March 7, 1944. J. E. BLACK ET AL 2,343,363

GLUE SPREADER, SURFACE COATER, AND THE LIKE

Filed Jan. 13, 1942 2 Sheets-Sheet 1

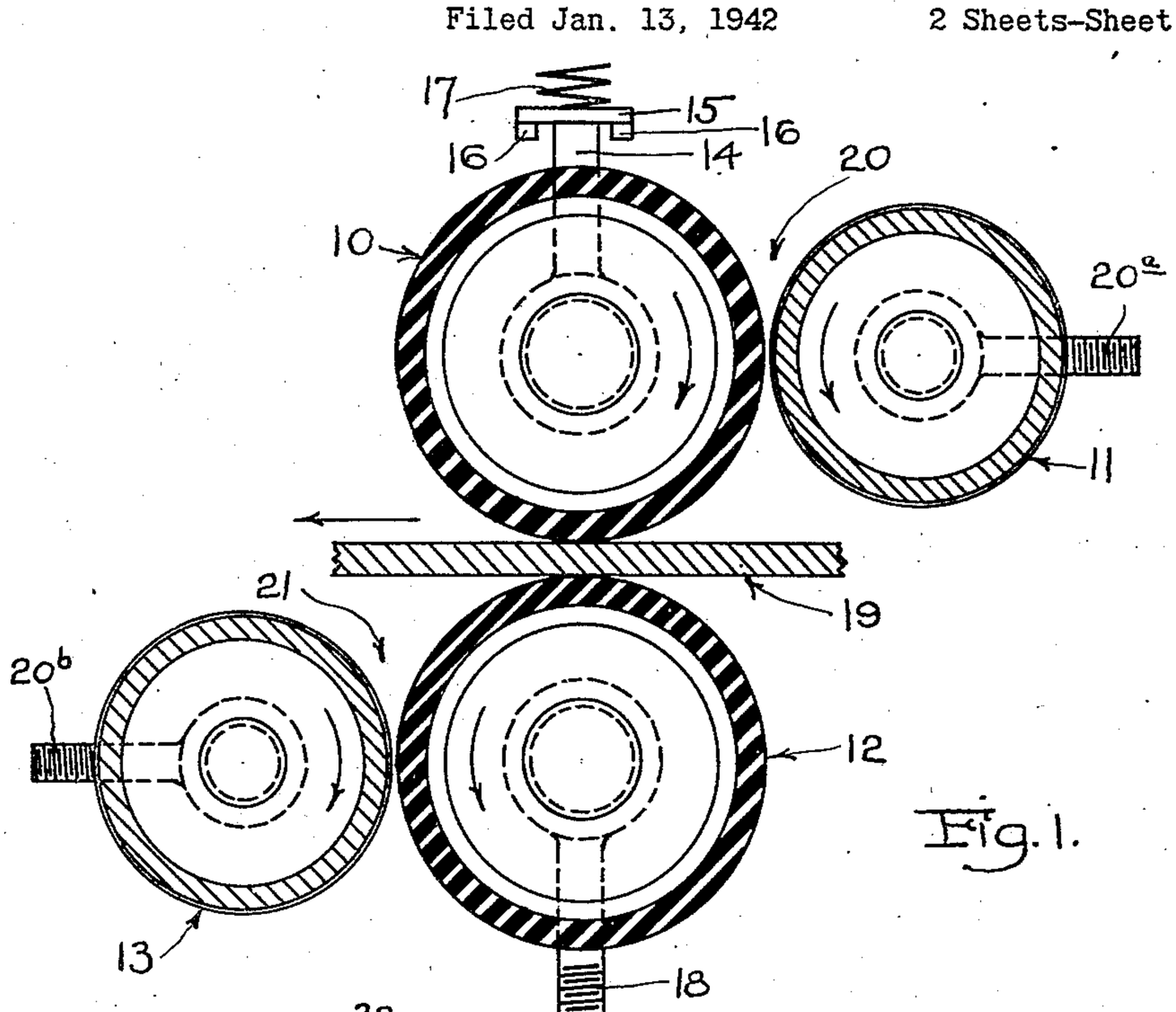

Fig. 1.

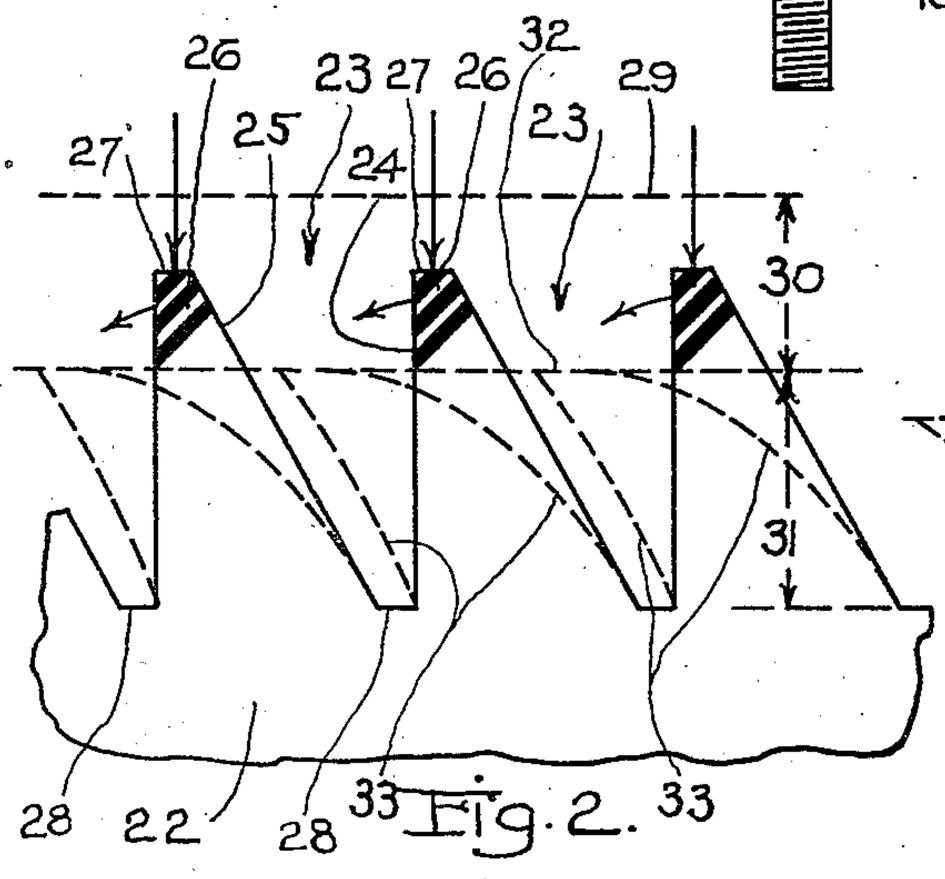

Fig. 2.

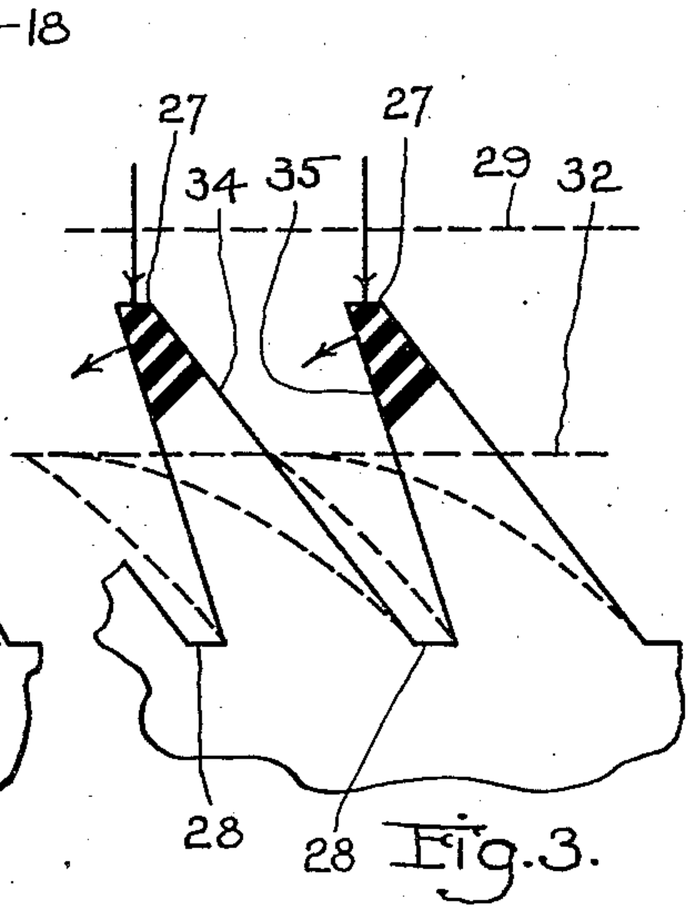

Fig. 3.

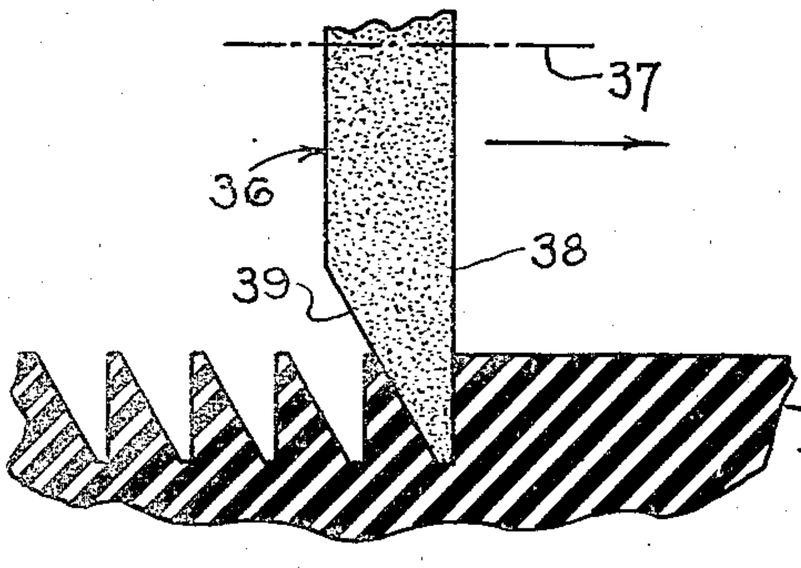

Fig. 4.

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GLUE SPREADER, SURFACE COATER, AND THE LIKE

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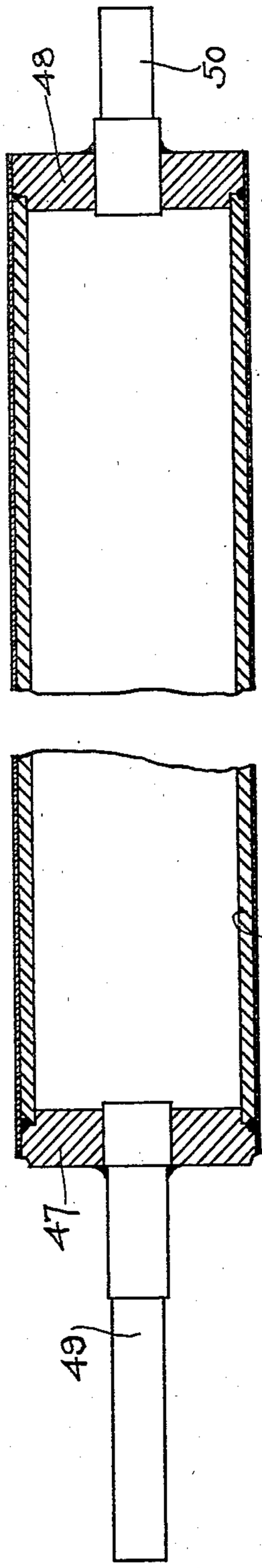

Fig. 6.

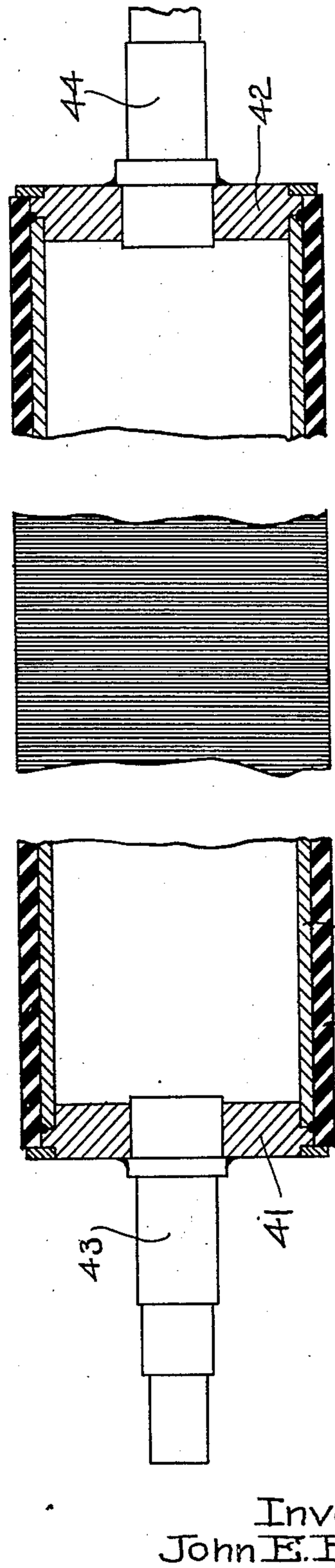

Fig. 5.

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UNITED STATES PATENT OFFICE

2,343,363

GLUE SPREADER, SURFACE COATER, AND THE LIKE

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Mendota, Ill.

Application January 13, 1942, Serial No. 426,574

3 Claims. (Cl. 91—67.8)

The present invention concerns itself with improvements in glue spreaders, surface coaters, and the like. While the features and improvements herein disclosed have been devised with particular reference to the spreading of glue and other adhesives, and to meet certain conditions encountered in the handling of such materials as the foregoing, still it will presently appear that the improvemets herein disclosed may also be advantageously used in connection with many other materials, such as paints and the like. Therefore we do not intend to limit the usefulness of said improvements, nor the protection of our invention to use in connection with glues and adhesives, except as we may do so in the claims to follow. Furthermore, in herein using the term glue spreaders and the like we wish it understood that such term is used as a matter of convenience and simplicity, and not with any intention of limitation, except as we may hereafter limit ourselves in the claims or otherwise.

The present invention concerns itself with improvements in roll type spreaders or coaters—that is, that type in which rolls are provided for delivery of the glue or other material to the surface being coated. Furthermore, the invention relates to improvements in coaters of the foregoing general type in which the surface of the roll or rolls is or are composed of a yieldable material, such as rubber, neoprene, or other suitable material. In the operation of coaters of the foregoing general type the main or coating roll or rolls is or are rotated or permitted to rotate in surface contact with the stock being coated, said roll or rolls carrying a film of the glue or other material which is delivered to the surface being treated by contact with such surface. The amount and distribution of such material being so delivered to the surface being treated will depend on various factors; but generally speaking it may be said that the thickness of the film carried by the roll or rolls is an important factor of the problem. When the surface of such roll or rolls is or are smooth the thickness of the film which may be carried thereby will be limited (without danger of dripping of the material from such roll surface); and such thickness will also depend on the nature of the material being handled, as well as other factors.

In order to increase the material carrying capacity of the roll surface (and for other reasons) grooves may be provided in the roll surface or surfaces, so that the amount of material which may be delivered during each revolution of the roll or rolls will be increased by the amount of material which is accommodated within such grooves and properly delivered therefrom to the surface being treated. We have discovered that the form and arrangement of such groove or goooves bears a very important relation to the results which may be secured with such an arrangement, especially when the surface of the roll or rolls is or are made of yieldable material, such as rubber, neoprene, and the like. The body of material carried by the roll or rolls thus includes that material contained within the groove or grooves, and also the superincumbent layer of material around the perimeter of the roll or rolls; and the amount and nature and regularity of delivery of these two components of said material to the surface being treated will depend, among other factors, on the form and placement of the groove or grooves in the roll surface.

We have found that sometimes the operation of grooved rolls, wherein the groove or grooves is or are of an encircling form, results in delivery of the material to the surface being treated in a ridged or uneven manner, so that the treated surface has thereon a coating of material of uneven form and including a series of ridges of the material extending parallel to each other and in the direction of travel of the treated stock through the coating machine. Such uneven distribution of the coating material is of course disadvantageous for various reasons, including the fact that the amount of coating material used for a given operation is thereby needlessly increased.

One important feature of the present invention relates to the provision of rolls having yieldable surfaces which are provided with grooves or a groove of new and distinct form or characteristics so that deflection of the roll surface under pressure against the surface being treated will result in expulsion or delivery of the material from the groove or grooves in much more complete manner than has heretofore been possible, and in such manner that the delivery of the material to the surface being treated will be very uniform and substantially without creation of ridges or other unevennesses.

In connection with the foregoing feature we have found that by provision of grooves or a groove so formed that pressure on the ridge between grooves will result in an unbalanced deflec-

tion or deformation of the groove or grooves there is produced a much greater and better expulsion of the material from such groove or grooves, so that a greater amount of the material may be delivered to the surface being treated than heretofore and with the use of a film of given thickness on the roll surface; and we have also found that we are able under these conditions to ensure a material coating of the surface substantially even over the entire surface being treated, and substantially without creation of any ridges or other unevennesses on the treated surface.

The exact form of groove embodying our present invention is subject to variation within the scope of our invention; but generally it may be stated that we so form the groove or grooves that they are unbalanced or non-symmetrical in cross-section so that pressure against the ridge between two such grooves will serve to produce a lateral deflection of the yieldable material of the roll surface with a consequent greater or increased closure of the groove or grooves by such deflection, and with a consequent increased expulsion of the material from the groove or grooves to the surface being treated.

Sometimes we form the groove or grooves of generally V-shaped cross-section, but non-symmetrical with reference to a line radial with respect to the axis of roll rotation, so that pressure against the ridge between the grooves and in a generally radial direction will result in lateral deformation of the rib or ribs between grooves, as distinguished from a deformation which is perfectly symmetrical in both directions. For example, we may form the groove or grooves of V-shaped cross-section, and with one wall of the V extending radially, the other wall being at an angle of substantially thirty degrees to the radial, in which case the deformation of the rib between grooves will be towards the radially extending wall; or we may even, on other cases form the groove or grooves with both walls thereof slanting in one direction, one wall more than the other, so that a sort of undercut groove is produced; in which case pressure against the ridge between two such grooves will result in still greater lateral movement of the said ridge, but such arrangement presents certain manufacturing objections, although it may be feasibly formed.

A further feature of our present invention relates to the provision of methods and means for cutting the groove or grooves in the roll surface and of the form or forms herein disclosed. In this connection we have found that the yieldable roll surface, such as rubber, neoprene, or other material, may be satisfactorily treated by a grinding operation in a grinder, to form and cut the groove or grooves, rapidly and uniformly and regularly, even when such groove or grooves is or are of relatively small dimensions.

Sometimes we treat the roll surface to produce a series of encircling grooves of strictly circular form, and sometimes we treat said surface to produce a continuous helical groove or grooves extending from one end of the roll to the other, and in this latter case we may so treat the roll surface as to produce a series of said helical grooves in the form of a multiple helix or the like. All these and other treatments fall within the scope of our invention.

In a practical embodiment of our present invention we provide suitable journals for the main roll or rolls, together with means for adjustment thereof towards or away from the surface of the stock being surface treated, such adjustment means being such that very accurate adjustments between the roll and the treated surface may be secured. By this means the amount of pressure which will be exerted between the treated surface and the ridges between the roll groove or grooves may be adjusted, with consequent adjustment of the amount of deformation which the ridges between grooves of the roll will take place, it being understood that the roll surface is made of a yieldable material such as rubber, neoprene, or the like.

Furthermore, in a practical embodiment of our present invention we provide for the main roll or rolls a doctor roll or rolls, each main roll and its doctor roll being set parallel to each other and with their surfaces close to each other (but preferably not in actual contact with each other). We also provide means to very accurately adjust each doctor roll towards and from its main roll so that the clearance between said rolls may be accurately adjusted, to thereby accurately adjust the thickness of the film of glue, paint, or other material which will be taken onto the main roll surface. In connection with the foregoing feature, the doctor roll or rolls may be suitably coated or finished, but we have found that smooth finishes of chromium are desirable for the doctor rolls, in connection with main rolls provided with rubber or neoprene coated surfaces, treated to provide a groove or grooves embodying features of our present invention.

We have found that rolls embodying the features of our present invention are well adapted for use in connection with various glues, paints, and other materials, which do not require to be heated. Thus, for example, these features have been found to be well adapted for use in connection with urea-formaldehydes, casein glues, and various synthetic glues, as well as others.

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 drawings:

Figure 1 shows, more or less schematically a simple form of spreader including rolls embodying the features of our present invention, said spreader including upper and lower sets of rolls which may be adjusted with respect to each other so as to ensure the proper compression of the rubber or yieldable surfaces of the main rolls for deflection of the ridges between the groove or grooves of said roll or rolls; and also including means to adjust each doctor roll towards and from its main roll so as to adjust the thickness of the film of glue or other material carried by the surface of the main roll and the groove or grooves thereof;

Figure 2 shows on greatly enlarged scale a fragment of the surface of one of the main rolls, in longitudinal section, and it shows the preferred form of the groove sections of unbalanced form; and it also shows by dotted lines the deflected form of the ridges between the grooves so as to ensure maximum delivery of glue or paint or other material from said groove or grooves under compression against the surface being treated;

Figure 3 shows a section similar to that of Figure 2, but it illustrates a modified form of groove or grooves in which one of the groove walls is actually undercut to a material extent;

Figure 4 shows, more or less schematically a simple form of cutting operation for forming the

groove or grooves by means of a grinder using a suitably formed grinding wheel;

Figure 5 shows a longitudinal section through one form of main roll embodying the features of our present invention, portions thereof being cut away to shorten up the figure, and a portion being shown in elevation; and

Figure 6 shows a view similar to that of Figure 5, but it illustrates a doctor roll for use with the yieldable surface main roll.

Referring first to Figure 1, we have therein shown the upper pair of rolls, including the main roll **10** and the doctor roll, **11**, and the lower pair of rolls, including the main roll **12** and the doctor roll **13**. Suitable means are provided for driving these rolls in the directions shown by the several arrows. The upper main roll, **10** is normally held in the elevational position shown as by means of a stem or stems **14**; and preferably there is provided a shouldered portion **15** thereon which sets down against a stationary stop **16** to limit the downward movement of the upper main roll under impulse of a strong spring **17**. In case of need said upper main roll may, however, yield upwardly to a slight extent but its elevation is normally fixed by said stop **16**.

The lower main roll **12** is held and journalled by a stem or stems **18**, which are conveniently threaded so that said stem or stems may be raised or lowered by suitable means (not shown) to thereby adjust the exact elevation of said lower main roll, and to thereby accurately adjust the clearance between the upper and lower main rolls, and to bring said rolls into exact parallelism. The clearance between these two main rolls is such as to accommodate the thickness of the sheet of stock **19** which is to be surface coated with the glue or other material on both its surfaces, said sheet travelling in the direction of the arrow in Figure 1. The details of construction of the main and doctor rolls may be varied as desired, within limits, but we have in Figures 5 and 6 shown convenient constructions for these rolls. These will be described in detail hereinafter.

The arrangements so far described are also shown and described and claimed in our co-pending application for Letters Patent of the United States, Serial No. 391,324, filed May 1, 1941, and entitled improvements in glue spreaders, surface coaters, and the like.

The glue or other material for the main roll **10** is contained within the upper pocket **20**, and the glue or other material for the main roll **12** is contained within the lower pocket **21**. The details of construction of the end portions of these pockets need not be herein described as they are fully shown and described in our said co-pending application; but it will suffice to here mention that the end portions of these pockets are suitably closed so as to retain the glue or other material therein.

Now it will be evident that rotation of the main rolls in the directions shown by the arrows will serve to carry films of said glue or other material on the roll surfaces and towards the surfaces of the stock sheet **19**; and further that the thicknesses of these film will be dependent, among other things, on the clearances established between the respective main and doctor rolls. To effect lateral adjustments of the doctor rolls with respect to the main rolls, the stems 20^a and 20^b to which the doctor rolls are journalled may be threaded as shown so that they may be accurately adjusted by suitable micrometer adjustments to bring the clearances between the main and doctor rolls to the exact amounts needed according to the desired thicknesses of the films of coating material to be carried by the main rolls. Consequently the amount of glue or other material which will be delivered to the surfaces of the stock sheet may be thus adjusted, within limits. However, the thickness of such films will in any case be limited due, among other things, to the nature of the material being coated onto the stock, and in any case too great a film thickness will result in uneven coating of the surface of the stock sheet. Fine grooves may therefore be formed on the surfaces of the main rolls, so that the glue or other material will fill these grooves and be carried by them also to the surface being coated.

Now it will be evident that if the two main rolls be so set with respect to each other—that is, at such separation from each other that the passage of the sheet of stock between these main rolls results in compression of the yieldable roll surfaces, some of the glue or other material contained within the groove or grooves will be expelled onto the surface being coated, with consequent increase of amount of material deposited on said surface. The main feature of the present invention concerns itself with the nature and form of these grooves.

Referring to Figure 2 we have therein shown in greatly exaggerated cross-section a fragment of the surface of one of the main rolls. The rubber or other yieldable material of said surface is shown at **22**. The thickness thereof radially may be of amount determined by the designer, or of reduced amount due to wear or resurfacing, but generally will originally be of, say 5/8" or thereabout. We provide in said yieldable surface material an encircling or longitudinal groove **23**, or a series of such grooves, but generally the same is conveniently made as a continuous helical encircling groove with its turns of small size and close together. For example, such turns may be of the order of twenty-two per inch, and of depth of the order of .025". It will be noted that the walls **24** and **25** of such groove or grooves are unsymmetrical with respect to a radial line through the roll, and in the form of Figure 2 the groove wall **24** is radial and the wall **25** lies at an angle of substantially thirty degrees with respect to the radial line, so that although the walls lie at an angle of substantially thirty degrees with respect to each other, still the rib or ridge **26** between these walls is unsymmetrical with respect to the radial line. Preferably, also, this groove or these grooves is or are so formed as to provide the slight flat surfaces **27** and **28** at the top of the ridge and at the bottom of the groove, respectively, similar to good practice in the cutting of threads.

Now it will be noted that the rubber or other yieldable surface normally stands in the full line position of Figure 2; and we have also shown, by means of the broken line **29** the typical surface position of the film of glue or other material taken onto the roll from the pocket **20** or **21**, as the case may be. It will be seen that the body of glue or other material therefore comprises the two portions **30** and **31**, **30** being that within the space between the line **29** and the maximum diameter or radius of the roll, and **31** being that within the groove itself. If the two main rolls should be so set with respect to each other as to exactly accommodate the thickness of the sheet of stock **19** between them without compression of

the yieldable roll surfaces the amount of glue or other material which could be delivered to the surface being coated would be limited to that film thickness up to the line 29 which could be carried by the roll without dripping or other objectionable results, and in case said thickness should be relatively large there might be danger that irregular or uneven coating would result. If, on the other hand, the main rolls 10 and 12 should be set closer together, so that passage of the sheet of stock between them would result in compression of the yieldable roll surfaces, in such case the peaks 27 of the ridges between the grooves would be depressed to a line such as the broken line 32 in Figure 2, with consequent reduction of the volume of the groove or grooves, and consequent expulsion of some or all of the glue from said groove or grooves onto the surface being coated; and this material so expelled from the groove or grooves would be in addition to that carried above the normal cylindrical surface of the roll proper.

Now we have found that when the groove or grooves is or are made symmetrical with respect to the radial line such compression of the peak portion of the ridge 27 sometimes serves to produce ridges of the glue or other material on the surface being coated, and that this is especially noticeable in the case of relatively stiff materials such as thick glues. Furthermore, the extent of closure of the groove or grooves occasioned by a given amount of compression of the peaks between grooves is limited, and for a given amount of such compression the amount of material which is expelled from the groove or grooves is limited materially.

We have found that when using the non-symmetrical groove form illustrated for example in Figure 2, a given depression or compression of the peaks between grooves serves to expel a much greater proportion of the glue or other material from the groove or grooves; and furthermore, that such depression of the peaks serves to cause a lateral deflection of the ridge between the two grooves, as shown by the dotted lines 33 in Figure 2. Instead of each ridge being merely bulged laterally in both directions with a large portion of the deformation being in the form of a direct radial compression of the rubber or other material, such non-symmetrical form of the grooves serves to ensure lateral deflection of the body of the ridge, so that the originally radial wall 24 moves laterally towards the originally slanting wall 25, and at the same time said originally slanting wall is bulged so that it does not move away from its original position to a material degree, and consequently the volume of the groove is greatly reduced, and the glue or other material originally in such groove is squeezed out therefrom to a much greater extent than in the case of symmetrical grooves. In fact, it is possible to secure a substantially complete expulsion of the glue from the groove with a relatively small compression of the peak of the ridge, and therefore a much improved operation in the coating of the sheet of stock material.

The arrangement shown in Figure 3 is similar to that above explained, but in the case of Figure 3 the walls 34 and 35 are both non-radial, and both slant in the same direction, but at different degrees of slant, as shown. Such a form of groove is in some respects superior to that of Figure 2, but it cannot be as easily cut as the form of Figure 2 according to present understood processes of manufacture. We contemplate various forms of non-symmetrical grooves, and do not intend to limit ourselves to either of the forms illustrated in Figures 2 and 3, except as we may do so in the claims to follow.

Grooves, such as shown in Figure 2 may be readily formed in the roll surface. For example, as shown in Figure 4 use may be made of a grinding wheel 36 of suitable material, such as Bakelite bound Carborundum, said grinding wheel being used in a suitable grinding machine, or carried by a thread cutting lathe, so that by rapid rotation of such grinding wheel, accompanied by longitudinal movement of the roll itself, and slow rotation of said roll, there will be cut a thread groove in the yieldable surface material of the roll. Such groove will be in the form of a helix; and by suitably forming the peripheral portion of the grinding wheel, as shown in Figure 4, the groove will be cut or ground to the desired form. The axis of rotation of this grinding wheel is shown at 37, and the peripheral portion of the grinding wheel shown has the flat side wall 38 on one face and the beveled edge portion 39, said bevelled edge portion being formed at an angle of sixty degrees with respect to the axis of rotation 37. Thus a groove of the form shown in Figure 2 will be cut or ground. By tilting the axis 37 the face 38 of the grinding wheel will be brought to a non-radial condition with respect to the axis of the roll proper, and it will be possible to grind or cut the groove to the general form shown in Figure 3. Other forms of grooves may be cut, and also other cutting or grinding operations may be used for the cutting or forming of the grooves, within the scope of our present invention.

In Figure 5 we have shown a convenient form of the entire body of one of the main rolls. It includes the cylindrical shell 40 welded or otherwise secured to the end caps 41 and 42, and the shaft sections 43 and 44 are secured to these end caps. The surface 45 of yieldable material such as rubber, neoprene, or the like, is applied to the cylindrical shell, either by sheet applications, or spraying or other suitable operations, and the groove or grooves is or are formed therein as set forth. After wear has occurred, or for other reasons, the yieldable surface may be re-treated, and brought to a slightly reduced size, and re-grooved; or the rubber or other coating may be removed and a new coating substituted as desired. With an original coating of substantially 5/8" the yieldable surface may be re-treated many times, so that a very long total life is possible therewith.

In Figure 6 we have shown a convenient form of the doctor roll. It includes the cylindrical shall 46 welded or otherwise secured to the end caps 47 and 48, and the shaft sections 49 and 50 may be suitably secured to these end caps. The surface of the cylindrical shell is suitably treated, as by chromium plating, and preferably polished to present a very smooth surface.

The yieldable surfacing 45 in which the grooves are formed may be any suitable material, it being only necessary, as a requirement of the present invention, that said groove or grooves be formed of an unbalanced form—that is, unsymmetrical with respect to the radial line. Preferably, also, said yieldable material is of rubber, either natural or artificial, such as neoprene, although other materials will be found satisfactory according to the coating material for which the rolls are intended. Generally, also

it will be found satisfactory to use a yieldable material of the general hardness of 40 to 60 on the scale of softness of the Shore durometer. Furthermore, said yieldable surfacing may be applied to the metal or other cylinder 40 in any suitable manner, as by a wrapping or moulding or spraying or other depositing operation.

It is also noted that while the groove or grooves will generally be of an encircling form, either circular or helical or otherwise, still, as far as the unbalancing feature herein disclosed is concerned, said groove or grooves may be placed longitudinally or spirally of the roll or rolls according to the preferences of the designer or builder.

We claim:

1. As a new article of manufacture, a main roll for a surface coating machine, comprising a cylindrical roll having a surfacing of rubber like material, the surface of said surfacing being provided with a series of encircling grooves of generally V-shaped cross-section lying in planes normal to the axis of roll rotation, and establishing ridges between them, each ridge being of inverted V-shaped formation and with both walls of such ridge lying at angles of less than ninety degrees with respect to the axis of roll rotation and measured in the same direction along said axis, whereby pressure against the ridges results in deflection of the ridges axially with consequent increase of expulsion of material from the grooves and improved action, substantially as described.

2. A main roll for a surface coating machine comprising a cylindrical roll having a surfacing of rubber or the like provided with a series of grooves of generally V-shaped cross-section lying in a plane substantially normal to the axis of roll rotation, and establishing ridges between them, each ridge being of inverted V-shaped formation and with one wall of such ridge lying radial to the axis of rotation, and whereby pressure against the ridges at the sides of the groove results in deflection of said ridges laterally and axially of the roll, with consequent improvement in expulsion of material from the groove, substantially as described.

3. A main roll for a surface coating machine comprising a cylindrical roll having a surfacing of rubber like material of a hardness of the order of 40 to 60 on the scale of a Shore durometer, there being a series of encircling grooves in said surface, establishing ridges between them, each ridge having its side walls lying at different acute angles with respect to a plane normal to the axis of roll rotation and measured in the same direction axially of the roll, whereby pressure against the roll against said ridge results in deflection of said ridge laterally and axially with respect to roll rotation, with consequent increase of expulsion of material from said groove, substantially as described.

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