ABSTRACT

An automatic, variable, high speed, plastic-bag-folding machine which takes flat plastic bags, rolls, folds, flattens and packages the bags; the machine consists of a conveyor belt assembly which is fed by the discharge of a plastic-bag-making machine and which feeds the bags into rolling, folding and multi-bag packaging sections, all synchronized by a pneumatic control system. The machine first produces a tubular, rolled bag by feeding the bag into a circularly disposed set of centrally gaped, interdigitated driven rollers, which is then ready for withdrawal and folding.

Having formed the rolled bag, an elongated compressed air nozzle located above and near the middle of the tubular bag jets or blows against the center of the tubular roll blowing the flexible bag down and out of the rolling section through its central gap, producing a half-fold; as the bag is blown out of the rolling section, it is passed between two sets of inwardly biased rollers to flatten the bag and then driven into the multi-bag packaging section. The multi-bag packaging section includes two laterally but oppositely disposed collection boxes between which is located a mechanical diverter. When the appropriate number of bags have been folded and collected in one collection box, the collected bags are transferred into a commercial packaging box, while the subsequently folded bags are diverted into the other collection box and the sequence continuously repeated.

20 Claims, 4 Drawing Figures
HIGH SPEED MACHINE AND METHOD FOR FOLDING PLASTIC BAGS AND THE LIKE

REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of the prior, copending application entitled "Machine And Method For Folding Plastic Bags And The Like," Ser. No. 92,087, filed Nov. 23, 1970, being issued as U.S. Pat. No. 3,671,033, June 20, 1972.

BACKGROUND OF THE INVENTION

The present invention relates to an improved, high speed bag-folding and packaging machine particularly designed to handle sheet or flat plastic materials, although other equivalent sheet materials may be processed, such as are used for plastic bags. The function of the machine is to receive the discharged bags from a bag-making machine at any given rate and to automatically process, fold and package the bags so that they are ready for commercial distribution.

The present invention is directed to an improved high speed version of the bag folding machine and method disclosed in my prior, copending application entitled Machine And Method For Folding Plastic Bags And The Like, Ser. No. 92,087, filed Nov. 23, 1970, being issued as U.S. Pat. No. 3,671,033, June 20, 1972, and in particular is directed to an improved means of removing the bag from the roller section of the bag folding machine. For completeness and an even fuller understanding of the present invention, the entire disclosure of the above-identified prior, copending application should be read in conjunction herewith, and its disclosure is hereby fully incorporated herein by reference thereto.

Because of the inherent speed capability involved in the positive mechanical, moving pin action used to remove the bags from the rolling section in the previous machine, it has had some application limitations, limitations which the present invention is directed to overcome. The present invention does this by, broadly speaking, substituting for the moving pin a centrally located air jet ejecting means, which by a jet or blast of air blows the bag out of the rolling section. It thus can operate much more rapidly.

As a matter of comparison, the prior machine handled bags at speeds of sixty bags per minute while the present invention has been run at a speed of over a hundred-and-twenty bags per minute. The speed potential of the present invention is practically unlimited.

Additionally, the present invention utilizes a different, improved multi-bag packaging section which includes two separate bag collection sections with a mechanical diverter which allows the final packaging to be carried on independently of the collection function, further enhancing the speed handling capability of the machine.

The present invention is particularly useful when folding small bags which are relatively easily blown out of the rolling section, and is inherently simpler in structure and correspondingly more reliable and cheaper to build.

Various other objects, distinctions and advantageous features of the present invention will become apparent from the description of the preferred embodiment below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a right, side view of the major working portion of the complete machine of the present invention, showing a part of the conveyor belt assembly and the rolling, folding and multi-bag packaging sections;

FIG. 2 is an end view, partially in cross-section (along section lines 2—2 of FIG. 1), of the rolling, folding, and multi-bag packaging sections, showing a bag being blown out of the rolling section into the folding section;

FIG. 3 is a perspective view of the diverter system used to guide the folded bags to one of the two collection boxes in the multi-bag packaging section; and

FIG. 4 is a cross-sectional view (along section lines 4—4 of FIG. 2) of the air jet ejector which blows the bag out of the rolling section into the folding section.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the present invention is a high speed machine for taking plastic bags, ultimately folding them flat, and packaging a certain number of the folded bags into boxes in a positive, continuous and automatic manner.

With reference particularly to FIG. 1, a discharged bag from a bag-making machine is fed into an upper 101 and lower 102 set of continuous or endless conveyor belts running in contact with each other at the same surface speed, each set consisting of eight two-inch-wide belts. The bag is held firmly between these belts and conveyed to the rolling section of the machine. The belts 101, 102 are driven by drive rolls 105, 106, respectively. (For purposes of comparison, many of the elements of the present invention are numbered similarly to the elements in the prior copending parent application but starting with a hundred series; thus for example conveyor belts 101 and 102 and rollers 105 and 106 hereof are functionally and structurally the same as elements 1, 2, 5 and 6, respectively, of the prior application.)

The belts 101, 102 are supported by suitable idler rollers conveniently placed along the belt path as desired and are driven by a suitable sprocket drive system. Belt tension is maintained on the belts 101, 102 by spring loaded tensioners, each belt having independent tensioners.

As best seen in FIG. 1, the belt sections 101, 102 feed the flat, unfolded bag into a group of intermeshing or interdigitating, driven rollers 112 whose surface interaction with the bag cause it by a positive driving action to be wound into a roll 100. The axes of the rollers 112 are disposed about 270° of a circle, leaving an opening into the bag rolling section into which the belt sections 101, 102 feed the bag. The peripheries of the rollers 112 facing inwardly into the circle thus define a generally circular, moving surface which drives the bag around into a roll. Driving force is transmitted to the bag by friction between the rubber surface of the rollers 112 and the bag itself. Also the belts 101, 102 push the bag into the rollers 112.

Although the axes of the rollers 112 are shown disposed in a precise circle, merely a curved disposition is satisfactory. Moreover, although approximately two hundred and seventy degrees of the curved rolling section formed by rollers 112 has been illustrated, it is possible to get a rolling section with much less coverage. It is only necessary to supply sufficient coverage so that
the bag would have a tendency to roll back upon itself and form a roll as it proceeds into the rolling section. As a normal rule it will usually require at least 180° of coverage to properly form a roll.

The rollers 112 thus form in effect a laterally and horizontally disposed cul-de-sac having an inner moving surface for driving the bag into a roll. Although, it is possible to introduce the bag into the rolling section at another angle or direction than that shown, it is particularly advantageous to introduce it at the bottom lip of the cul-de-sac so that as the bag is driven upward it has a tendency to roll back upon itself.

As brought out in detail in the prior parent application particularly with reference to FIG. 10 thereof, rather than a series of interdigitated rollers, the rolling section could be formed of a continuous curved belt system.

Centrifugal force, bag material stiffness and the increase in the bag diameter as it is being rolled contribute to the normal force which holds the bag against the drive rollers 112 surface and positively guide it to its rolled condition. The surface speed of rollers 112 is usually designed to be twenty-to-thirty per cent greater than belts 101, 102. Provided sufficient friction is maintained between the bag and drive rollers 112, the bag will completely roll up. The bag is thus changed from a large, flat sheet to a rolled cylinder, the first step in the folding process, without the necessity of a solid inner mandrel, as was often required in prior art rollers and folders.

To prevent the bag from escaping between the rollers 112, the rollers 112 have alternating protruding sections which interdigitate or intermesh with the adjacent rollers, as best shown in FIG. 2. This can be achieved by placing alternating rubber sleeves on the roller shafts as shown. The degree of interdigitation or intermeshing can be controlled by varying the sleeve width, diameter, spacing and thereby the amount of overlap or intermesh. Friction characteristics of the system can of course be varied by changing the sleeve material and hence its properties.

Although in the disclosed embodiment all the rollers 112 are driven at the same speed, their speed could be different. Particularly each roller 112 could be run at a higher speed than its immediate neighbor so that the last roller to touch the bag will be running at a higher speed than the initial roller.

It is noted that the inside diameter of the rolling section is directly proportional to the width of the folded bag. Therefore any change in the diameter will effect proportionally the width of the folded bag.

In order to permit the removal and flat folding of the rolled bag in a manner explained below, the rollers 112 do not extend the full width of the machine but rather are centrally gaped, that is, they are divided into two equal, separate but interconnected side sections. The central region between the central supports of the side sections of the rollers 112 is thus basically open.

Thus, as can be seen, entry of the bag 100 into the machine and rolling of the bag are essentially the same as that described in the prior parent application. However, the means of removal of the rolled bag 100 and subsequent folding and packaging of the bags is substantially different and will now be described in detail.

Rather than being removed by an elongated mechanical pin moving across the open, central region, the rolled bag 100 in the present invention is blown out by means of a horizontally disposed, downwardly directed air jet ejector which includes an extended or elongated nozzle 113 fed by air line 114. When the bag 100 is completely rolled, compressed air is supplied through line 114 to nozzle 113. Flow from the nozzle 113 is directed down at the bag 100, driving the bag 100 down into the initial rollers 115 (note FIG. 2).

The nozzle 113 is constructed to produce a thin elongated line of air which has a knifing effect as the air impinges on the bag 100 and extends substantially across the width of the rolling section. As shown in FIG. 4, this is accomplished by discharging the air from the nozzle 113 through an extended line of small orifices 129, or alternatively through a continuous thin slot (not illustrated). Internally to the nozzle 113 the orifices 129 are joined together by a lateral chamber 128 which through central line 127 and coupling 126 is connected to air line 114.

Initial rollers 115, 115' nip the bag 100 and pull and draw the bag 100 down from the rolling section. Bag 100 is then further driven by rollers 115 and 115' into a second set of opposed nip rollers 116, 116'. Rollers 116, 116' have less separation gap than rollers 115, 115' and provide a more positive nip or fold. Rollers 116, 116' also crease the plastic bag 100 which is desirable.

The folded bags 100 are directed by diverter 121 through a third, auxiliary nip section composed of rollers 116 and 117, or 116' and 117', depending on the position of diverter 121. The diverter 121 is generally speaking triangular in cross-section but has curved sides. As best shown in FIGS. 2 and 3, the selected diversion is accomplished by swinging or pivoting the diverter 121 about shaft 122. Force to move the diverter 121 is provided by air cylinder 125 which pushes or pulls link 124 which is connected to arm 123 as shown. Nips 116 and 117 or 116' and 117' further crease the bag and drive the bag into collection box 120 or 120', respectively. Diverter 121 thus position-controls the direction of the bag 100.

After a sufficient number of folded bags 100 are collected in one of the collection boxes, the diverter 121 positions itself to the other side to begin a new collection of folded bags in the other collection box while the previously collected bags are then commercially packaged in boxes. This dual collection box system further enhances the speed capability of the present invention.

Rollers 115, 115', 116, 116', 117 and 117' are all driven in the directions indicated (note arrows in FIG. 2) by means of a gearbox 118. Motor 119 drives the gearbox 118 at the desired speed. The surface speed of rollers 116 and 116' is equal to or greater than the surface speed of rollers 115 and 115'.

In most if not all of the prior art machines using a rolling technique prior to the folding, a certain degree of rigidity of the material being folded was necessary. By using a relatively high speed conveying drive, the relatively rigid type of material such as paper could be driven into a system of static circular guides to thereby form a roll. However, plastic bag or sheet material, having practically no rigidity, does not consistently work with such prior art machines.

The present invention provides, not a static guide, but rather a guide that generates or has its own driving force. The two particular embodiments disclosed of the present invention for the rolling section, namely, a set of driver rollers circularly disposed and a continuous
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The machine of claim 2 wherein said rolling section is a continuous, endless moving belt system which follows a curved path.

6. The machine of claim 2 wherein said rolling section forms a laterally and horizontally disposed cul-de-sac, the material being introduced into the cul-de-sac formed by said rolling section at its lower lip.

10. The machine of claim 2 wherein said extended pneumatic member includes a horizontally disposed, downwardly directed air nozzle means for producing a thin knife-like line of air blast extending substantially across the full inner diameter of said rolling section when it is activated.

11. The machine of claim 2 wherein said folding means includes an initial pair of parallel, juxtaposed rollers which bear toward each other and are disposed adjacent to said open area, said extended pneumatic member upon being activated blowing said rolled material into said juxtaposed rollers for further drawing the rolled material out of said rolling section and folding thereof.

12. The machine of claim 2 wherein there is included preliminary packaging means adjacent to said folding means for temporarily holding a series of rolled and folded materials prior to any packaging thereof.

13. The machine of claim 12 wherein said preliminary packaging means comprises two collection stages with a centrally located, moving diverter for sequentially diverting sets of folded bags from one collection stage and then to the other and then back again.

14. The machine of claim 13 wherein said preliminary packaging means further includes a second set of parallel, juxtaposed rollers which bear toward each other a greater degree than said first set, said second set being disposed adjacent to said first set, the folded material from said first set being fed directly to said second set for further folding, said diverter being an elongated member having a generally triangular cross-section with at least two curved sides, said diverter being placed in juxtaposition and centrally to said second set of rollers in face-to-face relationship through said curved sides and being pivotally mounted about an axis parallel to the axes of said second roller set for diverting the folded material toward one side or the other; and further includes an auxiliary set of two rollers, each of which faces and mates with a corresponding one of said second roller set and is associated with one of said collection stages, the folded material first passing between said second roller set, against said diverter and then finally between one of said auxiliary rollers and its corresponding one of said second roller set and ultimately to one of said collection stages.

15. A folding machine for folding flexible sheet material such as plastic bags and the like comprising:

rolling means for rolling the material into a roll comprising a rolling section disposed about at least 180° of a circle, said rolling section presenting on its inward side a moving surface throughout a substantial portion of said 180° of a circle, said moving surface driving the material into a roll, said rolling section being divided into at least two laterally disposed sub-sections having an open, unobstructed area therebetween;

introduction means for introducing the material into said rolling means;

removal means for removing the rolled material from said rolling means, said removal means including an extended pneumatic member extended in a direction at least generally perpendicular to the axis of the curved surface defined by said rolling section and a source of pneumatic pressure, the rolled material being removed from said rolling section by a blast of air from said source of pneumatic pressure to said extended pneumatic member directed through and across said open area, blowing the rolled material out of said rolling section; and

folding means for folding the rolled material as desired after it is removed from said rolling section by said removal means.

2. The machine of claim 1 wherein each of said rolling sub-sections has a substantial width as measured along their longitudinal axes, the total width of each being greater than the radius of said circle, the width of said open area being substantially less than the width of said rolling sub-sections.

3. The machine of claim 2 wherein each of said rolling sub-sections are of equal width, said open area being in the middle of said rolling means and said extended pneumatic member blowing against the rolled material in the vicinity of its mid-section as the rolled material is blown out of said rolling section.

4. The machine of claim 2 wherein said rolling section is a series of horizontally disposed, juxtaposed, parallel rollers whose axes are disposed about said circle to form the curved portion of said rolling section.

5. The machine of claim 4 wherein said rollers have alternating depressions and raised portions which interdigitate with the alternating depressions and raised portions of the adjacent roller(s).
driving the material into a roll, each set of rollers having each roller parallel and in line with a corresponding roller in the other set, said sets being laterally disposed to each other but separated apart and having an open, unobstructed area therebetween; introduction means for introducing the material into said rolling section; removal means for removing the rolled material from said rolling section, said removal means including an extended pneumatic member extended in a direction at least generally perpendicular to the axis of the curved surface defined by said rolling section and a source of pneumatic pressure, the rolled material being removed from said rolling section by an air blast from said source of pneumatic pressure to said extended pneumatic member directed through and across said open area, blowing the rolled material out of said rolling section; and folding means for folding the rolled material as desired after it is removed from said rolling section by said removal means.

16. The machine of claim 15 wherein the length of said rollers is substantially greater than the radius of said circle and the width of said open area being substantially less than the length of said rollers.

17. The machine of claim 16 wherein each of said sets of rollers are equal in length, said open area being in the middle of said rolling means and said extended pneumatic member blowing against the rolled material in the vicinity of its midsection as the rolled material is moved out of said roller section.

18. The method of folding flexible sheet material such as plastic bags and the like comprising the steps of:

1. providing rolling means for rolling the material into a roll comprising a rolling section disposed about at least 180° of a circle, said rolling section presenting on its inward side a moving surface throughout at least a substantial portion of said 180° of a circle, said rolling section being divided into two laterally disposed sub-sections having a substantial width and having an open, unobstructed area therebetween;

2. introducing the flexible sheet material in a flat state into said rolling means, and rolling said sheet material into a roll by said moving surface driving the material into a roll;

3. providing removal means for removing the rolled material from said rolling means, said removal means including an extended pneumatic member extended in a direction at least generally perpendicular to the axis of the curved surface defined by said rolling section and a source of pneumatic pressure;

4. removing the rolled material from said rolling section by means of an air blast from said source of pneumatic pressure to said extended pneumatic member directed through and across said open area of said rolling section and thereby blowing the rolled material out of said rolling section; and

5. folding said rolled material in half as the rolled material is being removed from said rolling section and flattening the folded, rolled material after it has been removed from said rolling section.

19. The method of claim 18 wherein said rolling section is formed of two sets of a series of horizontally disposed, juxtaposed, parallel rollers whose axes are disposed about said 180°, and wherein step (1) further includes driving said rollers at a relatively high speed, producing a centrifugal action forcing the material out against said moving surface, and thereby positively driving the material into a roll.

20. The method of claim 19 wherein said sets of rollers are of equal length, said open area being in the middle of said rolling means, and wherein step (2) includes introducing the material into said rolling means so that the mid-line of the material is introduced at said open area, the extended pneumatic member blowing against the rolled material in the vicinity of its midsection as the rolled material is being blown out of said rolling section.

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