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METHOD FOR THE ORIENTATION OF A CONTINUOUS SHEET MATERIAL BY
MEANS OF STRETCHING, AND APPARATUS FOR USE IN THE METHOD
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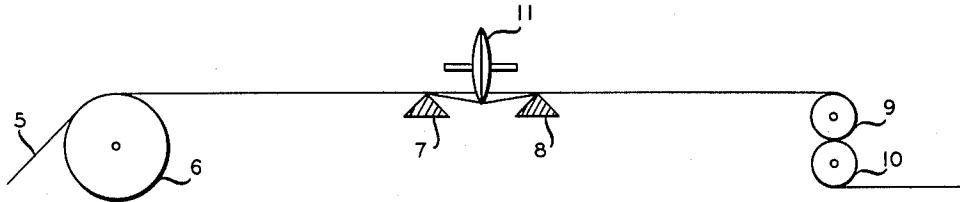


FIG. 1

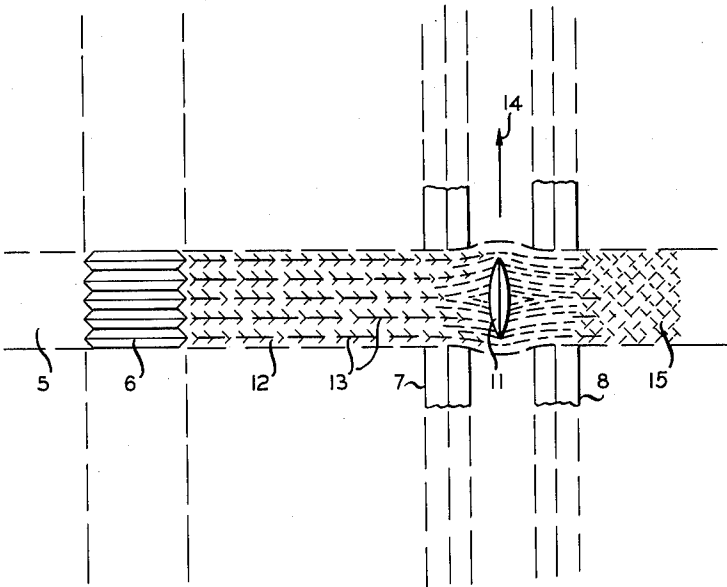


FIG. 2

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METHOD FOR THE ORIENTATION OF A CONTINUOUS SHEET MATERIAL BY MEANS OF STRETCHING, AND APPARATUS FOR USE IN THE METHOD

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9 Claims. (Cl. 264—288)

The present invention relates to a method for orientation of continuous sheet material by means of stretching with the particular object of obtaining a more uniform orientation of such material by cold stretching than has been possible by the hitherto known stretching methods.

Oriented sheets are used among other things for producing laminates and are likewise well suited for producing the so-called splitfibres by means of a splitting process.

The method can be applied to any orientable sheet material, but has special advantages when applied to low pressure polyethylene or polypropylene with which it has proved difficult to obtain a uniform orientation by cold stretching. The method also has special advantages when applied to sheets having varying thickness where the varying thickness tends to become accentuated by the stretching process, to sheets which, for example, by blowing up in combination with extrusion, have beforehand become more or less laterally oriented, and to thick sheets which according to experience are difficult to cold stretch.

The stretching characterisation of an orientable sheet, for example of low pressure polyethylene, has a special form, in that by increasing the applied force, an elastic elongation of the sheet will first take place. When the applied force exceeds a certain limit, depending on the material and the sheet dimensions, the elongation will no longer be elastic, but the material undergoes a permanent stretching, and the force necessary for continued stretching is substantially less than the maximum force in the elastic elongation.

The phenomenon has a certain resemblance to that of applying a force to a solid body which is resting on a support and is to be set in motion across the said support. A high initial force is required to start the motion, but once started, the motion can be maintained by means of a far smaller force.

It has also been found that the permanent stretching of an orientable sheet material is initiated with slippages occurring in the material, and this process once started can be continued by applying an essentially smaller force.

Further it should be mentioned that the stretching normally occurs in a narrow zone lateral to the stretching direction and is accompanied by a contraction in the breadth, conditions permitting. This gives rise to the so-called "shoulder-effect," and obviously involves varying force actions over the breadth of the sheet, thus tending to produce uneven stretching. If the contraction is counteracted, this will further accentuate the tendency towards uneven stretching.

Thus, by cold stretching in known manner of low pressure polyethylene sheet material between two fairly close-set pairs of rollers, the course of the stretching will be very heterogeneous, since unstretched sections will occur in the stretched foil and usually also formation of holes. The unstretched parts are due to that once the stretching or orientation has started at a place, it will chiefly continue in the nearer surroundings, since it requires an essentially smaller force to continue a stretching action in progress. The stretching process thus starts spontaneously in many parts of the section of sheet being stretched, and will spread within a radius of some

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millimeters or centimeters around these starting points, whereupon it ceases. This leaves unstretched parts between the stretched areas. The holes are due to the distortions occurring in the stretching action by this unordered progress of the orientation.

The basic idea of the invention is that the said deficiencies of the known orientation processes can be remedied by not leaving it to chance where the stretching process is initiated, but to apply the stretching force in such manner as to make the orientation progress in an orderly way. This is effected, according to the invention, by displacing locally applied pressures, which are sufficient for producing a permanent stretching of the part of sheet acted upon, crosswise over the sheet breadth in a narrow lateral zone as the sheet is being moved forward, and causing the said locally applied pressures to follow closely upon one another. A finishing stretching treatment can then be applied in known manner, if desired.

Thus, it is possible to secure that the stretching takes place over the entire sheet breadth in the lateral zone in question irrespective of possible variations of thickness and other irregularities in the sheet, and if the lateral zones follow each other in close succession, orientation is obtained over the entire sheet. Even if the lateral zones are spaced apart somewhat, it is possible by after-stretching in known manner to cause the oriented lateral zones to expand until the entire sheet has been oriented.

In an appropriate embodiment of the present method, the said pressure actions are localized, according to the invention, by carrying the sheet over two or more rollers or rods set close to one another, between which rollers or rods the pressures are applied. By pressing the material against said rollers or rods, the progress of orientation is limited in the longitudinal direction of the sheet and thus becomes more even.

It is furthermore convenient, according to the invention, to use a sheet material which has been pleated longitudinally; for, as mentioned in the foregoing, there is a tendency for the sheet to contract in breadth during the stretching causing the orientation, and a pleating of the said kind can be carried out in such a manner that the sheet when pleated is about the same breadth as the stretched smooth sheet, whereby unbalanced effects of the stretching force are reduced or even completely avoided.

This invention also comprises an apparatus for use in the said method, said apparatus being characterised in that it includes a system of parallel cross beams or rollers spaced a slight distance apart and across which the foil is to be passed, and a system of wheel- or ball-formed elements which can be moved forward in the spaces between the said beams or rollers in such manner that a continuous sheet which is passed over the beams or rollers will be depressed therebetween.

According to the invention, it is particularly advantageous in such an apparatus to place a cross-fluted roller in front of the system of cross beams or rollers and, if desired, an apparatus for producing longitudinal pleats in the continuous sheet. The fluted roller serves for producing suitable points of departure for the orientation. At the passage of the sheet over the fluted roller a slight pleating is produced, and at the same time the flutes cause a slight stretching to take place as manifested by the formation in the foil of a slipping line pattern consisting of short slipping lines at an angle of 45° to the longitudinal direction. The pleating apparatus serves to compensate for the breadth contraction arising during the orienting process.

By the passage over the system of cross beams or rollers and the local stretch action exerted in the space or spaces between the said beams or rollers, the slipping lines produced by the fluted roller are caused to develop

to a dense pattern, the material being so heavily stressed that a permanent elongation takes place.

Usually, however, one will not be content with the orientation thus obtained, but will follow up by a continuous after-stretching in known manner, for example to a length of three times the length of the unoriented sheet. Then the individual slipping lines will form points of departure for a further orientation, and the slipping line pattern apparently disappears. It has been found, however, that a sheet stretched in this manner is particularly suitable for fibre production since it yields extremely fine and homogeneous fibres, probably due to the fact that the orientation has been carried out in the described particular manner with the occurrence of a slipping line pattern.

An apparatus as hereinbefore described for orienting sheet material has been shown diagrammatically in the drawing, in which

FIG. 1 shows a longitudinal section through the essential parts, and

FIG. 2 shows some details seen from above.

In FIG. 1, 5 denotes a continuous sheet which is tightly passed over a cross-fluted roller 6 and from there further on over two cross-beams 7 and 8 and a pair of pulling rollers 9 and 10. Between the beams 7 and 8 is placed a member for the local application of pressure, consisting of a wheel 11, being one of a series of wheels which can be brought to roll across the continuous sheet in continuous succession by means of an endless chain arrangement (not shown), thereby locally applying pressure to the sheet.

In FIG. 2 are shown diagrammatically some details of the progress of orientation. The sheet 5 being passed over the fluted roller 6, the orientation is started by a slight contraction taking place on top of the flutes. A system of short slipping lines 12 is thus formed at angles of about 45° to the longitudinal direction, and at the same time a slight pleating is imparted to the sheet as indicated by lines 13. The wheel 11 pressing the sheet out of level between the beams 7 and 8, a local stretching and smoothing takes place which is displaced sideways as denoted by an arrow 14 showing the direction of motion of the wheel. When the wheel has passed, the foil goes back to the original level and simultaneously, owing to the distension, a fine longitudinal pleating will be formed continuing across the beam 8. The original slipping line system now forms a dense pattern 15 which disappears together with the fine pleating during a subsequent stretching in known manner.

I claim:

1. Method of orienting a sheet metal by stretching, comprising subjecting the sheet material successively across the breadth of the sheet to local pressure actions, which are sufficient for producing a permanent stretching of the sheet area acted upon, said successive pressure actions being performed successively over narrow lateral zones of the forward moving sheet material, the zones following close upon one another.

2. Method of orienting a sheet material by stretching comprising subjecting the sheet material successively across the breadth of the sheet to local pressure actions, which are sufficient for producing a permanent stretching of the sheet area acted upon, said successive pressure actions being performed successively over narrow lateral zones of the forward moving sheet material, the zones following close upon one another, and subsequently subjecting the sheet material to a finishing stretching.

3. Method of orienting a continuous sheet material by stretching, comprising subjecting said sheet material to longitudinal pleating, passing the sheet over two supporting members placed fairly close to one another, and

subjecting the sheet material during its forward movement to local pressure actions between the said supporting members, said pressure actions being exerted successively across the breadth of the sheet in narrow areas following one another closely, and being carried out with sufficient force to produce a permanent stretching of said areas acted upon.

4. The method of claim 3, in which the sheet material is subsequently subjected to a finishing stretching.

5. An apparatus for use in orienting a continuous sheet material by stretching, comprising at least two supports, over which the sheet material is to be passed, said supports being mounted close together and parallel to each other, and a system of pressure elements which can be carried forward in the spaces between said supports and press the sheet material passing over said supports out of level with a force sufficient to produce permanent stretching of the sheet area acted upon.

6. An apparatus according to claim 5, in which a cross-fluted roller supporting the sheet material is placed in front of the supports, between which the pressure actions are to be applied to the sheet material.

7. In an apparatus for stretching a continuous sheet material by stretching, the provision of a pleating mechanism for longitudinally pleating of the sheet material, followed by a cross-fluted roller for supporting the pleated continuous sheet material, at least two further supporting rollers, and in the space between the latter a system of pressure members being adapted to apply local pressure actions over the entire breadth of the sheet with sufficient force to effect permanent stretching of the sheet areas acted upon.

8. A method of pre-treating a sheet of orientable plastic material so that said sheet can be uniformly oriented by cold stretching which comprises applying pressures locally at small areas within a lateral zone across the breadth of said sheet with sufficient force to produce permanent stretching of said sheet within the lateral zone acted upon, and repeating such pressure actions along the length of said sheet as it is moved forward whereby slippage lines are produced uniformly across the face of said sheet, said slippage lines serving as loci of departure for further stretching when the sheet is placed under sufficient tension.

9. A method of uniformly orienting a sheet of orientable plastic material which comprises passing said sheet at a temperature suitable for orientation tightly over a grooved member having closely spaced parallel grooves running parallel to the direction of movement of said sheet so that the crown portions of the ridges between said grooves apply pressure locally at small areas across the breadth of said sheet with sufficient force to produce permanent stretching of said sheet of orientation in the lateral zone contacting said member, and thereafter stretching said sheet longitudinally to produce further orientation.

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