Jan. 30, 1934. F. O. WOODRUFF 1,945,173

ARTIFICIAL LEATHER MANUFACTURE

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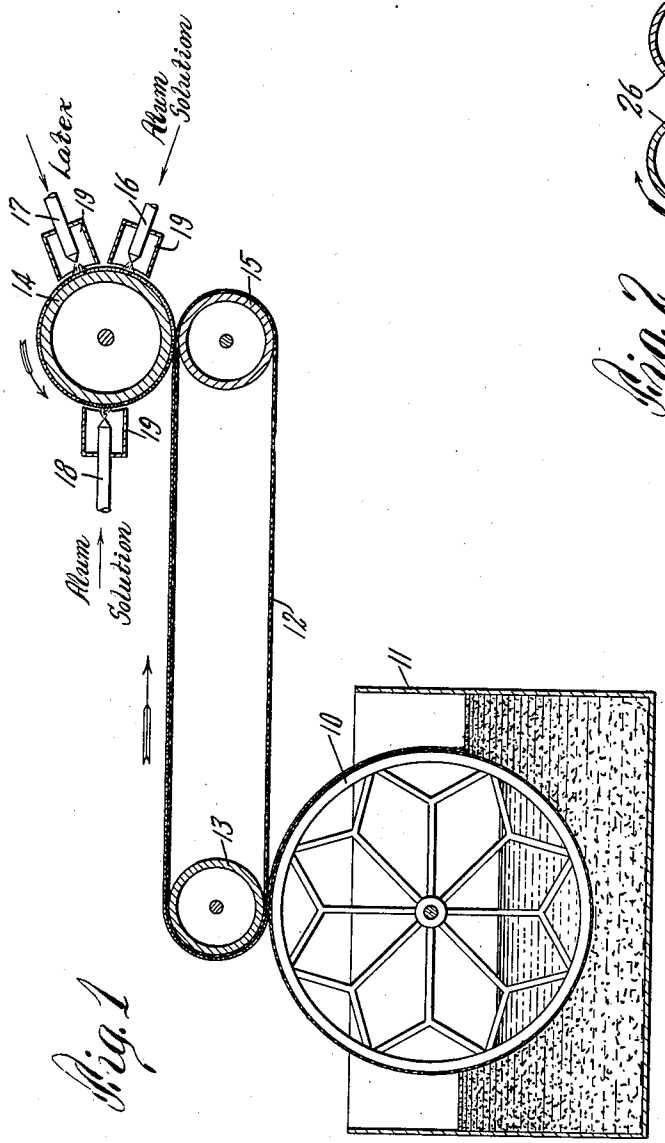


Fig. 1

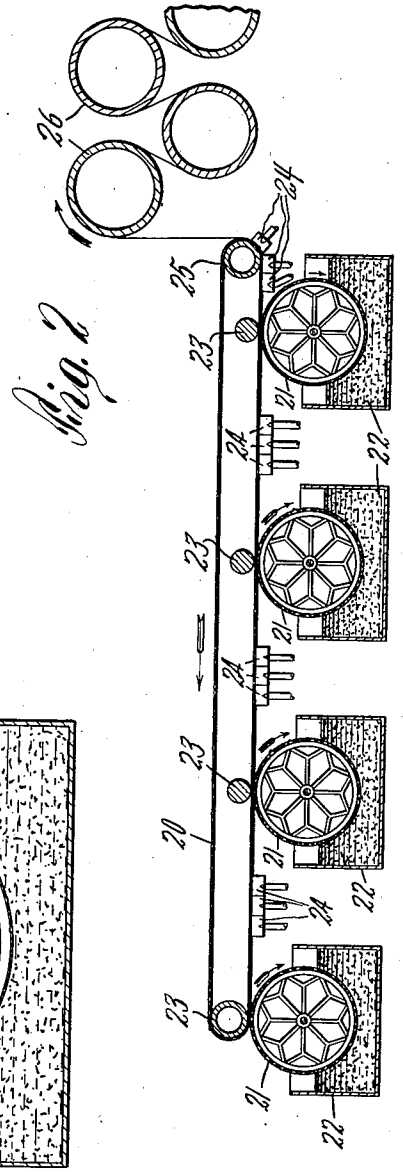


Fig. 2

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ARTIFICIAL LEATHER MANUFACTURE

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13 Claims. (Cl. 92—41)

This invention relates to the manufacture of artificial leather through the use of suitable fibrous material and aqueous rubber dispersions of the nature of latex as raw materials.

In making artificial leather from latex and a web of fibers, such as formed on a papermaking or carding machine, it is difficult to accomplish a satisfactory distribution of rubber as a binder throughout the web, especially when the web is built up to a considerable thickness. In the case of multi-ply webs such as made on cylinder papermaking machines, there is the additional problem of securing adequate ply adhesion so that there will be little tendency for the rubber-impregnated product to split on the planes of bonding between plies.

In accordance with the present invention, I prepare a plied sheet which is properly impregnated with rubber and whose plies are so tenaciously bonded together that there are no definite planes of cleavage therein. In the case of waterlaid webs made on papermaking machines, these results are had by incorporating a rubber coagulant in the wet, freshly-formed web and applying latex to the web, as by spraying, before it is built up into a multi-ply structure as on a make-up roll and is then dried, or before it is united with other webs being similarly treated on a multi-cylinder machine.

While the process of the present invention is applicable when cellulosic and/or other kinds of fiber are being formed into a web on papermaking or other machinery, it is especially useful when waste leather stock, e. g., waste leather of chrome or other tannage, is to serve as raw material for making a leather substitute. Such leather stock can be beaten in water to form a pulp, but the pulp thus produced is of such a "slow" or slimy nature that the desired dewatering on the papermaking machine, coupled with a running of the machine at an acceptable rate of speed, can be had only with a comparatively thin web. Consequently, in order to realize a web of the desired thickness, such beaten leather stock is generally formed into a multi-ply sheet from a single web built up on a so-called make-up roll or from a number of webs plied on a multi-cylinder machine. It is thus seen that my invention fits nicely into the picture when leather stock is being formed as ordinarily into a plied sheet, as I can add the coagulant and latex to the web while it is pursuing its course as usual through the machine.

While the rubber coagulant may be incorporated into the beaten leather stock before it is formed into the web, I prefer to add a solution of the coagulant, as by spraying, to the wet, freshly-formed web immediately before it receives the latex and is then plied. Indeed, even when a coagulant is added to the stock, I prefer to spray coagulant solution onto the web, then to apply the latex, and finally again to spray coagulant solution on the latex, as this ensures a complete coagulation of the latex, attended by the coating of the fibers with rubber and the development of a bonding fiber of rubber between plies. This sort of practice further means that when subsequent plying of the web is done under pressure, there is no tendency for uncoagulated latex to ooze at the edges of the sheet and to gum the felts or other instrumentalities of the machine.

Assuming that chrome-tanned leather waste is used as a raw material, I prefer to procure such waste while it is still wet with the chrome tanning liquor. In this condition, the leather waste may be put into a beater engine and readily disintegrated in the presence of water into a pulp amenable to web formation. Along with the leather water, I prefer to use a relatively small proportion, say 10%, of other fiber, so as to improve the felting action of the leather fiber on the papermaking machine. Cellulose fiber, e. g., cotton rag fiber, promotes good felting action, but I have found that natural silk fiber does the same and additionally enhances the strength, pliancy, and smoothness of surface in the ultimate product. Accordingly, I prefer to use as the fibrous material promoting felting action of the beaten leather stock a low grade waste natural silk such as is available at a cost not exceeding that of rag stock, wood pulp, or similar cellulosic fiber.

The wet, freshly-formed web of pulp receives, in accordance with my preferred procedure, first a spray of coagulant solution, then a spray of latex, and finally another spray of coagulant solution, before it is plied into a sheet of the desired thickness. The coagulant solution may, for instance, be one of alum of about 10% strength. The latex can be sprayed onto the web at various solids contents, but, considering the particular results which I am seeking, it is preferable to work with latex of a solids content, including compounding agents, of about 15% to 30%. The latex may, for example, be properly compounded with sulphur, zinc oxide, an accelerator of vulcanization, and suitable pigments or dyes, all colloidally suspended in the latex, so that there will be no trouble in the spraying op-

eration. The compounded latex may be prepared by adding to latex of about 30% solids content about 3% to 8% sulphur, about 5% to 7% zinc oxide, about ¼% piperidine or other accelerator of vulcanization, and a suitable dye or pigment, e. g., analine black, yellow, or green. These proportions of compounding agents are all based on the weight of the solids content of the latex. The compounded latex may be passed through a homogenizer or colloid mill, to ensure a condition therein compatible with its being properly sprayed. The latex so treated may be diluted, if desired, with water, to a solids content of about 15% for the spraying operation. By the use of such compounded latex, it is possible to realize a smooth, flexible, vulcanized sheet of the desired color and simulating in its strength, tear resistance, toughness, feel, and other qualities a natural leather. The sheet thus produced may be embossed and subjected to other customary leather-finishing operations. The finished sheet can, like natural leather, go into furniture upholstering, automobile tops, book covers, pocketbooks shoe inner and outer soles, counters and box toes for shoes, and other uses.

On the accompanying drawing,

Figure 1 illustrates diagrammatically and conventionally a cylinder machine equipped for the practice of the present invention.

Figure 2 is a similar illustration of a multi-cylinder machine equipped for the same purpose.

As shown in Figure 1, a cylinder mould 10 rotates partially submerged in a pulp suspension kept in the cylinder vat 11. The pulp may be of the character hereinbefore described or any other kind lending itself to deposition from water as a coherent, felted web. The web of pulp progressively deposited on the periphery of the mould is carried out of the vat and is then picked up by the usual transfer felt 12 making constant contact with the unsubmerged portion of the mould under the action of the roll 13. The felt conveys the wet web to a make-up roll 14 shown stationed above a roll 15 constituting the terminal roll for the felt. As the web is being convoluted on the roll 14 to the desired thickness, each ply or convolution receives first a spray of alum solution from a nozzle 16, then a spray of properly compounded latex from a nozzle 17, and finally a spray of alum solution from a nozzle 18. Each spray should be delivered over the full width of the web and is preferably kept within a chamber defined by the roll 14 and a box 19 whose inner edges clear the roll sufficiently to permit the web to be built up to the desired thickness. Inasmuch as the latex is completely coagulated on each of the plies, there is no tendency to squeeze latex from the web in the nip of the rolls 14 and 15 so as to gum the felt. Aside from the fact that the fibers of each of the plies are treated with rubber, the freshly coagulated rubber film developed between the plies ensures tenacious ply adhesion. After the desired sheet thickness has been reached on the make-up roll, the sheet is cut axially of the roll and removed in flat condition from the roll as ordinarily. The flat sheet is then dried at elevated temperature for the purpose of causing vulcanization of the rubber binder therein.

When a multi-cylinder machine such as depicted in Figure 2 is employed in making the plied sheet, the webs coming from the various cylinder moulds may, after being picked up by the carrier felt, successively undergo the spraying treatments hereinbefore described. As shown in this figure, a single felt 20 serves to pick up the webs or plies deposited on a series of four cylinder moulds 21, each of which is associated with a vat 22 and a roll 23 serving to keep the felt running in contact with each mould. The felt picks up a web from one cylinder mould and then acquires another from the next cylinder mould directly on the web previously picked up. Each ply receives the successive sprays of alum solution, latex, and alum solution while carried by the felt, before the next ply is deposited thereon. For this purpose, I have shown a series of three sprays 24 located under the felt 20 and in back of each cylinder mould, so that each ply becomes properly treated with rubber before the next ply is superposed thereon. The multi-ply sheet may be taken from the terminal roll 25 for the felt 20 and delivered over a bank of heated drier drums 26, which conduce to vulcanization of the rubber in the sheet, as well as drying of the sheet.

An important feature of the process of my invention is that a comparatively small amount of rubber need be used in producing a finished article of extraordinary toughness and strength. Indeed, I have found that the incorporation, through my process, of only about 15% to 50% of latex solids into a sheet composed essentially of chrome-tanned leather fibers and built up of plies to a thickness of 70/1000 of an inch makes for a product of such strength and toughness that its tearing cannot be initiated with one's hands.

It is, of course, possible to use artificial aqueous rubber dispersions of the nature of latex, rather than natural latex, as the coagulable binding agent. If desired, a prevulcanized latex such as is sold on the market as "Vultex", may be used, in which case mere drying of the latex even under room temperature conditions yields a vulcanized rubber. Accordingly, the term "latex" is used in the specification and claims in its comprehensive sense to mean not only natural latex, but also synthetic or artificial latices partaking of the qualities of natural latex. So, too, various well-known acid solutions or acid salt solutions may be used in lieu of the alum solution as the coagulant for the latex. The strength of coagulant solution may be varied, but in any event, it is desirable to use a solution of such strength as will cause quick and complete coagulation of the latex spray as it strikes the freshly-formed web wet with coagulant solution. The stock employed as the beater furnish is subject to considerable variation, some of these variations having already been indicated. In those instances where the leather stock contains, let us say, insufficient tanning agent to conduce to a finished product having the best characteristics, I may add to the beaten stock in the beater engine the desired proportion of tannic acid or other suitable tanning agent. For instance, when chrome-tanned leather waste lacking in the optimum proportion of tanning agent serves as raw material, this insufficiency may be made up by adding more chromium tanning agent, tannic acid, or the like. So, too, one may use along with the leather stock various proportions of cellulosic, silk, or other fibers to improve the texture of the web formed on the paper-making machine, as well as to lend other desirable characteristics to the ultimate article. By controlling the beater furnish through the use of the appropriate fibers or mixtures of fibers, as well as tanning or other modifying agents, I can realize in my finished article the qualities of flexibility, softness, or stiffness, as desired. For instance, so-called fat liquors con-

taining sulphonated castor oil, cod liver oil, or other softening agents for the leather fibers may be added to the furnish for the purpose of lending pliancy and mellowness to the finished articles.

The principles of the present invention extend to the manufacture of a plied sheet from webs of cotton and/or wool or the like formed in a dry way as on carding machines. A web or felt produced in this way may be treated with coagulant solution and latex as it is being wound on a mandrel or take-off roll to the desired thickness. The felt plied sheet removed from the mandrel may be dried and its rubber content vulcanized, if desired. Such an adaptation of my method may be of value especially in those instances when a thick artificial leather, say one whose thickness is ¼ to ½", is desired for such uses as shoe outer soles.

The artificial leather fabricated in accordance with my invention is characterized by having its rubber content distributed therethrough in such a way that, not only does each of the plies contain rubber latex coagulated on its fibers and penetrating thereinto, but the latex coagulated as a film between the plies serves to integrate them most effectively, especially since this film is substantially continuous with the latex coagulated in the plies themselves.

What I claim is:

1. As an article of manufacture, a multi-ply sheet of fibers containing rubber latex coagulated not only in its plies but also in between its individual plies as a film serving to integrate the plies, said film being substantially continuous with the latex coagulated in the plies.

2. As an article of manufacture, a multi-ply waterlaid sheet of essentially leather fibers containing rubber latex coagulated not only in its plies but also in between its individual plies as a film serving to integrate the plies, said film being substantially continuous with the latex coagulated in the plies.

3. As an article of manufacture, a multi-ply waterlaid sheet of essentially chrome-tanned leather fibers containing rubber latex in coagulated and vulcanized condition not only in its plies but also in between its individual plies as a film serving to integrate the plies, said film being substantially continuous with the latex coagulated in the plies.

4. As an article of manufacture, a multi-ply waterlaid sheet of leather fibers and a smaller proportion of other fibers containing rubber latex coagulated not only in its plies but also in between its individual plies as a film serving to integrate the plies, said film being substantially continuous with the latex coagulated in the plies.

5. As an article of manufacture, a multi-ply waterlaid sheet of leather fibers and a smaller proportion of cellulosic fibers containing rubber latex coagulated not only in its plies but also in between its individual plies as a film serving to integrate the plies, said film being substantially continuous with the latex coagulated in the plies.

6. As an article of manufacture, a multi-ply waterlaid sheet of leather fibers and a smaller proportion of natural silk fibers containing rubber latex coagulated not only in its plies but also in between its individual plies as a film serving to integrate the plies, said film being substantially continuous with the latex coagulated in the plies.

7. A process which comprises treating a web of fibers containing a rubber coagulant with latex, plying the resulting web containing freshly coagulated rubber into a sheet of the desired thickness, and drying the plied sheet.

8. A process which comprises treating a web of waterlaid fibers containing a rubber coagulant with latex, plying the resulting web containing freshly coagulated rubber into a sheet of the desired thickness, and drying the plied sheet at elevated temperature to cause vulcanization of the rubber therein.

9. A process which comprises spraying an aqueous solution of a rubber coagulant onto a wet, freshly-formed web of waterlaid fibers, spraying latex onto the web, plying the resulting web containing freshly coagulated rubber with similarly treated web into a sheet of the desired thickness, and drying the plied sheet.

10. A process which comprises the following progressive steps, viz., depositing fibers from aqueous suspension into a web, spraying an aqueous solution of rubber coagulant onto the wet, freshly-formed web, spraying latex onto the web, again spraying an aqueous solution of rubber coagulant onto the web, and plying the resulting web containing freshly coagulated rubber with similarly treated web into a sheet of the desired thickness.

11. A process which comprises the following progressive steps, viz., depositing fibers from aqueous suspension into a web, spraying an aqueous solution of rubber coagulant onto the wet, freshly-formed web, spraying latex onto the web, again spraying an aqueous solution of rubber coagulant onto the web, plying the resulting web containing freshly coagulated rubber with similarly treated web into a sheet of the desired thickness, and treating the plied sheet at elevated temperature to cause vulcanization of the rubber therein.

12. A process which comprises beating stock consisting essentially of waste leather in the presence of water until it has been reduced to a pulp, forming the pulp into a web, spraying latex onto the wet, freshly-formed web, plying the resulting web containing freshly coagulated rubber with similarly treated web into a sheet of the desired thickness, and drying the plied sheet.

13. A process which comprises beating stock consisting essentially of chrome-tanned leather waste while it is still wet with tanning liquor in the presence of water until it has been reduced to a pulp, forming the pulp into a web, spraying the web in wet, freshly-formed condition with latex and coagulant solution, plying the resulting web containing freshly coagulated rubber with similarly treated web into a sheet of the desired thickness, and drying the plied sheet.

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