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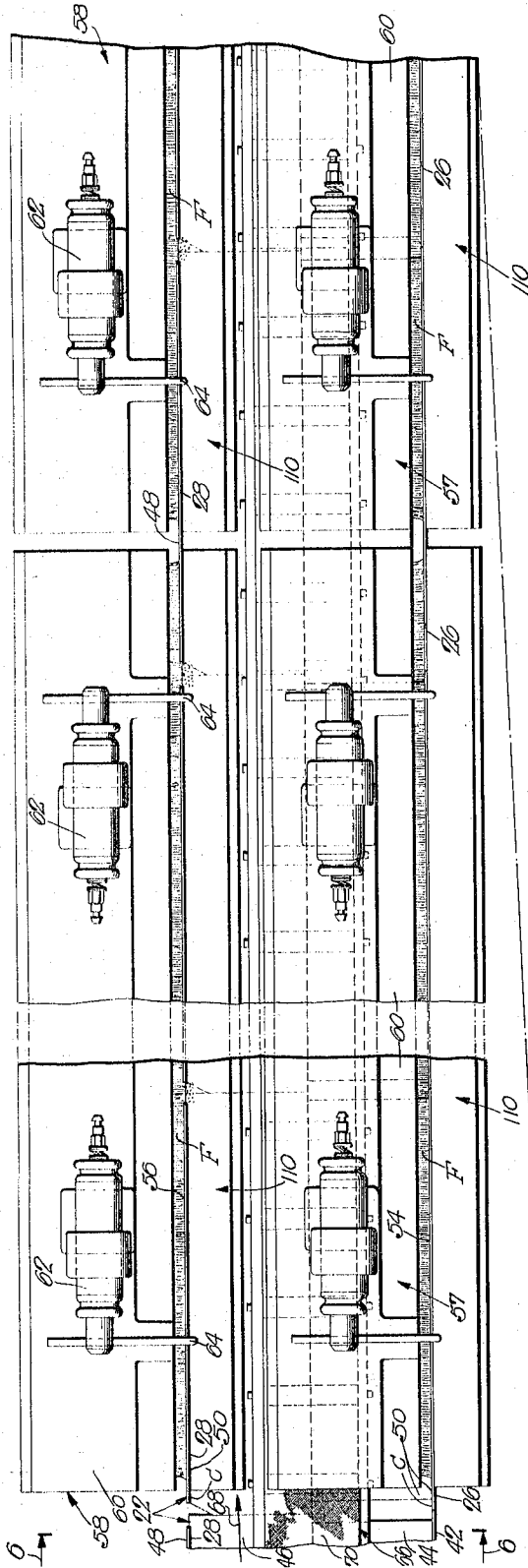
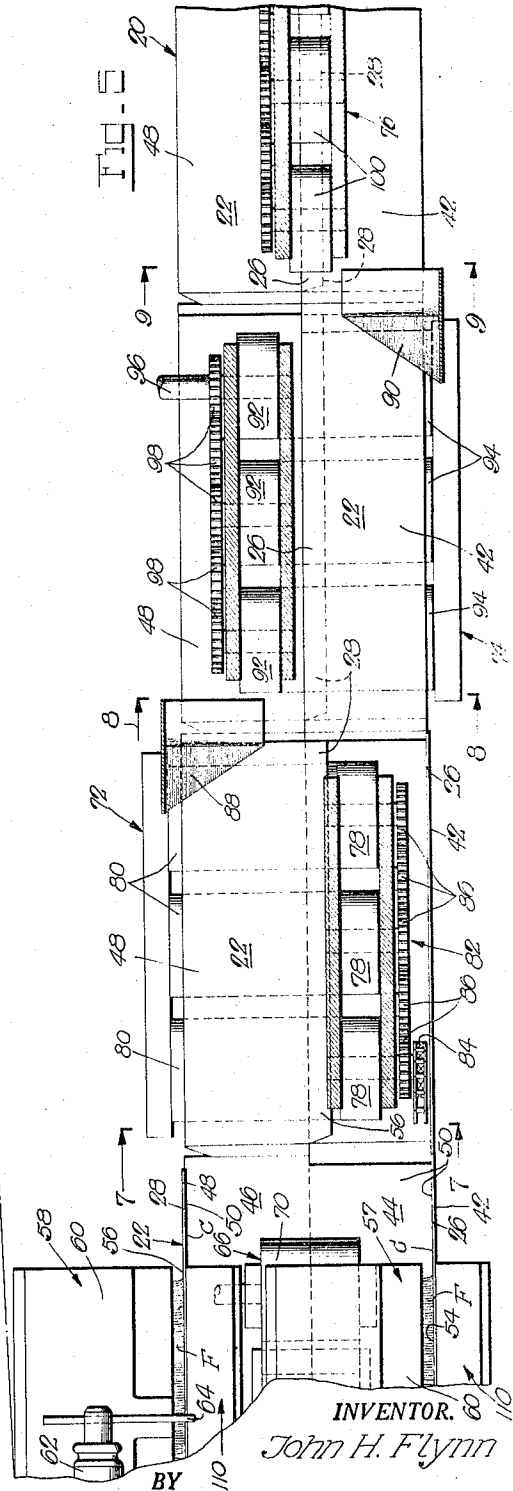
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3,300,350

METHOD OF MAKING JOINTED POLYOLEFIN-COATED PAPERBOARD PRODUCTS

Filed March 11, 1963

3 Sheets-Sheet 2



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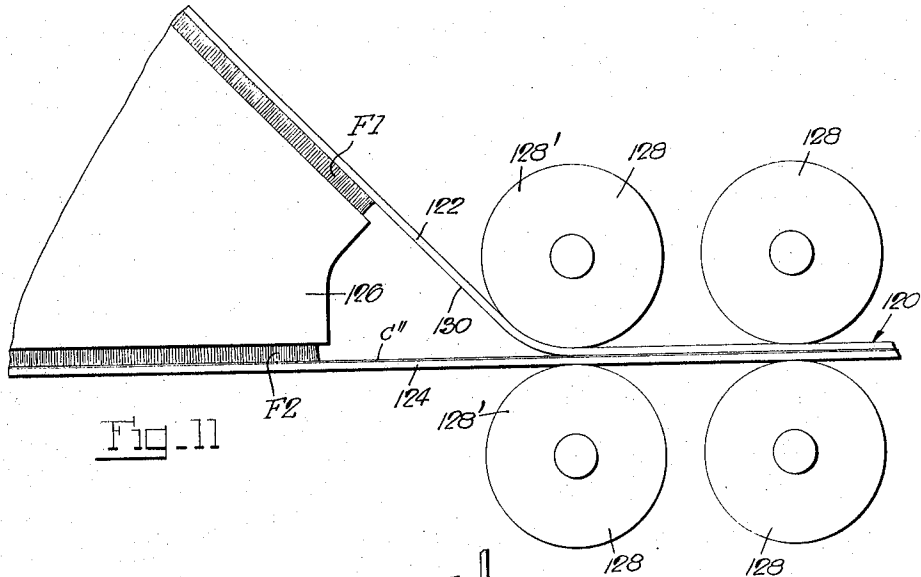
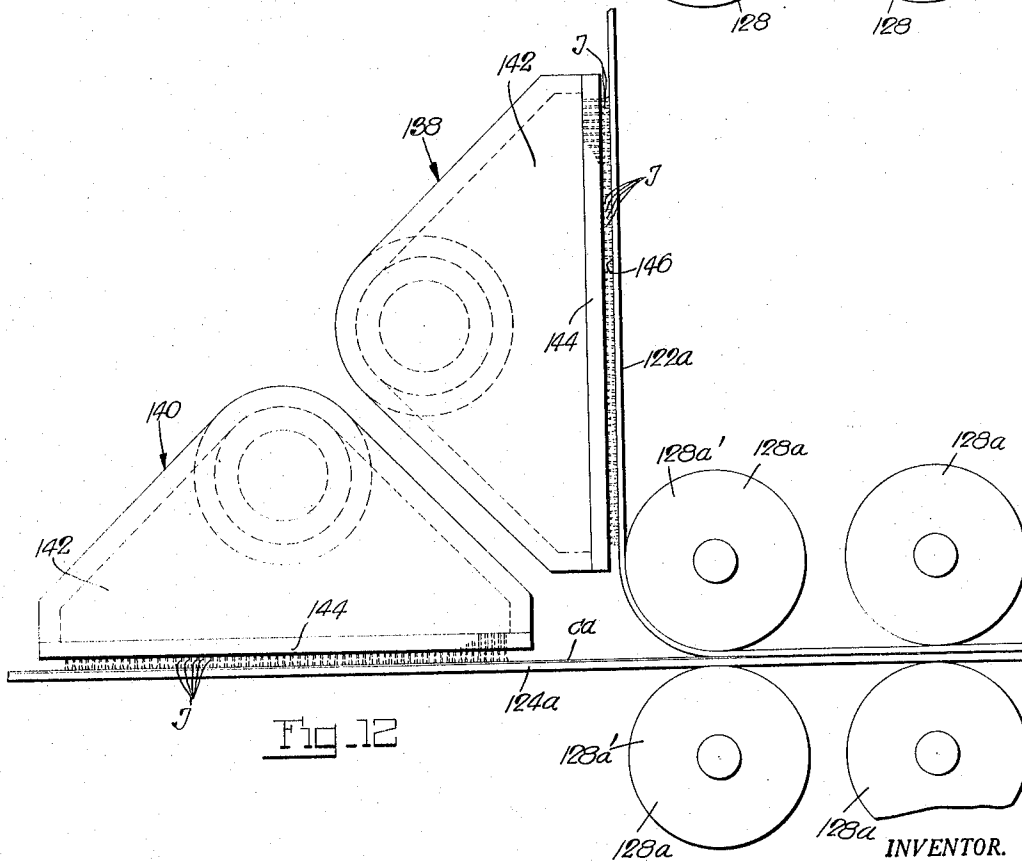
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3 Sheets-Sheet 3



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3,300,350 METHOD OF MAKING JOINTED POLYOLEFIN- COATED PAPERBOARD PRODUCTS

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2 Claims. (Cl. 156—82)

This invention relates generally to leakproof products made of paperboard stock, and more particularly to methods of making jointed products of this type.

The present invention is concerned with products which are made from paperboard, commonly referred to as "board," that is coated on one or both faces with a leakproof polyolefin, and which require a permanent joint or joints in their finished form. Exemplary products of this type which have come into wide use are all kinds of containers which have a permanent side joint and are usually closed at the top and/or bottom in various ways. Customarily, container products of this type are initially blanked from coated board stock and the blanks folded into tubular form with the complementary side joint margins or flaps thereof in overlap for sealing the joints.

The most commonly followed method for sealing the side joints of such container products involves the application of separate glue strips to at least one of the interfaces-to-be of the complementary joint flaps of the container blanks, then heat-softening the applied glue strips and immediately thereafter folding the blanks into tubular form with their side flaps in overlap and pressing the overlapped flaps together for their permanent bond to each other by the intermediate glue. Recently there has also become known a glueless method to seal the side joints of such container products solely and directly by the polyolefin coating on their blanks. This glueless method, which has been proposed for containers made from blanks that are coated on one face, involves treatment of the exposed surface of the blank coating on the respective side flap of a blank by heating the same above its melting point and oxidizing it by subjection to an oxidizing flame, and while this oxidized coating surface is still molten, folding the blank into tubular container form with its complementary side flaps in overlap and applying pressure to the overlapped flaps until the coating therebetween has sufficiently set to form a bond between the flaps. This glueless method has, in comparison to the above-mentioned glue-strip method, several obvious advantages, such as, for example, elimination of the cost of special glue and the even higher cost involved in its application to the blanks, and even more important, formation of the blanks into side-sealed tubular container form during continuous feed of the blanks past flame and through folding apparatus at high speed. However, while these advantages are highly desirable, they are more than offset by a rather serious deficiency of this glueless method. This deficiency of the glueless method lies in the formation of the side joints of such inferior strength that they do not reliably withstand even ordinary stresses to which they are subjected in the accustomed use of the containers.

It is an object of the present invention to provide container products of this type the joints of which are not only sealed solely by the polyolefin coating on their blanks, but also have fully adequate strength to withstand any and all stresses to which they may be subjected in the normal or even rough use or handling of the products.

It is another object of the present invention to devise a method of making container products of this type, according to which joints thereof are sealed solely by the polyolefin coating on their blanks and have the required strength to withstand the aforementioned stresses.

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It is a further object of the present invention to devise a method of making container products of this type, according to which the joints thereof are sealed by lamination of the overlapped joint flaps such that there is formed in the body of the joints a stratum of board stock which the polyolefin of the blank coating intermediate the overlapped flaps substantially pervades and in which the interfaces of these flaps are substantially assimilated, whereby the integration of the joint flaps is carried so far that the joints will readily withstand the aforementioned stresses.

Another object of the present invention is to devise a method of making container products of this type, according to which the joints thereof are formed by heating above melting temperature and blank coating on one or both designated interfaces of the joint flaps, depending on whether the container blanks are coated on one or both faces, and thereupon immediately overlapping these joint flaps and applying pressure to them to effect the seal, with the method further providing for conditioning the coating on the designated interface or interfaces of the joint flaps for sealing the joints by the aforementioned strong lamination of their flaps on overlapping the latter and applying pressure to them.

A further object of the present invention is to devise a method of making container products of this type, according to which the aforementioned conditioning of the blank coating on the designated interface or interfaces of the joint flaps consists in non-oxidizing this blank coating, i.e., in avoiding oxidation of this blank coating during its heating, pursuant to the discovery that a polyolefin coating must not be oxidized in the course of its heating to melting temperature in order to effect the aforementioned strong lamination of the joints which assuredly will lend them the required strength.

It is another object of the present invention to devise a method of making container products of this type, according to which oxidation of the blank coating on the designated interface or interfaces of the joint flaps is avoided by appropriate heating of this blank coating to its molten state. This is achieved preferably and conveniently by subjecting this blank coating either to non-oxidizing flame in the absence, or near absence, of atmospheric air at the surface of the coating, or to hot air which is below a temperature at which it will cause oxidation of the coating.

It is a further object of the present invention to devise a method of making container products of this type, according to which the coating on the designated interface or interfaces of the side joint flaps of the container blanks is subjected preferably to non-oxidizing flame, and the side joints are formed and sealed while the blanks are continuously fed. The present method thus has in the continuous feed of the blanks for their formation into side-sealed tubular container form the same great advantage as the prior glueless method without, however, having the aforementioned deficiency of the latter method.

Other objects and advantages will appear to those skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

FIG. 1 is a plan view of a blank adapted to be formed into a container in accordance with the present invention;

FIG. 2 is a perspective view of the same blank in partly-finished container form;

FIG. 3 is a section through the partly-finished container as taken on the line 3—3 of FIG. 2;

FIG. 4 is an enlarged section through a joint of the partly-finished container;

FIG. 5 is an interrupted plan view of apparatus in which to form blanks into partially finished containers;

FIGS. 6 to 9 are sections taken on the lines 6-6, 7-7, 8-8 and 9-9, respectively, of FIG. 5;

FIG. 10 is an enlarged section through a modified container in partly-finished form;

FIG. 11 is a side view of apparatus in which to form laminated sheet in accordance with the present invention; and

FIG. 12 is a side view of modified apparatus in which to form laminated sheet in accordance with the present invention.

Referring to the drawings, and more particularly to FIGS. 1 to 3 thereof, there is shown a partly-finished exemplary container 20 which is formed from a blank 22 of board stock and has a side joint 24 formed by overlapped side margins or flaps 26 and 28. The blank 22, which is suitably scored along the dotted lines 30 to 40 (FIG. 1) to define the side walls or panels 42 to 48 and the joint flaps 28 of the container, has a leakproof polyolefin coating *c* on one face 50 thereof which on the hereinafter described formation of the blank into its container form preferably forms the inner wall surfaces of the container (FIG. 2). The polyolefin coating is customarily extruded onto the board stock from which the blanks 22 are obtained.

In forming the exemplary container 20, the polyolefin coating *c* on the blank 22 is solely relied on to seal all joints, including the side joint 24, of the container. This is achieved in the case of the side joint 24 by heating the designated coated and non-coated interfaces 54 and 56 of the respective joint flaps 26 and 28 of the blank, with the interface 54 of the flap 26 being heated to bring its coating *c* above melting temperature and the interface 56 of the other flap 28 being heated to approximately the same temperature, and thereupon immediately folding the blank into flat tubular container form with its complementary joint flaps 26, 28 in overlap and pressing the latter together while the coating therebetween is still molten and until it has sufficiently solidified to seal the joint. In accordance with an important aspect of the present invention, and pursuant to the discovery that a polyolefin coating will form a seal of the required strength only if in the course of its heating to molten state it is not oxidized and, hence, apparently hydrophobic for its bond with the board stock of the joint, the face 54 of the joint flap 26 is heated in such manner that the coating *c* thereon will not become oxidized in consequence.

For the hereinafter described formation in the apparatus of FIGS. 5 to 9 of successive blanks into the side-sealed tubular container form of FIG. 2 while the blanks are advantageously fed continuously, the designated interfaces 54 and 56 of the respective joint flaps 26 and 28 of the blanks are heated preferably by subjection to flame, with the flame designated for the coated faces 54 of the joint flaps 26 of the blanks being a non-oxidizing flame. The formation of successive blanks into side-sealed tubular container form in the apparatus shown in FIGS. 5 to 9 is also in accordance with a method, which involves folding the blanks into flat tubular container form with their side joint flaps in overlap and pressing the overlapped flaps together at successive first and second stations, respectively, while continuously feeding the blanks to and through these stations, and which features heating of the side joint flaps of the blanks at their designated interfaces during the continuous feed of the blanks to the first station, with the coated flap interfaces being heated by subjection to a non-oxidizing heating medium to have the coating thereat molten and substantially non-oxidized when the blanks reach the first station. To heat the designated interfaces 54 and 56 of the joint flaps 26 and 28 of the blanks 22, the apparatus referred to provides two series of burners 57 and 58 (FIGS. 5 and 6), with each series having in this instance two burners in tandem. The individual burners, which

may be of conventional type and identical in all respects, have elongated casings 60 with usual burner slots that preferably hold conventional burner ribbons from which issue flames *F* in sheet form. A combustible mixture of gas and air is fed to each burner casing 60 through a conduit (not shown). Mounted on each burner casing 60 is an electrical ignition unit 62 which on energization discharges sparks from an electrode 64 that ignite the combustible mixture at the flame slot to start an operation.

The blanks 22 are introduced preferably end-to-end into a conveyor 66 which carries them past the burners 57 and 58 in the direction of the arrow 68 in FIG. 5. The conveyor 66, which may be of any suitable type, has in this instance power-driven endless belts 70 which grip the blanks from opposite sides and carry them along, with the blanks being at their score lines 30 and 34 folded into U-shape (FIG. 6) in order to have the designated interfaces 54 and 56 of their respective joint flaps 26 and 28 confronting the flame sheets *F* at the respective burners 57 and 58 while passing the latter.

Immediately following the burner series 57 and 58 are successive blank folding devices 72 and 74 and a pressing device 76 at the aforementioned first and second stations, respectively, of the continuous forward pass of the blanks (FIG. 5). The folding device 72 assumes the continuous forward feed of the blanks after they leave the belt conveyor 66 at the end of the burners 57 and 58 (FIG. 5), and to this end provides in this instance companion top and bottom rolls 78 and 80 of which at least one set of rolls, and preferably both set of rolls, are power-driven in synchronism with the belt conveyor 66. For simplicity of illustration, there is shown in FIGS. 5 and 7 a power drive 82 for only the top rolls 78, the drive comprising a chain-driven sprocket 84 for one of the top rolls and meshing gears 86 for the remaining top rolls. The folding device 72 also has a conventional blank folder shown in the form of a plate 88 which is so inclined to the blanks that the upturned side panel 48 of each blank moving into engagement therewith is cammed or folded into overlap with the coplanar side panels 44 and 46 thereof, with the heated non-coated face 56 of the joint flap 28 facing upwardly.

The continuously fed blanks 22 pass from the folding device 72 directly into the other folding device 74 which performs similarly as the device 72, except that its folder plate 90 cams the remaining upturned side panel 42 of each passing blank 22 into overlap with the side panel 44 thereof, with the joint flap 26 coming with its coated face 54 into overlap with the face 56 of the other joint flap 28 (FIG. 8). The folding device 74 also assumes the continuous forward feed of the blanks as soon as they leave the folding device 72, and has to this end companion top and bottom rolls 92 and 94 of which only the top rolls are shown as being driven by a power shaft 96 and meshing gears 98, though the lower rolls are preferably also driven.

On leaving the folding device 74, the blanks pass directly into the pressing device 76 which has a plurality of power-driven rolls 100 that not only continue the forward feed of the blanks but also press them together in the region of the overlapped joint flaps 26 and 28 (FIGS. 5 and 9). The blanks, which are now in the form of side-sealed flat tubular containers, pass from the pressing device onto conventional stacking equipment (not shown) from which they are removed for their subsequent finish-formation.

As already mentioned, the flames *F* from the burners 57 are non-oxidizing flames, and to this end the combustible gas-air mixture supplied to these burners is regulated so that there is no excess oxygen in the flames and, hence, no oxygen atoms from this source will be added to the polymer structure of the coating-being-heated on the joint flaps 26 to oxidize it. Furthermore, with the temperature of these flames being preferably well above that at which atmospheric air would oxidize

the polyolefin coating on even relatively short exposure thereto, the air immediately surrounding these flames and, hence, heated thereby likely above oxidizing temperature, is kept away from the coating on the joint flaps 26 by arranging the flames so that they will impinge on these coated joint flaps (FIGS. 5 and 6). In being thus enveloped by non-oxidizing flame from the burners 57, the coating on the joint flaps 26 of the continuously fed blanks is thus heated to a temperature above its melting point by the time the blanks leave the burners, with the coating on these joint flaps being still in a molten and substantially non-oxidized state when the blanks pass through the second folding device 74 and succeeding pressing device 76, so that on the overlap of the joint flaps 26, 28 and their subjection to pressure in these devices 74 and 76 the coating on the flap 26 will establish between the flaps a strong seal (FIG. 4).

With the burner arrangements 57 and 58 being identical in this instance, the non-coated faces 56 of the joint flaps 28 of the blanks are subjected to flame over the same pass of the blanks over which their coated joint flaps 26 are subjected to non-oxidizing flame, but the flames from the burners 58 for the non-coated joint flaps 28 need not be non-oxidizing, as will be readily understood. Heating of the non-coated faces 56 of the joint flaps 28 prior to the joint formation is essential in order to establish a satisfactory joint. Joints entirely satisfactory in strength have been obtained on keeping the flames from the burners 57 and 58 at approximately the same temperature and impinging them on the respective joint flaps in like manner, thereby heating the non-coated faces 56 of the joint flaps 28 to approximately the same temperature as the coating on the joint flaps 26, i.e., above the melting temperature of the coating. However, equally strong joints have been obtained by heating the non-coated faces 56 of the joint flaps 28 to approximately the melting temperature of the coating on the other joint flaps 26 or even somewhat below this temperature. Apparently, these non-coated faces of the joint flaps 28 must be heated sufficiently to prevent on their contact with the other joint flaps any chilling of the molten coating on the latter which would prevent it from pervading the joint flaps 28 at their interfaces 56.

The method according to which blanks are formed into flat tubular container form with side joints of the required strength is applicable to any polyolefin coating on the blanks, with the temperatures of the flames from the burners 57 and 58 being regulated in light of different melting temperatures of different polyolefins. Thus, among the polyolefins, polyethylene has a lower melting point than polypropylene, for example. At that, the suitable melting temperature of any polyolefin in carrying out the present method may be within a range, rather than at a given point, depending on such factors as the density of the polyolefin coating and the porosity of the board stock to which it is bonded, for example. Thus, polyethylene coatings on many container blanks and of a thickness within a range of from less than one mil, were heated to approximately 230° F., with the ensuing joints having fully adequate strength.

It is certain that heating of the sealing polyolefin coating to a molten state without accompanying oxidation thereof is imperative in order to obtain the required strength of the side joints of containers thus formed. To what slight extent, if any, the surface of extruded coating on blanks may be oxidized before the latter are formed into side-sealed tubular containers according to the present method is not known, but such coating has been found to be non-oxidized for all practical intents and purposes pertaining to the making of a strong joint. Joints thus formed have been opened by tearing them apart, with the torn areas having the ragged appearance of torn-apart board stock with no visible trace of polyolefin. Quite apparently, the molten and non-oxidized polyolefin will on the overlap and pressing together of

the complementary joint flaps pervade to some depth the non-coated flap at its interface, and it is believed that this polyolefin will then also penetrate more evenly into the flap face onto which it was extruded. The best efforts in determining the exact make-up of the joint at the sealing non-oxidized polyolefin coating have shown that there is in the body of the joint an intermediate stratum s1 of paperboard stock from both flaps pervaded with this polyolefin, as shown in somewhat exaggerated fashion in FIG. 4. The joint thus consists of homogeneous outer and inner strata (FIG. 4) of which the outer strata s2 and s3 are composed of by far the greater parts of the board stock of the respective flaps, and the inner stratum s1 is composed of the remaining parts of the board stock of both flaps and the polyolefin pervading it.

In forming successive blanks into side-sealed tubular container form in accordance with the present method, the only limitation on the rate of continuous feed of the blanks is imposed by the blank handling capacity of the folding devices and the usual stacking equipment therebeyond, for it is a simple matter to adapt the flame subjection of the joint flaps to most any blank feed rate by providing in each burner series a number of individual burners in tandem that extend over the proper distance at proper regulation of the flame temperatures for the purpose. With the coated and non-coated interfaces of the joint flaps being heated to a relatively high temperature as described, it is highly desirable to confine their heating largely to these interfaces and prevent the build-up of any appreciable heat in the body of these flaps, so that on the brief pass of the blanks through the pressing device at any practical blank feed rate the joints are sufficiently sealed to remain sealed on leaving the pressing device. To this end, the apparatus in FIG. 5 preferably provides alongside the series of burners 57 and 58 cooling devices 110 on which ride the joint flaps 26 and 28 with their faces opposite to their designated interfaces 54 and 56 so as to be cooled thereby. The cooling devices 110 may be of any suitable type, and are preferably elongated casings through which a suitable cooling medium is circulated.

The following pertinent data of a successful operation are given, by way of example only, for better practical acquaintance with the present invention. Thus, blanks of 12 mil board stock coated on one face with polyethylene of $\frac{3}{4}$ mil thickness were fed end-to-end at a rate of 1500 feet per minute past two series of burners each of an overall length of 96". The flames from the burners had a temperature of approximately 2000° F. and impinged on the designated coated and non-coated side joint flaps of the blank. Immediately on leaving the flame areas, the blanks passed into folding devices and a pressing device similar to those shown in FIG. 5. The side joints of the tubular containers thus formed from the blanks had entirely adequate strength to withstand any and all stresses to which they were subjected in ordinary and even rough use and handling of the finished containers.

FIG. 10 shows an enlarged section through a side joint 24' of a partly-finished container which is formed from a blank 22' that may in all respects be like the described blank 22 of FIG. 1, except that it has a polyolefin coating c on both faces. The blank 22' is formed into side-seamed tubular container form in the apparatus of FIG. 5 according to the present method, with the flames from both burner series being non-oxidizing. The joint 24' formed thereby is quite similar to the described joint 24 of FIG. 4, except that the inner stratum s1' of board stock from both joint flaps 26' and 28' is pervaded with the polyolefin of the coating on both flaps.

The present method, while highly advantageous for the formation of containers from polyolefin-coated blanks, is equally advantageous in forming laminated products, such as laminated sheet, for example. FIG. 11 shows, somewhat diagrammatically, the essential parts of appa-

ratus in which to form continuous laminated sheet 120 from webs 122 and 124 of board stock of which one face of the web 124 has a polyolefin coating *c''* in this instance. The apparatus comprises separate burners for the webs, with the burners being shown for the sake of simplicity as having a single casing 126 from which issue flames F1 and F2. The apparatus further comprises one or more pairs of power-driven companion rolls 128. The continuous webs 122 and 124, which are of the same given width, are separately led in any suitable manner apart from each other past the flames F1 and F2, respectively, and into the bite of the rolls 128' where they are in exact superposition with each other, with the coating on the web 124 confronting the non-coated face 130 of the other web 122. The driven rolls 128 thus continuously feed the webs 122 and 124 forwardly and also press them together over their entire widths. The flames F1 and F2, of which at least flames F2 are non-oxidizing, impinge on the face 130 of web 122 and coating *c''* on web 124, respectively, throughout their widths so that the coating *c''* will be heated above its melting point and will still be in molten and non-oxidized state when reaching the rolls 128', while the face 130 of the web 122 may have a similar temperature when reaching the rolls 128'. The bond thus obtained between the webs will be substantially the same as the described intermediate stratum s1 of the joint 24 of FIG. 4. The apparatus may further comprise cooling devices, similar to the cooling devices 110 of FIG. 5 on which the webs 122 and 124 may ride with their backfaces while their front faces are subjected to the respective flames F1 and F2, thereby largely to confine the heating of the webs 122 and 124 to their respective face 130 and coating *c''*.

While in the apparatus of FIG. 11 flame is resorted to for the heat treatment of the webs of the laminated sheet 120, FIG. 12 shows apparatus in which the heat treatment of these webs is accomplished by hot air. To this end, the present apparatus comprises, besides the power-driven rolls 128a, two air heaters 138 and 140 of any suitable type, having in this instance a manifold 142 with a perforated plate 144 from which issue hot air jets *j*. The air heaters may be, and preferably are, of the type shown in my copending application, Serial No. 252,276, filed January 16, 1963, now Patent No. 3,156,454, dated November 10, 1964. The webs 122a and 124a are led past the hot air jets from the respective heaters 138 and 140 and into the bite of the rolls 128a', with the air jets from the heaters 138 and 140 impinging on the face 146 of web 122a and on the coating *ca* on web 124a, respectively, throughout their widths, so that the coating *ca* will be heated above its melting point and will still be in molten and non-oxidized state when reaching the rolls 128a', while the face 146 of the web 122a may have a similar temperature when reaching the rolls 128a'. In order that the coating *ca* on the web will not be oxidized in its heat treatment, the air jets from the heater 140 are kept below coating-oxidizing temperature. Thus, in the case of a polyethylene coating the temperature of the air jets is kept below 600° F. around which oxidation would begin. The bond thus obtained between the webs 122a and 124a is as strong as that between the webs 122 and 124 (FIG. 11) obtained by flame treatment of the latter.

Reverting back to the described container formation of FIGS. 1 to 3, the partly-finished container of FIG. 2 is finish-formed by folding the top and bottom panels 150 and 152 into top and bottom closures. The folding of these exemplary panels 150 and 152 into end closures is rather obvious and requires no explanation, especially since it forms no part of the present invention. Also, appropriate apparatus for folding these or similar panels on partly-finished containers into end closures is well known and, hence, is neither shown nor described. However, with the inner surfaces of the partly-finished container of

FIG. 2 having a polyolefin coating as described, this coating may advantageously serve to form a strong seal between the superposed panel parts of the top and bottom closures of the container. To this end, recourse may be had to hot-air treatment of the designated interfaces of joints to-be-made as shown in FIG. 12, by subjecting the designated interfaces of the top and bottom closure panels of partly-finished containers to hot air jets below coating-oxidizing temperature from air heaters similar to those of FIG. 12 but with appropriately modified perforated air-discharge plates for the purpose. These designated coated and non-coated interfaces of the top and bottom closure panels of the partly-finished containers may thus be heated to bring the coating above its melting point and have it in molten and non-oxidized state on the immediately following folding of these panels into the respective end closures and application of sufficient pressure thereto to finish the seal.

While the heat treatment of the sealing polyolefin coating to the end of having it in molten and non-oxidized state for completing the joint is achieved preferably by impinging thereon non-oxidizing flame or hot air jets below coating-oxidizing temperature, as described, it is, of course, fully within the purview of the present invention to heat-treat this coating to the same end by any other known means, such as a highly heated gas devoid of oxygen, for example.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

What is claimed is:

1. A method of laminating webs of paperboard stock of which one face of one web has a polyolefin coating oxidized from its prior extrusion onto the web, which comprises impinging non-oxidizing flame on the coating to bring it above its melting point heating the other web at one face thereof; and while the coating is still molten and said one face of said other web still hot, superposing the webs with the coating confronting said hot face of said other web and pressing the webs together.

2. A method of laminating two webs of paperboard stock of which one face of each web has a polyolefin coating oxidized from its extrusion onto the web, which comprises subjecting the coating on each web to non-oxidizing flame to bring it above its melting point and while the coating on each web is still molten superposing the webs with their coatings confronting each other and pressing the webs together.

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