view of a portion of the apparatus for practicing the invention, and illustrating the third dimension of the inventive machine;

FIG. **3** is a view essentially similar to FIG. **1**, but which shows the arrangement of machine components at the beginning of the first folding step, i.e., the step of transferring the web segment from the carrier roll to the folding roll;

FIG. **4** is a view similar to FIG. **3** but which features a subsequent stage of the inventive method, i.e., the first transverse fold being formed;

FIG. **5** is a view similar to FIGS. **3** and **4**, but which represents yet a subsequent stage in the development of the twice folded web segment and which shows the first transverse folded leading edge transferred to a second folding roll; and

FIG. **6** is a view essentially identical to FIG. **1** but which features a stage in the practice of the invention subsequent to that shown in FIG. **5** and wherein the second transverse fold is being formed.

Referring first to FIG. **2**, the numeral **10** designates generally a frame of the machine which is provided to support in rotatable fashion the plurality of rolls employed in the practice of the invention. It will be appreciated that the mounting and drive for the rolls can be achieved in conventional fashion, so that details thereof are omitted here.

Referring now to FIG. **1**, the numeral **11** designates generally a folding board which is advantageously mounted on the frame **10**, and which serves to develop a longitudinal fold in a web **12**. Cooperating with the folding board **11** are a pair of draw rolls **13** also usually rotatably mounted on the frame **10**.

The web **12**, during its passage through the machine, thereafter moves into partially wrapping engagement with a carrier roll **14**. Cooperating with the carrier roll **14** (again in conventional fashion) is a cutoff roll **15** which is equipped with the usual knife blade **16** so as to develop a web segment **17** (see FIG. **3**). In the illustration given, the diameter of the carrier roll **14** is twice the size of the cutoff roll **15**. Additionally, the carrier roll **14** is equipped with a pair of creasing bars **18** which cooperates with a creasing roll **19** constructed and arranged in accordance with the teachings in U.S. Pat. No. 3,689,061.

Located on the frame **10** in juxtaposition to the carrier roll **14** is a first folding roll **20**. In the illustration given, the folding roll **20** has a diameter three times the diameter of the cutoff roll, and therefore has a 3:2 relationship to the carrier roll **14**.

The function of the first folding roll **20** can be readily appreciated from the operational sequence set down in FIGS. **3–6**. Before going into the structural details of the first folding roll **20**, a brief description of that operation will be given, making reference to a first vacuum port or passage **21** and a second vacuum port or passage **22** — it being noted that the first vacuum port **21** leads the second vacuum port **22**, i.e., being first when considered in the direction of rotation of the first folding roll **20**.

Referring now to FIG. **3**, it will be noted that the first vacuum port **21** is aligned with a midlength portion of the web segment **17**. At this instant in time, a source of vacuum (not shown) is in communication with the first vacuum port **21** by virtue of the fact that the port **21** is aligned with an interruption in the stationary blanking ring **23** (still referring to FIG. **3**). At this stage in time, the web segment **17** is no longer urged against the carrier roll **14** — the vacuum port (not shown) in the carrier roll **14** no longer being communicated to a source of vacuum. Thus, the first vacuum port **21** in the first folding roll **20** applies a withdrawal force to the web segment **17** and, preferably, at the raised portion developed by the creasing bar **18**.

Reference is now made to FIG. **4** which illustrates the configuration of machine elements a short time later than the configuration depicted in FIG. **3**. In FIG. **4**, it will be seen that the web segment, now designated **24**, has been substantially removed from the carrier roll **14** with the trailing portion **25** moving into wrapping engagement with the first folding roll **20**. At the stage in time depicted in FIG. **4**, the first vacuum port **21** is still subjected to vacuum so as to maintain a midlength portion of the segment **24** in engagement with the first folding roll **20**. However, by this time, the second vacuum port **22** has come into communication with the source of vacuum — by virtue of the fact that it is aligned with the interruption in the stationary blanking ring **26**. Through this arrangement and operation a superior control over the trailing portion **25** is achieved, viz., circumferentially spaced vacuum ports as at **21**

and 22 are both exerting a controlling force on the trailing portion 25. A short time later, in the rotation of the first folding roll 20 (see FIG. 5), finds the first vacuum port 21 disconnected from the source of vacuum by virtue of now being aligned with the blanking ring 23. This removes the control force on the midlength portion of the web segment 24, permitting the same to be diverted by virtue of a positive diverting force exerted by the second folding roll 27. The second folding roll 27 (see FIG. 4) is equipped with its own crease bar 27*a*, a vacuum port, as at 28, and a suitable stationary blanking ring 29. Between the times represented in FIGS. 4 and 5, the vacuum port 28 comes into alignment with the midlength portion 30 of the web segment 24 (see FIG. 4) and causes it to move away from the orbital path it previously had been following by virtue of having been maintained against the surface of the first folding roll 20. In practice, the blanking ring 29 in the second fold roll 27 is arranged relative to the blanking ring 23 in the first folding roll 20 so that vacuum is applied to port 28 at the time vacuum is removed from the port 21. This results in the leading portion 31 of the now once-folded web segment 32 (see FIG. 5) being moved to the condition pictured in FIG. 5. In FIG. 5, the vacuum port 28 has just moved into alignment with the blanking ring 29, so that the diverting force previously referred to is no longer effective and the web is in a condition to proceed to the form depicted in FIG. 6. Meanwhile, vacuum is still applied to the second vacuum port 22 of the first folding roll 20, so that the third quarter length 33 of the once-folded segment 32 is maintained against the first folding roll 20. This phenomenon results in the development of the second transverse fold, much the same as the operation of the first vacuum port 21 which resulted in the development of the first transverse fold.

Now, referring to FIG. 6, the once-folded web segment designated 34 is seen completely removed from engagement with the second folding roll 27, and is in the process of being confined between the surface of the first folding roll 20 and an ironing shoe 35 also advantageously mounted on the frame 10. The ironing shoe 35 tends to urge the diverted portion 36 of the once-folded segment 34 into contacting or conforming relation with the remaining portion 37 of the once-folded segment 34. After the roll 20 has rotated further in a counterclockwise direction than that pictured in FIG. 6, the second vacuum port 22 becomes aligned with the stationary blank ring 26, so that there is no longer a force tending to maintain the twice-folded web segment against the first-folding roll 20. At that stage, the third quarter portion of the web segment 34 encounters a take-away mechanism generally designated 38 which is arranged to support previously twice-folded segments as at 39 and 40 in stacked, generally planar condition.

A numer of significant advantages accrue from the method and apparatus just described in comparison to the method and apparatus used in the past. In the past, it has been necessary to physically transfer the once-folded web from a first-folding roll to a second-folding roll. This has had to be achieved in a relatively short period of time, which makes it difficult to maintain adequate control over the once-folded segment, particularly when higher speeds are desired. For example, a very limited amount of time is available to apply the vacuum on the second folding roll in the prior art arrangement. Further — according to the prior art —, when transferring the once-folded web from a first to a second folding roll, it was necessary to have the vacuum port in the second folding roll applied to a midlength portion of the once-folded web. In other words, in the prior art arrangement, the vacuum port in the second folding roll had to engage and effect a transfer on the third quarter length portion as at 33 in FIG. 5 hereof. This taxed the vacuum system, and also constituted a speed limitation. On the other hand, according to the invention, no physical transfer of the once-folded web segment is needed for effecting the second transverse fold. All that is required is the slight diversion of the leading edge portion of the once-folded web as is exemplified in FIG. 5. Still further, according to the prior art machines, it was necessary to use a relatively small-diameter first-folding roll. This resulted in high centrifugal forces, tending to make the once-folded web segment — viz., napkin or hankie — leave the first-folding roll, so that control became difficult. However, according to the invention, it is no longer necessary to transfer the midlength portion of a once-folded web (more precisely, the three-fourths length portion of the initial segment) from one roll to another. Also, through the practice of the invention, a much larger diameter first-folding roll is available which not only results in a lower centrifugal force, but also a more favorable meeting angle, i.e., greater length of tangency, and yields more time to establish the vacuum in the first-folding roll.

Now referring to FIG. 2, the third dimension of the apparatus can be seen. Inasmuch as the general arrangement of folding machinery in this third dimension is conventional for the most part, only a fragment of the apparatus is pictured. For this purpose I have selected to show only the second-folding roll 27, and it will be appreciated that a similar support is provided for the other rolls. Again, the numeral 28 represents the vacuum port in a second-folding roll 27. In the illustration given, I employ a plurality of ports for each web, and it will be seen that there are two groups of ports so as to accommodate two webs side-by-side in the machine. It will be appreciated that, by lengthening the roll 27 (and the other rolls in the apparatus), a greater number of webs can be processed simultaneously. To apply vacuum to the ports 28, a stationary manifold 41 is supported by the frame 10 and urged against the rotating end face 44 of second-folding roll 27. In the illustration given, this is advantageously achieved by equipping the manifold 41 with laterally extending pins as at 42, which are spring-urged as at 43 away from the frame 10, causing the manifold 41 to bear against the end face 44. The confronting face of the manifold 41 is equipped with the blanking ring 29. As can be appreciated from a consideration of FIG. 5, the blanking ring serves to control the application of vacuum to the vacuum port 28. In the illustration given, the source of vacuum (not shown) is connected to the manifold 41 by means of a passage 45. As the roll 27 rotates, the longitudinal bore 28′ comes into alignment with the interruption 29′ in the stationary blanking ring 29, thus communicating the ports 28 with the vacuum source.

SUMMARY OF OPERATION

In FIG. 3 there is shown the beginning of the transfer of the discrete length web segment 17 from the carrier roll 14 to the first-folding roll 20. The crease bar 18

helps to define the first transverse fold which is located immediately forward of the place of engagement of the web segment **17** with the first vacuum port **21.**

FIG. **4** shows the first transverse fold being formed, and with both vacuum ports **21** and **22** in the "on" condition to hold the trailing portion **25** of the web segment **24** against the folding roll **20.**

Between the steps illustrated in FIGS. **4** and **5,** the vacuum is removed from the port **21,** while vacuum is applied to the port **28** in the second folding roll **27,** which results in initially diverting the midlength portion **30** from the orbital path it was following when traveling on the first folding roll **20** and into a path whereby it follows the rotation of the second folding roll **27** — the end of this travel being illustrated in FIG. **5.** Meanwhile, vacuum continues to be applied to the second port **22** which is aligned with what I have termed the third quarter length portion of the web segment, i.e., **33.**

Lastly, when vacuum has been disconnected from the port **28,** the second transverse fold can be achieved, and this is illustrated in FIG. **6.** Remaining on the folding roll **20** is the fourth quarter portion of the web, as at **37,** and the diverted portion **36** is urged against this fourth quarter portion **37** by means of a shoe, roll, or like structure for defining a confined path of travel.

I claim:

1. In a method of producing napkins, hankies or the like from an elongated web, the steps of advancing a continuous web into wrapping engagement on a rotating carrier roll, severing said web on said carrier roll to provide a sequence of separate web segments while temporarily maintaining each segment in general wrapping engagement with said carrier roll, rotating a first folding roll adjacent to and in synchronism with said carrier roll and in a direction opposite the direction of rotation of said carrier roll, applying vacuum to a first vacuum port in said first folding roll when a midlength portion of each segment on said carrier roll is aligned with said first vacuum port to start withdrawing each segment from said carrier roll while forming a first transverse fold of each segment about a first fold line located at the midlength of each segment, continuing rotating said first folding roll while causing each web segment portion immediately behind said first transverse fold line to move in a path diverging from the rotation of said carrier roll and thereby bring the trailing portion of each web section behind said first transverse fold line into engagement with said first folding roll with the previously leading portion superimposed thereon, then applying vacuum to a second vacuum port in said first folding roll, said second vacuum port being located behind said first vacuum port approximately one-quarter legnth of a web segment while continuing to apply vacuum to said first port whereby for a discrete time the said trailing portion is held against said first folding roll by simultaneous application of vacuum to both of said ports, thereafter substantially simultaneously terminating the application of vacuum to said first port and applying vacuum to a port in a second folding roll positioned adjacent said first folding roll to bring the leading edge of each web segment adjacent said first transverse fold into wrapping engagement with said second folding roll and to positively divert said leading edges from wrapping engagement with said first folding roll to commence the development of a second transverse fold adjacent said second port, thereafter terminating the application of vacuum to said second folding roll port while continuing to apply vacuum to the second port of said first folding roll, urging the portion of each web segment diverted by said second folding roll into general conformity with the trailing portion remaining held by said second vacuum port on said first folding roll, and terminating the application of vacuum to said second port and removing in generally planar configuration the twice transversely-folded segment from engagement with said first folding roll.

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