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APPARATUS FOR PRODUCING NON-FIBROUS FILM

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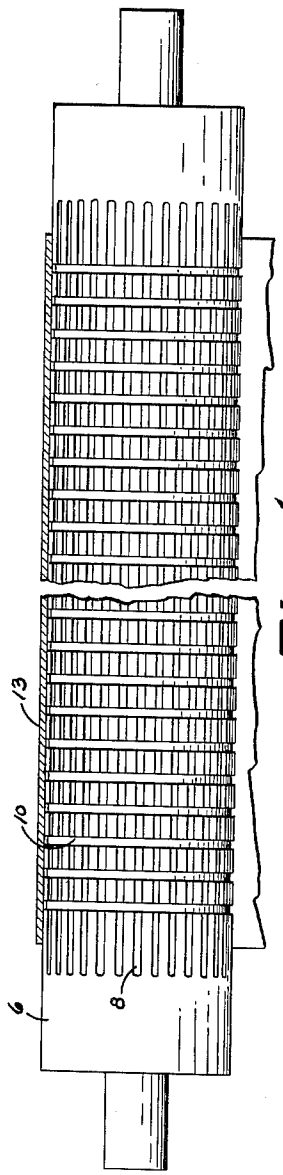

FIG. 1

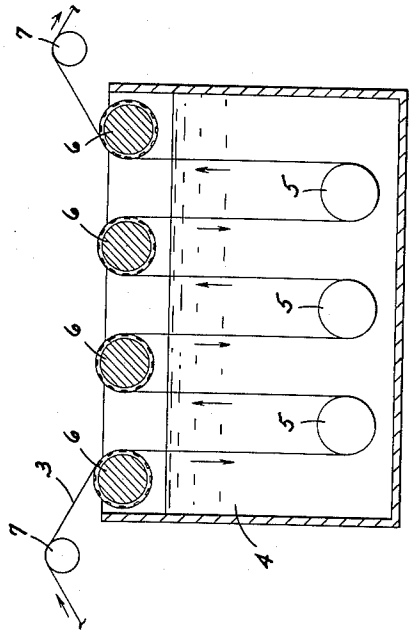

FIG. 3

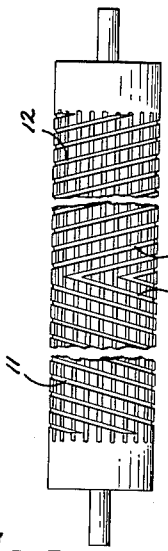

FIG. 5

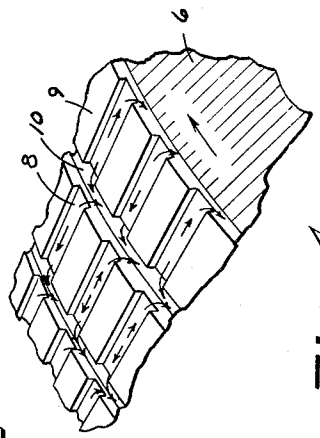

FIG. 4

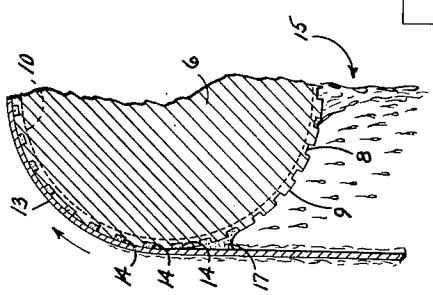

FIG. 2

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APPARATUS FOR PRODUCING NON-FIBROUS FILM

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1 Claim. (Cl. 18—15)

This invention relates to apparatus for producing non-fibrous relatively impervious film continuously. More particularly, the invention relates to an improved guiding means for handling of the film as it is passed through the casting or like machine. Films having improved transparency, durability and surface properties are thereby obtained.

This application is a continuation-in-part of the patent application of Frank H. Reichel and Arthur O. Russell entitled Method and Apparatus for Producing Non-Fibrous Film, Serial Number 204,114, filed on January 3, 1951, and now abandoned.

When treating films with a liquid medium, by passing the same through treating baths by means of rollers, the liquid picked up by the film, and on the surface thereof, acts as a lubricant as the film passes over the rolls or rollers. Because of this layer of liquid between the film and roller surface the film, in reality, never contacts the roller and consequently slippage occurs because of lack of contact or friction or traction between the film and roller surface. When treating fibrous materials, such as paper, woven and knit fabrics, and the like, or perforate sheet materials, slippage between the material being treated and the roller surface is of no concern since the liquid layer between the material and roller is squeezed out through the perforate or fibrous material thus allowing contact between the material and roller surface. It is only in the case of non-fibrous and relatively impervious films and sheets that the problem of slippage on the drawing or feeding guide members or rollers arises. It has now been found that this slippage, caused by the lubricating action of the treating liquid between the film and roller surfaces, can be alleviated.

While the present invention is applicable to the manufacture of all types of non-fibrous and relatively impervious films and sheets, such as those formed from cellulose ethers and esters, cuprammonium cellulose, various plastic materials such as saran, polyethylene, vinyl acetate, vinyl chloride, etc., rubber, and the like, the invention is particularly adaptable to the production of regenerated cellulose film made in a continuous manner from viscose and the invention will be shown and described as it is applicable in connection therewith. It is to be understood, of course, that this is merely intended for the purpose of illustration and simplicity and the invention should only be limited to the extent found in the appended claim.

Continuous films of regenerated cellulose are usually produced by extruding a cellulosic solution, such as viscose, through a slit-like orifice of a hopper into a coagulating and/or regenerating bath, or by casting viscose or the like by causing it to flow on the surface of a rotating wheel, the wheel carrying the layer of viscose into a coagulating and/or regenerating bath. In both of these conventional methods, the films so produced are passed from the coagulating and/or regenerating bath in a sinuous path through various treating baths, such as baths for washing, desulphurizing, bleaching and softening. After emerging from the final treating bath, the film is led over a series of heated rollers to dry it, and is finally wound upon a roll. In both of such prior processes, the film must pass over and around more than a hundred

rollers in its travel from the wet to the dry end of the machine.

The rollers or guides are positioned some above the baths and some near the bottom of the baths so that the film follows an up-and-down course in and out of the treating baths. It has been found to be practical to employ glass tubes or guides in the bottoms of the tanks in place of driven rollers since this eliminates the mechanical difficulty of preventing leakage of the baths about the driving axles of the rolls where they extend through the sides of the vats or tanks containing the baths. The top rolls above the baths are driven. The glass tubes or guides of any other acid-proof material work satisfactorily since the film is adequately lubricated by the layer of the bath liquid between it and the guides, and as a result it rides smoothly thereover without being scratched.

However, apparatus of this type has not proved too successful in high speed operations with wide webs or films because of undesirable slippage over the top driven rolls. This slippage is caused by the lubricating action of the bath liquid between the film and the smooth surface of the top driven rolls. Since the viscose or other material is being extruded continuously at the same rate, a slack in the film on the machine results from the slippage and in addition, the slippage will cause streaks, scratches and other blemishes in the web or film surface. Further, because of the aforementioned lubricating action of the bath liquid on the top rolls, the web gel film has a tendency, when the rolls are not perfectly level, to work or migrate toward one or the other of the ends of the rolls and off the ends. This not only damages the film surface but usually causes the film to break necessitating rethreading of the machine.

It is therefore an object of the present invention to overcome the aforementioned difficulties and disadvantages and provide an improved means for handling non-fibrous relatively impervious film in an aqueous treating medium.

It is another object to provide an improved apparatus for producing non-fibrous relatively impervious film continuously.

It is still another object to provide means for producing non-fibrous relatively impervious films, and especially regenerated cellulose film, at a higher rate of speed than heretofore attainable and without danger of damage to the surface thereof.

It is a specific object to provide new and improved upper guiding members or rolls for the continuous production of non-fibrous relatively impervious films.

Other objects and advantages of the present invention will be obvious from the drawing and description thereof hereinafter.

In general, the objects of the present invention are accomplished by providing upper rolls or guiding means on a film casting or extruding machine which have an irregular surface formed by longitudinal (i.e. parallel to the axis) and transverse (i.e. direction of rotation) or helical grooves or flutes cut therein. The flats or uncut portions of the rolls present a smooth surface for contact with the film passing thereover and support the film in such a manner that it does not extend into the grooves or flutes. Slippage is prevented by reason of the fact that the main portion of the bath liquid, acting as an lubricant between the film and roll, runs off through the grooves into the bath thus making the frictional attraction or traction between the film and roll much greater. The driven upper feed rolls or guiding members thus have a greater drawing or feeding effect on the film enabling the machine to be operated at a much higher speed than heretofore possible. When the speed of the machine is increased and slippage between the film and roll should occur, it is im-

mediately arrested by reason of the edges of the longitudinal grooves or flutes acting as a wiper or scraper thus removing the lubricating bath luquid from between the film and roll and draining the liquid off into the bath through the transverse grooves.

For a more detailed description of the invention, reference should be had to the accompanying drawing, which is merely intended to be illustrative, and in which:

FIGURE 1 is a front view of one form of roll or guiding member,

FIGURE 2 is an enlarged sectional view of a portion of the roll or roller shown in FIGURE 1 showing the film in contact therewith,

FIGURE 3 is a diagrammatic side elevation view, partly in section, of a treating bath employed on a casting machine showing generally the arrangement of the rolls and guides and the passage of the film thereover,

FIGURE 4 is an enlarged view of a portion of the surface of the roll shown in FIGURE 1, and

FIGURE 5 is a front view of another form of roll or guiding member.

Referring to FIGURES 1 to 4 of the drawing and particularly FIGURE 3 for the moment, a regenerated cellulose film **3** is fed into a treating bath **4** over a guide roll **7**, which may also be grooved if desired, down under a non-rotating guide member or tube **5**, up over a grooved driven roll **6**, down under another guide **5**, and so on, and then led to the next treating bath. There may be as many rolls and guides employed in conjunction with each bath as desired, the number usually being determined by the time necessary to treat the film with the aqueous treating medium in the particular bath. The driven rolls **6** are of the type shown in FIGURES 1, 3 and 4.

The principal feature of the present invention is the grooved or fluted surface of the driven rolls **6** positioned above the baths. In one embodiment shown on the drawing, the roller **6** has a series of equally spaced grooves or flutes **8** cut in the surface thereof parallel to the axis of rotation of the roll. These grooves or flutes may be any desired shape and size and spaced at any desired distance. However, when preparing the roll surface for treating regenerated cellulose film, the grooves **8** are preferably approximately ¼ inch to ⅜ inch wide and at least ⅛ inch deep and the flats **9** between the grooves **8** approximately 0.3 to 0.5 inch in width.

A secnod series of grooves or flutes **10** are cut in the surface of roll **6** extending around the periphery thereof and perpendicular to the axis of rotation. While here again, these flutes or grooves may be of any desired shape and size, they are preferably, when used with regenerated cellulose film, approximately ¼ inch to ⅜ inch wide and at least 5/32 inch deep and the flats **9** between grooves **10** being approximately 0.6 to 0.8 inch in width.

While both the longitudinal and transverse or circular grooves have been shown in the drawing as rectangular in cross-section, they may be rounded on the bottom if desired, i.e., semi-circular in cross-section.

The longitudinal grooves **8**, i.e., parallel to the roll axis, are herein referred to as the wiper grooves since they receive the bath liquid between the film and roll. The circular grooves **10** are referred to as the draining grooves and allow the liquid in the grooves **8** to drain off. It is to be noted that the draining grooves **10** are deeper than the wiping grooves **8**. This is clearly shown in FIGURE 4, which shows an enlarged section of the surface of roller **6**. The arrows shown therein indicate generally the flow of the treating liquid through the grooves. In addition, the grooves **8** extend beyond the circular grooves **10** and also beyond the edges of the film **13** passing thereover. The circular grooves do not extend beyond the edges of the film **13** and thus prevent any tendency for the edges of the film **13** from folding over into the outermost circumferential grooves and cause a break or other damage to the sheet. The smooth ungrooved portions at opposite ends of the rolls also eliminate any tendency of the sheet from migrating over the end of the roll. The film **13** may entirely cover the longitudinal grooves **8** if desired. The film beyond the last circular groove has the liquid between it and the roll picked up by the extensions of the longitudinal grooves **8**.

It should be noted that the film **13** (FIGURE 1) is supported by the flats **9** between the grooves **8** and **10** in such a manner that the film does not, at any point, extend into the grooves. This is important since it insures the production of a smooth, unmarked sheet or film. There is no wrinkling effect on the surface of the finished film, such as might be produced if the film extended into the grooves while in the wet gel state.

Referring in particular to FIGURE 2, there is shown the manner in which the film **13** contacts roller **6** as it emerges from the treating bath. As the film **13** comes into tangential contact with the roller surface the trailing edges **14**, of the longitudinal grooves **8**, direct the treating liquid from between the film and roller into the grooves **8** which in turn drain the liquid into the transverse grooves **10** which return the liquid to the treating bath, as shown generally at **15**. Thus, contact and good traction between the film and roller surface is assured. The liquid **17**, between the film and roller just before they come into tangential contact, is squeezed into the grooves **8** and **10** and drained off before the trailing edges **14** of grooves **8** contact the film. The capacity of the grooves is more than sufficient to remove the liquid from between the film and roller surface and thus insure good frictional contact therebetween. The grooves are capable of removing the liquid at all operational speeds.

As shown in FIGURE 5, the drainage grooves may comprise one or more continuous helical grooves, such as **11** and **12**, each starting at the center of the roll and terminating inwardly of the ends thereof. The helical drainage grooves **11** and **12** are approximately ¼ inch to ⅜ inch wide and as deep as possible with a depth of 5/32 inch being a minimum. The wiper grooves and the flats between the wiper and drainage grooves of the roll shown in FIGURE 5 are substantially of the same construction and size as the grooves **8** and flats **9** heretofore described. As in the structure shown in FIGURE 1, the drainage grooves or flutes must be slightly deeper than the wiper grooves which are parallel to the axis of the roll. When employing a roll having helical drainage grooves, the helical grooves **11** and **12** each have a tendency to cause sheet **13** to advance toward its end of the roll and thus these grooves, being of opposite slope, together cooperate to draw the opposite edges of the sheet **13** laterally and maintain the sheet flat. Of course, if the sheet **13** is not centered relative to the roll, the helical grooves **11** and **12** may have a tendency to exaggerate any side shift since more of the groove **11** or **12** would then be in contact with the sheet. However, the smooth areas at each end of the roll with which the sheet **13** is in contact prevent such initial side shift from causing one side of the sheet from engaging more helical groove length on one side than the other. For example, if the length of the roll grooved on each side of the center line by grooves **11** and **12** is in each case x inches and the width of the sheet is $2x+y$ inches, a width of the sheet equal to $\frac{1}{2}y$ rides upon each of the smooth areas of the roll. When a side shift of the sheet occurs, x inches of the width of the sheet will be in contact with groove **11** and a similar width of the sheet will be in contact with the groove **12**, as long as the side shift is equal to or less than $\frac{1}{2}y$ inches. Thus, the smooth areas of the roll do not accentuate an increase of any side shift of the sheet. The helical grooves **11** and **12** should each have a small slope, or in other words be a wide pitch spiral, approximately 5 inches, to prevent the edge portions of the sheet from folding under. Aside from the differences noted, the roll shown in FIGURE 5 will operate in the same manner as that shown in FIGURES 1, 2 and 4 in removing liquid from the travel-

ing sheet to effect the necessary and desired traction therebetween.

The rolls described herein should be formed of materials which will not corrode under the action of the chemicals involved, will not grow or expand radially during use or when heated and are difficult to scratch. Any suitable materials fitting these requirements may be employed, with rolls having at least an outer covering formed of hard rubber or graphite or porcelain being preferred.

When employing conventional smooth driving rolls, regenerated cellulose film can be produced at rates up to 40 feet per minute before slippage occurs. When employing the new and improved driving rolls of the present invention, production of regenerated cellulose film at a rate of 120 to 150 feet per minute or greater can be attained. In addition, the danger of damaging the film surface by roll slippage is alleviated and the breakage of the film, because of the film migrating over the ends of the rolls, is likewise alleviated. Preferably, all the top driven rolls of a film casting machine should be grooved as described herein. Numerous other advantages of the invention will be obvious to those skilled in the art.

It is to be understood that the above description is merely illustrative and that changes and variations may be made without departing from the spirit and scope of the invention as defined in the appended claim.

We claim:

In apparatus for the casting of regenerated cellulose film comprising in combination a plurality of tanks containing treating fluids and rotatably mounted, positively driven, cylindrical film advancing rolls over which a wet regenerated cellulose film passes into and out of said tanks, the improvement which comprises as the film advancing

rolls in said combination rolls each having two spiral surface grooves of equal and opposite pitch, said spiral grooves leading from a point midway from the ends of said roll and extending toward opposite ends of said roll and a plurality of straight surface grooves parallel to the longitudinal axis of said roll and spaced about the circumference thereof, the grooves being sufficiently wide and deep to permit deformation therein of a wet film on said roll.

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