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H. DREYFUS

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MANUFACTURE OF ARTIFICIAL MATERIALS

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FIG. 1

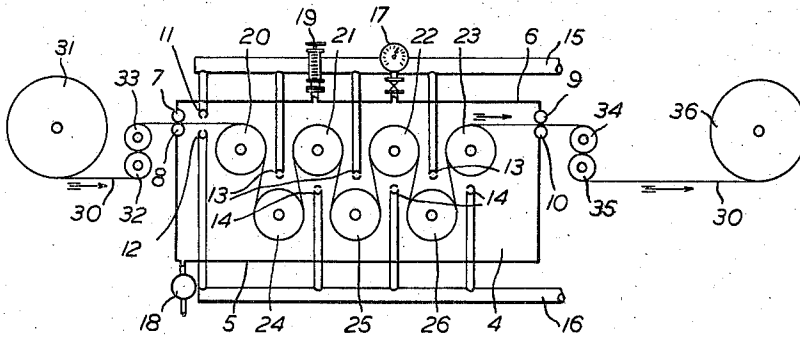


FIG. 2

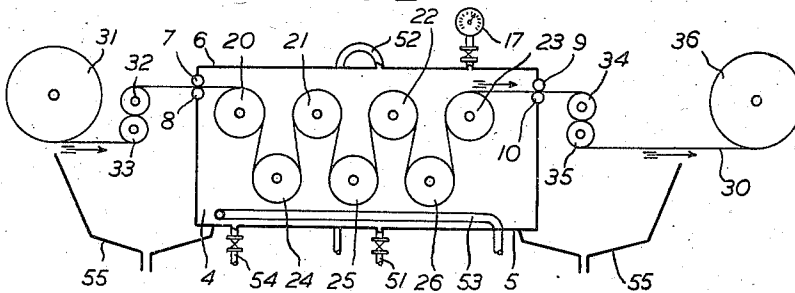
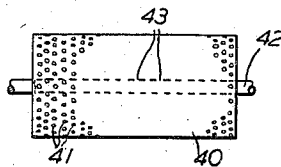


FIG. 3



Inventor:
Henry Dreyfus
by
Sheltzer and Krueger
Attorneys

UNITED STATES PATENT OFFICE

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MANUFACTURE OF ARTIFICIAL MATERIALS

Henry Dreyfus, London, England

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4 Claims. (Cl. 18—57)

This invention relates to improvements in the treatment of artificial materials, and particularly to improved methods and apparatus for the stretching of artificial foils, films and similar materials.

U. S. applications S. Nos. 4,510 and 4,511, both filed on February 1, 1935, describe inter alia processes for the treatment of artificial foils, films and similar materials, hereinafter referred to generically as "films", wherein they are stretched in the presence of steam or hot water during their travel from one point to another in order to improve their tensile strength. The present invention relates to improvements in such processes and to novel apparatus for the carrying out of such improved processes.

According to the present invention the stretching of artificial films in the presence of steam or hot water is effected in a plurality of stages during their travel from one point to another. In this manner products having improved mechanical properties may be obtained, particularly when a considerable degree of stretch is to be produced. Moreover by the process and apparatus of the present invention the stretching of films to a considerable extent may be facilitated and the tendency to lateral deformation may be reduced. The films may be subjected to a stretching tension during the whole of the stretching operation, or such tension may be removed during a part or parts of the operation, so that between stages at which stretch is applied are stages during which the film is not stretched, but travels forward without its length being increased. Such stages will hereinafter be referred to as "rest" stages.

While the invention includes the stretching of artificial films, sheets and all similar materials, it is particularly concerned with the stretching of foils such as are employed for packaging purposes, since it is of particular importance that such materials should be thin and yet should possess a high tensile strength.

The present invention is particularly concerned with stretching films in the presence of wet or saturated steam or hot water at a temperature above 100° C., and especially above 120° C. since, in general, it is found that the most satisfactory results are obtained under such conditions. Steam or hot water at lower temperatures, e. g. 95° C., may however be employed. For details regarding the temperature, pressure and other conditions under which the steam or hot water may be employed reference is made to U. S. ap-

plications S. Nos. 4,510 and 4,511, referred to above.

In carrying out the process according to the present invention the films may travel from a roll or other source of supply to a feed device and thence to suitable stretching devices, positioned in a vessel containing steam or hot water, which effect stretching in a plurality of stages with or without intermediate rest stages. The feed device may be contained in the stretching vessel, but is preferably outside it. After issuing from the stretching vessel the film may pass in contact with a positively driven forwarding device and thence to a roll or other take-up device. When stretching is carried out in the presence of hot water, the films are preferably immersed in the water during the whole of their travel through the stretching vessel.

When steam is employed, it may be introduced by means of one or more orifices positioned in the vessel. Preferably, it is projected directly on to the films across their whole width and on both sides from orifices close to the films. It is also desirable that such direct application should be effected during each stage of stretching.

The first roller or other device of the stretching mechanism may forward the film at the same speed as that at which it enters the stretching vessel so that no stretch is effected until the film has passed this roller or other device, or the roller or other device may forward the film at a greater speed so that stretching is effected before the film reaches the first roller or other device. Stretching may be longitudinal only, i. e. in the direction of travel of the film, or a lateral tension may also be applied, such tension being sufficient to stretch the film laterally also or sufficient only to prevent or control lateral shrinkage under the action of the longitudinal stretching tension.

The film may pass directly from the external atmosphere into the stretching vessel, or it may pass into the stretching vessel from a chamber containing air or other suitable inert fluid maintained at any required pressure or temperature. Alternatively, or in addition, it may pass into a similar chamber on issuing from the stretching vessel. By this means any tension on the film due to escape of steam or hot water through the inlet or outlet orifices for the film may be reduced or substantially completely eliminated and the characteristics of the product obtained may be controlled. Processes wherein such "end chambers" are employed and apparatus for car-

rying out such processés are described in U. S. application S. No. 17,242, filed April 19, 1935, to which reference is made for details with regard to the construction and use of the end cham-

5 An apparatus according to the invention for stretching artificial films in the presence of steam comprises a rectangular vessel having a width slightly greater than the width of the film which
10 it is proposed to treat, and a suitable length, for example 6 to 10 feet. The vessel consists of two portions, a detachable, flanged, box-like lid and a box-like bottom portion having corresponding flanges to which the lid is fixed, so that a sub-
15 stantially steam-tight joint is obtained. In the ends of the two portions rollers are rotatably mounted, the method of their mounting or the material of which they are made being such that it is just possible for the film to pass easily be-
20 tween them while leakage of steam around the film is substantially avoided. For example, rubber rollers may be employed, or alternatively incompressible rollers carried in bearings sliding in vertical guides and forced together by springs
25 inserted behind the bearings may be used. Inside the bottom portion of the vessel are mounted driven rollers extending across the width of the vessel and preferably close together, for example having their adjacent surfaces only about $\frac{1}{4}$ or
30 $\frac{1}{2}$ an inch apart. The rollers are arranged in two sets, those of one set being above those of the other, so that the film passes under the lower rollers and over the upper ones. With this ar-
35 rangement the film may lap round a considerable portion of the surface of each roller and slip may be avoided. Each roller is positively driven so that the rates of rotation of the different rollers may be varied as desired. Thus, on start-
40 ing up, the rollers may be all rotated at the same peripheral speed until the film has reached a satisfactory condition for stretching, when the rollers may be rotated at successively increasing speeds until the desired degree of stretching is
45 obtained. Each roller may be rotated at a peripheral speed greater than that of the roller preceding it, so that a stretch is applied to the film which extends along the whole length of its travel between the first and last stretching roll-
50 ers, or, if desired, as described above, rest stages may be inserted by rotating one or more pairs of adjacent rollers at the same peripheral speed. Steam is introduced into the vessel by means of
55 steam pipes extending across its width and arranged close to the film so that steam is projected directly on to each side of the film before the initial stretching roller and between each of the subsequent rollers. The apparatus may also
60 comprise a pressure gauge, a pressure release valve, a steam trap and a temperature indicator. The apparatus may also comprise means for stretching the film laterally or preventing it from
65 shrinking under the longitudinal tension. Such means may consist of a series of pairs of rollers, having their axes normal to the length of the film or suitably inclined thereto, between which the film is gripped, or a pair of endless bands on
70 each side of the film which grip the edges. Suitable apparatus for applying a lateral tension is described in U. S. application S. No. 666,656 filed April 18, 1933.

A similar form of apparatus with suitable modifications may be employed for stretching in the presence of hot water.

75 The invention also includes processes and apparatus for stretching artificial films wherein

perforated drums are employed into which steam, hot water or other stretch-assisting agent is introduced internally, so that the stretch-assisting agent reaches that surface of the film which is actually in contact with the drums and also is-
5 sues into the vessel through the holes which are not covered by the film. Such drums may be employed in any stretching operation, whether it is carried out in a plurality of stages, as described in the present specification, or in a single stage.
10 Moreover, besides being introduced into the interior of the perforated drums, the stretch-assisting agent may also, if desired, be introduced at other points in the vessel, for example by means
15 of perforated pipes extending across the vessel. Alternatively such pipes or the like may be the sole means of introducing the stretch-assisting agent into the vessel, since the perforations in the drums render it possible for the agent to reach
20 that surface of the film in contact with the drums, whether or not the stretch-assisting agent is introduced directly into the interior of the drums.

Examples of apparatus according to the present invention are illustrated in the accompanying
25 drawing wherein

Fig. 1 is a cross-sectional elevation of an apparatus containing a plurality of stretching rollers for stretching in the presence of steam;

Fig. 2 is a similar view of an apparatus for
30 stretching in the presence of hot water; and

Fig. 3 is a side elevation of a stretching roller having means for the introduction of steam internally.

In Fig. 1 the stretching vessel 4 consists of a
35 box-like bottom portion 5 and a lid portion 6. In the ends of the lid and box are rollers 7, 9 and 8, 10 respectively, which are rotatably carried in bearings slidable vertically in guides formed in the end wall of the box and lid and
40 which are forced together when the box and lid are in position by means of springs carried in the guides above the bearings in the lid and below those in the box. The edges of the sides and ends of the box and lid are flanged except in the por-
45 tions where the rollers are mounted so that the box and lid can be held together by means of bolts and wing nuts or other suitable fixing devices.

Inside the box portion of the vessel are an up-
50 per series of rollers 20, 21, 22 and 23 and a lower series 24, 25 and 26 which are rotatably mounted and which are positively driven by infinitely variable gearing fitted to the outside of the vessel. Steam is introduced into the vessel through steam
55 pipes 11, 12, 13 and 14 which extend across the whole width of the vessel. Steam is supplied to these pipes through headers 15 and 16 which are connected to the steam main (not shown). The steam pipes 11 and 12 are perforated or slotted
60 so that the steam emerging from them is directed vertically downwards and upwards respectively directly on to the film, while pipes 13 and 14 are perforated or slotted so that steam is projected from both sides of them on to the adjacent
65 film. A pressure gauge 17, a steam trap 18 and a safety valve 19 are also provided.

Fig. 2 illustrates a similar apparatus adapted for use with hot water under pressure. As in the case of the apparatus illustrated in Fig. 1 it
70 comprises a vessel 4 having flanged box and lid portions 5 and 6, fitted at the ends with rollers 7, 8, 9, 10. Two series of stretching rollers 20, 21, 22, 23, 24, 25 and 26 are mounted inside the box portion. Instead of the steam pipes illustrated
75

in Fig. 1 the apparatus comprises a water inlet 51, a water outlet 52 and a steam heating coil 53 for maintaining the required temperature. The apparatus also comprises a pressure gauge 17, a drain pipe and valve 54 and catch trays 55 to catch any water escaping through the rollers 7, 8, 9 and 10.

Fig. 3 is a side elevation of a cylindrical drum 40, the sides of which are perforated with a large number of small holes 41. One axis 42 of the drum is formed from a hollow tube 43 which extends into the interior of the drum, and which is perforated or slotted so that steam can be blown through it into the interior of the drum.

In carrying out the process of the invention with the apparatus illustrated in Fig. 1 a film 30 proceeding from a suitable supply 31 passes first round a feed device consisting of two positively driven rollers 32, 33, which control its rate of travel, then between the rollers 7 and 8 into the stretching vessel where it passes round the two series of stretching rollers 20—23 and 24—26 to the other end of the vessel. Here it emerges through the rollers 9 and 10, passes round a forwarding device consisting of two positively driven rollers 34, 35, and thence to a take-up device 26. The stretching rollers in the stretching vessel may be either driven at continuously increasing peripheral speeds so that stretching is effected between each pair of rollers, or one or more pairs of adjacent rollers may be driven at the same peripheral speed so that no stretch is effected between the pair or pairs. The first roller 20 may either be driven at the same speed as the roller 33 so that no stretching is effected until after the film has passed roller 20 or it may be driven at a higher speed than the roller 33 so that stretching is effected between these two rollers. Similarly stretching may or may not be effected between the roller 23 and the roller 34.

Any tendency for condensed steam to collect in the angles made by the film with the bottom rollers 24, 25 and 26 may be reduced by tilting the vessel so that the axes of these rollers are inclined to the horizontal.

The present invention is of particular importance in the stretching of artificial films containing cellulose acetate, but it may also be employed in the stretching of such materials containing other derivatives of cellulose, for example cellu-

lose formate, cellulose propionate, cellulose butyrate, cellulose nitro-acetate, cellulose nitrate and other esters or mixed esters of cellulose, cellulose ethers or mixed ethers, for example methyl, ethyl and benzyl cellulose, and cellulose ether-esters, for example ethyl cellulose acetate and oxy-ethyl cellulose acetate. Other artificial films may also be stretched according to the present invention, for example, films having a basis of regenerated cellulose obtained by the viscose process, or of polymerized vinyl compounds or other film-forming bases.

Having described my invention what I desire to secure by Letters Patent is:—

1. Process for improving the properties of artificial films having a basis of an organic derivative of cellulose, which comprises stretching them in a plurality of stages in the presence of a hot aqueous fluid at a temperature above 100° C. during their travel from one point to another and directing hot aqueous fluid at a temperature above 100° C. on to the films during each stage of stretching.

2. Process for improving the properties of artificial films having a basis of an organic derivative of cellulose, which comprises stretching them in a plurality of stages in the presence of wet steam at a temperature above 100° C. during their travel from one point to another, and directing wet steam at a temperature above 100° C. on to the films during each stage of stretching.

3. Process for improving the properties of artificial films having a basis of cellulose acetate, which comprises stretching them in a plurality of stages in the presence of wet steam at a temperature above 120° C. during their travel from one point to another, and directing wet steam at a temperature above 120° C. on to the films during each stage of stretching.

4. Process for improving the properties of artificial films having a basis of an organic derivative of cellulose, which comprises stretching them in a plurality of stages in the presence of wet steam at a temperature above 100° C. during their travel from one point to another, and directing wet steam at a temperature above 100° C. on to each side of the films during each stage of stretching.

HENRY DREYFUS. 50