

FILM STRETCHING APPARATUS

FIELD OF THE INVENTION

The invention relates to stretched films and more particularly to an improved
5 apparatus for suitably stretching a plastic film used for wrapping a load on, for example, a pallet.

BACKGROUND OF THE INVENTION

Conventionally, an employee of a freight company may use one or more
10 fastening members to secure a load prior to shipping. Otherwise, the goods to be transported may be damaged due to collision. Thus, the transportation cost can also be reduced. As shown in FIG. 1, typically, goods 520 are placed on a pallet (not numbered) and a stretched film 514 is wrapped around the goods 520 prior to shipping. The stretched film 514 is transparent and is made of LLDPE (linear low
15 density polyethylene). An adhesive layer (not shown) is formed on an inner surface of the stretched film 514. For packaging the goods 520 of different sizes, an employee of a freight company manually stretches the stretched film 514 to put on the goods 520 with the adhesive layer of the stretched film 514 adhered around a surface of the packed goods 520. The goods 520 are thus secured by the adhesive layer as the
20 stretched film 514 shrinks. As such, the goods 520 are packaged so as to prevent the goods 520 from being stolen easily.

It is known that the stretched film is stretchable and is robust in nature. The stretched film can be stretched about 3.5 times of its length. The stretched film can be broken only when the stretched film has been stretched beyond its limit with its
25 thickness being greatly reduced. The purpose of stretching the stretched film by an employee of a freight company is to not only wrap and secure the packed goods but also increase the effective length of the stretched film per roll, i.e., reducing the cost of

stretched film. Typically, a stretched film has a thickness of about 20 micron. The thickness of the stretch film can be decreased to about 18 micron after manually stretching. Thus, the above purposes of increasing the effective length of the stretched film per roll and reducing the cost of stretched film are generally not
5 achieved. The stretched film can lose its resilience due to vibration and jarring of the goods in the shipping even when the stretched film has not stretched to its predetermined limit. As an end, the goods secured by the stretched film are loose or disengaged.

For overcoming the above drawback, some producers of the stretched film
10 propose to pre-stretch the film of a roll to an extent within a breaking point of the stretched film (e.g., the film stretched to have a thickness about 10 micron) prior to winding a stretched film on a roll. This has the benefits of increasing the effective length of the stretched film per roll and reducing the cost of stretched film. Further, it can reduce time and labor of an employee of a freight company to manually stretch a
15 film, resulting in an improvement of the packaging process by means of stretched film.

A well known film stretching apparatus 500 is schematically shown in FIG. 2 and comprises sequentially an upstream supply roller 501, a plurality of drive rollers 502, and a downstream take-up roller 503. A film 504 is wound up on the supply roller 501. The rotatable drive rollers 502 are arranged in parallel relationship each other in the
20 film stretching apparatus 500. An idler roller 505 is provided between any two adjacent drive rollers 502. The drive rollers 502 are driven at different speeds. For example, the first drive roller 502 closest the supply roller 501 has a speed less than the second drive roller 502 in the downstream relative to the first drive roller 502. The second drive roller 502 close the first drive roller 502 has a speed less than the third drive
25 roller 502 in the downstream relative to the second drive roller 502. The third drive roller 502 close the second drive roller 502 has a speed less than the fourth drive roller 502 in the downstream relative to the third drive roller 502. That is, the drive

roller 502 closest the supply roller 501 has a lowest speed and the drive roller 502 closest the take-up roller 503 has a highest speed among the drive rollers 502. In the film stretching process, a film 504 is continuously delivered from the supply roller 501 to frictionally engage with surfaces of the next drive roller 502 and the adjacent idler roller 505 in the downstream in one phase of the stretching process wherein the film 504 engages with an upper arc portion of the drive roller 502 and a lower arc portion of the idler roller 505. This has the effect of guiding and stretching the film 504 being conveyed. Thus, the film 504 is stretched and tightened. In detail, the drive rollers 502 of different speeds are adapted to stretch the film 504 between the supply roller 501 and the take-up roller 503. As a result, after passing the drive rollers 502, the film 504 is stretched to form a stretched film 504 as it is wound up on the rotating take-up roller 503 at the end of the stretching process.

The film stretching apparatus 500 thus can achieve the purposes of increasing the effective length of the stretched film per roll, reduce the cost of stretched film, and reduce time and labor of an employee of a freight company to manually stretch the stretched film. However, the stretch film produced by the well known film stretching apparatus suffered from several disadvantages which really bother the stretched film producers and also employees of a freight company. These disadvantages are detailed below.

i) Width of the film is reduced after being stretched. For example, a film having a width of 500 mm can be stretched to have a width of 300 mm. This can significantly reduce the area of the goods adhered and secured by the stretched film.

ii) Wrinkles are formed on the surface of the film after being stretched due to permanent elastic deformation of the plastic film. This in turn decreases the transparency of the stretched film. As a result, the external appearance of the goods fastened by the stretched film is adversely detracted and to the worse, it can cause difficulties in shipping.

iii) An employee of a freight company has to manually repeatedly unwind the film from the supply roller, pass the film through the roller, the next idler roller, and the next roller arranged as V, and finally wind up on the take-up roller. Next, the stretching process begins. This is however a time consuming and labor intensive process.

5 Further, it does not comply with ergonomics.

The well known film stretching apparatus can reduce the cost of stretched film. However, it also brings much inconvenience to the employees of a freight company. Thus, it is desirable to provide a novel film stretching apparatus in order to eliminate the above drawbacks of the produced stretched film.

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SUMMARY OF THE INVENTION

After considerable research and experimentation, a film stretching apparatus according to the invention has been devised so as to overcome the above drawbacks (including width of the film reduced after being stretched, resulting in a significant
15 reduction of the area of the goods adhered and secured by the stretched film, wrinkles formed on the surface of the stretched film, resulting in a decrease of the transparency of the stretched film, an external appearance of the goods fastened by the stretched film being adversely detracted, and causing difficulties in shipping, and an employee of a freight company having to manually repeatedly unwind the film from the supply
20 roller, pass the film through the roller, the next idler roller, and the next roller arranged as V, and finally wind up on the take-up roller prior to stretching which is a time consuming and labor intensive process and it does not comply with ergonomics) of the conventional film stretching apparatus.

It is an object of the invention to provide a film stretching apparatus comprising an
25 upstream supply roller and a downstream take-up roller. A heating zone, a stretching zone, and a cooling zone are sequentially provided between the supply roller and the take-up roller. At least one first drive roller and a plurality of heater rollers are

sequentially provided in the heating zone. A plurality of cooling rollers and at least one second drive roller are sequentially provided in the cooling zone. The film stretching apparatus further comprises at least one retractably extended first idler roller, at least one retractably extended second idler roller, and at least one retractably extended third idler roller. Each first idler roller is adapted to dispose either between any two adjacent heater rollers or between one heater roller and one first drive roller, each second idler roller is adapted to dispose in the stretching zone, and each third idler roller is adapted to dispose either between any two adjacent cooling rollers or between one cooling roller and one second drive roller in operation. Further, the rollers in the cooling zone have a rotating speed greater than the rollers in the heating zone. Prior to stretching a film by the film stretching apparatus, a film is continuously delivered from the supply roller to sequentially pass the rollers in the heating zone and the rollers in the cooling zone until being wound up on the take-up roller. Next, extend the first, second, and third idler rollers to be frictionally engaged with the passing film. Thereafter, the film stretching process can begin. In the process, the film is heated and softened by the heater rollers. There is a speed difference between the rollers in the cooling zone and the rollers in the heating zone since the rollers in the cooling zone have a rotating speed greater than the rollers in the heating zone. The speed difference will stretch the film in the stretching zone as the film is conveying toward the take-up roller. As such, the film is flattened with its length being prolonged uniformly. Next, the flattened film has its shaped being fixed by being cooled by the cooling roller. Finally, the stretched film with shape being fixed is wrapped up on the take-up roller. By utilizing this film stretching apparatus, the produced stretched film can maintain its original width and transparency with its length being prolonged a predetermined percentage as compared with the original film.

The above and other objects, features and advantages of the invention will become apparent from the following detailed description taken with the accompanying

drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a conventional stretched film secured to the goods
5 by wrapping therearound;

FIG. 2 is a schematic illustration of a conventional film stretching apparatus;

FIG. 3 is a schematic illustration of a first preferred embodiment of film stretching
apparatus according to the invention;

FIG. 4 is a schematic perspective view of the roller shown in FIG. 3; and

10 FIG. 5 is a schematic illustration of a second preferred embodiment of film
stretching apparatus according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 3, a film stretching apparatus in accordance with a first preferred
15 embodiment of the invention is shown. The apparatus is mounted in a housing 1.
Within the housing 1 there are provided an upstream supply roller 10 and a
downstream take-up roller 50. The supply roller 10 is adapted to deliver a wound film
70 to be stretched. The stretched film 70 is finally wound up on the take-up roller 50. A
heating zone 20, a stretching zone 30, and a cooling zone 40 are sequentially
20 provided between the supply roller 10 and the take-up roller 50. A first drive roller 21
and a plurality of heater rollers 22 are sequentially provided in the heating zone 20. A
plurality of cooling rollers 42 and a second drive roller 43 are sequentially provided in
the cooling zone 40. Surfaces of the first and second drive rollers 21 and 43 are
formed of a material of high friction (e.g., rubber) such that the film 70 frictionally
25 engaged therewith can be forwarded. Further, as shown in FIG. 4, a plurality of
knurled portions 211 are formed on the surfaces of the first and second drive rollers 21
and 43 and are adapted to escape air between the film 70 being stretched and each of

the first and second drive rollers 21 and 43. As a result, the film 70 can be forwarded smoothly. The activated heater rollers 22 are adapted to generate high heat which is dissipated from surfaces of the heater rollers 22 to heat and thus soften the film 70. To the contrary, the activated cooling rollers 42 are adapted to cool air therearound. Thus, the passing film 70 is cooled by the cooling rollers 42 so that the film 70 can be fixed in shape prior to wrapping up on the take-up roller 50.

Referring to FIG. 3 again, a first bracket 601, a second bracket 602, a third bracket 603, and a fourth bracket 604 are provided at one side of the housing 1. A first idler roller 61 retractably extended from the first bracket 601 is provided between the first drive roller 21 and the heater rollers 22 in an operating position. Another first idler roller 61 retractably extended from the first bracket 601 and parallel with the above one first idler roller 61 is provided between the heater rollers 22 in an operating position. Two parallel second idler rollers 62 retractably extended from the second bracket 602 are provided in the stretching zone 30 in an operating position. Also, the second idler rollers 62 are disposed between the closest one of the heater rollers 22 and the closest one of the cooling rollers 42. A third idler roller 63 retractably extended from the third bracket 603 is provided between the cooling rollers 42 in an operating position. Another third idler roller 63 retractably extended from the third bracket 603 and parallel with the above third idler roller 63 is provided between the cooling rollers 42 and the second drive roller 43 in an operating position. A fourth idler roller 64 is retractably extended from the fourth bracket 604 to be rotatably, frictionally engaged with the second drive roller 43 in an operating position as detailed below.

Referring to FIG. 3 again, prior to stretching a film by the film stretching apparatus, a film 70 is continuously delivered from the supply roller 10 to wavyly pass the first drive roller 21, the heater rollers 22, the cooling rollers 42, and the second drive roller 43 until being wound up on the take-up roller 50. Next, extend the first, second, third, and fourth idler rollers 61, 62, 63, and 64 toward and proximate the first drive roller 21,

the heater rollers 22, the stretching zone 30, and the cooling rollers 42 respectively wherein one first idler roller 61 is disposed between the first drive roller 21 and the closest heater roller 22 to frictionally engage with the film 70, and the other first idler roller 61 is disposed between the heater rollers 22 to frictionally engage with the film 70 so as to increase a contact area of the film 70 with the first drive roller 21 and the heater rollers 22. Also, the second idler rollers 62 are disposed in the stretching zone 30 to frictionally engage with the film 70 so as to flatten the passing film 70. Further, a third idler roller 63 is disposed between the cooling rollers 42 to frictionally engage with the film 70, and the other third idler roller 63 is disposed between the second drive roller 43 and the closest cooling roller 42 to frictionally engage with the film 70 so as to increase a contact area of the film 70 with the second drive roller 43 and the cooling rollers 42. Furthermore, the fourth idler roller 64 is frictionally engaged with the second drive roller 43 with the film 70 passing therebetween so as to flatten the film 70.

The cooling rollers 42 and the second drive roller 43 in the cooling zone 40 have a speed (i.e., rotating speed) greater than the first drive roller 21 and the heater rollers 22 in the heating zone 20 in operation. With respect to the cooling rollers 42 and the second drive roller 43 in the cooling zone 40, the closer of the rollers 42 and 43 relative to the take-up roller 50 the greater of the speed thereof will be. Such design aims at suitably stretching the film 70 passing the cooling rollers 42 and the second drive roller 43. Otherwise, the passing film 70 may slacken between the cooling rollers 42 and between the second drive roller 43 and the proximate cooling roller 42 respectively. Similarly, with respect to the heater rollers 22 and the first drive roller 21 in the heating zone 20, the closer of the rollers 22 and 21 relative to the stretching zone 30 the greater of the speed thereof will be. Such design aims at suitably stretching the film 70 passing the heater rollers 22 and the first drive roller 21. Otherwise, the passing film 70 may slacken between the heater rollers 22 and

between the first drive roller 21 and the proximate heater roller 22 respectively.

High heat generated by the heater rollers 22 can evenly heat molecules of the film 70 passing the heater rollers 22 by contacting. As a result, the film 70 is softened. It is designed that the cooling rollers 42 and the second drive roller 43 in the cooling zone 40 have a speed greater than the heater rollers 22 and the first drive roller 21 in the heating zone 20. As such, a speed difference between the rollers in the cooling zone 40 and the rollers in the heating zone 20 can stretch the film 70 in the stretching zone 30 conveying toward the take-up roller 50. The stretching in the stretching zone 30 is facilitated since the film 70 has been softened by the heater rollers 22. As a result, the film 70 is more uniformly flat with the length thereof being increased. The hot softened film 70 then passes and frictionally contacts surfaces of the cooling rollers 42 to be suddenly cooled by the low temperature of the surfaces of the cooling rollers 42. As a result, the resiliently deformed film 70 is fixed in shape in order to prevent the stretched film 70 from returning to its original shape and length. Finally, the stretched film 70 is wound up on the take-up roller 50. By evenly heating, stretching, and cooling the film 70, the produced stretched film 70 can maintain its original width and transparency with its length being prolonged a predetermined percentage as compared with the original film 70.

The heater rollers 22 are hollow cylinders and one kind of liquid having a high heat transfer coefficient (e.g., oily liquid) 221 is filled in the heater rollers 22. The cooling rollers 42 are hollow cylinders and another kind of liquid having a high heat transfer coefficient (e.g., water) 421 is filled in the cooling rollers 42. Liquid 221 in the heater rollers 22 is heated when the film stretching apparatus is activated. And in turn, the surfaces of the heater rollers 22 are heated by the hot liquid 221 due to convection. Also, liquid 421 in the cooling rollers 42 is cooled when the film stretching apparatus is activated. And in turn, the surfaces of the cooling rollers 42 are cooled by the cold liquid 421 due to convection.

Referring to FIG. 3 again, in the above embodiment, dew may appear on the cool surfaces of the cooling rollers 42 and dew can adversely affect the passing of the film 70 on the surfaces of the cooling rollers 42 by contacting. This problem can be solved by referring to a second preferred embodiment of film stretching apparatus according to the invention illustrated in FIG. 5. The characteristics of the second preferred embodiment are detailed below. As illustrated, at least one third drive roller 23 is provided in the heating zone 20 between the stretching zone 30 and the heater roller 22 proximate the stretching zone 30. The third drive roller 23 serves to stably convey the softened film 70. Also, the third drive roller 23 has a speed greater than the proximate heater roller 22. Moreover, another first idler roller 61 retractably extended from the first bracket 601 is provided between the third drive roller 23 and the proximate heater roller 22 to be frictionally engaged with the softened film 70 in an operating position. Further, the third drive roller 23 is rotatably engaged with the proximate second idler roller 62. As a result, the second idler roller 62 and the third drive roller 23 co-rotate and have the same speed. Likewise, at least one fourth drive roller 41 is provided in the cooling zone 40 between the stretching zone 30 and the cooling roller 42 proximate the stretching zone 30. The fourth drive roller 41 serves to stably convey the softened film 70 to the cooling roller 42 proximate the stretching zone 30. Also, the fourth drive roller 41 has a speed less than the proximate cooling roller 42. Moreover, another third idler roller 63 retractably extended from the third bracket 603 is provided between the fourth drive roller 41 and the proximate cooling roller 42 to be frictionally engaged with the softened film 70 in an operating position. Further, the fourth drive roller 41 is rotatably engaged with the proximate second idler roller 62. As a result, the second idler roller 62 and the fourth drive roller 41 co-rotate and have the same speed. Surfaces of the third and fourth drive rollers 23 and 41 are formed of a material of high friction (e.g., rubber) such that the film 70 frictionally engaged therewith can be forwarded. Further, as shown in FIG. 4, a plurality of

knurled portions 211 are formed on the surfaces of the second and fourth drive rollers 23 and 41 and are adapted to escape air between the film 70 being stretched and each of the second and fourth drive rollers 23 and 41. As such, the film 70 can be forwarded smoothly. By providing the second and fourth drive rollers 23 and 41, the film 70 can be conveyed from the heating zone 20 to the cooling zone 40 in a more smooth and stable way.

The speed difference between rollers is discussed in detailed below. Referring to FIG. 3 again, a first drive roller 21 and two heater rollers 22 are provided in the heating zone 20 and two cooling rollers 42 and a second drive roller 43 are provided in the cooling zone 40 respectively. The cooling roller 42 proximate the take-up roller 50 and the second drive roller 43 has a speed increase ratio of 3% and 6% relative to the cooling roller 42 distal the take-up roller 50. For example, the cooling roller 42 proximate the take-up roller 50 has a speed of 72.1 RPM (revolutions per minute) and the second drive roller 43 has a speed of 76.4 RPM respectively if the cooling roller 42 distal the take-up roller 50 has a speed of 70 RPM. Likewise, the first drive roller 21 and the heater roller 22 proximate the supply roller 10 has a speed decrease ratio of -6% and -3% relative to the heater roller 22 distal the supply roller 10. For example, the heater roller 22 proximate the supply roller 10 has a speed of 38.8 RPM and the first drive roller 21 has a speed of 36.4 RPM respectively if the heater roller 22 distal the supply roller 10 has a speed of 40 RPM. As such, a speed difference between any two adjacent ones of the first drive roller 21 and the heater rollers 22 in the heating zone 20, a speed difference between any two adjacent ones of the cooling rollers 42 and the second drive roller 43 in the cooling zone 40, and a speed difference between the rollers in the cooling zone 40 and the rollers in the heating zone 20 together can stretch the film 70 in the stretching zone 30 conveying toward the take-up roller 50. Moreover, average speeds of the rollers in the heating zone 20 and the cooling zone 40 can be adjusted depending on the desired stretched length of the film 70. It is

designed that the average speed of the rollers in the cooling zone 40 is greater than that of the rollers in the heating zone 20.

As shown in FIG. 5, the first drive roller 21, the heater rollers 22, and the third drive roller 23 in the heating zone 20 can rotate at the same speed which is less than
5 the speed of any of the fourth drive roller 41, the cooling rollers 42, and the second drive roller 43 in the cooling zone 40 in operation. Likewise, the fourth drive roller 41, the cooling rollers 42, and the second drive roller 43 in the cooling zone 40 can rotate at the same speed which is greater than the speed of any of the first drive roller 21, the heater rollers 22, and the third drive roller 23 in the heating zone 20 in operation.

10 While the invention herein disclosed has been described by means of specific embodiments, numerous modifications and variations could be made thereto by those skilled in the art without departing from the scope and spirit of the invention set forth in the claims.

WHAT IS CLAIMED IS:

1. A film stretching apparatus mounted in a housing, comprising:

a supply roller in the housing adapted to deliver a film to be stretched;

a take-up roller in the housing adapted to wind up the stretched film thereon;

5 a heating zone between the supply roller and the take-up roller and proximate the supply roller, the heating zone including a plurality of heater rollers sequentially disposed therein, wherein surfaces of the heater rollers are rotatably heated to soften the film sent from the supply roller by frictionally engaging therewith;

a cooling zone between the supply roller and the take-up roller and proximate the
10 take-up roller, wherein the cooling zone is spaced from the heating zone by a stretching zone, the cooling zone includes a plurality of cooling rollers sequentially disposed therein, each cooling roller has a rotating speed greater than that of each heater roller so as to generate a speed difference between the cooling rollers and the heater rollers for stretching the softened film passing the stretching zone, and the
15 passing film is cooled by surfaces of the rotating cooling rollers for fixing the shape of the stretched film;

a first bracket at one side of the housing and having at least one first idler roller each retractably extended therefrom to be disposed between any two adjacent ones of the heater rollers and frictionally engaged with the film being heated;

20 a second bracket at the same side as the first bracket in the housing and having a plurality of second idler rollers each retractably extended therefrom to be disposed in the stretching zone and frictionally engaged with the film for flattening; and

a third bracket at the same side as the first bracket in the housing and having at least one third idler roller each retractably extended therefrom to be disposed between
25 any two adjacent ones of the cooling rollers and frictionally engaged with the film being cooled.

2. The film stretching apparatus of claim 1, further comprising:

at least one first drive roller in the heating zone and between the supply roller and one of the heater rollers proximate the supply roller, each first drive roller being adapted to convey the film to be stretched to the proximate heater roller, wherein each first drive roller has a rotating speed less than that of each heater roller; and

5 at least one second drive roller in the cooling zone and between the take-up roller and one of the cooling rollers proximate the take-up roller, each second drive roller being adapted to convey the shape fixed film to the take-up roller, wherein each second drive roller has a rotating speed greater than that of each cooling roller.

3. The film stretching apparatus of claim 2, further comprising:

10 at least one third drive roller in the heating zone and between the stretching zone and one of the heater rollers proximate the stretching zone, each third drive roller being adapted to convey the softened film to the stretching zone, wherein each third drive roller has a rotating speed greater than that of each heater roller; and

15 at least one fourth drive roller in the cooling zone and between the stretching zone and one of the cooling rollers proximate the stretching zone, each fourth drive roller being adapted to convey the softened and flattened film to the proximate cooling roller wherein each fourth drive roller has a rotating speed less than that of each cooling roller.

4. The film stretching apparatus of claim 3, wherein each first drive roller, each
20 heater roller, and each third drive roller rotate at the same rotating speed.

5. The film stretching apparatus of claim 3, wherein each first drive roller rotates at a first rotating speed, each heater roller disposed more distal the supply roller than each first drive roller rotates at a second rotating speed which is greater than the first rotating speed, and each third drive roller disposed more distal the supply roller than
25 each heater roller rotates at a third rotating speed which is greater than the second rotating speed.

6. The film stretching apparatus of claim 3, wherein each fourth drive roller, each

cooling roller, and each second drive roller rotate at the same rotating speed.

7. The film stretching apparatus of claim 3, wherein each fourth drive roller rotates at a fourth rotating speed, each cooling roller disposed more proximate the take-up roller than each fourth drive roller rotates at a fifth rotating speed which is greater than the fourth rotating speed, and each second drive roller disposed more proximate the take-up roller than each cooling roller rotates at a sixth rotating speed which is greater than the fifth rotating speed.

8. The film stretching apparatus of claim 3, wherein a surface of each of the first, the second, the third, and the fourth drive rollers is formed of a material of high friction.

9. The film stretching apparatus of claim 8, further comprising a plurality of knurled portions formed on the surface of each of the first, the second, the third, and the fourth drive rollers.

10. The film stretching apparatus of claim 3, wherein each heater roller is a hollow cylinder which is adapted to store a first liquid having a first heat transfer coefficient.

11. The film stretching apparatus of claim 3, wherein each cooling roller is a hollow cylinder which is adapted to store a second liquid having a second heat transfer coefficient, and wherein the second liquid is different from the first liquid.

12. The film stretching apparatus of claim 9, further comprising a fourth bracket at one side of the housing, the fourth bracket has at least one fourth idler roller each retractably extended therefrom to be frictionally engaged with the second drive roller with the shape fixed film passing therebetween.