We have found that neither of the above known methods of winding cheeses is wholly satisfactory when synthetic polymer yarns are cheese-wound after drawing. With the constant wind ratio method of winding, bulging of the ends of the cheese occurs if the wind ratio is too high. If the wind ratio is too low, there is undercutting near the bobbin, and hard edges on the outside of the cheese together with "dishing" of the cylindrical surface of the cheese. With the constant traverse rate method of winding, the high traverse speed which is necessary if bulging is to be minimised, also leads to hard edges and "dishing" and to yarn being laid so as to slip wholly or in part beyond the ends of the cheese (overthrown ends). Bulging is usually greatest at about a quarter by weight of the winding, and is present up to and somewhat beyond the mid point by weight of the winding. It results from the contraction of the outer layers on those inner layers which are not constrained by the bobbin. Bulging is unsightly and can lead to defective withdrawal of the yarn from the cheese.

Overthrown ends are to be avoided as they are likely to lead to breakage or filamentation of the yarn during take-off.

Undercutting of the cheese, involving the initial layers of yarn being of less than the mean length throughout the cheese, is again unsightly and may lead to withdrawal troubles.

Having now stated what we believe to be the cause of bulging, undercutting and overthrown ends, we have invented a new method of winding cheeses wherein the rate of traverse is "programmed," i.e. varied systematically in relation to the winding speed, in a way such that the tendency to give rise to these defects is minimised.

According to the invention, a method of winding yarn into the form of a cheese, as hereinafore defined, comprises winding-up the yarn on a bobbin that is rotated at a gradually decreasing rotational speed throughout the period of winding, and, independently of said winding-up, traversing the approaching yarn to and fro axially of the bobbin to lay the yarn in a package of layers of helical coils, the rate of traversing being varied in such a way that it is not constant throughout the period of winding and that it attains the maximum rate at a time after about 15% and before about 75% by weight of the yarn in the final package has been wound.

According to another aspect, the invention comprises a cheese, as hereinafore defined, consisting of layers of helical coils wound in a package, the helix angle of some at least of the coils in those layers which lie between about the first 15% and about the last 25%, by weight of the yarn in the package being at least as great as that of any other of the coils in the package and greater than that of the coils in the said first 15%.

Preferably, the rate of traverse is gradually (i.e. in the shape of a smooth curve in a graph plotting traverse speed against time or against weight of yarn wound) increased to reach a maximum around the time when a third of the package, by weight, has been wound, and thereafter is gradually decreased to nearly the same value at the time of doff, as it was at the start of winding. However, such rate of increase and decrease may be linear if some simplification of the mechanisms may result. In certain cases some improvement in package shape may be obtained even if the rate of traverse is maintained at the maximum for the period of winding after the prescribed time.

The above-defined invention results from our finding
that bulging can be cured by arranging for the maximum traverse rate to occur at about that point in the winding where the tendency to bulge is greatest. At the highest traverse rate, the effective stroke length of the traverse (from the point-of-view of the length of the layers of yarn wound) will be least (for a given traverse guide-to-package distance) by the use of the yarn behind the movement of the traverse guide: and furthermore, because the yarn is then in a more open helix, i.e. the helix angle of the coils is greater, the retractive forces in the yarn can more easily prevent axial spreading of the layer. Naturally, in one context, it should be understood that the helix of the coils at the ends of the layers will be varying between one direction and the other; and therefore the references to helix angle do not relate to the angles in those ends.

Similarly, initial undercutting can be cured by arranging for the traverse rate initially to be low, because at low traverse rates the length of the effective stroke length of the traverse will be nearer to the actual stroke length of the traverse guide.

The above remarks about effective traverse stroke length apply strictly only when the distance of the traverse guide from the surface of the package maintains constant throughout the winding. Although this is the desirable state-of-affairs for accurate control of high-speed winding, my invention is not to be regarded as being limited to such a fixed distance being maintained, as variation of the distance, either of a short-term or long-term variety, may be of some added advantage in producing stable, straight-sided cheeses under some conditions of processing.

A winding programme in which a gradual increase in traverse speed to a maximum, followed by a gradual decrease therefrom is used, has the further advantage that it leads to a reduction of tear and wear on the traverse mechanism, which is likely to be working close to its mechanical limits.

The extent of traverse rate variation required, i.e. the starting rate and the maximum rate, have to be determined by experiment, and these variables will depend on the denier of the yarn, the speed at which the yarn is wound, the length of traverse stroke, the diameter of the bobbin on which the yarn is wound, and the weight of yarn required in a full package.

The required “programming” of the traverse rate can be effected by various means, e.g. by driving the traverse guide by a separate motor from driving the spindle and by varying the speed of this separate motor by well-known means, as, for instance, a cam. Alternatively, the traverse could be driven from the spindle motor through a P.I.V. gearbox, suitably programmed.

The invention has proved to be of especial value in winding large cheeses of continuous filament nylon yarn at high speeds on the drawing machine. Such a process is desirable for economic reasons and is particularly difficult to achieve in the case of lower denier yarns, such as 60/20 nylon.

The winding of such yarns can take place either with a surface drive or a direct drive to the spindle, in the latter case with provision for the reduction of the speed of the drive in order to compensate for package growth. In both cases “ribbon-breaking” is necessary to avoid patterning at regions of the package during the period of winding.

The above-mentioned 60 denier nylon yarn has been wound into stable 6 lb. cheeses having very slightly tapered ends, according to the following condition:

Yarn speed as delivered by draw rolls—2,000 feet/minute
Nominal traverse stroke length—5½ inches
Initial traverse speed—200 cycles/minute
Maximum traverse speed—550 cycles/minute
Final traverse speed—375 cycles/minute
Maximum traverse speed attained—½ way through the winding

The invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a frontal view of yarn being wound on a cheese;
FIGURE 2 is a side view of such winding;
FIGURE 3 is a diagram of a cheese showing bulging sides, wound according to the prior art;
FIGURE 4 is a diagram of a cheese with a “dished” sides, wound according to the prior art;
FIGURE 5 is a diagram of a cheese with straight sides and a flat surface, wound according to the invention;
FIGURE 6 is a graph of traverse speed against time for an embodiment of the invention;
FIGURE 7 is the cam profile for varying this speed of traverse according to that graph.

FIGURES 1 and 2 show a cheese wind-up on a nylon drawtwister, in diagrammatic form. Drawn nylon yarn Y is forwarded from draw roll 1 and is wound in the form of cheese 3 on a bobbin as, for instance, a cylindrical former 5. The cheese is rotated by surface drive from drive roll 7. The yarn is traversed by traverse guide 9 which is reciprocated across the width of the cheese in a horizontal slot in traverse cam box 11. A speed then bulging sides as shown at 15 in FIGURE 3 tend to result, and if winding is carried out at a constant low wind ratio or at a constant low traverse speed then as shown in FIGURE 4 this surface of the cheese tends to be “dished,” between hard edges 17, and the cheese is undercut, at 19, near to the bobbin.

In contradistinction, the cheese shown in FIGURE 5, which is indicative of one wound according to the invention, has straight, slightly tapered sides and a flat surface. The graph of FIGURE 6 shows how the rate of traverse may be gradually increased to a maximum at about ½ of the total winding time of the cheese and then gradually reduced.

FIGURE 7 shows the shape of cam for imparting such a programme to the traverse motor, according to known techniques.

What I claim is:

1. A method of winding yarn into a cylindrical-bodied, straight-ended yarn package wound on a bobbin comprising, winding yarn layers in layers of helical coils on a bobbin which is rotated at a gradually decreasing rotational speed throughout the period of winding traversing the yarn to and fro axially of the bobbin at a rate that is not constant throughout said period of winding by increasing the rate of traversing from its initial rate so that it attains the maximum rate at a time after about 15% and before about 75% by weight of the yarn in the final package has been wound.

2. A method according to claim 1 further comprising gradually decreasing the rate of traversing after the maximum rate has been obtained.

3. A method according to claim 1 in which the rate of traversing is gradually increased to the maximum at the time when about one third by weight of the yarn in the final package has been wound, and thereafter gradually decreasing the rate of traversing.

4. A cylindrical-bodied, straight-ended yarn package wound on a bobbin in layers of helical coils, characterized by the helix angle of the coils in those layers which lie between about the first 15% and about the last 25% by weight of the yarn in the package is at least as great as the helix angle of any other of the coils in the package and is greater than the helix angle of the coils in the said first 15%.

5. A yarn package according to claim 4 in which the
first-mentioned helix angle is also greater than that of the coils in the said last 25% by weight of yarn in the package.

6. A yarn package according to claim 4 in which the helix angle of the coils gradually increases throughout the first layers of the package to the maximum angle in those layers at the end of about the first one-third by weight of yarn in the package, and then gradually decreases throughout the subsequent layers.

7. A yarn package according to claim 6 having very slightly tapered ends and consisting of drawn nylon yarn.

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