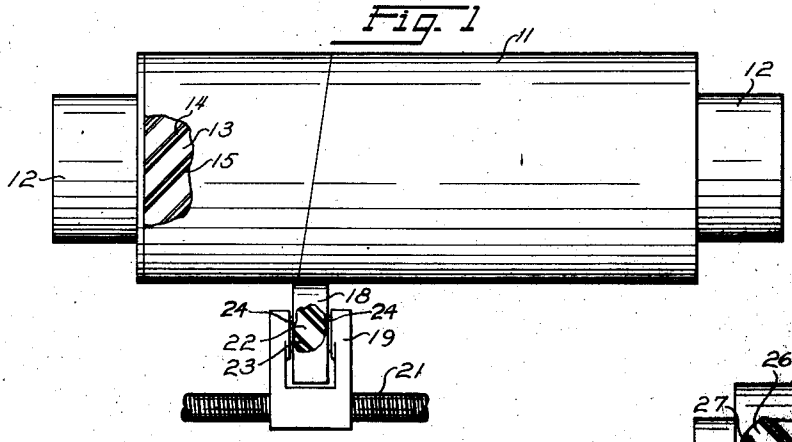
Feb. 24, 1942. R. B. LEECH 2,273,967

METHOD OF MAKING COATING DEPOSIT ROLLERS

Filed May 8, 1939

Fig. 1



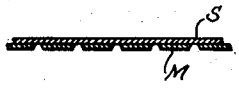


Fig. 3

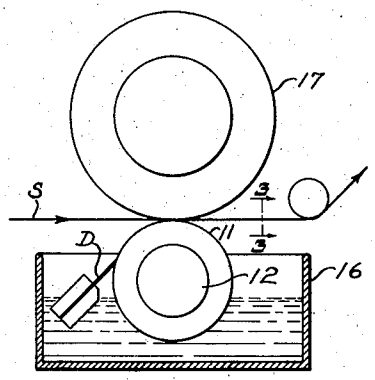
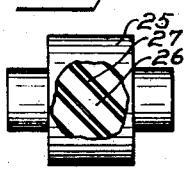


Fig. 2

Fig. 4



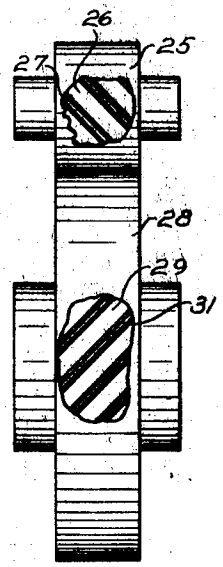


Fig. 5

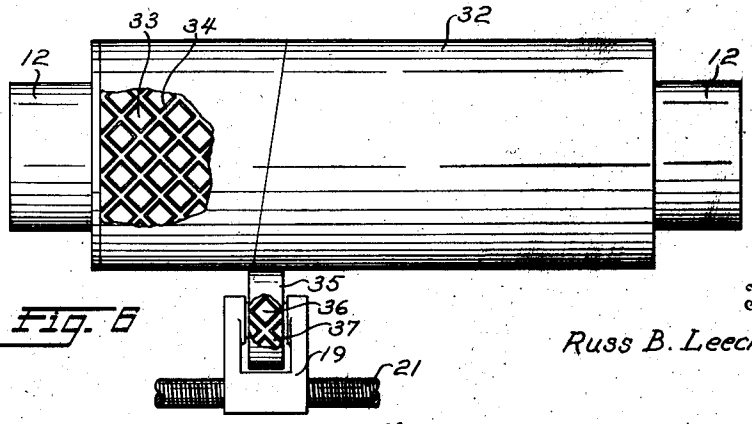


Fig. 6

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METHOD OF MAKING COATING DEPOSIT ROLLERS

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Application May 8, 1939, Serial No. 272,526

2 Claims. (Cl. 80—5.1)

This invention relates to coating material deposit rollers and the like and methods of making them; and is more particularly concerned with coating material deposit rollers which have surface recesses for retaining coating material, and with methods of forming such recesses.

The present invention is a continuation-in-part of copending applications Serial No. 251,841, filed January 19, 1939, and No. 260,188, filed March 6, 1939 entitled "Coating methods and apparatus"; and the coating rollers to be described below are especially adapted to be used in the apparatus disclosed in the above-identified applications.

While rollers for depositing coating materials of various kinds upon sheet surfaces or the like are known and have been used heretofore, none of these rollers are capable of exactly controlling the quantities of coating material deposited. In contra-distinction the coating rollers of the present invention are especially designed and accurately made to transfer and deposit measured quantities of the coating material on the surface to be coated.

Accordingly, it is a major object of the present invention to provide a novel coating deposit roller designed for accurately and measurably controlling the amount of coating material deposited upon a surface to be coated.

It is a further object of the present invention to provide a novel coating material deposit roller having a plurality of uniformly spaced, uniform coating material retaining depressions upon its peripheral surface. Specifically, these depressions are all of the same size and depth so that each will carry the same amount of coating material, and preferably are so proportioned with respect to the roller surface areas between them that no embossing of the surface to be coated occurs under pressures required to insure satisfactory drawing of the coating material from the depression.

A further object of the invention is to provide a novel coating material depositing roller having either a plurality of fine, closely adjacent surface grooves or uniformly spaced pockets of uniform predetermined depth; and novel methods for making the same.

It is a further object of the invention to provide a novel method of making a coating deposit roller in which a relatively small rotatable tool, bearing in relief the design to be recessed into the roller surface, is simultaneously rotated by the contact under pressure with the roller surface and fed uniformly longitudinally along the roller surface at a predetermined rate and in such a manner that a substantially continuous design is progressively impressed along the surface of the roller as it rotates.

Further objects of the invention will presently appear as the description proceeds in connection with the appended claims and the annexed drawing, in which:

Figure 1 is a plan view of a coating roller comprising a preferred embodiment of the invention with the nature of the grooved depressions at the surface of the roller illustrated in an enlarged portion of that surface. This figure also illustrates the manner in which the surface of the roller is mechanically impressed by means of a special milling tool, a portion of whose surface is enlarged to illustrate the ridged design thereupon.

Figure 2 is a diagrammatic illustration of the manner in which the coating rollers of the invention are used to deposit coating material upon a sheet or web surface or the like.

Figure 3 is a section taken along line 3—3 in Figure 2 greatly magnified to illustrate the manner in which a coating material such as a melted thermoplastic or liquid adhesive is deposited upon the web surface.

Figure 4 is a plan view of a special ridged preliminary tool.

Figure 5 is an enlarged plan view illustrating the manner in which an intermediate matrix tool is made up from the tool of Figure 4, the matrix surface containing fine line grooves impressed therein by the ridges of the tool of Figure 5.

Figure 6 is a view similar to Figure 1 illustrating a coating roller being surfaced by a toothed tool having a different surface design than that illustrated in Figure 1.

Referring to Figure 1, coating deposit roller 11 is provided with an accurately ground cylindrical surface. For the deposit of melted thermo-plastics and adhesives, diameters between six and ten inches, depending upon the width of the web to be coated, have given excellent results. The base roller before the impressions are made upon it, is usually comprised of, or surfaced with relatively soft steel or copper or some similar substance. It is provided with opposite end supporting shafts 12 adapted to be mounted in suitable journals (not shown).

As illustrated in the enlarged portion of Figure 1, the surface of roller 11 is formed with a plurality of parallel fine line grooves 13 of uniform size and shape which are uniformly spaced

and separated by roller surface line spaces 14. The side walls 15 of grooves 13 preferably are outwardly inclined at about 30 degrees due to the manner in which they are made, later to be described.

Grooves 13 are arranged at such an angle with respect to the roller axis, and the line surfaces between the depressions, that proper wiping of the cylindrical roller surface is insured as it emerges from the bath of coating material, by a doctor blade D (see Figure 2) as hereinafter set forth. For practical purposes it has been found most satisfactory to dispose grooves 13 at about 45 degrees to the roller axis although they may be disposed at almost any angle between 10 degrees and 80 degrees, as desired.

Grooves 13 are usually very small and relatively shallow so that their exact nature can be studied accurately only by microscopic examination. The dimensions of grooves 13 and the groove spacing are factors which depend upon the nature of the material to be deposited and the conditions under which it is deposited, the nature and speed of the web or other surface to be coated, the amount of material to be deposited per unit area of surface to be coated, and other contributing factors arising from special problems.

It has been found that for best results in coating with a thermoplastic material such as "Liquafilm" the preferred ratio of the width of the line spacing 14 to the width of grooves 13 should be about one to four. In other words, the space between the fine line grooves on the cylindrical surface is preferably about one-fourth the distance across each groove. This ratio of line width to groove width is such that sufficient area is provided on the raised surfaces or lines on the roller periphery so that no embossing of the web or sheet surface to be coated occurs under pressures required to insure satisfactory drawing of the coating material out of the grooves.

The absolute dimensions of the groove width may vary greatly, especially in accordance with the thickness of the coating desired. Generally, a spacing of about one hundred and ten grooves per inch has been found the lowest practical limit for depositing very thin coatings of "Liquafilm," and for heavier coatings, the spacing is generally higher and may be about thirty two grooves per inch. These practical limits will of course vary according to the factors above discussed under different conditions and for applying different materials.

The depths of the grooves also vary mainly according to the thickness of the coating required to be deposited. It has been found that groove depths of about .00075 inch are satisfactory for very thin coatings of "Liquafilm" and these groove depths may go up to about .003 inch for heavier coatings.

In all instances, for a uniform deposit of these relatively thin coatings it is essential that all of the grooves be of uniform depth and other dimensions so that each shall deposit the same amount of material upon the surface to be coated.

When it is desired to accurately deposit a coating of given thickness upon the sheet surface, all of the above mentioned factors are taken into consideration and then a roller having its surface impressed or otherwise worked to provide grooves of suitable depth and size is selected or prepared for the job at hand by the above described methods.

A practical coating roller, which has been used with great success for depositing melted solid lacquer or "Liquafilm" at a rate of 5.1 pounds per 3000 square feet of sheet surface, has its grooves cut exactly at 45 degrees of the cylinder axis; and these grooves are equally spaced and to the order of about thirty-four grooves per inch. Each groove is .001 inch deep and the wall or line space between the grooves is one third the width of the grooves.

In Figure 2, roller 11 is illustrated in operative position in the apparatus of the above mentioned application for depositing coating material upon the web S. Roller 11 is rotatably mounted with a portion of its surface continually immersed in a bath of coating material in a container 16. Doctor blade D, of thin flexible steel or the like extending the whole length of roller 16, wipes off excess material from the roller surface after it emerges from the bath so that substantially only the material retained in the accurately formed grooves on the surface of the roller is transferred to the web surface. Where the coating material is a thermo-plastic, container 16 and roller 11 are supplied with suitable heating means for maintaining the coating material in melted condition until it has been deposited upon the web surface. A suitable impression roller 17 is combined with roller 11 to form a pass through which the web S passes under sufficient pressure to draw the coating material out of the retaining impressions on the roller surface. Since grooves 13 have divergent side walls the material is drawn out of them relatively easily.

In Figure 3, spaced piles of coating material M upon the bottom surface of web S are illustrated as deposited from the material retaining pockets of the roller 11.

Grooves 13 could be cut directly into the surface of roller 11 by a suitable cutting or milling operation. Such an operation, however, would take a great deal of time and would be prohibitive in cost from a practical viewpoint. Accordingly, a novel method of forming these roller surface grooves has been developed which will now be described.

Surfacing of coating roller

In the apparatus illustrated in Figure 1, the smooth surfaced cylindrical roller 11 is suitably mounted and rotated in a lathe mechanism (not shown). Tool 18, having a suitable ridged surface design for impressing the surface of roller 11, is idly mounted for rotation upon a suitable rigid bifurcated support 19 with its axis parallel to roller 11.

Support 19 is mounted in well known manner in a suitable tool holding and adjusting device of the lathe mechanism (not shown) which is advanced automatically and longitudinally of the roller 11 in a well known manner at a predetermined controlled rate by the lathe screw indicated diagrammatically at 21.

Tool 18 is forced against the roller surface by the lathe tool adjusting means under sufficient pressure to force ridges 22 on the tool surface the desired depth into the roller surface. Upon rotation of roller 11, engagement between the roller and tool 18 causes rotation of the tool and the ridged design on the tool surface is recessed into the roller surface in the form of the uniform, accurately spaced and aligned grooves 13.

Ridges 22 are tapered so that they will draw out of the roller surface grooves without binding or undue friction. Since the groove dimensions and spacing are very small as compared to the

circumferences of the roller 11 and tool 18 which are in rolling contact, at least one or more of ridges 22 are always pressed into the material of the roller surface during rotation of the latter so that the roller actually positively drives the tool in a controlled manner and interlock it in proper register with the grooves being formed thereby.

The roller and tool circumferences are so related that a uniform number of grooves will be impressed into the roller surface as hereinafter set forth.

After the first complete revolution of roller 11, a track of parallel fine line grooves will be formed in a substantially spiral path about the roller surface, this path advancing to the right in Figure 1 due to the automatic feed of lathe screw 21. Upon the second complete revolution of cylinder 11, a second substantially spiral path, similar to the first path or track, will be formed upon the surface of roller 11 but displaced to the right a lap or distance equal to the feed of the screw during that revolution.

The relative diameters of roller 11 and tool 18 are so selected and designed that the grooves of each spiral track made by the projection 22 will be exactly aligned with the grooves of the preceding track; and, as the tool is fed along the roller surface, a substantially continuous grooved design is progressively engraved or milled thereupon as illustrated in Figure 1. To insure the formation of continuous grooves upon the roller surface, the feed of support 19 is so regulated that each spiral track formed by the tool slightly overlaps the preceding track.

When tool 18 reaches the right hand side of the roller 11 of Figure 1, the entire roller surface will be impressed with the continuous grooved design. If desired, roller 11 may be finished with a hardening treatment before it is used in the coating apparatus described in the above applications.

Roller surfacing tool and method of making it

Tool 18 is cylindrical and bears upon its peripheral surface the fine line ridges 22 separated by parallel grooves 23. Ridges 22 are of a suitable size, shape and arrangement as to impress grooves of desired shape and design into the coating roller surface as above described. Tool 18 is provided with a sturdy arbor 24 for rigidly supporting upon the lathe tool holder during surfacing of the coating roller.

While tool 18 may be made up by directly cutting grooves 23 into its surface by a suitable milling operation or the like, the following process has been found to be much less expensive and more practical for making an accurate tool of such a size as to be adapted for practical use in the roller surfacing operation above described.

Figure 4 illustrates a small tool, 25 of hardened steel, having a plurality of closely adjacent fine line ridges 26 spaced by grooves 27 upon its peripheral surface. Ridges 26 are of the identical size, shape and design desired for ridges 22 of tool 18. Tool 25 may be of the type which is used commercially for correcting fine line screens which have been formed by electrodeposition and other methods, or because of its small size, may be especially made at low cost, depending upon the final roller grooving or recessing desired.

While tool 25 has the desired surface design to be impressed into the coating roller surface, it is only about ¼" to $\frac{3}{16}$" in diameter which is too small and lacks the necessary durability for practical use in the above described roller surfacing operations.

Tool 18 which is preferably about 1½ inches in diameter for use in surfacing a coating roller such as that above described is made up in the following manner.

Referring to Figure 5, preliminary tool 25 is arranged with its ridged surface in contact under pressure with a suitable matrix roller 28 of soft steel or the like several times the diameter of roller tool 25. Matrix roller 28 and tool 25 are mounted for rotation about parallel axes in a suitable lathe mechanism such as that described above as used in surfacing the coating roller, but since the matrix and tool are preferably of the same width the automatic feed screw is disengaged from the work holder.

The relative diameters of matrix 28 and tool 25 are such that a uniform number of uniformly spaced grooves 29, spaced by ridges 31, will be impressed into the matrix surface upon rotation; and the matrix surface is therefore reversely impressed with the final desired tool design.

The matrix surface is then hardened and matrix 28 is arranged in surface contact under pressure with the larger cylindrical base roller from which tool 18 is to be formed. This base roller is initially surfaced with soft steel or the like and, upon rotation of matrix 28 and base roller 22 in surface contact in a manner similar to that illustrated in Figure 5, the surface design of the matrix 28 will be reversely impressed into the surface of tool 18 whereby the surface of tool 18 will bear ridges 22 and grooves 23 in accurate reproduction of the design on the surface of the tool 25. After being formed as above, the surface of tool 18 is hardened and it is ready for use in the coating roller surfacing operation above described.

If either matrix 28 or tool 18 are to be made wider than tool 25, this can be accomplished by feeding tool 25 along matrix 28 or tool 18 while they are being surfaced, in the manner above described for surfacing the coating roller.

Modification

The coating roller 32 illustrated in Figure 6 is of the same size as roller 11, but has its peripheral surface formed with a plurality of rows of material retaining pockets 33 spaced by surface line areas 34. The absolute and relative dimensions of pockets 33 and areas 34 are generally of the same order as those of grooves 13 and areas 14 for coating with various materials. Roller 32 may be substituted for roller 11 in the coating apparatus of Figure 2.

For applying adhesive, in a manner to prevent curling of the coated sheet, a purpose for which roller 32 is especially adapted, it is necessary to insure enough space between the deposited patches to prevent them from flowing together. This spacing is wider than used in most coating processes. In a practical form of adhesive applying roller, it has been found satisfactory to employ a ratio of line area width to material retaining pocket width of substantially one to one, and the rows of pockets are arranged at 45 degrees to the roller axis and spaced to the order of thirty-two lines per inch. Precise dimensions depend ordinarily upon the nature of the adhesive, the surface tension of the paper and other factors peculiar to the job at hand.

Coating roller 32 is surfaced in substantially the same manner as roller 11 with a tool 35 having a suitable surface design employed in the sur-

facing process. Tool **35** is provided with a plurality of rows of surface projections **36** spaced by normally disposed surface line areas **37**. Surface projections **36** are preferably generally pyramidal in shape and of a suitable size and design to impress the desired pocket design into the surface of roller **32** when tool **35** is mounted upon tool holder **19** and applied to the roller surface in the manner above described in connection with roller **11**.

Preferably tool **35** is made up from a suitable smaller tool by means of an intermediate matrix in the same manner that tool **18** is made up from tool **25** as above described.

While the coating roller surfaces have been disclosed as having depositing recesses or material retaining impressions on substantially their entire peripheries, it will be understood that these recesses may be formed at any desired area or spaced areas around the periphery of the cylinder for spot coating purposes.

Coating rollers made according to the present invention afford means for repeatedly, accurately and measurably depositing controlled quantities of coating material upon a web surface or the like. As the web passes through the pass defined by rollers the impression and coating deposit, the material in the shallow surface recesses on the coating roller is drawn out onto the web surface in even uniform deposits, without embossing the web surface with the pattern of the roller.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In a method of accurately forming material retaining impressions on an elongated cylindrical coating deposit roller, the steps of continuously rotating said roller in peripheral contact under pressure with a narrow cylindrical tool rotatable on an axis parallel to said roller and having its surface formed with a plurality of uniformly spaced projections of the same size separated by crossed grooves extending at acute angles to the axis of said roller, said projections being shaped and sized to accurately form impressions of desired shape and size in predetermined design in said roller surface, and continuously advancing said tool longitudinally of said roller during said rotation at such a rate as to progressively and continuously extend said impressed design along said roller until a complete and continuous coating deposit area in said design comprising a plurality of pockets of the same size and shape spaced and separated by crossed line walls arranged at acute angles to the roller axis is formed on substantially the entire coating deposit surface of the roller.

2. In a method of accurately forming material retaining impressions on a cylindrical coating deposit roller, the steps of continuously rotating said roller in peripheral contact under pressure with a narrow cylindrical tool rotatable on an axis parallel to said roller and having its surface formed with a plurality of cooperatively arranged individual projections of known dimensions separated by crossed grooves extending at acute angles to the axis of said roller, said projections being shaped and sized to accurately form impressions of desired shape and size in predetermined design in said roller surface, and continuously advancing said tool longitudinally of said roller during said rotation at such a rate as to progressively and continuously extend said design along said roller until a complete and continuous coating deposit area in said design comprising a plurality of pockets of known size and capacity spaced and separated by crossed line walls arranged at acute angles to the roller axis is formed on substantially the entire coating deposit surface of the roller.

RUSS B. LEECH.