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(54) **Method and device for pre-stretching of a stretch film**

(57) In a method for pre-stretching a stretch film (1), the film (1) is caused to run on two means (3, 4), of which the front means (4) as seen in the direction of feed of the film (1) is a draw means and the rear means (3) as seen in the direction of feed of the film (1) is a brake means (3). A parameter, which is dependent on the tensile force (P) generated by the two means (3, 4) in the portion (11, 12) of the stretch film (1) that is located between said means (3, 4), is measured, and the meas-

ured value thus obtained is used to control the action of the front and rear means (3, 4) on the film (1) in such manner that said tensile force (P) is kept within a predetermined range (I). A device for pre-stretching a stretch film comprises, in addition to a draw means (4) and a brake means (3) of the type mentioned above, a measuring device (7) for measuring the above parameter as well as control means (20) for controlling the action of the draw means (4) and the brake means (3) on the film (1).

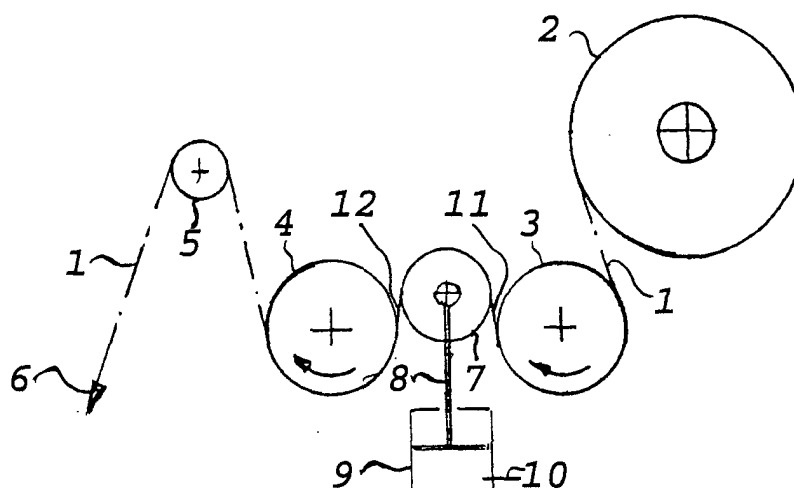


Fig 3

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Description

Field of the Invention

[0001] The present invention relates to a method for pre-stretching a stretch film, in which the film is caused to run on two means, of which the front means as seen in the direction of feed of the film is a draw means and the rear means as seen in the direction of feed of the film is a brake means.

[0002] The invention further relates to a device for pre-stretching a stretch film, said device having two means, on which the film can run, the front means as seen in the direction of feed of the film being a draw means, and the rear means as seen in the direction of feed of the film being a brake means.

Background Art

[0003] Stretch film is used to package goods so that they form a single unit. Such goods may, for example, be packages of different size and shape, which have been stacked on a loading pallet, as shown, for instance, in EP 0,842,850.

[0004] The stretch film is unwound from a stretch film roll and pre-stretched, usually by means of two pre-stretching rollers, on which the film is running. The rear roller as seen in the direction of feed of the film rotates at a lower peripheral speed than the front roller as seen in the direction of feed of the film, which means that the rollers will exert a tensile force on the film. For each film quality, the maximum possible elongation due to pre-stretching is indicated, and the difference in peripheral speed between the rear and front rollers is adjusted accordingly. The film is then wrapped around the goods that are to be packaged.

[0005] EP 0,653,352 (which corresponds to SE 502,041) discloses a method for varying the percentage elongation of the film in seven steps. This makes it possible to change the degree of elongation in a relatively simple manner. The disadvantage is that the maximum possible elongation of the particular film must be known and the elongation preset at this value. In practice, it is necessary to set the actual elongation at a lower value than the maximum elongation value of the film, since the quality of the film varies. Naturally, this problem is particularly pronounced in films of lower quality, since the variation in maximum elongation is considerable for these films.

[0006] SE 444,660 discloses a method in two steps for elongating stretch film. An advantage of this method is that the stretch film, after a first stretch, is relaxed on a idler roller. Heat is thereby generated in the film, which allows the film to be elongated even more than what would otherwise have been possible. However, this method also requires that the set elongation value be lower than the maximum elongation value of the film.

Summary of the Invention

[0007] An object of the invention is to provide a method for pre-stretching a stretch film, in which the elongation of the stretch film is controlled on the basis of the maximum elongation value of the film.

[0008] According to the present invention, this object is achieved with a method of the type described by way of introduction, which is characterised in that a parameter, which is dependent on the tensile force generated by the two means in the portion of the stretch film that is located between said means, is measured, and that the measurement result thus obtained is used to control the action of the front and rear means on the film in such manner that said tensile force is kept within a predetermined range. Said parameter is thus measured during the pre-stretching.

[0009] The draw means is preferably a front pre-stretching roller and the brake means a rear pre-stretching roller, of which the front pre-stretching roller is rotated at a higher peripheral speed than the rear pre-stretching roller, said parameter being used to control the difference between the peripheral speed of the front and rear rollers in such manner that said tensile force is kept within the predetermined range. Owing to the use of pre-stretching rollers, the pre-stretching can be easily controlled by changing the number of revolutions, and thus the peripheral speed, of one or both of the rollers.

[0010] Said action on the stretch film is suitably controlled automatically and during operation in such manner that said tensile force is kept at a predetermined, substantially constant value. By controlling the action on the stretch film automatically, the film can be stretched to its maximum even if the quality of the film varies along the extent of the film.

[0011] Said parameter is preferably measured by means of a sensing roller, which is arranged between the draw means and the brake means and abuts against the film, said parameter being the force exerted by the stretch film on the sensing roller. The sensing roller has no detrimental effect on the film during measurement and provides a continuous measuring of the tensile force. In addition, the sensing roller serves the purpose of stretching the stretch film in two steps with an intermediate relaxation and heating, which allows the film to be stretched even more without rupturing.

[0012] Said action on the stretch film is preferably controlled so as to maintain said tensile force at a value which is lower than the force corresponding to the breaking point of the film, but higher than the force corresponding to the yield point of the film. This way of controlling the pre-stretching allows the film to be stretched considerably without breaking. Since many different types of stretch film have about the same yield point and breaking point, despite the fact that the maximum elongation differs significantly, the same preselected force value may be used for different films without necessitating a change of machine settings.

[0013] It is even more preferred that said value lies substantially within an area on the force-elongation curve of the stretch film where the force, after a slow increase, rises steeply towards the breaking point. This area is the area where the maximum elongation of a particular film is obtained without the film rupturing. This area differs substantially from one type of film to another in terms of elongation, whereas the force remains about the same. By setting a force value that lies within said area, a maximum elongation is obtained for different types of film and even for different parts of one and the same film, the properties of which varies along its extent, without having to change the force value.

[0014] Another object of the invention is to provide a device for pre-stretching a stretch film, said device comprising means for controlling the elongation of the stretch film on the basis of the maximum possible elongation of the film.

[0015] According to the present invention, this object is achieved with a device according to the preamble of claim 7, said device being characterised in that a measuring device is arranged to measure a parameter, which is dependent on the tensile force generated by said two means in the portion of the stretch film that is located between said means, and that control means are arranged to control, by means of the measurement result from the measuring device, the action of the front and rear means on the film in such manner that said tensile force is kept within a predetermined range. The measuring device is thus arranged to measure said parameter during the pre-stretching.

[0016] In a preferred embodiment, the draw means is preferably a front pre-stretching roller, and the brake means is a rear pre-stretching roller, of which the front pre-stretching roller is arranged to be rotated at a higher peripheral speed than the rear pre-stretching roller, said control means being arranged to control the difference between the peripheral speed of the front and rear rollers in such manner that said tensile force is kept within the predetermined range. Owing to the use of pre-stretching rollers, the pre-stretching can be easily controlled by changing the number of revolutions, and thus the peripheral speed, of one or both of the rollers.

[0017] The control means are preferably arranged to control said action of the film automatically and during operation in such manner that said tensile force is kept at a predetermined, substantially constant value. Since the control means control the action on the stretch film automatically, maximum stretching of the film can be ensured all the time even if the quality of the film varies along the extent of the film.

[0018] It is preferred that the measuring device comprises a sensing roller, which is arranged between the two means so as to abut against the film, said parameter being the force exerted by the stretch film on the sensing roller. The sensing roller has no detrimental effect on the film at the time of measurement. In addition, the sensing roller serves the purpose of stretching the stretch film in

two steps, which allows the film to be stretched even more without rupturing.

[0019] It is even more preferred that the sensing roller is arranged to be moved against a resistance by the force exerted by the film on the sensing roller, said measuring device further comprising a position transducer, which is arranged to measure the position of the sensing roller. This measuring device provides a simple and accurate measurement of a parameter that is dependent on the tensile force in the stretch film. It is also possible to change the action of the resistance during operation in order to reduce, for example, the pre-stretching, as appropriate.

[0020] In a preferred embodiment, the measuring device further comprises a pressure sensor, against which the sensing roller is arranged to be pressed by means of the force exerted by the film on the sensing roller, said pressure sensor being arranged to measure this force. Pressure sensors are standard parts, which are easy to mount. The sensing roller does not have to be slidably mounted.

[0021] The sensing roller is preferably rotatably arranged on a cover, which is pivotable about an axis parallel to and located at a distance from the axis of the sensing roller, so as to remove the sensing roller and allow access to the stretch film. The cover allows easy access to the pre-stretching rollers and the film. This is a considerable advantage when new film is to be pulled through.

[0022] In another preferred embodiment, the stretching device comprises a driving motor, a servomotor and a differential gear comprising a toothed belt pulley having at least one pinion, said driving motor being arranged to directly drive the front pre-stretching roller by means of a shaft, which is non-rotatably connected to a gear wheel in the differential gear and extends axially through the differential gear, said servomotor being arranged to drive, in continuously controllable manner and depending on the above parameter, the toothed belt pulley of the differential gear, the toothed belt pulley being arranged to transfer rotation to the rear pre-stretching roller by means of a transmission. An advantage of this embodiment is that the device is started with only the driving motor running. The film is then substantially unstretched. When the servomotor is started, the pre-stretching will increase gradually. When the degree of pre-stretching is great, the servomotor is running at high speed, which makes it easier to control and reduces the risk of it being damaged. Thus, the servomotor completely controls, through the differential gear, the pre-stretching process depending on the measured tensile force in the film, whereas the driving motor only controls the advancing of the film.

Brief Description of the Drawings

[0023] The invention will now be described with reference to the accompanying drawings, in which

Fig. 1 is a general force-elongation diagram for a stretch film;

Fig. 2 is a force-elongation diagram for three thin, polyethylene-based stretch films;

Fig. 3 is a schematic plan view of a device according to the invention;

Fig. 4 is a plan view showing the course of the film between two pre-stretching rollers in a device according to the invention;

Fig. 5 is a side view of the driving unit of the pre-stretching rollers;

Fig. 6 is an enlargement of a differential gear in the driving unit shown in Fig. 5.

Description of Preferred Embodiments

[0024] With reference now to Fig. 1, a typical force-elongation diagram for a thermoplastic stretch film is shown, in which P is the tensile force and E is the resulting elongation of the stretch film in per cent. As the tensile force P increases from zero, the elongation E will first increase linearly up to the yield point SF. Once the yield point SF has been passed, the elongation increases considerably without any increase in the tensile force P. After a certain degree of elongation, the tensile force P rises again steeply towards the breaking point SB. The film ruptures at the breaking point SB. In conventional methods of pre-stretching stretch film, a fixed elongation is set, as indicated by the arrow K in Fig. 1, the elongation being specific for the stretch film concerned. The fixed elongation K is substantially smaller than the maximum elongation at break, as indicated by the arrow EB in Fig. 1, so as to avoid that the more or less uneven quality of the film leads to rupture during pre-stretching. The consequence is that optimum stretching of the film is not obtained.

[0025] With reference to Fig. 2, a force-elongation diagram for three different types of thin, polyethylene-based stretch films F1, F2 and F3 is shown. The film F1 is a type of film, which is mono-oriented and which cannot be elongated very much, but which has a high breaking point. The film F2 is of ordinary stretch film quality, and the film F3 is of excellent stretch film quality and has good elongation properties and, at the same time, a high breaking point. The films F1 and F3 thus represent extremes as far as thin, polyethylene-based stretch films are concerned. The yield points SF1, SF2 and SF3, respectively, of the films are located in almost exactly the same point in the diagram, whereas the breaking points SB1, SB2 and SB3, respectively, are located at completely different degrees of elongation E of the three films F1, F2 and F3, respectively. Similar differences in maximum elongation can also be observed along one and the same stretch film, since the quality of the film varies along the extension of the film. However, by continuously measuring the tensile force P of the stretch film, in accordance with the present invention, the tensile force may be controlled in such manner that maxi-

mum elongation E is always obtained. This is possible due to the fact that the force at the breaking points SB1, SB2 and SB3, respectively, is significantly higher than at the yield points SF1, SF2 and SF3, respectively. The tensile force P is controlled in such manner that it will be in a range I, the upper limit of which is below the breaking points SB1, SB2 and SB3 of all the films and the lower limit of which is above the yield points SF1, SF2 and SF3 of all the films. The tensile force is suitably directed towards a fixed value V in this range I. This means that films of different types as well as one film with varying quality along its extent will be elongated maximally without rupturing. The tensile force V is suitably set in such manner that the resulting elongation E lies within areas Q1, Q2 and Q3, respectively. These areas Q1, Q2 and Q3 are situated where the tensile force, following a slow increase, starts to rise steeply towards the breaking points SB1, SB2 and SB3, respectively.

[0026] With reference to Fig. 3, a device intended to carry out this method according to the invention is shown schematically. The stretch film 1 is purchased from a supplier on a roll 2 with a typical width of 0.5 m. The stretch film 1 first runs on a rear pre-stretching roller 3 and then on a front pre-stretching roller 4, which rotates at a higher peripheral speed than the rear roller 3 and which, in this case, has substantially the same diameter as the rear roller 3. As both pre-stretching rollers 3, 4 have good friction against the film 1, the film 1 will be affected by a tensile force P, since the front pre-stretching roller 4 pulls the film, and the rear pre-stretching roller 3 brakes the film. After the pre-stretching rollers 3, 4, the pre-stretched film 1 is conveyed over a front guide roller 5 and subsequently towards the goods that are to be packaged (arrow 6).

[0027] A sensing roller 7 is arranged between the pre-stretching rollers 3, 4. The sensing roller 7 is a rotatable idler roller, which measures the force exerted on it by the film 1. Thus, the stress on the sensing roller 7 is a measure of the tensile force P in the film 1 caused by the pre-stretching rollers 3, 4. The sensing roller 7 is supported by a roller holder 8. The roller holder 8 is connected to a compressed-air cylinder 9. The compressed-air cylinder 9 is connected by means of a compressed-air connection 10 to a compressed-air source (not shown), which is capable of supplying the desired pressure to the cylinder 9.

[0028] The sensing roller 7 also serves the purpose of dividing the pre-stretching process into two parts with an intermediate relaxation and heat build-up in the film 1. The film 1 is thus pre-stretched on the one hand in a first portion 11, which is located between the rear pre-stretching roller 3 and the sensing roller 7 and, on the other hand, in a second portion 12, which is located between the sensing roller 7 and the front pre-stretching roller 4. The film can thereby be stretched even more without rupturing.

[0029] The tensile force in the respective portions 11,

12 of the film 1 will result in a compressive force on the sensing roller 7.

[0030] With reference to Fig. 4, it is shown how a film 1 is conveyed towards a rear idler guide roller 13, which ensures that the film 1 abuts against the rear pre-stretching roller 3. The rear guide roller 13 and the sensing roller 7 are mounted on a cover 14. The cover 14 is provided with hinges 15 at one end. When the cover 14 is pivoted away from the pre-stretching rollers 3, 4, the sensing roller 7 and the rear guide roller 13 come along, which makes it easy to unwind new film 1 from the roll 2 and pull it through the pre-stretching rollers 3, 4 to the front guide roller 5.

[0031] The roller holder 8 has at its upper end a lateral guide means 16 that allows the sensing roller 7 to slide in a direction perpendicular to the axial direction. The outermost position of the sensing roller 7, i.e. the position assumed by the sensing roller when it is not subjected to a load and the air pressure in the air cylinder 9 has ejected the roller holder 8 as far as possible, is indicated by a dashed roller 7' in Fig. 4. This is the position assumed by the sensing roller 7 when there is no pre-stretching of the film 1, i.e. when the pre-stretching rollers 3, 4 rotate at the same speed. This is normally the case both in a first phase in packaging of goods and in a last phase when the film is to be fastened on the goods.

[0032] During the actual pre-stretching process, a preset air pressure is released by a valve 17 to the short-stroke air cylinder 9. The air pressure in the compressed-air cylinder 9 is chosen on the basis of the desired value V of the tensile force P in the film 1. A position transducer 18, which is fixedly attached to the cover 14, continuously measures the distance between the position transducer 18 and the sensing roller 7. The signal 19 from the position transducer 18 is received by a control unit 20. The control unit 20 controls the difference in peripheral speed between the pre-stretching rollers 3, 4. If, for example, the distance from the position transducer 18 to the sensing roller 7 increases, this means that the tensile force in the film 1 decreases (i.e. the force generated by the air pressure in the cylinder 9 is higher than the resulting compressive force exerted by the film 1 on the sensing roller 7). The control unit 20 then increases the difference in peripheral speed between the pre-stretching rollers 3, 4, which results in the tensile force in the film 1 increasing once more, and this leads to a decrease in the distance between the sensing roller 7 and the position transducer 18.

[0033] Referring now to Fig. 5, a drive unit 21 drives the pre-stretching rollers 3, 4. A driving motor 22 drives the front pre-stretching roller 4 via a shaft 23. The power supply to the driving motor 22 is provided by a first frequency converter (not shown). The number of revolutions of the motor 22 is controlled by the frequency converter on the basis of the amount of film 1 that has to be fed to the goods that is to be packaged.

[0034] A servomotor 24 regulates the number of rev-

olutions of the rear pre-stretching roller 3. The power supply to the servomotor 23 is provided by a second frequency converter (not shown). The second frequency converter is controlled by the output signal 25 from the control unit 20. The servomotor 24 thus regulates the difference in the number of revolutions between the pre-stretching rollers 3, 4, and thereby the difference in their peripheral speed, depending on the tensile force in the film 1 that is measured by means of the sensing roller 7 and the position transducer 18.

[0035] The servomotor 24 drives a first toothed belt pulley 26, which is connected by means of a drive belt 27 to a differential gear 28. The differential gear 28 drives, via an output gear wheel 29, a driving gear wheel 30, which is non-rotatably connected to shaft 31 of the rear pre-stretching roller 3.

[0036] The rotating parts are contained in a housing 32. The pre-stretching rollers 3, 4 are each carried in a bearing 33, 34, which is mounted in the lower wall 35 of the housing 32.

[0037] The differential gear 28, as shown in Fig. 6, has a first bevel gear wheel 36, which is non-rotatably connected to the shaft 23 by means of a first wedge 37. A second bevel gear wheel 38 is mounted on the shaft 23 and is rotatable about the shaft 23 by means of a bearing bush 39. A second toothed belt pulley 40 is arranged between the two bevel gear wheels 36, 38. The second toothed belt pulley 40 is rotatably mounted on the shaft 23 by means of a bearing bush 39'. The toothed belt pulley 40 supports two pinions 41, 42. Each of the pinions 41, 42 is arranged in an opening 43, 44 in the toothed belt pulley 40 and journaled in a bearing on a shaft 45, 46. The shafts 45, 46 are attached to the toothed belt pulley 40. The pinions 41, 42 are provided with bearing bushes (not shown), which allows them to rotate about the respective shafts 45, 46.

[0038] The output gear wheel 29, which drives the driving gear wheel 30 of the rear roller 3, is non-rotatably attached to the second bevel gear wheel 38 by means of a second wedge 47.

[0039] The differential gear 28 operates as follows. To feed the film 1, first the driving motor 22 is started. The toothed belt pulley 40 is idle, and the pinions 41, 42 will therefore transfer the rotation of the first bevel gear wheel 36 directly (with the opposite direction of rotation) to the second bevel gear wheel 38. The rotation is transferred to the rear pre-stretching roller 3 by means of the gear wheels 29 and 30. The gear ratios of the differential gear 28 are such that the rear and front pre-stretching rollers 3, 4 will rotate at substantially the same speed, and thus no pre-stretching takes place. When the film 1 has been attached to the goods, prestretching is initiated by starting the servomotor 24. The second toothed belt pulley 40 will then rotate faster and faster, which will cause the pinions 41, 42 to transfer less and less of the rotation of the first bevel gear wheel 36 to the second bevel gear wheel 38. The number of revolutions of the rear pre-stretching roller 3 is thereby reduced, which

means that the pre-stretching of the film 1 begins. The control unit 20 described above regulates the number of revolutions of the servomotor 24 via the second frequency converter in such manner that the pre-stretching gives rise to the desired tensile force in the film 1. When the packaging of the goods is finished, the servomotor 24 is stopped first, which means that the two pre-stretching rollers 3, 4 rotate once more at the same speed and that the pre-stretching is discontinued. Then, the driving motor 22 is also stopped.

[0040] It will be appreciated that a number of modifications of the embodiment described above are possible within the scope of the invention.

[0041] For example, the pre-stretching rollers 3 and 4 described above may be made up of some other type of brake and draw means. Examples of other brake means are conveyor belts and suction boxes. Examples of other draw means are conveyor belts.

[0042] The compressed-air cylinder 9, which provides a pressure on the roller holder 8 holding the sensing roller 7, may be an oil cylinder. Another alternative is to use a spring, which exerts a pressure on the roller holder 8. The roller holder 8 may also be attached directly to pressure sensors, for example a number of load cells. The output signal from the load cells will then be a measure of the compressive force exerted by the film on the sensing roller, which may be used to control the difference in peripheral speed and, thereby, the tensile force in the film.

[0043] The pre-stretching rollers 3, 4 need not have the same diameter. The servomotor 24 controls the difference in peripheral speed, and the number of revolutions of the rollers per se is thus not important.

[0044] The sensing roller 7 may be replaced by other means for measuring the tensile force in the film. Thus, the sensing roller may, for example, be replaced by a rigid, smooth, non-rotating beam. The beam can measure the load exerted by the film 1 in the same way as the sensing roller 7, but it will cause greater wear on the film than the sensing roller 7. Another advantage of the sensing roller 7 is that, while it measures the load exerted by the film 1 on the sensing roller, said pressure being a measure of the tensile force in the film, it also provides a stretching in two steps with an intermediate relaxation and heat build-up, which allows the film to be stretched more than in stretching in only one step.

[0045] As an alternative to the drive unit 21 described above, the pre-stretching rollers 3, 4 can be driven by means of two motors, which are completely separated and which each directly drive a roller 3, 4. The motors are supplied with power from separate frequency converters. This alternative is a simple mechanical solution, but it has certain disadvantages. For example, in order to avoid undesirable pre-stretching of the film, the motors have to start exactly at the same time and stop exactly at the same time as the packaging of goods begins and ends, respectively. Furthermore, the motor driving the rear pre-stretching roller 3 will have a low number of

revolutions when the braking is at its maximum, i.e. when the pre-stretching is at its maximum. This is difficult to control and entails a risk of the motor burning.

[0046] The type of thin, polyethylene-based film described above may, of course, be replaced by any other type of stretch film that is suitable for packaging of goods.

[0047] The measuring device used to measure the tensile force in the film, or a parameter that is dependent on the tensile force, may be a separate unit, such as a sensing roller 7, located between the pre-stretching rollers 3, 4, or a unit connected directly to one of the pre-stretching rollers. In the latter situation, it is possible to carry out a pre-stretching in one step, without a sensing roller, and to measure the load exerted by the film on one or both of the pre-stretching rollers.

[0048] The compressed-air cylinder 9 can work with a variety of pressures during operation. Since the control unit 20 aims at maintaining a constant distance between the sensing roller 7 and the position transducer 18, high pressures in the compressed-air cylinder 9 result in high tensile stress in the film 1. Thus, it is possible to vary the pre-stretching and, consequently, the load on the goods during packaging. For example, it is possible to use a very low air pressure in the start phase, when no pre-stretching is wanted, and then to increase the pressure to a high level, which results in a considerable degree of pre-stretching, when the lower portion of the goods and a loading pallet supporting the goods are to be packaged. During packaging of the upper, mechanically sensitive part of the goods a third intermediate air pressure is to be used, and the packaging is then terminated at the above-mentioned first low pressure. It is also possible to vary the pre-stretching during operation in a completely continuous manner by regulating the air pressure by means of an air-pressure reducer.

Claims

1. A method for pre-stretching a stretch film (1), in which the film (1) is caused to run on two means (3, 4), of which the front means (4) as seen in the direction of feed of the film (1) is a draw means (4) and the rear means (3) as seen in the direction of feed of the film (1) is a brake means (3), **characterised in that** a parameter, which is dependent on the tensile force (P) generated by the two means (3, 4) in the portion (11, 12) of the stretch film (1) that is located between the means (3, 4), is measured, and that the measurement result thus obtained is used to control the action of the front and rear means (3, 4) on the film (1) in such manner that said tensile force (P) is kept within a predetermined range (I).
2. A method according to claim 1, wherein the draw means (4) is a front pre-stretching roller (4) and the brake means a rear pre-stretching roller (3), of

which the front pre-stretching roller (4) is rotated at a higher peripheral speed than the rear pre-stretching roller (3), said parameter being used to control the difference between the peripheral speed of the front and rear rollers (3, 4) in such manner that said tensile force (P) is kept within the predetermined range (I).

3. A method according to claim 1 or 2, wherein said action on the stretch film (1) is controlled automatically and during operation, in such manner that said tensile force (P) is kept at a predetermined, substantially constant value (V).

4. A method according to any one of the preceding claims, wherein said parameter is measured by means of a sensing roller (7), which is arranged between the draw means (4) and the brake means (3) and abuts against the film (1), said parameter being the force exerted by the stretch film (1) on the sensing roller (7).

5. A method according to any one of the preceding claims, wherein said action on the stretch film (1) is controlled so as to maintain said tensile force (P) at a value (V), which is lower than the force corresponding to the breaking point (SB1, SB2, SB3) of the film, but higher than the force corresponding to the yield point (SF1, SF2, SF3) of the film.

6. A method according to claim 5, wherein said value (V) lies substantially within an area (Q1, Q2, Q3) on the force-elongation curve of the stretch film, where the force (P), after a slow increase, starts to rise steeply towards the breaking point (SB1, SB2, SB3).

7. A device for pre-stretching a stretch film (1), said device comprising two means (3, 4), on which the film (1) can run, the front means (4) as seen in the direction of feed of the film (1) being a draw means (4), and the rear means (3) as seen in the direction of feed of the film (1) being a brake means (3), **characterised in that** a measuring device (7, 18) is arranged to measure a parameter, which is dependent on the tensile force (P) generated by the two means (3, 4) in the portion (11, 12) of the stretch film (1) that is located between said means (3, 4), and that control means (20) are arranged to control, by means of the measurement result from the measuring device (7, 18), the action of the front and rear means (3, 4) on the film (1) in such manner that said tensile force (P) is kept within a predetermined range (I).

8. A device according to claim 7, wherein the draw means (4) is a front pre-stretching roller (4) and the brake means (3) a rear pre-stretching roller (3), of

which the front pre-stretching roller (4) is arranged to be rotated at a higher peripheral speed than the rear pre-stretching roller (3), said control means (20) being arranged to control the difference between the peripheral speed of the front and rear rollers (3, 4) in such manner that said tensile force (P) is kept within the predetermined range (I).

9. A device according to any one of claims 7-8, wherein the control means (20) are arranged to control said action of the film (1) automatically and during operation in such manner that said tensile force (P) is kept at a predetermined, substantially constant value (V).

10. A device according to any one of claims 7-9, wherein the measuring device (7, 18) comprises a sensing roller (7), which is arranged between the two means (3, 4) so as to abut against the film (1), said parameter here being the force exerted by the stretch film (1) on the sensing roller (7).

11. A device according to claim 10, wherein the sensing roller (7) is arranged to be moved against a resistance (9) by the force exerted by the film (1) on the sensing roller (7), said measuring device (7, 18) further comprising a position transducer (18), which is arranged to measure the position of the sensing roller (7).

12. A device according to claim 10, wherein the measuring device (7, 18) further comprises a pressure sensor, against which the sensing roller (7) is arranged to be pressed by means of the force exerted by the film (1) on the sensing roller (7), said pressure sensor being arranged to measure said force.

13. A device according to any one of claims 10-12, wherein the sensing roller (7) is rotatably arranged on a cover (14), which is pivotable about an axis (15) parallel to and located at a distance from the axis of the sensing roller (7), so as to move aside the sensing roller (7) and allow access to the stretch film (1).

14. A device according to claim 8, which comprises a driving motor (22), a servomotor (24) and a differential gear (28) comprising a toothed belt pulley (40) having at least one pinion (41, 42), said driving motor (22) being arranged to directly drive the front pre-stretching roller (4) by means of a shaft (23), which is non-rotatably connected to a gear wheel (36) in the differential gear (28) and extends axially through the differential gear (28), said servomotor (24) being arranged to drive, in continuously controllable manner and depending on the above parameter, the toothed belt pulley (40) of the differential gear (28), the toothed belt pulley (40) being ar-

ranged to transfer rotation to the rear pre-stretching roller (3) by means of a transmission (41, 42, 38, 29, 30).

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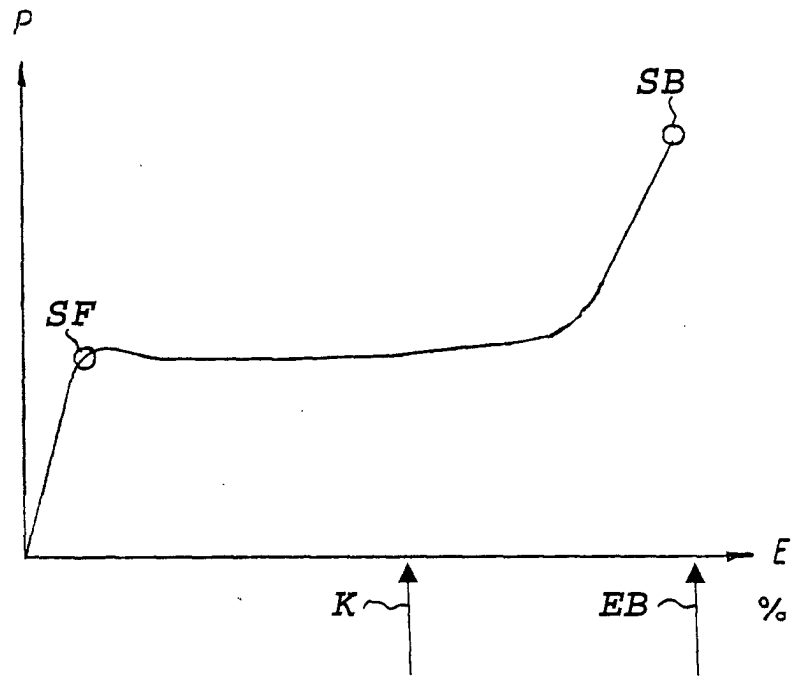


Fig 1

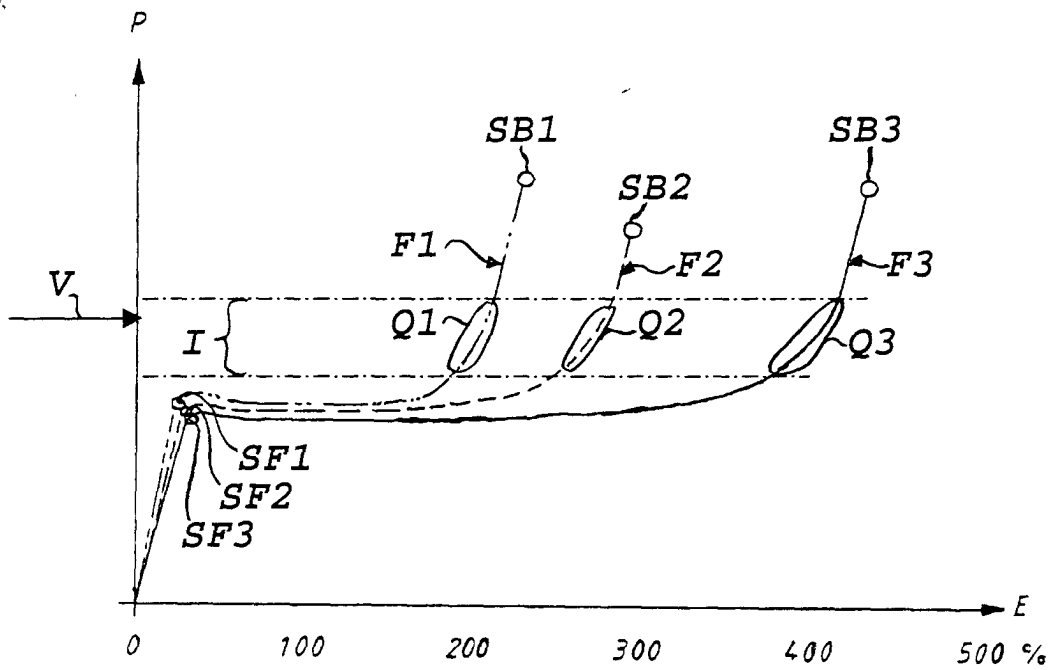


Fig 2

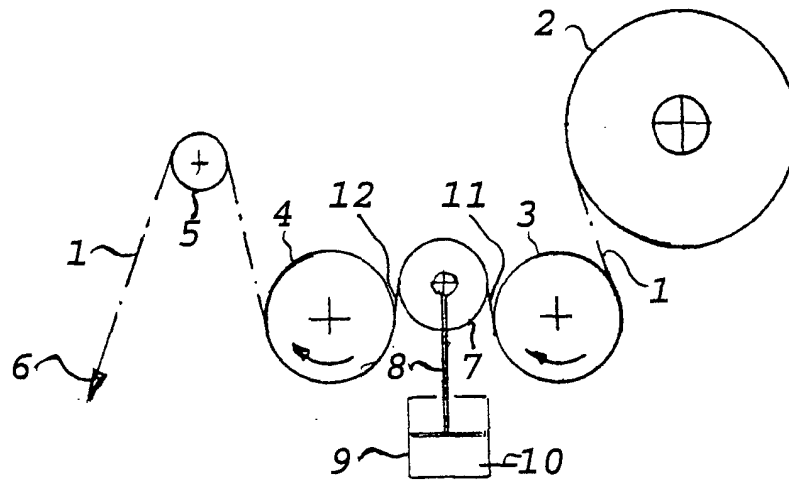


Fig 3

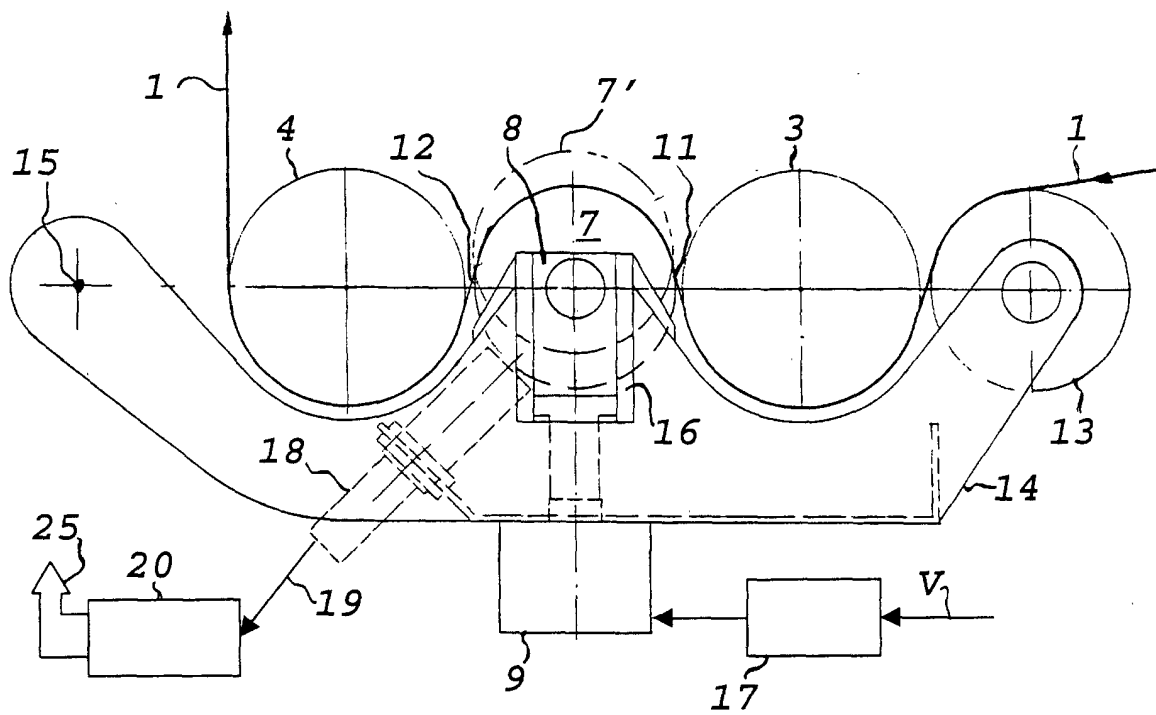


Fig 4

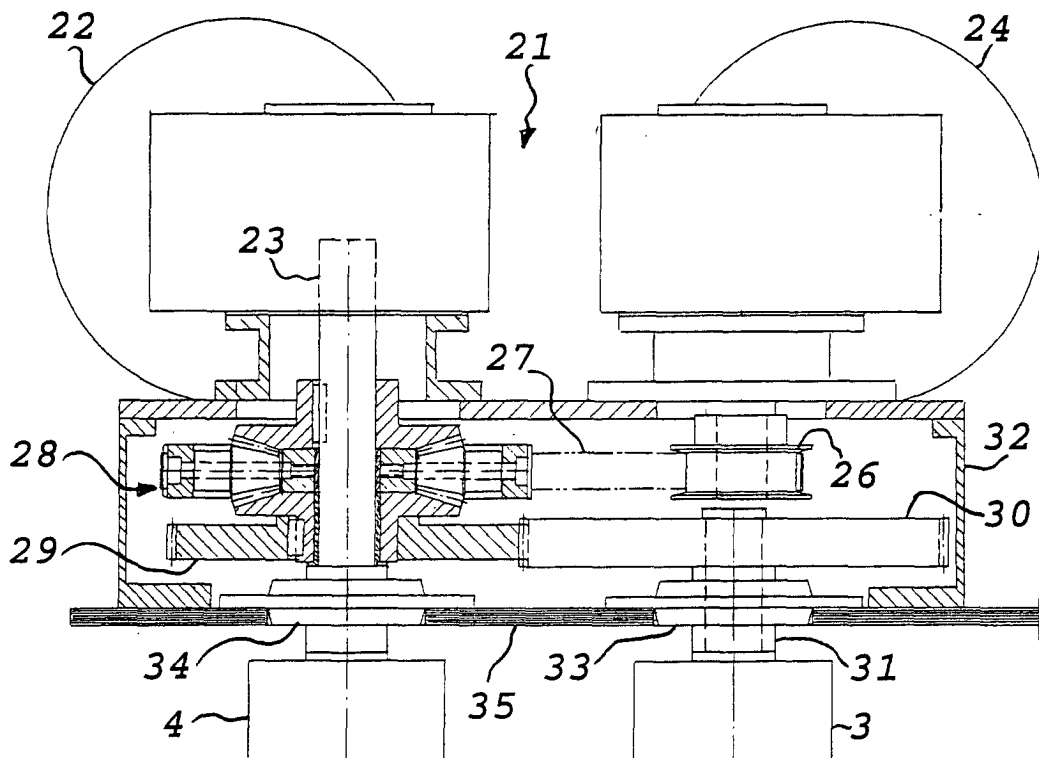


Fig 5

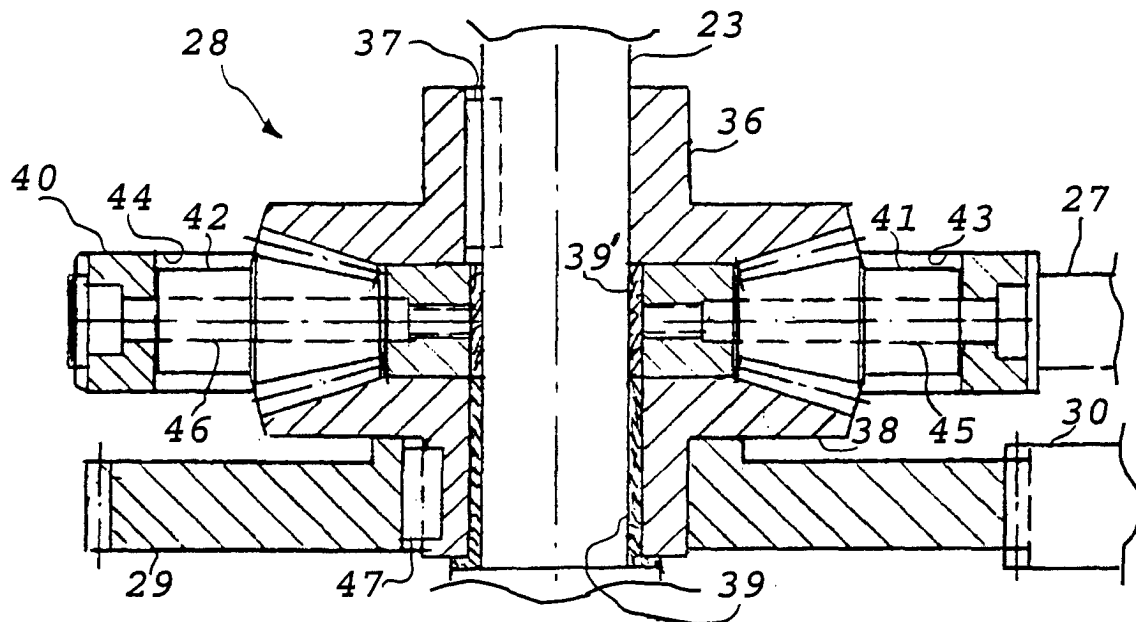


Fig 6



European Patent
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EUROPEAN SEARCH REPORT

Application Number
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			B65B B65H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 4 January 2002	Examiner Claeys, H
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

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