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ROLL TYPE GLUE SPREADERS, SURFACE COATERS, AND THE LIKE

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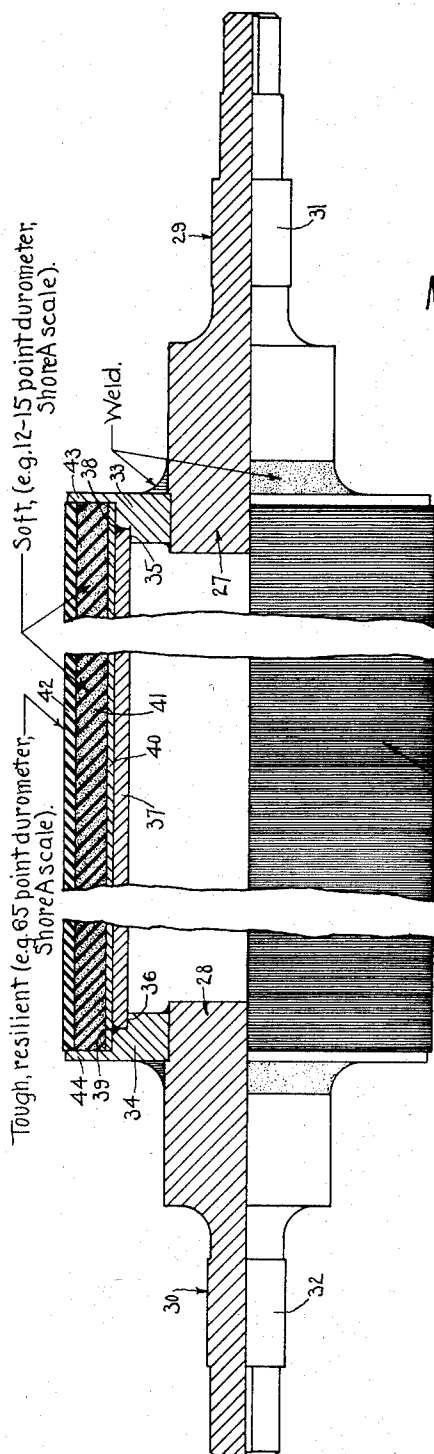


Fig. 2.
Grooved Surface.

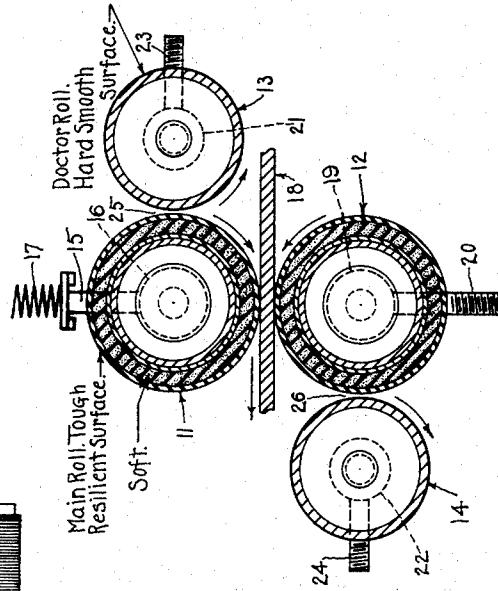


Fig. 1.

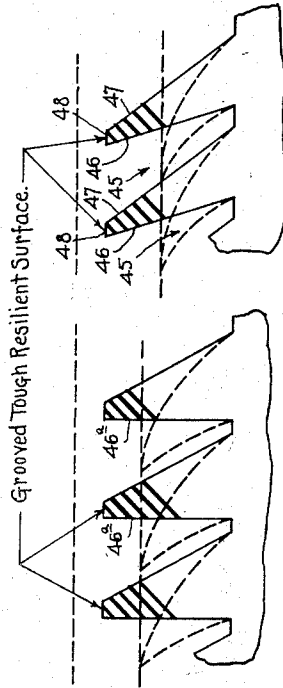


Fig. 3.

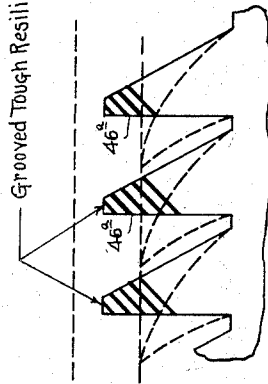


Fig. 4.

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ROLL TYPE GLUE SPREADERS, SURFACE COATERS, AND THE LIKE

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11 Claims. (Cl. 118—244)

This invention relates to that general type of glue spreader, or surface coater, disclosed in Letters Patent of the United States No. 2,326,429, issued August 10, 1943 on the application of John E. Black and Robert S. Black, but as will hereinafter appear, certain features of novelty herein disclosed are not limited in their application to devices of the general type of that earlier patent and are of more general application. However, for purposes of illustration of the present improvements we will hereinafter make reference to that earlier patent. In so doing, however, we do not intend to limit the protection to be afforded by the present application and the Letters Patent to be issued thereon, except as we may do so in the claims to follow.

Generally speaking the presently disclosed device includes two "main rolls" which are journaled one above the other in a common vertical plane and with their respective axes extending horizontally, together with means to apply to the surfaces of such rolls the desired adhesive in liquid form. When both surfaces of a sheet are to be coated such adhesive is applied by maintaining both of the rolls coated with the adhesive; when only one surface of the sheet is to be coated only one of the rolls is maintained coated with the adhesive, generally the upper roll. The sheet is passed horizontally between the two rolls, for which purpose such rolls are set to a clearance between them proper to pass the thickness of the sheet then being coated. Usually a resilient device is provided in the roll supporting assembly to permit one of the rolls to shift slightly away from the other under resilient force, to take care of slight inequalities in sheet thickness and for other purposes; but the roll supporting assembly also includes means to enable the operator to accurately predetermine and maintain the normal separation between the rolls at that value which will properly receive and treat the thickness of sheets being treated. Such general types of device are disclosed in that earlier patent, and are also disclosed in the devices herein disclosed.

In order to provide on the main roll or rolls a film of adhesive to be applied to the sheet surface or surfaces suitable means are provided to produce this function. One such means comprises a "doctor roll" for each main roll, suitably journaled with its axis parallel to that of its main roll, and in substantial horizontal alignment therewith. Each such doctor roll thus provides in conjunction with its main roll a V-shaped trough or crotch, and suitable end plates are provided in contact with the ends of the pair of rolls at the location of such trough or crotch to enclose the ends thereof, and thus provide a pocket within which the adhesive is retained and from which it is fed to the surface of the main roll. By adjusting such doctor roll with respect to its main roll a slight clearance is provided between the two rolls, through which the desired film of adhesive is carried on the surface of the main roll. The thickness of such film of adhesive (usually of the order of a few thousandths or hundredths of an inch) may be accurately determined and maintained by a micrometer adjustment under control of the operator,

and acting to shift the axis of the doctor roll towards or away from the axis of the main roll. Such devices are also shown in the aforesaid Letters Patent No. 2,326,429, and means to effect such adjustments are also disclosed in the present application.

In order to better control the thickness of the film of adhesive which is applied to the surface of the sheet being coated, and to ensure a more uniform thickness of such film over the entire surface being coated, it has been found desirable to provide the surfaces of the main rolls with rather fine encircling grooves, either circular and self-contained, or of spiral form. These grooves, when provided, are of small dimensions both as to pitch between successive grooves, and as to their depth. Such grooves may be of the order of 22 per inch axially of the roll, and depth of the order of 0.025 inch. Sometimes such grooves are of V-shape with one side wall of the V extending radially of the roll, or normal to its axis, and the other side wall of such V of sufficient angle to the plane normal to the roll's axis to provide the desired cross-section of the groove. Sometimes such grooves are formed so that neither wall of the groove lies normal to the roll's axis but both of the walls of the groove lie within planes or surfaces (conical in form) which are at acute angles to the axis of the roll. In such case an "undercut" form of groove is produced. Both forms of such grooved main rolls are shown in Letters Patent of the United States No. 2,343,363, issued March 7, 1944 on the application of John E. Black and Robert S. Black.

In order to permit slight deformations of the surface of the main roll as it exerts pressure against the surface of the sheet being coated the peripheral surface of the main roll is generally formed of yieldable and resilient material such as rubber, neoprene or like materials. Rolls of such type are also shown in the aforesaid Letters Patent of the United States, and said Letters Patent also shows such surfaced rolls as provided with grooves of both of the forms previously referred to herein. It is here noted, however, that the surfacing of rubber, neoprene, or other yieldable material as disclosed in that earlier patent is homogeneous through its entire thickness from its outer perimeter to the supporting tube or hub on which such surface of yieldable material is mounted. Thus the hardness and characteristics of such surface coating are substantially uniform for the entire radial dimension of such surfacing. It is here noted, also, that such surface coating is subjected to wear during usage, thus changing its overall diameter and the contours of the grooves. To meet this condition it is desirable to use, for such surface coating, a yieldable material of considerable toughness combined with that degree of resiliency needed to meet the operating conditions. Those operating conditions include both the need of allowing for slight inequalities in the thicknesses of the sheets at different locations as such sheets ride between the two main rolls, as well as permitting the grooves to deform under surface pressure exerted radially against the main rolls by the sheet being treated so as to expel the desired amount of adhesive onto each unit area of the surface being coated. Thus, in that earlier patent it was disclosed that yieldable material of the general hardness of the order of 40 to 60 on the scale of the Shore durometer was considered satisfactory.

Now, evidently the deformation of the surface of the main roll which is produced by the pressure of the sheet against such roll surface will depend on the surface pressure exerted between the sheet and the roll's surface; or conversely, the deformation of given amount will produce a pressure of resistance by the yieldable surface of the roll dependent on the material from which such roll surfacing is formed, the radial dimension of that surfacing, the form and size of the grooves, their spacing, and

other factors. In any case, however, the variations in sheet thickness at different areas thereof will necessarily produce corresponding variations in the deformation of the main roll's surface since the parts are under opposing pressure conditions. These deformations of the main roll's surface are of two kinds; First, they include deformations of the ridges between the successive grooves of the roll surface, and Second, they include bodily shift of the ridges radially inwards towards the axis of rotation. The latter deformations can be produced only at the expense of the former deformations, since the deforming pressure is exerted radially inward from the elemental areas of roll surface which are in contact with the surface of the sheet being treated, and these elemental areas which first receive the pressure from the sheet being treated are the outer edges of the ridges between the grooves. When the entire thickness radially of the yieldable surfacing is homogeneous, as disclosed in that earlier patent, is it evident that by far the greater portion of the yield produced by the pressure of the sheet being treated will be taken up by the ridges between the grooves, since the body of such ridges (per unit radial dimension) is much smaller than the body of the supporting non-ridged section of the surfacing of the yieldable material. In other words, the pressure exerted per square inch section of the ridges is much greater than the pressure exerted per square inch section of that portion of material radially inwards from the ridges. Thus, for a given pressure exerted against the perimeter of the so-formed roll, most of the deformation will occur within the radial dimensions of the ridges between the grooves, and only a very small deformation radially will occur in that body of yieldable material located radially inwards from the ridges themselves.

Variations in the amounts of deformations of the ridges will necessarily result in variations of amount of adhesive expelled over corresponding areas of the main rolls, and with corresponding variations in the thickness of the film of adhesive planted on the various elemental areas of the sheet surface being coated. Thus, it now becomes evident that variations in the sheet thickness must necessarily result in variations in the thickness of the film planted on the surface of the sheet at corresponding locations. Thus a serious disadvantage in the uniformity of treatment of the sheet's surface occurs, and the uniformity of application of the adhesive to all areas of the sheet's surface is destroyed. Since it is a desirable quality of the coating machine to ensure substantial uniformity of application of the adhesive to all areas of the sheet's surface it is desirable to make provision to meet and counteract the underlying structural features of the main rolls which features have heretofore produced this objectionable condition. It is the prime object of the present invention to provide in the main rolls further structural features which will ensure attainment of this desirable result.

We have provided and shall disclose herein a main roll construction in such roll type glue spreaders and surface coaters wherein we provide a rather thin surface of tough, somewhat hard resilient yieldable material, capable of resisting the wear necessarily attendant on the operation of such devices, and provided with a grooved and ridged surface capable of ensuring the expulsion of the desired amount of adhesive by deformation of such ridges, together with a supporting base of rather soft, preferably spongy material of yieldable material of elastic nature, such soft base being such as to yield sufficiently to take care of most of the inequalities in thickness of the sheet being treated, with a minimum variation in the deformations of the ridges at the surface of the roll. Thus we have combined the function of expulsion of a desired amount of adhesive by slight radial deformation of the roll's surface ridges, together with provision to take care of the inequalities in sheet thickness by varying amounts of yield of the soft base.

The functional operation of the foregoing combination may be likened to an elastic unit formed of a rather stiff spring and a "softer" spring in series so that the deforming force is exerted through both sections. Such an arrangement when subjected to a deforming force will produce a slight deformation of the stiff spring section, and a much greater deformation of the "softer" spring section, so that slight variations of deforming force will act principally to produce changes in the deformation of the softer section, and comparatively insignificant changes in the deformation of the stiff section. By way of illustration only, and not as a matter of limitation we have successfully used main rolls having surface sections of tough, resilient long wearing material, of a hardness of substantially 65 point durometer on the Shore "A" scale, such material conveniently being rubber or neoprene, together with a base section, preferably very spongy and of a softness of substantially 12-15 point durometer on the Shore "A" scale. With such a combination, and using a surface section of substantially $\frac{3}{8}$ inch radial dimension, and a base section of substantially 1 inch radial dimension all of the desirable qualities hereinbefore explained have been attained, and the objectionable qualities eliminated. The base section may conveniently be formed of sponge rubber, neoprene, or other resilient material. Taking account of the greater radial dimension of the soft base and its greater softness specification, and the much smaller radial dimension of the hard outer section and its much greater hardness of lesser softness, it is evident that by far the greater amount of the deformation changes produced by slight inequalities in the thickness of the sheet being coated will be taken up by the base section, and substantially without change in the deformations of the ridges between the grooves of the contacting surface. Thus a substantially uniform rate of delivery of the adhesive to the surface being treated will be ensured, ensuring substantially equal amounts of adhesive to all equal areas of the treated surface, notwithstanding inequalities in the thickness of the sheet being treated, or other like irregularities.

Other objects and uses of the invention will appear from a detailed description of the same, which consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawing:

Figure 1 shows, schematically, a surface coater embodying the features of the present invention, and including two main rolls in vertical alignment, together with corresponding doctor rolls located in substantial horizontal alignment with their main rolls, together with spring yieldable means urging the upper main roll downwardly, and horizontally adjustable doctor rolls which may be adjusted with respect to their companion main rolls to provide the desired small clearances between the main and doctor rolls, and also including means to adjust the elevation of the lower main roll to provide for accommodation of sheets of various thicknesses, but with slight vertical adjustability of the upper main roll corresponding to sheets of deviation from intended thicknesses, etc.;

Figure 2 shows a longitudinal view of a main roll embodying the features of the present invention, the upper one-half of such figure being in vertical section, and intermediate sections of the roll being left out to shorten the figure;

Figure 3 shows on greatly enlarged scale a fragmentary radial section through a portion of the outer of grooved and ridged surface of the main roll, with the grooves thereof undercut; and

Figure 4 shows on greatly enlarged scale, a fragmentary radial section corresponding to that of Figure 3, but showing a grooving and ridging modification in which the grooves are not undercut but are provided with planar surfaces on one side of each ridge, such planar surfaces being normal to the axis of rotation of the roll.

In Figure 1 the upper and lower main rolls are shown

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at 11 and 12, respectively, and the companion doctor rolls are shown at 13 and 14, respectively. The upper main roll is shown schematically as provided with the upwardly extending vertical stem 15 carrying one of the journals for such roll, shown at 16. The other journal and stem are not shown in Figure 1 as they have been cut away in such figure. A spring 17 urges the stem 15 downwardly to produce a pressure of the upper main roll against the sheet 18 being coated, such sheet travelling towards the left as shown in Figure 1. The journal 19 is shown for one end of the lower main roll, being connected to a stem 20. The journal for the near end of such roll is not shown in Figure 1 as it too has been cut away in such figure, and this is also true of the corresponding downwardly extending stem. By adjusting the stems for the lower roll's journals the elevation of such lower roll may be adjusted to meet requirements of various specified thicknesses of sheet stock being fed between the two rolls. To effect such adjustments such lower stem 20 is shown as being threaded to receive an adjusting screw element. The two doctor rolls are shown as provided with the journals 21 and 22, respectively, each such journal being provided with a corresponding horizontally extending stem 23 or 24 as the case may be, it being understood that the near journals and stems have been cut away in Figure 1. These stems 23 and 24 are shown as being threaded to receive adjusting elements whereby the doctor rolls may be adjusted towards and away from their companion main rolls to adjust the clearances 25 and 26 between such doctor rolls and their companion main rolls. Pockets or crotches are thus provided between the doctor and main rolls, the ends whereof are closed by plates (not shown) so that adhesive or other liquid material to be applied to the surfaces of the sheet 18 may be carried by the main rolls to the sheet areas being treated, the amount or thickness of the film of such adhesive which will be planted on the surface of the sheet being thus adjustable by the setting of the doctor rolls. Such arrangements are disclosed in the aforesaid Letters Patent No. 2,326,429, and here shown for purposes of illustration only, and as showing the relationship of various features of the present invention to the functions and operations which are produced by the complete machine.

Reference is now had to Figure 2 which shows the detailed construction of one of the main rolls. It comprises the two end blocks 27 and 28 which are provided with the outwardly extending shaft extensions 29 and 30, respectively. These shaft extensions are provided with suitable journal receiving sections 31 and 32, which receive journals such as those shown at 16 and 19 in Figure 1. The blocks 33 and 34 are secured to the blocks 27 and 28, preferably by seating such blocks onto the inner end portions of the blocks 27 and 28, respectively, and welding the parts together as indicated in Figure 2. The blocks 33 and 34 are conveniently shouldered as shown at 35 and 36 to receive the ends of a tube 37 which constitutes the unyieldable element on which the yieldable elements of the roll are mounted. Conveniently the proximate portions of the tube ends and the blocks 33 and 34 are kerfed as shown at 38 and 39 to enable the tube ends to be welded to said blocks, thus providing a strong rigid support for the yieldable elements of the roll.

The yieldable section of the roll is tubular in form, comprising the inner rather thin tubular sheet 40, of metal or rather hard rubber or the like, on which is directly mounted the cylindrical inner soft resilient yieldable section 41. Onto this soft inner section 41 there is mounted the outer harder cylindrical section 42 also of yieldable, resilient material, such as rubber, neoprene, or other like material. The roll illustrated in Figure 2 has an outside diameter of substantially 11 $\frac{3}{4}$ inches. The thickness of the outer section 42 then

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has a value of substantially $\frac{3}{8}$ inch, and the thickness of the inner section a value of substantially 1 inch. These two sections may be cemented or otherwise secured together, or the outer section may be slightly expanded in diameter and then slipped onto the inner section, and then allowed to contract into firm engagement with such inner section. In operation the two sections are in sufficiently firm engagement, the one with the other that they must rotate at all times exactly as a unit. Preferably the outer perimeters of the blocks 33 and 34 are carried outwardly as flanges 43 and 44, respectively to overlie and protect the ends of the yieldable sections; but it is noted that such flanges are of slightly smaller external or outside diameters than the outer surfaces of the section 42 so that such flanges 43 and 44 do not come in contact with 13 or 14 or shall not come into direct engagement with the surface of the sheet being coated in case such sheet should inadvertently overrun the end or ends of the roll.

Reference to Figures 3 and 4 will show two alternative forms of grooving and ridging the outer surface of the yieldable section 42. Due to the fact that the grooves shown in Figures 3 and 4 have a depth of only the order of 0.025 inch they cannot be conveniently shown in the section of Figure 2, but they are indicated by the annular lining of the lower, unsectioned one-half of Figure 2. In the form shown in Figure 3 the grooves 45 are shown as being undercut at their left-hand faces 46 by forming such faces at an acute angle to a plane normal to the axis of roll rotation; and the right-hand faces 47 are then formed at a greater acute angle to such plane normal to the axis of rotation, the outer encircling annular surface 48 lying within the perimeter of the roll. The surfaces 48 are those which come into direct contact with the sheet surfaces being treated. Upon exerting directly inward radial pressure against such outer surfaces 48 the ridges which they terminate will be laterally deformed as shown by the dotted lines in Figure 3, thus expelling some of the adhesive contained in the groove since the volume of such groove will thereby be reduced. In the modified form of groove shown in Figure 4 the left-hand faces 46^a of the ridges are formed in planes normal to the axis of rotation instead of at acute angles as in the former showing. However, generally speaking both forms of groove and ridge are subject to the same laws of operation and analysis.

Now the hardness (or lack of softness) of the outer section 42 as compared to the section 41 is such that when a deforming force has been exerted on the outer surfaces 48 to deform the ridges at any extent, inward pressure is also being developed against the soft inner section 41. Thus such section will also yield inwardly, so that a less deformation of the ridges will occur than would be the case with an inner section of material substantially of the same hardness (or lack of softness) as the outer section 42. Accordingly, less adhesive will be expelled from the adjacent grooves than would be the case with a harder inner section. The hardnesses of the two sections can be made such in relation to each other that when a certain pressure or force has been developed against the outer ridge surfaces 48 with corresponding expulsion of desired amount of adhesive, further force developed against such ridges will cause inward deformation of the inner section as fast as the outer surface 48 is forced inward, so that a limit is then reached as to the amount of adhesive which may be expelled from the groove. Thus, excessive pressures developed against the surfaces 48 will not thereafter change the amount of adhesive which will be expelled. This function is directly related to the fact that the outer section 42 is formed of much harder yieldable and resilient material than the inner section 41.

We claim:

1. In a roll type surface coater, the combination of a pair of main rolls, means to journal said rolls for ro-

tation on parallel axes and with the proximate surface portions of the rolls separated from each other a distance to accommodate the thickness of a sheet of stock to be surface coated, means to rotate said rolls in opposite directions, at least one of such main rolls comprising a stiff cylindrical base, a tubular section of soft, yieldable, resilient material of substantially uniform radial thickness of the order of one inch mounted on said cylindrical base, and a tubular section of tough, resilient material of substantially uniform radial thickness of the order of $\frac{3}{8}$ inch mounted on said soft yieldable resilient material section, together with means to supply a controlled thickness film of coating material to the surface of said main roll the radial dimension of said tubular section of tough resilient material being not over substantially one-half the radial dimension of said tubular section of soft, yieldable resilient material.

2. Means as defined in claim 1, wherein said soft, yieldable, resilient material section is composed of rubber-like material.

3. Means as defined in claim 1, wherein said soft, yieldable, resilient material section is of spongy formation.

4. Means as defined in claim 3, wherein said soft, yieldable, resilient spongy material section is composed of rubber-like material.

5. Means as defined in claim 1, wherein said tough, resilient material section is composed of rubber-like material.

6. Means as defined in claim 1, wherein said soft, yieldable, resilient material section has a hardness of substantially 12-15 point durometer on the Shore "A" scale of hardness.

7. Means as defined in claim 1, wherein said tough, resilient material section has a hardness of substantially 65 point durometer on the Shore "A" scale of hardness.

8. Means as defined in claim 7, wherein said soft, yieldable, resilient material section has a hardness of sub-

stantially 12-15 point durometer on the Shore "A" scale of hardness.

9. In a roll type surface coater, the combination of a pair of main rolls, means to journal said rolls for rotation on parallel axes and with the proximate surface portions of the rolls separated from each other a distance to accommodate the thickness of a sheet of stock to be surface coated, means to rotate said rolls in opposite directions, at least one of such main rolls comprising a stiff cylindrical base, a tubular section of soft, yieldable, resilient material of substantially uniform radial thickness mounted on said cylindrical base, and a tubular section of tough, resilient material of substantially uniform radial thickness mounted on said soft yieldable resilient material section, together with means to supply a controlled thickness film of coating material to the surface of said main roll, and a series of circular grooves in the surface of said tough, resilient tubular section, with circular ridges between said grooves, the outer edge portions of such ridges comprising sheet stock surface engaging areas of said tough, resilient tubular section the radial dimension of said tubular section of tough, resilient material including the circular ridges thereof being not over substantially one-half the radial dimension of said tubular section of soft, yieldable resilient material.

10. Means as defined in claim 9, wherein the opposite faces of each ridge are formed at different angles with respect to the axis of rotation of said main roll.

11. Means as defined in claim 10, wherein the depths of said grooves radially are substantially one fifteenth of the radial thickness of said tough, resilient tubular section.

References Cited in the file of this patent

UNITED STATES PATENTS

620,286	Dodge	Feb. 28, 1899
2,326,429	Black et al.	Aug. 10, 1943
2,343,363	Black et al.	Mar. 7, 1944