This invention relates to a method and apparatus for the manufacture of bags and, more particularly, for the manufacture of bags produced from a continuous web of suitable material which is formed into a tube and then separated into bag sections, each of the bag sections being provided with registering reinforced openings in the front and back thereof for the entry of fingers to enable it to be conveniently carried.

More particularly, the invention relates to the manufacture of a type of bag which is produced by the following steps:

1. A web of material from which the bags are to be formed is fed through the bag forming machine.
2. Successive pairs of transversely spaced areas of the web are gummed to provide for the attachment of reinforcing patches in the areas of the web through which finger openings are to be provided.
3. Individual patches are severed from a suitable patch supply strip and applied over the transversely spaced pairs of gummed areas.
4. The web is gummed along one edge thereof.
5. The web is perforated in lines extending transversely thereof and spaced longitudinally in accordance with the length of the bag sections to be produced and properly located with respect to the pairs of patches.
6. The web is folded into a tube with the pairs of patches in superimposed relation.
7. The web is parted at the transverse perforations to form individual bag sections.
8. Finger openings are cut in the bag sections through the superimposed reinforcing patches.
9. The one end of each bag is closed; and
10. The completed bags are delivered from the machine.

The most desirable method of parting the bag web along the perforated transverse lines is to accelerate the movement of the last bag section of the web which is to be detached from the remainder of the web. This invention contemplates the incorporation of this method of parting.

It will become evident that a machine of this type must be capable of producing bags of various lengths without requiring machine changes or readjustment attended by any extreme difficulties of procedure. In its most desirable form, a machine of this type is constructed to include an accelerating roll to cause parting of the bag sections from the web and the accelerating roll is driven at a constant speed thus producing a constant number of bags per minute regardless of the length of the bags produced.

A machine constructed in accordance with these principles must have provision for increasing the web speed when bags of increased length are to be produced. This is accomplished either by changing the diameter of the drive rolls to accommodate the necessary increase in web speed or, preferably, by increasing the speed of rotation of the drive rolls. Operation performing rolls such as the perforating rolls, the creasing rolls and the like are preferably driven at a constant rate of speed regardless of bag length and are changed in diameter for the production of bags of various lengths.

As previously noted, the means for positioning a bag section from the bag web is an accelerating roll. The accelerating roll is oscillated into and out of engagement with the bag web and, when it engages the web, it drives the last bag section thereof at a speed in excess of the speed of advance of the remainder of the bag web and thereby severa the bag section from the web. A clamping roll is desirably provided to prevent tension from being imparted to the perforated lines in the web prior to the last perforated line therein. The accelerating roll is operated at constant speed regardless of the length of bag section produced and is in synchronized speed relation with means for closing the ends of the bags and for removing the bags from the forming machine.

I have found that in a machine of this general type it is possible to position a finger opening cutout die roll between the accelerating roll and the clamping roll and satisfactorily cut the handle openings of a plurality of lengths of bags. As will become evident hereinafter, there is a limited space and a limited time in which this cutting operation can be performed in this location for any particular length of bag. This positioning of the finger opening die roll permits the roll to be driven at a constant speed in conjunction with the accelerating roll regardless of the length of bag produced and thus the problem of changing the finger opening die roll for each length of bag for which the machine is adjusted is eliminated.

When the handle openings are cut in the bag lengths after they are severed from the web, perfect register of the handle opening is insured because of the fact that they are cut substantially simultaneously by a single cutting die.

Having now described in a general way the invention involved, I will proceed to describe the invention in greater detail in conjunction with the accompanying drawings, in which:

Figure 1 is a diagrammatic view of a bag forming apparatus embodying the invention and adapted for carrying out the method according to this invention; 
Figure 2 is a showing of a fragmentary portion of the structure of the apparatus shown in Figure 1; 
Figure 3 is a plan view of the web of bag material showing the various successive operations performed thereon in the continuous production of bags; and 
Figure 4 is a graph representative of the time intervals and space intervals available for the die cutting operation between the accelerating roll and the clamping roll when bags of various lengths are being produced. Referring to Figures 1 and 3 there is shown at 2 a roll of material of the desired type and width for the bag to be produced. From the roll 2 a web 4 is drawn over suitable guide rolls 6 and 8. Cooperating with the guide roll 8 are two gum applying rolls 10 and 10'. The rolls are positioned adjacent and are adapted through mechanism which will now be described to apply pairs of paste bearing areas on the web as indicated at 18 and 20 in Figure 2. A transfer roll 14 is positioned to transfer gum from a suitable container 12 onto the gum applying roll 10. The gum applying roll 10 is mounted on a pivoted arm 16 which is actuated by means of a cam not shown in order to cause the roll 10 to engage the web 4 for such intervals as to provide for the application of a gummed area 20. A similar transfer roll 14' running in a second gum container 12' is mounted on pivoted arm 16' which is also actuated by a cam and serves to apply the gummed areas 18 to the web 4. It will be evident that these gum applying operations are entirely conventional and may be carried out by numerous conventional
means such as, for example, that described in the patent to Howard A. Wolf No. 2,281,964. The mechanisms for applying gum to each of the areas 18 and 20 are preferably independent arrangements in order that the spacing between these areas may be varied as the machine is readjusted for the production of bags of different sizes. This is left to the leaving the roll 18 passes around a roll 22 and between the roll 22 and a roll 24. A pair of rolls 26 and 26' of reinforcing material of a desired type such as, for example, a heavy paper, fabric, or the like, and of desired width are supported adjacent to the roll of paper 2 and one behind the other, as viewed in Figure 1. Web 26 is joined at its adjacent end by a relatively short diagonally extending blade 71. These two pairs of blades cooperating with the rubber surface 64 of the roller 62 serve to perforate the web 4, as indicated at 72, 73 and 74 in Figure 2, the perforations 72 being produced by the blades 70, the perforations 74 being produced by the blade 68 and the perforation 73 being produced by the blades 71.

Web 4 containing the perforations just indicated is carried around the roller 64 to a position where a pair of bars 78 mounted on an adjacent roller 76 successively bear against the web 4 in cooperation with the rubber surface 64 and 26' of reinforcing material 26 as indicated at 80 in Figure 2. This crease line provides the base or line for the top closure flap of the bag after the successive bag lengths have been severed from the web 4, this severing, of course, taking place after the web is formed into a tube as will now be described.

Web 4 leaving the scoring and creasing roller 62 passes over a guide roll 82 and through a guide plate 84, around a roller 86 and under a mandrel 88. This arrangement serves to form a flat web into a tube as indicated generally at 90 in Figure 3 in a manner well-known in the art. It will be evident that the gummed edge 87 of the web when the web is folded into a tube will come in contact with the opposite edge of the web and adhere thereto, thus sealing the web into the form of a tube from which individual bags are to be separated. As the web is folded into a tube, the pairs of patches fall into superimposed relation in order that, when in a subsequent operation of the machine, which will be described, finger openings are cut through the bag and the reinforcing patches, the patches will provide the proper reinforcement around the openings.

The tube is drawn through auxiliary driving rollers 92. The driving rollers 82 serve to draw the tube through the tube forming means and the web through the creasing and scoring roller 62 previously described. The driving rollers 92 are driven through a friction slip clutch driven by a shaft running at a slight overspeed, the slip clutch being adjusted so that excessive tension is not applied to the perforations in the web between the perforating roller 66 and the drive rolls 92. The drive rolls 92 merely serve to keep a reasonable tension on the portion of the web extending beyond the main drive rolls 51 and 52.

A clamp roll 94 and an anvil roll 95 which follow the friction drive rolls 92 are clamped into and out of engagement with the web by means as will be described in conjunction with Figure 2, to intermittently clamp the bag web once each bag length. An accelerating roller 100 and an anvil roll 102 are positioned following the rollers 94 and 95. The peripheral velocity of the rollers 100 and 102 is selected to be considerably in excess of the peripheral velocity of the rollers 92 within a definite range of bag lengths. This immediately upon engagement of the bag web by the accelerating roll 100, the last section 104 of the web will be accelerated and carried away at a speed in excess of the rate of feed of the web through the tube forming apparatus and the drive rollers 92. Thus the severing occurs during the time interval when the clamping roller 94 is in engagement with the bag web. Thus the severing tension is not carried back through the bag web ahead of the slipping drive rolls 92.

When the severing occurs, a space indicated generally at 106 will be created between the bag web and the portion 104 thereof which has been severed from the web. Separated web sections 104, 104', etc. which are in tubular form will then have their lower folds completed in a pair of rollers 110 and 112. The roller 112 is provided with members 114 which are adapted to engage a roller 118 supplied with paste from a reservoir 116. The paste carried by the ends of the members 114 is applied to the lowermost portions of the bag lengths 104' which
are thereafter each pressed into a recess 120 in the roll 110 by one of the blades 122 mounted on the roller 112. A dished recess 124 in the roller 110 is provided to permit clearance of the passage of a member 114 over each bag as the rolls 112 and 110 rotate with respect to each other.

The accelerating roll is provided with a raised portion 101, the leading edge 103 of which is adapted to engage the bag tube at a predetermined time and cause the tube causing separation of a bag length. The accelerating roll is oscillated upwardly and downwardly once every revolution and the oscillations so timed that the leading edge 103 of the raised portion 101 of the roll touches the bag web both as a result of rotation of the roll and as a result of downward motion of the roll. This means of engagement insures the provision of a consistent engagement with regard to time and a sharp engagement of the accelerating roll with the web. In Figure 2 there is shown a typical roll oscillating structure in which a pair of guide bars 128 mounts a bearing block 130. A pair of guide bars and mounting blocks are provided adjacent to each side of the bag web and serve to support a shaft 132 extending transversely of the bag web which supports and drives the accelerating roll 100. A cam 134 having extended cam surfaces 136 and 138 is positioned above the shaft 132 and adapted to engage a cam follower roll 140 mounted thereon. The diameter of the cam roll 134 is twice the diameter of the cam follower roll 140 and thus the cam follower roll and the accelerating roll 100 will be urged downwardly once every revolution of the accelerating roll and twice every revolution of the cam 134. The cam 134 and the accelerating roll 100 are each driven by suitable gear trains not shown. It will be evident that the clamping roll 94 may be oscillated by similar mechanism. This mechanism would be identical to that shown in Figure 2 except that the roll 100 in this instance would be, of course, the roll 94.

A spring 142 acting between the bearing block 130 and the frame of the machine 131 urges the accelerating roll 100 upwardly out of engagement with the bag web 4. Thus it is only during periods of engagement of the cam surfaces 136 or 138 with the cam follower 140 that the raised portion of the accelerating roll 100 is in engagement with the bag web.

The period of engagement of the raised portion 101 of the accelerating roll 100 with the bag web is determined by the length of the raised portions 136 and 138 of the cam 134. The leading edges of the portions 136 and 138 of the cam 134 are so placed with respect to the leading edge 103 of the raised portion of the accelerating roll that the accelerating roll is depressed at the instant that the raised portion 103 comes into position over the bag web 4. It will be evident that the position of the accelerating roll may be so phased with regard to the position of any bag section that the accelerating roll will engage the bag section at any desired location thereof. It will be further evident that under certain conditions, when it is desirable to depress the accelerating roll only on every other revolution of the accelerating roll, as will be hereinafter made clear, the cam may be provided with only one raised portion, for example 136 and the other raised portion 138 may be omitted.

An alternative arrangement for depressing the accelerating roll only every other revolution of the accelerating roll is to reduce by one-half the speed of rotation of the two-lobe cam 134.

The finger opening die cutting roll 144 is positioned between the accelerating roll 100 and the clamp roll 94. The roll 144 is provided with raised die cutting portions 146 which are adapted to act against an anvil roll 148 and cut the finger opening 44 and tongue lines 46 in each bag section. The position of the die cutting portion 148 of the roll 144 is so phased with regard to the passage of the bag web thereunder that the finger openings 44 will be cut in a properly located position through the aligned reinforcing patches 32 and 34. Figure 1 shows the position of rotation of the clamping roll 94, die cutting roll 144, and the accelerating roll 100 are shown respectively at 151, 152 and 153.

Inasmuch as the die roll 144 is one-half the diameter of the accelerating roll, the die roll must be oscillated once every other revolution. It will be evident that, if this oscillation were not provided and bags of lesser length than the circumference of the die roll are made, the die will undesirably engage the anvils without bag material being therebetween and, if bags of greater length than the circumference of the die roll are made, two finger openings would be undesirably cut in the bag.

The die cutting operation includes the cutting of lines 46 in the flap of the bag. These lines form the boundaries of a tongue which is adapted to be folded through the finger openings when the top flap of the bag is folded over closing the bag. The die cutting operation also includes the forming of the score lines in the tongue which serve to facilitate the folding of the tongue through the finger openings.

In the graph of Figure 4, the ordinate is divided into inches and represents distance along the line of advance of bag web starting from the axis of the clamp roll indicated at 151 and extending to the axis 152 of the die cutting roll and the axis 153 of the accelerating roll. The abscissa is divided into time in terms of seconds.

The line 154 is an extension of the axis 153 of the accelerating roll. The slope of line 156 indicates the peripheral velocity of the accelerating roll which is selected to be 31.6 inches per second. This of course, represents the linear velocity of the parted bag section being driven by the accelerating roll.

One limitation in the bag length is that bags may not be run which are equal in length to less than half the distance between the axis 152 of the accelerating roll and the axis 151 of the clamp roll. Thus with the accelerating roll positioned with its axis 11.6 inches from the axis of the clamp roll, a practical minimum bag length is 6.3 inches. Bags of shorter length have substantially no utility when finger openings are cut into the bag.

A satisfactory linear velocity for the bag web through the machine when 6.3 inch bags are being made is 12.6 inches per second. The slope of line 158 indicates this velocity. It will be evident from the foregoing that the accelerating roll cannot engage the last bag portion until the bag web until the perforated line of the bag section is within 6.3 inches of the accelerating roll. The line 162 extending from the point 160 to the accelerating roll center line 154 is drawn parallel to the accelerating roll peripheral velocity line 156. The line 162, of course, represents the position of the rear end of the severed bag sections at any time. Thus the spacing between the end of each severed bag section and the web at any location between the point 160 and the line 154 will be indicated by the perpendicular distance between the lines 158 and 160 at that location.

If the accelerating roll has a diameter of 5.07 inches and if the die cutting roller 144 is selected to have a diameter equal to one-half the diameter of the accelerating roll and is positioned closely adjacent thereto, the axis of the die cutting roller will be on the line 164 which is approximately 7.7 inches from the center of the clamping roller. When the trailing edge of the parted bag section passes below the die roll 144, the distance between this edge and the edge of the bag web will be approximately 1.3 inches as indicated by the dimension arrow 166. Inasmuch as the flapsize of the 6.3 bag is approximately 1 1/4 inches in length, the 1% spacing provides sufficient clearance to permit die cutting of the extending flap of the parted bag section without cutting the extended flap portion of the leading end of the bag web which is to be the bottom of the next succeeding bag section.
As previously noted, the accelerating roll speed remains constant and thus, as the bag lengths are increased, the bag web's velocity must be increased. With the accelerating roll velocity noted, the maximum bag lengths which may be run with sufficient speed differential between the accelerating roll peripheral velocity and the web velocity to provide satisfactory parting is a bag of 11.6 inches in length. For this bag the web speed will be approximately 11.3 inches per second. The line 170 is indicative of this velocity.

If the accelerating roll 100 is phased to engage the leading edge of the 11.6 inch bag section, the distance between the accelerated bag section and the leading end of the bag web at any location between the axis of the clamp roller and the axis of the accelerating roller is indicated by the perpendicular distance between the lines 156 and 170 at the location. Thus, when the trailing edge of the bag web section passes under the die cutting roll 144, the distance between this trailing edge and the leading edge of the bag web will be approximately two inches as indicated by the dimension line 172. Inasmuch as flap of an 11.6 inch bag is approximately 1½ inches long, it will be evident that adequate clearance is provided for the die cutting operation.

From the foregoing it will be seen that bags within the range of 6.3 inches long to 11.6 inches long can be made on the apparatus described. It is frequently desirable, however, to produce bags of lengths in excess of 11.6 inches. To produce bags of lengths in excess of 11.6 inches, the various operation performing rolls in the machine are modified by the elimination of one of their operation performing elements. Thus the web perforating roller 66 is provided with only one set of perforating blades 70, 71 and 68, the scoring roller 76 is provided with only one score blade 78 and the clamp roller 94 is provided with only one raised portion 96. By a change in their actuating cams, the gum applying rollers 10 and 10' are made to oscillate at one-half the frequency of the rate of their oscillation when the smaller bags were being run. It will be evident that under these conditions with the web speed at 21.6 inches per second as indicated by the line 158, bags of twice the 6.3 inch length or 12.6 inch bags will be produced.

Under these conditions a die cutting roll can be employed which is of the same diameter as the accelerating roll and which may have its axis of rotation located at 155 along the ordinate of the graph. An extension of this axis is indicated at 157. Under these conditions of operation, the 12.6 inch bag length will have a spacing at approximately 3¾ inches as exists between the point 174 on the accelerating roll velocity line 156 positioned perpendicularly above the point 176 on the web velocity line 158. It is noted that the point 174 is, of course, on the die roll axis line 158 for the larger die roll.

It should be noted that under these conditions, the accelerating roll velocity is still unaltered. However, assuming as only half the number of bags per minute are being produced, when bags of 6.3 inches to 11.6 inches were being run, it is necessary that the accelerating roll be brought downward into engagement with the bag section only once for every two revolutions of the accelerating roll. Similarly, the die roll which is the same diameter as the accelerating roll must also be brought down into engagement with the bag section only once for each two revolutions of the die roll. This is, of course, due to the fact that for bags of lengths greater than the circumference of the die roll, the die would cut two handle openings in the bag.

When bags of 23.2 inch length are run, the velocity of the bag web is the same as when bags of 11.6 inch lengths are being run. Thus a clearance for the operation of the die cutting roller under these conditions is the perpendicular distance between the point 174 on the accelerating roll velocity line 156 and the point 178 on the line 170. This distance is approximately 1½ inches which is, of course, sufficient to provide clearance for the 1½ inch flap encountered.

It should be noted that the smaller die roll 144 may be employed for cutting all of the bag flaps. However, it is preferable to employ a larger die roll where possible both because of the fact that it is involved and because of the fact that the die cutting operation against the back-up cylinder is performed more satisfactorily with a roll of larger diameter.

From the foregoing it will be evident that the invention provides an apparatus for cutting the actual flaps of lengths from 6.3 to 23.2 inches and that all of these bags may be produced by having the finger openings therein die cut after the individual bag sections are parted from the bag web by the accelerating roll.

It will be noted that the finger opening die may be placed on the accelerating roll as well as on a separate die carrying roll such as roll 144. In either event, the finger openings are cut in the bag before the bag passes the accelerating roll. It will also be noted that inasmuch as the size of the finger openings, the distance between the finger openings and the tongue lines, and the distance between the edge 103 of the accelerating roll and the die will vary for bags having a substantial variation in length, thus it is necessary to change the finger opening die each time the machine is readjusted to produce bags having a substantial difference in length from the bags previously produced.

It should be noted that all of the figures set forth in this disclosure are relative for example, the accelerating roll velocity could be increased and all of the other velocities proportionately increased. The essential factors involved are the relations between the velocities and dimensions involved rather than the actual figures themselves. The figures given are practical values in view of mechanical limitations resulting from forces and mechanical loadings involved. However, these limitations should be considered in no way binding. It will be evident that these and other modifications may be made to the embodiment of the invention disclosed herein without departing from the scope of the invention as set forth in the following claim.

What is claimed is:

Apparatus for forming bags comprising means for advancing a web of bag material, means for applying patches of reinforcing material at spaced intervals along the web of bag material, means for producing a tube from the web of bag material having weakened lines extending transversely across the web forming the tube at spaced intervals equal to the patch spacing, means including a roll for accelerating the rate of advance of successive end portions of the tube to part the successive end portions from the tube along the last weakened line therein, means including a roll for restraining the tube on the opposite side of the last weakened line therein from the accelerating roll during acceleration of each successive end portion of the tube, and means including a die cutting roll for cutting a finger opening through each separated tube portion and reinforcing patch thereon before it has passed the accelerating roll.

References Cited in the file of this patent
UNITED STATES PATENTS
1,649,760 Vieregel November 15, 1927
2,129,842 Holweg September 13, 1938
2,281,964 Wolf May 5, 1942
2,586,514 Canno February 19, 1952