Feb. 10, 1970 P. THWAITES 3,494,562

YARN WINDING MACHINES

Filed Dec. 21, 1967 2 Sheets-Sheet 1

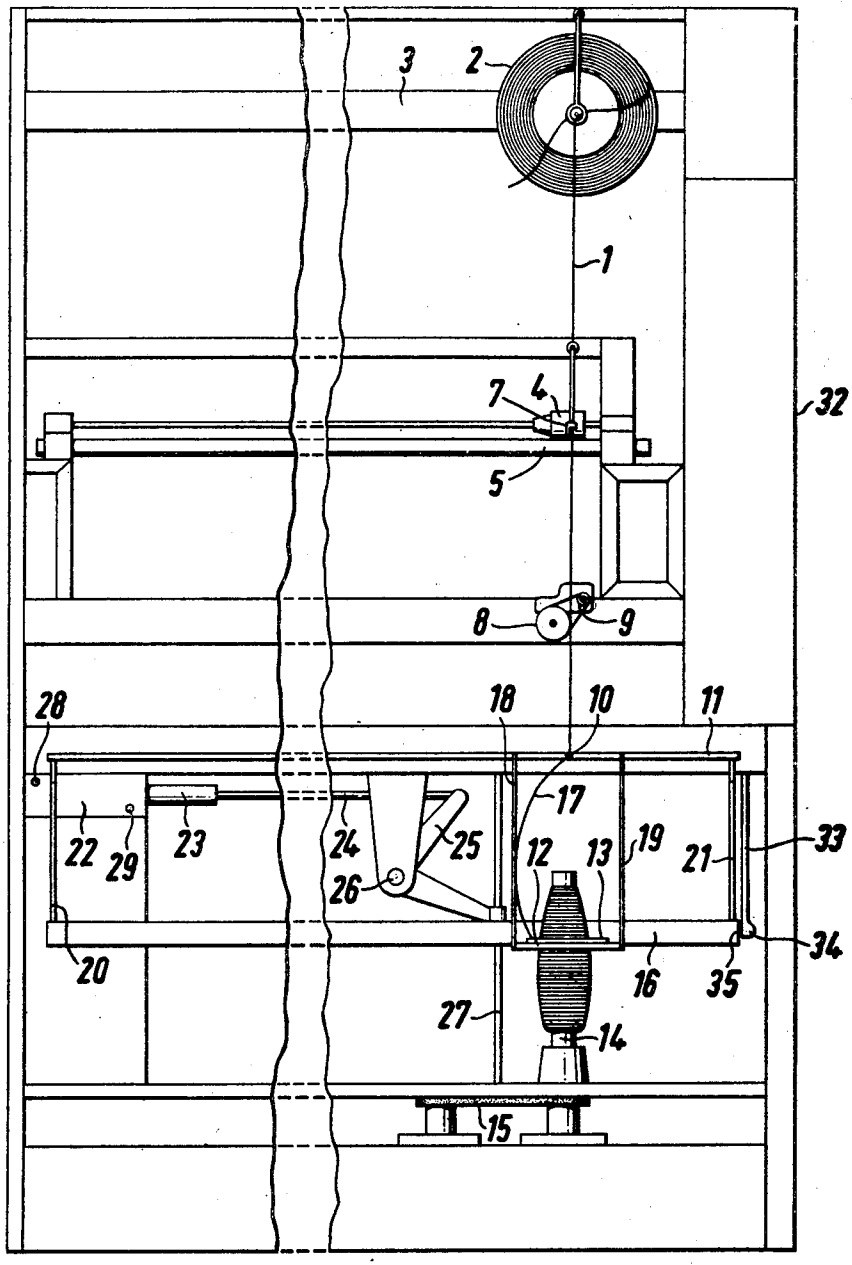

FIG.1.

PETER THWAITES
INVENTOR

BY Davis Hoxie Faithfull & Hapgood
ATTORNEYS

Feb. 10, 1970 P. THWAITES 3,494,562

YARN WINDING MACHINES

Filed Dec. 21, 1967 2 Sheets-Sheet 2

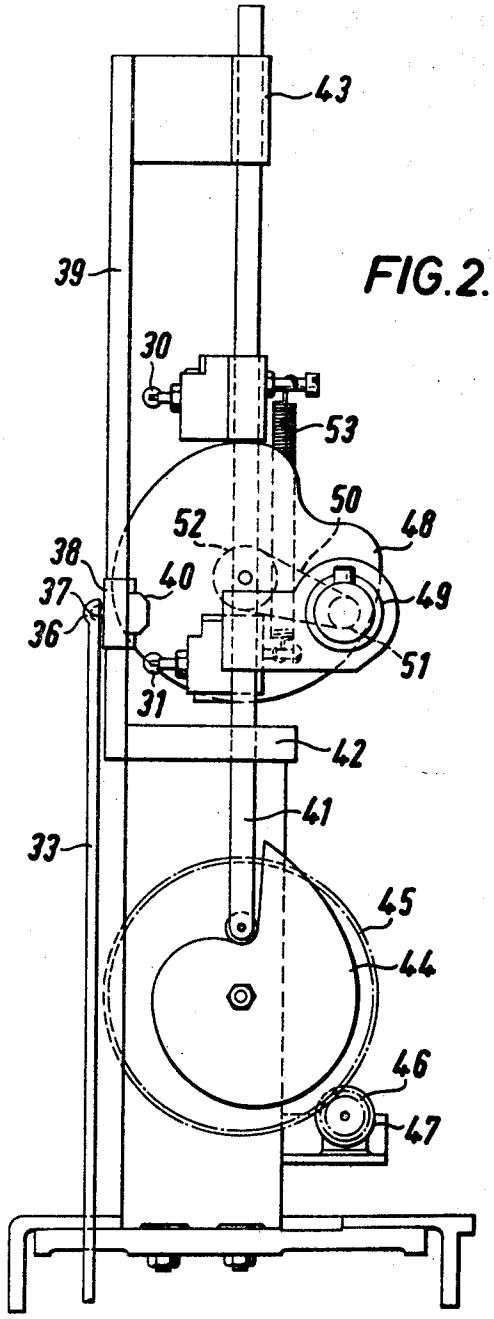

FIG. 2.

PETER THWAITES
INVENTOR

BY Davis Horn Fairbairn & Hapgood
ATTORNEYS

United States Patent Office 3,494,562
Patented Feb. 10, 1970

3,494,562

YARN WINDING MACHINES

Peter Thwaites, Bulkington, Nuneaton, England, assignor to Courtaulds Limited, London, England, a British company

Filed Dec. 21, 1967, Ser. No. 696,968
Int. Cl. B65h 54/04
U.S. Cl. 242—26.1 10 Claims

ABSTRACT OF THE DISCLOSURE

A yarn winding machine has a control mechanism which imparts to the traverse reversal positions gradual unidirectional movements axially of the spindle and superimposes on one of those reversal positions a reciprocatory motion. Preferably the gradual unidirectional movements applied to the reversal positions are both in the same direction and of the same speed, which is preferably constant. A yarn package of improved quality is produced by a process using the yarn winding machine.

This invention relates to yarn winding machines for producing tapered yarn packages of the so-called composite-pirn build. Machines of this type comprise a traverse mechanism for reciprocating a yarn guide axially along a spindle on which a yarn package is to be wound, or, of course for reciprocating the spindle relatively to the yarn guide, and a control mechanism for controlling the reversal positions at opposite ends of the traverse stroke. For producing a composite-pirn package, the control mechanism is arranged so that the reversal position at one end is reciprocated axially of the spindle between fixed limits and the reversal position at the opposite end is gradually moved axially of the spindle towards the reciprocating reversal position.

If we consider a winding machine of the conventional ring-rail type in which the package formed is to have its yarn drawn off over the upper end at a later stage, then a suitable composite-pirn package is formed by reciprocating the upper reversal position and gradually raising the lower reversal position.

The reversal positions are commonly defined by limit switches which, on being actuated by a fixed member attached to the yarn guide or the spindle mounting, cause the reversal of the direction of the drive of the traversing mechanism. Variations of the reversal positions can be achieved, therefore, by variation of the positions of the limit switches. A simple arrangement for doing this comprises a cam mounted on a driven shaft and a cam follower rigidly fixed to the limit switch. The locus of the limit switch is thus defined by the shape of the cam.

Devices other than limit switches may be used to define the reversal positions, for example knock-over cams which actuate hydraulic valves are used on some machines, but for convenience the description in this specification will deal with the use of only limit switches.

Using conventional ring-rail winding machines, composite-pirn packages have been formed by making the upper limit switch responsive to a heart-shaped cam, thereby producing reciprocation of the upper reversal point between fixed limits axially of the spindle, and by making the lower limit switch responsive to a snail cam so that the lower reversal point is gradually raised. The locus of the lower reversal point in a graph of its axial position against time usually is made a straight line.

The composite-pirn package shares with the pirn package easy draw-off from the lower end of the unwinding traverse. One disadvantage, however, is that at the end of the package where the reversal position was reciprocated, a phenomenon known as ridging may arise. Ridging arises

when the reciprocation of the reversal position comprises uniform cycles throughout the winding operation and is the result of the extremities of layers of yarn being laid upon the extremities of previously laid layers of yarn, i.e., at the same position axially of the spindle, because of the coincidence of the reversal positions in corresponding parts of different cycles of the reciprocation of the same. Ridging is detrimental to the unwinding of the package because yarn from a surface layer can become temporarily trapped under or between yarn in the adjacent inner layer so that as the yarn is unwound from the surface layer it is subjected to a sudden increase in tension. Whilst tension variations are not so critical for some purpose, particularly where heavy denier yarn is used, they are undesirable if the yarn is to be used in hosiery or warp knitting where iet is required that the yarn be drawn from the package at a constant low take-off tension.

British patent specification No. 1,025,228 describes a yarn winding machine for producing composite-pirn packages having reduced ridging effects. The machine may be arranged so that the wave form of the reciprocatory motion of the reversal position is continuously varied so that the different cycles are non-uniform, or alternatively, so that the speed of the traverse motion is continuously varied.

We have now devised a more simple method of reducing ridging and a winding machine for performing it.

According to this invention, a yarn winding machine comprises a rotatable spindle onto which yarn may be wound to form a package, driving means for rotating the spindle, a yarn guide, a traverse mechanism for effecting reciprocal traversing of one of the yarn guide and the spindle along the other and including limiting means defining reversal positions at opposite ends of the traverse, and a control mechanism for controlling the positions of the limiting means, the control mechanism comprising first control means arranged to impart to the limiting means defining the reversal position at one end of the traverse, a reciprocatory motion axially with respect to the spindle, and second control means arranged to impart to the limiting means defining the reversal position at the opposite end of the traverse, a gradual movement axially with respect to the spindle towards the reciprocated limiting means, and third control means arranged to superimpose on the reciprocatory motion imparted to one limiting means by the first control means, a gradual movement in one direction axially with respect to the spindle.

The first control means of the control mechanism may comprise a cam follower fixed to one limit switch, together with a cam, for example a heart-shaped cam mounted on a rotatable shaft, for causing reciprocation of the limit switch axially with respect to the spindle. The second control means may comprise a cam follower fixed to the other limit switch, together with a cam, for example a snail cam mounted on a rotatable shaft, for causing gradual movement of that limit switch towards the reciprocating limit switch.

The third control means of the control mechanism may also comprise a cam, for example a snail cam mounted on a rotatable shaft, arranged to gradually move the first control means bodily in one direction axially with respect to the spindle. Thus, the first and third control means may comprise, in combination: a snail cam mounted on a rotatable shaft; a cam follower responsive to the snail cam; a heart-shaped cam mounted on a shaft which is rotatably mounted on the snail cam follower; and a cam follower responsive to the heart-shaped cam and fixed to the limit switch, and being movably mounted on the snail cam follower so that it can respond to the heart-shaped cam. In operation, the heart-shaped cam is

rotated to cause its follower and therefore the limit switch to reciprocate, while at the same time the snail cam is rotated to cause its follower to gradually move in one direction axially with respect to the spindle. As the cam causing the reciprocation is actually mounted on the follower of the cam causing the gradual movement in one direction, the two motions are superimposed on the limit switch.

The heart-shaped cam may be driven by a motor which is itself mounted on the snail cam follower or by a motor which is mounted on the adjacent framework of the machine. In the latter case, the driving connection may be a flexible belt.

The cam followers of the second and third control means of the control mechanism may be arranged to respond to the same cam or to identical cams mounted on the same shaft in which case the two limit switches share the same gradual unidirectional movement.

The invention also includes a process for winding a yarn package comprising passing a yarn through a yarn guide and winding it onto a rotating spindle, reciprocating one of the yarn guide and the spindle along the other controlling the reversal positions of that reciprocation whereby one reversal position is subjected to two superimposed motions, one reciprocatory axially with respect to the spindle and the other a gradual unidirectional movement axially with respect to the spindle, while the other reversal position is subjected to a gradual unidirectional movement axially with respect to the spindle and towards the reciprocating reversal position.

In a more usual form, the process of the invention is operated with a reciprocating yarn guide, as for example, in a ring-rail machine, with the upper reversal position being subject to the superimposed reciprocatory and unidirectional motions.

Preferably, the unidirectional movements applied to the two reversal positions are identical both in direction and speed, and it is preferred that the said speed should be constant.

The invention further includes a yarn package made according to the process of the invention. Such yarn packages have few, if any, ridging effects and therefore this type of package build may be used in applications such as hosiery or warp knitting. Ridging is eliminated for practical purposes, because the superimposition of the unidirectional movement upon the reciprocating reversal position causes the reversal positions in corresponding parts of different cycles of its reciprocation to be different.

When the process of the invention is operated in its preferred form, with the unidirectional movements of the reversal positions having the same direction, for example in a conventional ring-rail machine the upper and lower reversal positions will gradually move upwards towards the upper end of the spindle, then the package formed has a further important advantage. This arises from the increased spindle length over which the extremities of the successive layers of yarn are laid at the end of the package which has been formed according to the superimposed motions, and the consequent small angle between the package surface at that end and the axis of the spindle, and takes the form of increased stability and improved unwinding characteristics of the package.

The invention is illustrated, by way of example, by the accompanying drawings in which:

FIGURE 1 is a diagrammatic side elevation of part of a draw-twisting machine, and

FIGURE 2 is a diagrammatic side elevation of the control mechanism for controlling the reversal positions of the ring rail.

In FIGURE 1, opposite ends of a draw-twisting machine are shown and for the purpose of clarity, the necessary equipment for dealing with only a single end of yarn is shown; in actual fact the draw-twisting machine has several dozen such units of equipment. A yarn **1** is taken over-end off a large cheese package **2**, mounted on a rail **3**, by a take-off roller **4** having a friction surface around which the yarn is wrapped. The roller **4** is surface driven by a drive roller **5**. Guides **6** and **7** facilitate respectively the unwinding of the yarn from the cheese and its wrapping around the roller **4**. The yarn is then passed in serveral wraps around a draw roller **8** and an adjacent wrap roller **9**. The draw roller **8** is rotated at a faster peripheral speed than the take-off roller **4** so that the yarn is stretched therebetween.

From the draw roller **8** the yarn is taken successively through a pigtail guide **10** mounted on a rail **11** and a traveller guide **12** running on a ring **13** before being wound onto a spindle **14**. The spindle **14** is rotated by a belt drive **15**, which also drives the adjacent spindle. The ring **13** is mounted on a ring rail **16** which is reciprocated up and down axially of the spindle so as to build up the yarn package on the spindle. The traveller guide **12** runs around the ring **13** during winding at a rate calculated with respect to the spindle speed to put a desired degree of twist into the yarn. The yarn balloon **17** formed between the pigtail guide **10** and the traveller guide **12** is sectioned off from adjacent yarn balloons by plates **18** and **19** which are connected at opposite ends to the ring rail **16** and the rail **11** on which the pigtail guide **10** is mounted. These rails are also rigidly connected at their ends by the bars **20** and **21** so that the rail **11** reciprocates with the ring rail **16**.

The ring rail **16** is reciprocated by a double-acting hydraulic piston and cylinder **22**, the piston **23** of which is connected to the ring rail by a long rod **24** and a bell-crank lever **25**. On its outward stroke the piston **23** causes the bell-crank lever **25** to be pivoted clockwise with respect to its mounting **26** so that the ring rail is pushed down a guide bar **27**. On its inward stroke, the piston, through the rod **24**, causes the bell-crank lever to be pivoted anti-clockwise so that the ring rail is pulled up the guide bar **27**.

The flow of hydraulic fluid to opposite ends of the cylinder **20** is controlled by electromagnetic valves **28** and **29** which operate in response to actuation of limit switches **30** and **31** shown in FIGURE 2. Thus, the reciprocation of the ring rail **16** is controlled by the limit switches **30** and **31**.

The control mechanism for controlling the reversal positions of the ring rail is housed in a unit **32** and is shown in FIGURE 2. The ring rail is connected to the control mechanism by a control bar **33** which has a snap-fit socket at both ends, the socket **34** at one end fitting onto a complementary projection **35** on the ring rail and the socket **36** at the other end fitting onto a complementary projection **37** on an actuating head **38**. The actuating head is slidable along a rail **39** and has a shaped contact face **40** for pressing in the actuating members of the limit switches **30** and **31** to actuate them. The actual positions of the limit switches **30** and **31** therefore define the upper and lower reversal positions, respectively, of the ring rail. The purpose of the remaining parts of the control mechanism is to vary the positions of the limit switches **30** and **31** during winding according to a predetermined sequence so as to obtain a particular package build.

The lower limit switch **31** is arranged to move gradually upwards at a constant rate during a winding cycle and this is achieved by mounting the limit switch **31** rigidly on a cam follower **41** slidable in guides **42** and **43** and responsive to a snail cam **44** which revolves once per winding cycle. The snail cam is fixed to a gear wheel **45** which meshes with a toothed pinion **46** driven by an electric motor **47**.

The upper limit switch **30** is also mounted on the cam follower **41** and so is also subject to the gradual upward movement. However, its mounting is not fixed but sliding so that it can also respond to a heart-shaped cam **48** which is rotatably mounted on the cam follower

41 at a position below the limit switch 30. The cam 48 is driven by an electric motor 49, also mounted on the cam follower 41, by means of a belt 50 which passes around the motor pulley 51 and a pulley 52 fixed to the cam. Rotation of the cam 48 causes the limit switch 30 to reciprocate up and down the cam follower 41, and in contrast with the snail cam 44, the heart-shaped cam 48 revolves many times during a winding cycle.

A tension spring 53 connected between the limit switch mountings pulls that of the limit switch 30 down onto the cam surface of the heart-shaped cam 48 but allows the limit switch to "ride" the cam.

The upper limit switch 30 is therefore subjected to two superimposed motions, one a gradual upward movement due to the snail cam and the other a reciprocatory movement due to the heart-shaped cam. During a winding cycle, the movements of the limit switches 30 and 31 reflect exactly the movements of the upper and lower reversal positions, respectively, of the ring rail, and so determine the package build.

What I claim is:

1. A yarn winding machine comprising a rotatable spindle onto which yarn may be wound to form a package, driving means for rotating the spindle, a yarn guide, a traverse mechanism for effecting reciprocal traversing of one of the yarn guide and the spindle along the other and including limiting means defining reversal positions at opposite ends of the traverse, and a control mechanism for controlling the positions of the limiting means, the control mechanism comprising first control means arranged to impart to the limiting means defining the reversal position at one end of the traverse a reciprocatory motion axially with respect to the spindle, and second control means arranged to impart to the limiting means defining the reversal position at the opposite end of the traverse a gradual movement axially with respect to the spindle towards the reciprocated limiting means, and third control means arranged to superimpose on the reciprocatory motion imparted to one limiting means by the first control means a gradual movement in one direction axially with respect to the spindle.

2. A yarn winding machine as claimed in claim 1 in which the yarn guide is reciprocated along the spindle and comprises a ring running on a rail.

3. A yarn winding machine as claimed in claim 1 in which the limiting means comprise limit switches.

4. A yarn winding machine comprising a rotatable spindle onto which yarn may be wound to form a package, driving means for rotating the spindle, a yarn guide, a traverse mechanism for effecting reciprocal traversing of one of the yarn guide and the spindle along the other and including limiting means defining reversal positions at opposite ends of the traverse, and a control mechanism for controlling the positions of the limiting means, the control mechanism comprising first control means arranged to impart to the limiting means defining the reversal position at one end of the traverse a reciprocatory

motion axially with respect to the spindle, and second control means arranged to impart to the limiting means defining the reversal position at the opposite end of the traverse a gradual movement axially with respect to the spindle towards the reciprocated limiting means, and third control means arranged to superimpose on the reciprocatory motion imparted to one limiting means by the first control means a gradual movement in one direction axially with respect to the spindle, at least one of the three control means comprising a cam and a cam follower fixed to one of the limiting means.

5. The yarn winding machine claimed in claim 4 in which the first control means comprises a heart shaped cam operatively connected with a limiting means and the third control means comprises a snail cam and a cam follower, the heart shaped cam of the first control means being rotatably mounted on said follower and said limiting means being slidably mounted on said follower.

6. The yarn winding machine claimed in claim 5 in which the second control means comprises said snail cam and follower and means rigidly mounting the other limiting means on said follower.

7. A process for winding a yarn package comprising passing a yarn through a yarn guide and winding it onto a rotating spindle, reciprocating one of the yarn guide and spindle relative to the other, axially of the spindle, between a first and second reversal position, reciprocating the first reversal position in a direction parallel to the spindle axis while simultaneously moving said first position gradually and unidirectionally parallel to the spindle axis, and moving the second reversal position gradually and unidirectionally parallel to the spindle axis and towards the first reversal position.

8. A process as claimed in claim 7 in which the unidirectional movement applied to opposite reversal positions are both in the same direction.

9. A process as claimed in claim 8 in which the unidirectional movement applied to opposite reversal positions have the same speed.

10. A process as claimed in claim 9 in which the speed of the unidirectional movements applied to opposite reversal positions is constant.

References Cited

UNITED STATES PATENTS

2,629,559	2/1953	Ayala	242—26.4
2,764,363	9/1956	Stammwitz	242—26.2
3,243,131	3/1966	Greive	242—26.3
3,334,828	8/1967	Harrison	242—26.1
3,372,882	3/1968	Graf	242—26.1

OTHER REFERENCES

German printed application, No. 1,067,349, published October 1959, Sagehomme.

STANLEY N. GILREATH, Primary Examiner

W. H. SCHROEDER, Assistant Examiner