The invention relates to a thermo-forming packaging machine and a method for automatic adjustment of chain guides in order to be able to change over in certain sections between chain guides being aligned parallel and converging to each other so that both shrinkable as well as non-shrinkable lower films can be processed on only one thermo-forming packaging machine.
THERMO-FORMING PACKAGING MACHINE WITH ADJUSTABLE CHAIN GUIDE

CROSS-REFERENCE TO RELATED APPLICATIONS


FIELD OF THE INVENTION

[0002] The invention relates to a thermo-forming packaging machine and to a method for operating a thermo-forming packaging machine.

BACKGROUND OF THE INVENTION

[0003] A thermo-forming packaging machine is known from DE 1 586 180 which discloses manual parallel adjustment of the chain guides relative to each other to adjust the distance of the chain guides to different film widths.

[0004] DE 10 2008 016 243 A1 discloses a thermo-forming packaging machine with a chain guide in a loading stretch adjustable by using pneumatic cylinders. The adjustment is provided for relaxing the film transverse to the direction of transport in order to determine as accurately as possible the weight of the product loaded into the trays being molded into the film.

[0005] Thermo-forming packaging machines processing polypropylene (PP) films or polystyrene (PS) films as a lower film occasionally already comprise a chain guide convergingly aligned by factory provision at least immediately downstream of the forming station. This is due to the special property of PP and PS films which are heated in the forming station and into which the trays are molded, where the subsequent cooling of the PP or PS film results in shrinkage of the film by 1% to 2% width transverse to the direction of transport. Without a converging chain guide, the clamping chains disposed on both sides would as a film transport device not be able to hold the film shortened in the transverse direction. Convergence of the chain guide is designed corresponding to the film to be processed. Convergence of the chain guide is via adjustment pins connecting the chain guide to the frame adjustable to a small degree in order to be able to set a transverse tension as homogeneous as possible with respect to a type of film along the film in the direction of transport. Adjusting the transverse tension along the chain guide is difficult and requires much skill and experience, as otherwise the transverse tension is not measurable. These packaging machines have the further drawback that they can only be used for PP or PS films, since processing polyethylene terephthalate (PET), polyamide (PA), or polyethylene (PE) films require a continuous parallel chain guide as these films exhibit little or no shrinkage after the molding process. Processing such non-shrinkable films is not possible in a known thermo-forming packaging machine with an at least partially convergingly aligned chain guide.

SUMMARY OF THE INVENTION

[0006] The object of the present invention is to improve a thermo-forming packaging machine to the extent that both shrinkable films, such as PP or PS films, as well as hardly shrinkable or non-shrinkable films, such as PE, PET or PA films, can be processed.

[0007] The thermo-forming packaging machine according to one embodiment of the present invention comprises a forming station for molding trays into a lower film, a loading stretch, and a sealing station for closing the trays filled with a product with a top film, where the lower film can be transported by two clamping chains disposed on both sides of the lower film and the clamping chains are each guided in a plurality of chain guide sections of which at least one are adjustable transverse to the direction of production along one or both clamping chains. The thermo-forming packaging machine according to one embodiment is characterized in that at least one of two oppositely disposed chain guide sections is adjustable using a controller and power-operated actuators, where the two oppositely disposed chain guides are alignable optionally either parallel to each other or converging to each other. Preferably both oppositely disposed chain guide sections are adjustable converging to each other. This allows the processing of shrinkable and non-shrinkable lower films without any retooling or manual activities by the operator on the chain guide sections. The flexibility of such a thermo-forming packaging machine is thereby increased. "Converging to each other" is to be understood such that one chain guide section approaches the other, where either one chain guide section is aligned parallel to the direction of production and the other chain guide section is aligned at an angle to the direction of production, or both chain guide sections are aligned at an angle (i.e. non-parallel) to the direction of production.

[0008] The adjustable chain guide sections may be disposed downstream, in particular immediately downstream of the forming station, since the lower film shrinks in this region when cooling after and during the molding process and this film shrinkage can be compensated for by the adjustable chain guide sections.

[0009] The actuators can comprise pneumatic cylinders, lifting spindle drives or servo motors in order to be able to first receive a transverse tension and secondly to be able to perform other flexible adjustments of the chain guide sections.

[0010] At least one lifting stroke limiter by way of an adjustable stop position can be provided when employing of pneumatic cylinders. The adjustable stop position may be provided in or on the pneumatic cylinder. For example, a lifting limiter can be effected by one or two stop switches that detect the position of the piston in a non-contact manner through the housing.

[0011] In one embodiment, an adjustment range of up to 12 mm is provided for the actuators in order to be able to process both shrinkable and non-shrinkable films as well as different film widths.

[0012] A plurality of successive chain guide sections can be adjustable in the direction of production in order to be able to achieve an evenly converging course of a chain guide along a longer stretch.

[0013] In one embodiment, the controller is configured to store the position of the actuators in recipes and to adjust the adjustable chain guide sections accordingly when changing recipes so that the thermo-forming packaging machine comprises automatic chain guide adjustment.

[0014] Sensors may be provided to detect transverse tension, transverse to the direction of production, which acts via
the lower film upon the adjustable chain guide sections, in order to adjust the actuators or the chain guide sections, respectively, automatically such that a predetermined transverse tension along the entire chain guidance can in the thermo-forming packaging machine be set in a controlled manner. Wrinkling of the lower film can thereby be avoided.

[0015] In an alternative embodiment, the controller is configured to perform the adjustment of the chain guide sections in dependence on the power input of a transport drive of the clamping chains. This is a simple structural design, because information about current or power input is with servo drives given at the servo control card and is also readable by the controller. By using a formula, a factor, or a table, the translation to an average transverse tension can be performed in the controller.

[0016] A method according to the invention for operating a thermo-forming packaging machine, which in the direction of production can include consecutively a forming station for molding trays into a lower film, a loading stretch, and a sealing station for closing the trays filled with a product with a top film, where the lower film is transported by two clamping chains disposed on both sides of the lower film and the clamping chains are each guided in a plurality of chain guide sections of which at least some are along one or both clamping chains adjustable transverse to the direction of production, provides a controller. This controller may adjust at least one of two oppositely disposed chain guide sections by use of power-operated actuators, so that the two oppositely disposed chain guides are brought from an orientation that is parallel to each other into one that is converging to each other. Adjustment of the chain guide is thereby possible automatically between chain guides that are aligned parallel to each other and that are oriented converging to each other, and both shrinkable as well as non-shrinkable lower films can be processed on such a thermo-forming packaging machines.

[0017] Adjustment of the chain guide sections by use of the controller can be preformed in dependence on the transverse tension of the lower film acting upon the chain guide sections.

[0018] The transverse tension can be determined by sensors or alternatively indirectly via the power input of the transport drive of the clamping chains.

[0019] A range for the transverse tension to be set may be entered in the controller and stored there so as to allow automatic adjustment of the chain guide sections when changing from a shrinkable to a non-shrinkable lower film.

[0020] Other and further objects of the invention, together with the features of novelty appurtenant thereto, will appear in the course of the following description.

DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0021] In the accompanying drawing, which forms a part of the specification and is to be read in conjunction therewith in which like reference numerals are used to indicate like or similar parts in the various views:

[0022] FIG. 1 is a schematic plan view of a thermo-forming packaging machine with chain guides set in parallel in accordance with one embodiment of the present invention.

[0023] FIG. 2 is a schematic plan view of a thermo-forming packaging machine with partially converging set chain guides for the same film width as in FIG. 1 in accordance with one embodiment of the present invention;

[0024] FIG. 3 is a schematic plan view of a thermo-forming packaging machine with chain guides set in parallel in accordance with one embodiment of the present invention;

[0025] FIG. 4 is a schematic plan view of a thermo-forming packaging machine with partially converging set chain guides for a film width differing from FIG. 3 in accordance with one embodiment of the present invention;

[0026] FIG. 5 is a schematic view of the adjustable chain guide of FIG. 2, and

[0027] FIG. 6 is an enlarged section view of the adjustable chain guide from FIG. 5 in the direction of production.

[0028] Same components are throughout the figures designated with the same reference numerals.

DETAILED DESCRIPTION OF THE INVENTION

[0029] The invention will now be described with reference to the drawing figures, in which like reference numerals refer to like parts throughout. For purposes of clarity in illustrating the characteristics of the present invention, proportional relationships of the elements have not necessarily been maintained in the drawing figures.

[0030] The following detailed description of the invention references specific embodiments in which the invention can be practiced. The embodiments are intended to describe aspects of the invention in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments can be utilized and changes can be made without departing from the scope of the present invention. The present invention is defined by the appended claims and the description is, therefore, not to be taken in a limiting sense and shall not limit the scope of equivalents to which such claims are entitled.

[0031] FIG. 1 schematically shows a thermo-forming packaging machine 1 according to the invention with a forming station 2 for molding trays 3 into a lower film 4, a sealing station 5 for sealing a top film 40—shown in broken lines—onto the lower film 4, and a cutting station 6 for separating the packages 7. In a direction of production R downstream of the forming station 2, a loading stretch 8 can be provided which extends to the sealing station 5. Products 30 are manually or automatically loaded into the trays 3 along the loading stretch 8.

[0032] The thermo-forming packaging machine 1 comprises a machine frame 9 with two side frames 10 extending on both sides along the direction of production R. A chain guide is provided on each side frame 10 and each can comprise a plurality of chain guide sections 11. They can guide one clamping chain 12—in FIG. 1 only indicated schematically—for each side frame 10 for grasping the lower film 4, unwinding it from a film roll 13, and transporting it in the direction of production R through the thermo-forming packaging machine 1 by use of a common transport drive 14. In one embodiment, the lower film 4 has a film width A and is made, for example, of PE, PA, or PET. For processing or transporting these lower films 4, the chain guide sections 11 on both sides are aligned parallel to each other and thereby ensure generally even transverse tension F of the lower film 4 at the chain guides, and the lower film 4 can be transported through the thermo-forming packaging machine 1 without wrinkles.

[0033] The inventive thermo-forming packaging machine 1 is shown in FIG. 2 having convergently set chain guide sections 11. The lower film 4 has the same original film width A as shown in FIG. 1, but the lower film 4 is in the present case made of PS or PP. Since the lower film 4 may be for thermo-
forming greatly heated in the forming station 2, the lower film 4 cools down after the molding process and the film undergoes shrinkage of between approximately 1% to 2%. This leads to a reduction of the film width A and also to a reduction of the dimensions of the trays 3 themselves both transverse to and along the direction of production R.

[0034] The transverse tension F, increased due to the reduced film width A, can firstly lead to the clamping chains 12 in parallel oriented chain guides, as shown in FIG. 1, no longer being able to hold and thereby no longer being able to transport the lower film 4. Secondly, wrinkling of the lower film 4 can occur when the transverse tension F becomes too great. To counteract these problems, the chain guide sections 11 can be, at least in the region of the loading stretch 8, set converging or conical to each other so as to compensate for the shrinkage of the lower film 4 transverse to the direction of production R. The term “converging” is defined such that, as shown in FIG. 2, the chain guides, being oppositely disposed when viewed in the direction of production R, can approach their distance B in the direction of production to become a distance B'. The chain guide sections 11 are in the lower film transport plane at an angle relative to one another or the chain guide tapers as a whole, respectively. It is also conceivable, however, that only the chain guide sections 11 from one side are at an angle to the other and therefore both oppositely disposed chain guide sections 11 are at an angle to one another and are therewith also aligned convergingly.

[0035] The converging course of the chain guide may be provided in the region in which the lower film 4 undergoes shrinkage. In the regions following downstream in which there is no further shrinkage of the lower film 4, the chain guide sections 11 can be again aligned parallel to one another and have a distance B' that is reduced in accordance with shrinkage.

[0036] Since the trays (or troughs) 3, due to shrinkage of the lower film 4, also experience a change in their dimensions to become slightly smaller trays 3', the tools of the sealing station 5 and the cutting station 6 may be adjusted to the trays 3. A controller 16, can be provided in or on a controller cabinet 15 to control the actuators 17—shown in more detail in FIGS. 5 and 6—in order to adjust the chain guide sections 11 accordingly. For this purpose, the adjustment positions of all actuators 17 can be stored in the controller 16 and associated to programs or recipes. The actuators 17 and their direction of motion are shown in FIG. 2 schematically by black arrows. When changing films between shrinkable and non-shrinkable lower films 4, the thermo-forming packaging machine 1 may be adjusted automatically. The chain guide sections 11 can be adjusted such that there is always an optimal transverse tension F given during the transport of the lower film 4.

[0037] FIGS. 3 and 4 show a variant in which the thermo-forming packaging machine 1 processes various film widths C, D with the lower film 4 being of different film material. In FIG. 3, the lower film 4 is, for example, a film made of PE, PA, or PET (i.e., non-shrinkable film) having a film width C. In FIG. 4, the lower film 4 is, for example, a film made of PS, or PP (i.e., shrinkable film) having a film width D, where film width D is greater than film width C. When converting from non-shrinkable lower film 4 with chain guide sections 11 aligned parallel to each other (FIG. 3) to a broader, shrinkable lower film 4 (FIG. 4), the chain guide sections 11 can be adjusted by the controller 16 using the actuators 17. In contrast to FIG. 2, the chain guide sections 11 are, in the region of the loading stretch 8 and upstream in the forming station 2 and upstream thereof, adjusted outwardly to accommodate the new, wider lower film 4 and transport it with optimal transverse tension F and without wrinkles.

[0038] FIG. 5 shows an enlarged section of FIG. 2 in the region of the dashed line. The clamping chain 12 is guided in the chain guide sections 11 and holds the lower film 4. The actuators 17 may be mounted to the side frame 9 and connected to one end of a chain guiding section 11. Each adjustable chain guide section 11 can comprise one respective actuator 17 at each end. The actuator 17 is shown schematically in FIG. 5 as a pneumatic cylinder. Actuator 17, however, can in FIGS. 1-5 comprise a servo motor or a lifting spindle drive or the like. A sensor 18 can optionally be provided between actuator 17 and the chain guide section 11 and measure the tension stress corresponding to the transverse tension F. Sensor 18 may be connected to controller 16 in order for the controller 16 to be able to adjust the actuators 17 such that all adjustable chain guide sections 11 are set such that an even transverse tension F acts upon lower film 4 long the direction of production R.

[0039] FIG. 6 shows a sectional view of FIG. 5 in the direction opposite to the direction of production R. The pneumatic cylinder of actuator 17 can comprise two adjustable stop switches 19 attached to the outer side via which the stroke of the piston 20 is limited. Sensor 18 may be provided at the piston end and in turn connected to the chain guide section 11. The clamping chain 12 can comprise clamps 21a and 21b clamping the lower film 4. The clamping force may be generated by a spring 22.

[0040] Alternatively, the adjustable stop position 19 can also be provided as a set screw at one or both face ends of the pneumatic cylinder 17. When employing a lifting spindle drive, a linear drive or a servo drive as an actuator, mechanically adjustable stop positions 19 can be omitted and the position of the chain guide sections 11 or the position of the actuator 17, respectively, can be transmitted to the controller 16 using a position measuring system. Controller 16 can in turn perform the adjustment of the actuators 17 without an operator.

[0041] The material specification for films such as PP, PS, PE, PET or PA films does not constitute any restriction to in particular these films, but they are merely films that are very common in the market.

[0042] From the foregoing, it will be seen that this invention is one well adapted to attain all the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure. It will be understood that certain features and sub combinations are of utility and may be employed without reference to other features and sub combinations. This is contemplated by and is within the scope of the claims. Since many possible embodiments of the invention may be made without departing from the scope thereof, it is also to be understood that all matters herein set forth or shown in the accompanying drawings are to be interpreted as illustrative and not limiting.

[0043] The constructions and methods described above and illustrated in the drawings are presented by way of example only and are not intended to limit the concepts and principles of the present invention. Thus, there has been shown and described several embodiments of a novel invention. As is evident from the foregoing description, certain aspects of the present invention are not limited by the particular details of the examples illustrated herein, and it is therefore contem-
plated that other modifications and applications, or equivalents thereof, will occur to those skilled in the art. The terms "having" and "including" and similar terms as used in the foregoing specification are used in the sense of "optional" or "may include" and not as "required". Many changes, modifications, variations and other uses and applications of the present construction will, however, become apparent to those skilled in the art after considering the specification and the accompanying drawings. All such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by the invention which is limited only by the claims which follow.

What is claimed is:

1. Thermo-forming packaging machine comprising: a forming station for molding trays into a lower film; a loading stretch; a sealing station for closing said trays filled with product with a top film; clamping chains disposed on both sides of said lower film for transporting said lower film; chain guide sections for guiding said clamping chains; and a controller and power-operated actuator for adjusting at least one said chain guide section transverse to a direction of production.

2. Thermo-forming packaging machine according to claim 1, wherein two oppositely disposed said chain guide sections are adjustable to converge to each other.

3. Thermo-forming packaging machine according to claim 1, wherein said chain guide sections are disposed downstream of said forming station.

4. Thermo-forming packaging machine according to claim 1, wherein said actuator comprises at least one of a pneumatic cylinder, a lifting spindle drive, and a servo motor.

5. Thermo-forming packaging machine according to claim 1, wherein said actuator comprises a pneumatic cylinder and at least one lifting stroke limiter is provided by one adjustable end position.

6. Thermo-forming packaging machine according to claim 1, wherein said adjustable end position is provided in or at said pneumatic cylinder.

7. Thermo-forming packaging machine according to claim 1, wherein an adjustment range for said actuator is provided of up to 12 mm.

8. Thermo-forming packaging machine according to claim 1, wherein a plurality of said chain guide sections disposed consecutively in the direction of production are adjustable.

9. Thermo-forming packaging machine according to claim 1, wherein said controller is configured to store a position of said actuator in recipes and to adjust said chain guide sections accordingly when recipes are changed.

10. Thermo-forming packaging machine according to claim 1 further comprising sensors to detect tension stress transverse to the direction of production.

11. Thermo-forming packaging machine according to claim 10, wherein said sensors are each disposed between an actuator and a chain guide section.

12. Thermo-forming packaging machine according to claim 1, wherein said controller is configured to perform the adjustment of said chain guide sections in dependence on a power input of a transport drive of said clamping chains.

13. Method for operating a thermo-forming packaging machine, said method comprising the steps of: providing said thermo-forming packaging machine that comprises consecutively in the direction of production: a forming station for molding trays into a lower film; a loading stretch; and a sealing station for closing said trays filled with product with a top film; transporting said lower film by two clamping chains disposed on both sides of said lower film; guiding said clamping chains in a plurality of chain guide sections, wherein at least one said chain guide section is adjustable transverse to a direction of production; and adjusting at least one of two oppositely disposed said chain guide sections by use of a controller and power-operated actuator so that said two oppositely disposed chain guide sections are brought from an orientation that is generally parallel to each other into an orientation that is converging to each other.

14. Method according to claim 13, wherein said step of adjusting at least one said chain guide section is performed by said controller in dependence of a transverse tension of said lower film acting upon said chain guide sections.

15. Method according to claim 14, wherein said transverse tension is detected using at least one sensor.

16. Method according to claim 14, wherein said transverse tension is detected indirectly via a power input of a transport drive of said clamping chains.

17. Method according to one of the claim 14, wherein a range for said transverse tension to be set is entered and stored in said controller.