United States Patent [19]

Mackie

[11] **3,856,223**

[45] **Dec. 24, 1974**

[54] **WINDING MACHINE**

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[22] Filed: **Feb. 29, 1972**

[21] Appl. No.: **230,235**

[30] **Foreign Application Priority Data**

Mar. 10, 1971 Great Britain 6475/71

[52] **U.S. Cl.** **242/26.3,** 57/71, 57/99

[51] **Int. Cl.** **B65h 54/36**

[58] **Field of Search** 242/26.3, 26.2, 26.1, 26.45; 57/71, 99, 156

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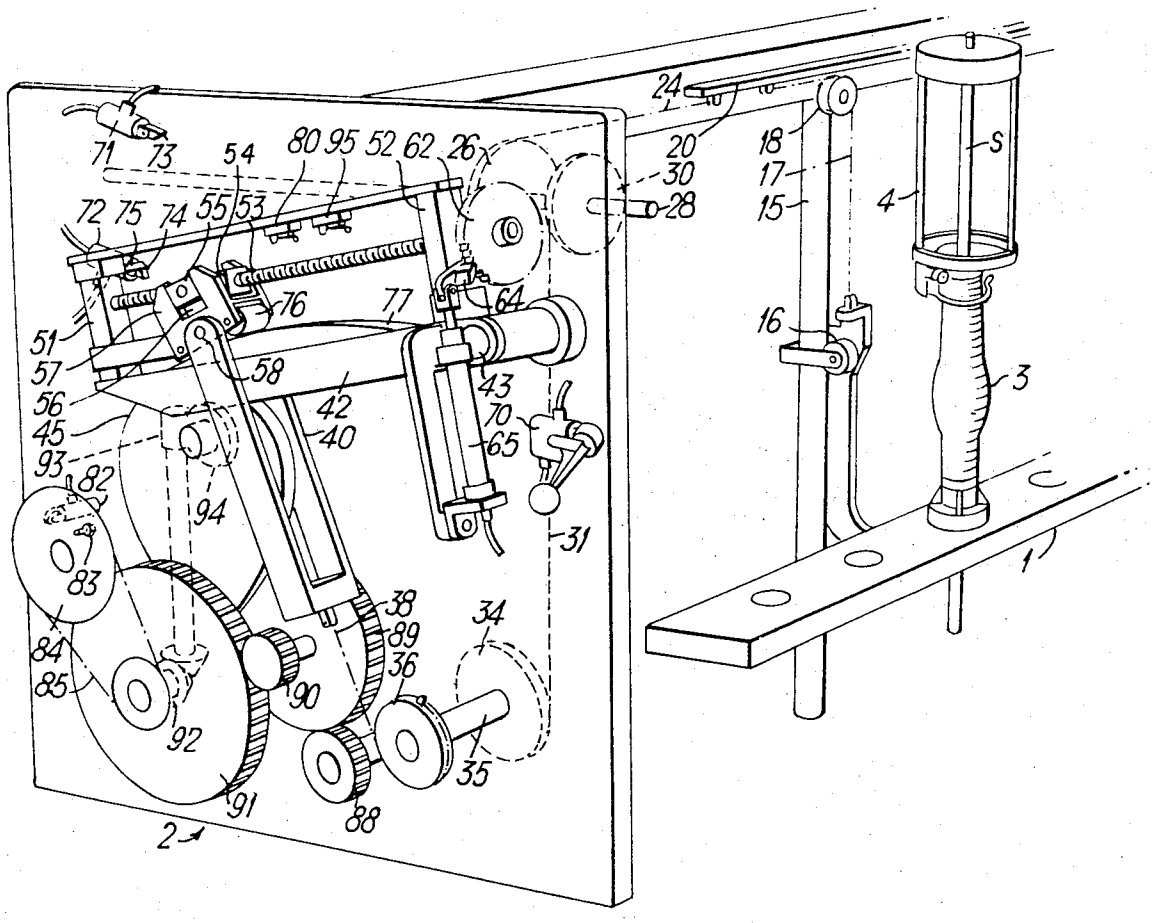
Primary Examiner—Stanley N. Gilreath
Attorney, Agent, or Firm—Brisebois & Kruger

[57] **ABSTRACT**

A multihead winding machine for the winding of material delivered from a controlled speed source of supply in which each winding head comprises a rotary guide, mounted to be driven around a nonrotary package support with a relative axial traversing motion produced by traverse mechanism common to at least a group of winding heads. The machine also includes mechanism for progressively reducing the length of traverse stroke during winding and a control for increasing the rate of reduction of stroke during the period of winding when completed packages are being doffed and fresh packages started. The traverse mechanism preferably comprises a lever arm which is rocked about its fulcrum under the control of a cam, and the mechanism for reducing the length of traverse stroke of the builder rail then serves to reduce the distance from the fulcrum of the lever arm of the point of connection to a link for transmitting the traversing movement. The connection of the link to the lever arm may be made by way of a connection block in the form of a nut mounted on a lead screw extending along the length of the arm so as to form part of the arm, the screw being turned step by step to produce the adjustment of the length of traverse stroke.

7 Claims, 5 Drawing Figures



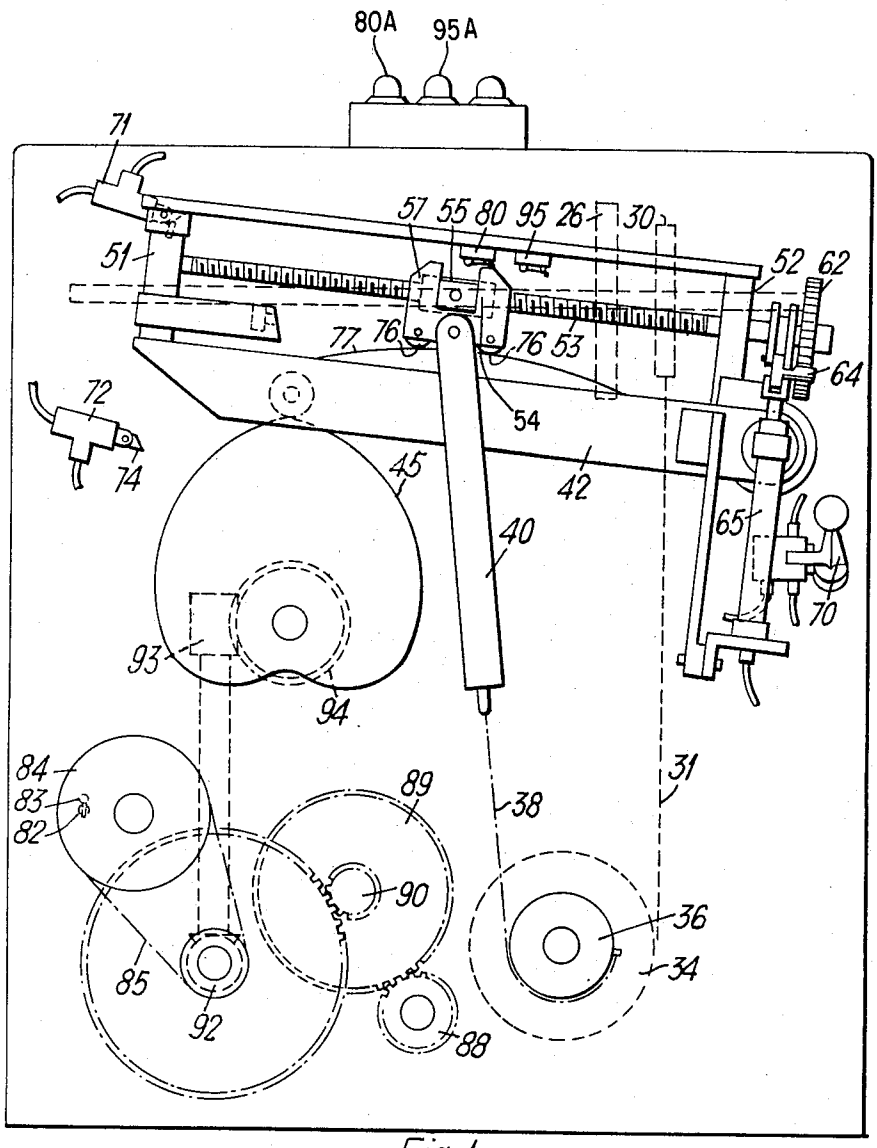

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Fig. 1.

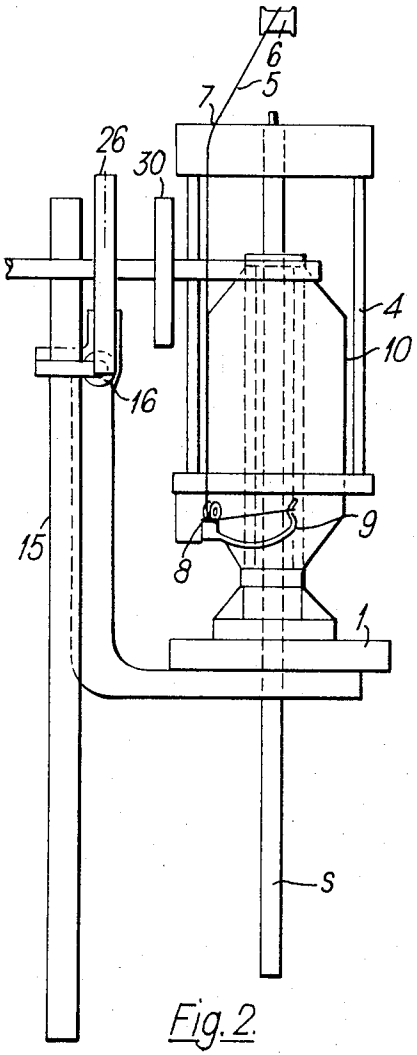

Fig. 2.

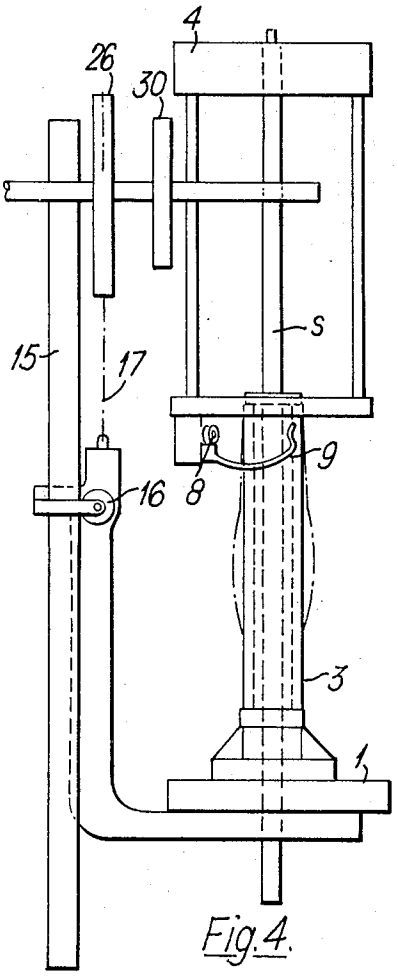

Fig. 4.

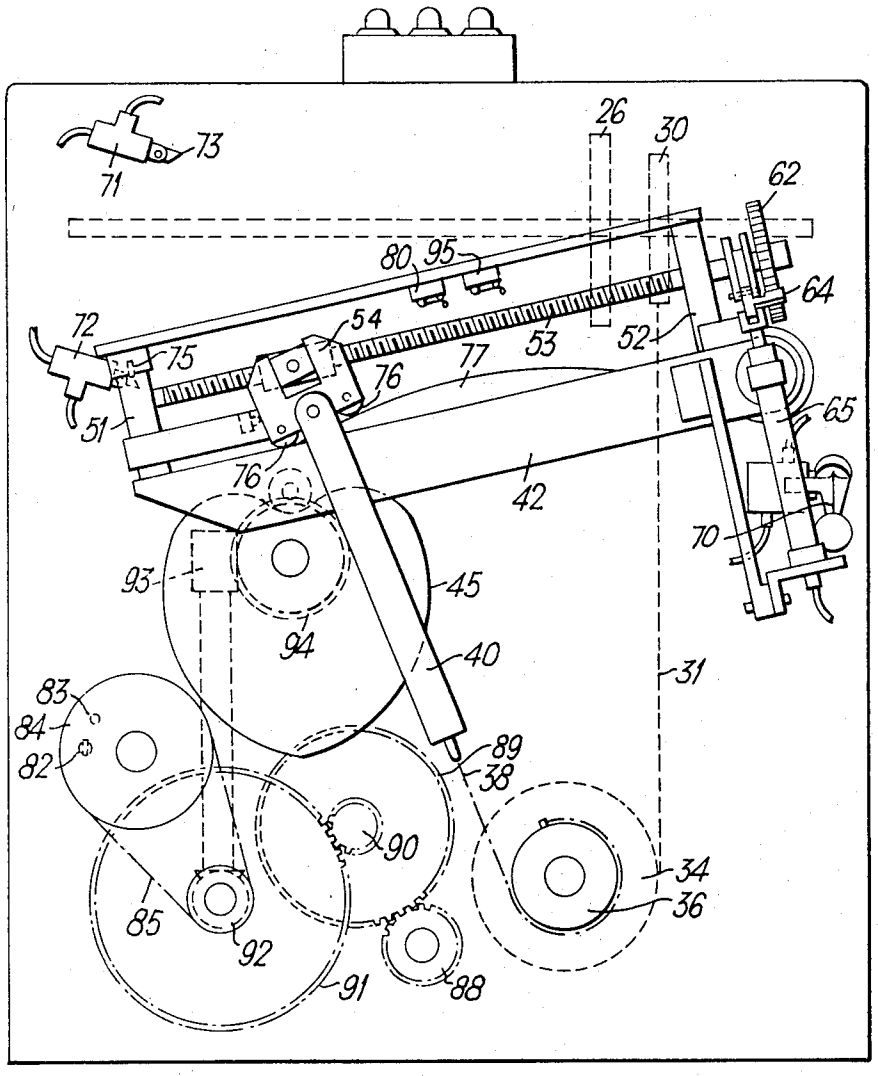
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Fig. 3.

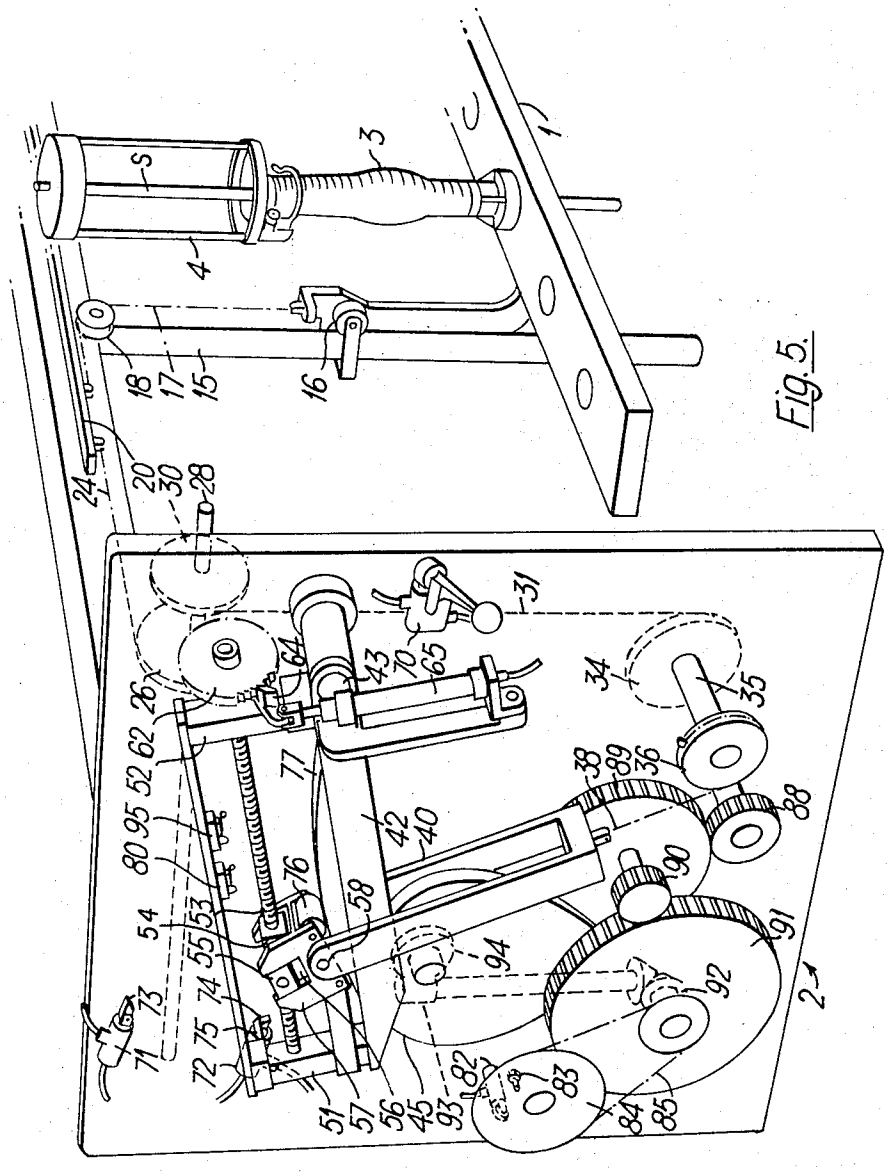
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Fig. 5.

WINDING MACHINE

This invention relates to the winding of synthetic plastic tape to form packages and is particularly concerned with the winding of a relatively large number of tapes as described, for example, in British Pat. No. 1,209,921.

As described in this earlier specification a multi-head winding machine is used to form individual packages from a number of tapes from an extruder or other controlled speed source of supply which cannot be stopped to allow the packages to be doffed. In a winding head of this kind, each winding head comprises a rotary winding guide mounted to be driven around a non-rotary support for the package with a relative axial traversing movement. This movement has one component in the form of a relative reciprocating motion, of stroke considerably less than the length of package, common to all the winding heads, and a second in the form of a progressive uni-directional motion produced by mechanism which is independently adjustable at each winding head. A tape can be led to each winding head in turn to start forming a package, and, although the reciprocating motion is common to all the packages, they can be at different stages of progressive formation. Each package may then be completed in the sequence at which they were started and each complete package doffed and the next started before the next package in sequence is ready for doffing.

However, with this type of compound motion, the length of the reciprocating stroke extends only over the tapered nose portion of the package, so that the tape is laid over this portion. It is therefore necessary to make the taper a gradual one, since otherwise, when unwinding, the tape is inclined to pull off in "gulps," i.e. a number of successive coils, rather than be unwound coil by coil. This can be a cause of frequent stoppages. If a nose of sufficient length and taper is formed to prevent this occurring, for a given length of package this appreciably restricts the diameter and weight of the package. In most cases, of course, it is desirable to get the effective maximum amount of material on a given length of package.

It is possible to make the nose shorter and yet prevent the tape pulling off in gulps if it is wound with a traverse extending over the effective length of the package rather than just the nose. This can be achieved by using a different form of traverse mechanism in which, at the start, the traverse extends for the full length of the package, and it is then progressively reduced as the package is wound to form the taper at each end. In one example of package wound with this form of traverse motion for a particular type of material, the ends of the package can have a taper of approximately 30° as compared with approximately 10° as obtained with the method previously described, thus permitting the building of a larger diameter package for a given length, and hence a heavier package.

With such a form of traversing motion, however, it is not practicable to treat the separate packages individually since the reciprocating motion cannot be split into two separate components in the manner described above. At the completion of a package the length of traverse may have been reduced, depending on the length of package being wound, to almost half the maximum value, for example. As a package is doffed a new one is started and when all the completed packages

have been doffed the traverse mechanism is re-set to the full stroke. As a result, packages which have been restarted before the resetting of the traverse mechanism have the first layer or first few layers of coils wound over only a proportion of the length of the support. The full length layers of coils which follow after the re-setting of the traverse mechanism are then merely wound on top of the shorter core portion previously formed before re-setting the traverse mechanism. While this creates no difficulties during the winding operation it does, however, lead to difficulties during unwinding. As already described the taper at the end of the package is of the order of 30° so that the smaller package formed initially presents a relatively sharp corner to the subsequent turns of the full length package wound on top. Consequently when the package is being unwound there is a risk of plucking and stoppages caused by the turns being unwound fouling this corner.

The angle of taper at the end of the package is controlled by the rate of reduction of the length of traverse and the present invention is based on the principle of increasing this rate of reduction during the period in which the packages are being doffed so that the portion of each package wound during this period (i.e., the much shorter core portion already described) has a much smaller angle of taper, e.g., 8°. In this way the sharp corner referred to above is eliminated and the resultant gradual taper presents a smooth surface over which the unwinding tape can slip quite easily without plucking.

Apparatus in accordance with the invention operating in this manner comprising a multi-head winding machine of the kind referred to above and intended for the winding of material delivered from a controlled speed source of supply has traverse mechanism common to at least a group of winding heads and includes mechanism for progressively reducing the length of traverse stroke during winding and a control for increasing the rate of reduction of stroke during the period of winding when completed packages are being doffed and fresh packages started. This mechanism leads to the elimination of the sharp corner on the core portion of each package wound during the doffing period and thus facilitates unwinding in the manner already described. Although the problem has been described primarily in terms of the winding of tape, a winding machine in accordance with the invention may also be used for the winding of yarn and other similar material.

As just mentioned the traverse mechanism is common to at least a group of winding heads and preferably a single mechanism serves for all the winding heads of the machine, the package supports being mounted on a common length or lengths of builder rail to which the traversing motion is applied by the traverse mechanism. The traverse mechanism may conveniently comprise a lever arm which is rocked about its fulcrum under the control of a cam and which is connected to the builder rail or rails by way of a link including one or more lengths of chain or the like by means of which the reciprocating movement is transmitted and the mechanism for reducing the length of traverse stroke of the builder rail or rails serves to reduce the distance from the fulcrum of the lever arm of the point of connection to the link. This mechanism may conveniently operate by a standard amount for each stroke of the arm during the greater part of the winding process, the

amounts of adjustment increasing in length or frequency during the doffing period.

In order to provide smooth adjustment of the connection point between the link and the lever arm, this connection may be made by way of a connection block in the form of a nut mounted on a lead screw extending along the length of the arm so as to form part of the arm, the screw being turned step by step to produce the adjustment. For this purpose the screw may carry an indexing wheel capable of being turned through successive angular steps by means of a pawl operated by a reciprocating mechanism. The reciprocating mechanism may comprise a pneumatic cylinder, the stroke of which may be adjustable, and which is controlled either by a valve operated by rocking movement of the lever arm or by a second valve operated more rapidly by a member driven by gearing in the drive to the cam, the respective valve being selected by a change-over switch. Thus, during the greater part of the winding process the pneumatic cylinder may operate the pawl once or twice for every stroke of the lever arm while during the doffing period the second valve may produce more rapid operation.

A construction in accordance with the invention will now be described in more detail by way of example, with reference to the accompanying drawings, in which:

FIG. **1** is a view of traverse mechanism showing its parts in a position taken up just before the beginning of the doffing period;

FIG. **2** is an end view of a builder rail including a package support and a completed package;

FIGS. **3** and **4** are views corresponding to FIGS. **1** and **2** but showing the parts after resetting at the end of the doffing period; and

FIG. **5** is a perspective view of the traverse mechanism with the parts in the same position as in FIG. **3** and also showing part of the builder rail and a newly started package.

The multi-head winding machine shown in the drawings has a common builder rail **1** which extends for the length of the machine and is controlled by a single traverse mechanism indicated generally as **2.** Although, as illustrated, the machine is single-sided, the traverse mechanism **2** can equally well control a double-sided machine having similar builder rails on both sides. The builder rail **1** carries a number of non-rotary package supports **3,** one of which is best seen in FIG. **4** and one only of which is shown in FIG. **5** carrying the initial stages of a package. Each non-rotary support has a co-operating flyer **4,** the two together constituting an individual winding head and the relative reciprocating motion between the two is produced by traversing movement of the builder rail **1.** As best seen from FIG. **2,** the material to be wound, which will be assumed to be tape, is shown as **5** and passes via a let-off roller **6,** over the shoulder of the flyer at **7** and via a guide roller **8** and a winding-on guide **9** to the surface of a package shown as **10.** The invention is primarily concerned with the traversing movement of the builder rail **1** which will now be described in more detail.

The builder rail **1** is mounted to reciprocate on vertical guides **15** and is fitted with rollers **16** bearing against these guides. Although only a single guide **15** is shown in the drawings, the guides are, in fact, spaced at intervals along the length of the machine and the traversing movement of the rail **1** is controlled by a separate chain **17** passing over a roller **18** at each vertical guide **15.**

The chain **17** is attached to a bar **20** which extends along the length of the machine and has a chain **17** attached to it at intervals. The bar **20** in its turn is caused to reciprocate by means of a chain **24** forming part of a winch mechanism and wound up by a winch wheel **26.** The wheel **26** is mounted on a shaft **28,** the rotary movement of which is produced by a second winch wheel **30** also secured to the shaft and controlled by a chain **31.** The chain **31** passes around a further winch wheel **34** mounted on a shaft **35** which carries a further wheel **36** controlled by a chain **38.** The chain **38** is connected in its turn to a link member **40** which is indirectly connected to a traverse arm **42** having a fulcrum **43** and caused to rock by a heart cam **45.** The rocking movements of the arm **42** are thus transmitted to the builder rail **1** by way of a link which includes the successive lengths of chain **17, 24, 31,** and **38** and also the link member **40.**

The stroke of the traversing movement of the builder rail **1** is thus controlled by the distance from the fulcrum **43** of the point of connection of the link member **40** to the arm **42.** In order to provide an adjustable connection, the arm **42** includes members **51** and **52** which are spanned by a lead screw **53.** This lead screw carries a nut member **54** which has transverse projections **55** capable of sliding in a slot **56** in a member **57** which is connected to the link member **40** at **58.** The combination of the parts **54, 55** and **57** together constitute a connection block by means of which the effective connection point of the link member **40** to the arm **42** can be adjusted in respect of its distance from the fulcrum **43.** The adjustment is effected by an indexing wheel **62** which is fixed to the end of the lead screw **53** and is turned step by step by means of a pawl **64** operated by a pneumatic cylinder **65.** As the connection block constituted by the parts **54, 55** and **57** moves along the lead screw **53,** the chain **38** together with the link member **40** turns about the edge of the winch wheel **36** as centre and rollers **76** on the part **57** run along an arcuate support **77** centred about the centre of the turning arc so that the tension applied to the chain **38** does not apply any loading to the lead screw **53,** but applies the loading directly to the arm **42** by way of the rollers **76** and the supporting surface **77.**

The pneumatic cylinder **65** is of adjustable stroke so that the amount by which the indexing wheel **62** is indexed for each stroke of the cylinder **65** can be adjusted as required. The pneumatic supply to the cylinder **65** passes by way of a change-over valve **70,** in one position of which the supply then passes via valves **71** and **72** to the cylinder **65.** The valves **71** and **72** have projecting triggers shown as **73** and **74** respectively which are operated by a small projection **75** at the left hand end of the lever arm **42.** In other words, as the arm **42** reaches the anti-clockwise limit of its travel, the valve **72** is operated and when it reaches the clockwise limit of its travel the valve **71** is operated, the wheel **62** being indexed by an amount dependent on the adjustment of the pneumatic cylinder **65** for each operation of these valves.

As mentioned above, FIGS. **3** and **5** show the traversing mechanism immediately after it has been reset at the beginning of a set of packages and when the traverse stroke is required to be a maximum. For this purpose the connection point to the arm **42** is towards the

left hand end of the arm so that the distance from the fulcrum **43** is a maximum. As the arm **42** reciprocates under the control of the heart cam **45,** the wheel **62** is progressively indexed under the control of the valves **71** and **72** and the connection block comprising the parts **54, 55** and **57** is progressively moved to the right along the lead screw **53,** thus progressively shortening the traverse stroke. When the packages being wound reach a size ready for doffing, a light **80A** is caused to flash by means of a switch **80** which is engaged by the part **57** as shown in FIG. **1.** This indicates to the operator that doffing should start and the change-over valve **70** is then operated to divert the control from the two valves **71** and **72** to a third valve **82** which is operated by a stud **83** projecting from a wheel **84** driven by a chain **85** from the drive to the heart cam **45.** The heart cam itself is driven from a motor driving pinion **88** and gearing **89, 90, 91, 92, 93** and **94.** It is the wheel **92** in this train of gearing which drives the chain **85.** The rate of revolution of the wheel **92** is chosen so that the rate of indexing of the wheel **62** and hence the rate of reduction of the traverse stroke is considerably increased, e.g. by a factor of 4. As already described, this reduces the taper of the portion of each package which is being built at this stage. For the packages which have not yet been doffed, no advantage is obtained, but for the packages which have been doffed and new packages restarted, this achieves the important advantage already described. It will be understood that at this point the traverse stroke is close to its minimum value so that the initial core portion of each new package will be very short and once the traverse mechanism has been reset to its starting value, the subsequent layers of turns will be wound over the top of this short core portion as shown by the package illustrated in FIG. **5.** It will be seen that although this package is of full length it has a localised central swelling which is constituted by the initial core portion.

As soon as the operator has changed over the rate of reduction of the traverse stroke by operation of the change-over valve **70,** he proceeds to doff the finished packages in a conventional manner and then restart them with all speed.

The spindle S which runs up the center of the stationary package is driven near its base by a belt (not shown). The top of the spindle is slotted to accommodate a correspondingly shaped portion of the flyer during normal running. When the package is full, a brake is applied to the spindle, thus causing the drive belt to slip. Suitable brakes for this purpose are disclosed in British Pats. No. 1,023,935, No. 1,281,806, and No. 1,187,829. The flyer is then simply lifted off the spindle to permit the doffing of the full package and its replacement by an empty package support. The brake is then disengaged from the spindle and normal drive resumed.

Alternatively, the flyer may be mounted on a spindle which is driven through a friction clutch capable of slipping, as described in U.S. Pat. No. 3,559,917. In this case the flyer can easily be stopped by hand, thus causing the clutch to slip while the package is doffed. Meanwhile, the traverse stroke continues to decrease and the member **57** next operates a further switch **95** which operates a further flashing light **95A** to warn the operator that the doffing of the packages should soon be completed since their diameter has reached a size which will soon foul the flyers of the winding heads.

As soon as the last package has been doffed, the pneumatic control is switched back to the two valves **71** and **72** by operation of the change-over valve **70,** thus resetting the indexing of the wheel **62** to its original slower rate. At the same time the operator turns the lead screw **53** by hand to bring the nut **54** back to its original position, i.e., to produce the full traverse stroke, as a result of which the short core portions which have been wound on the package supports are covered by a layer of turns extending for the full traverse length as already described. It will be understood that each short core portion at the start of each new package is wound when the indexing action is under the control of the valve **82,** that is to say at a high rate of reduction of the traverse stroke so as to give a small angle of taper which causes no difficulty during unwinding. This renders it possible to wind the larger packages associated with the type of traversing motion described but without their associated disadvantages.

I claim:

1. In a multihead winding machine for the winding of material delivered from a controlled speed source of supply, having a plurality of winding heads, each said winding head comprising a rotary guide, a non-rotary package support and means for driving said rotary guide around said support; traverse mechanism common to a plurality of winding heads to produce a relative axial traversing motion between each said rotary guide and said respective package support, said traverse mechanism including a lever arm mounted to rock about a fulcrum, means for progressively reducing the stroke of said traversing motion at either of two predetermined rates of reduction, and control means manually operable while said driving means is in operation to change the rate of reduction produced by said stroke reducing means from one of said predetermined rates to the other, whereby the higher of said predetermined rates may be applied during the period of winding when completed packages are being doffed and fresh packages started, said control means comprising a pressure-actuated cylinder connected to actuate said stroke-reducing means and to be actuated through a pneumatic circuit having two branches, a source of fluid pressure, a change-over device whereby said branches may be alternatively connected between said cylinder and said source, one of said branches including first valve means operated by rocking movement of said lever arm, and the other of said branches including second valve means, and means for operating said second valve means more rapidly than said first valve means.

2. A winding machine as claimed in claim **1** in which said traversing mechanism comprises a length of builder rail common to said package supports and through which said traversing motion is applied to said package supports.

3. A winding machine according to claim **2,** in which said traverse mechanism also comprises, cam means for rocking said lever arm about said fulcrum, and a link including one or more lengths of flexible connector, connecting a point on said lever arm to said builder rail, said means for reducing the length of said traverse stroke of said builder rail serving to reduce the distance between said fulcrum of said lever arm and the point of connection to said link.

4. A winding machine according to claim **3** said stroke reducing means including a lead screw extend-

ing along the length of said arm so as to form part of said arm, a connection block in the form of a nut mounted on said lead screw, said connection block serving to connect said link to said arm, an indexing wheel carried by said lead screw, a pawl for turning said indexing wheel through successive angular steps, and said cylinder connected to said pawl for operating said pawl.

5. A winding machine according to claim **4** including first and second warning devices and first and second switches respectively controlling said devices, said switches being mounted alongside said lead screw whereby said connection block operates said first switch and hence said first warning device at a point in its travel corresponding to that at which doffing of the packages should start, and said connection block operates said second switch and hence said second warning device at a further point in its travel when doffing should be completed.

6. In a method for the simultaneous winding of a plurality of packages of elongate material drawn from a controlled speed source of supply, by winding successive layers of said material on a corresponding plurality of stationary supports, starting with an initial layer having a predetermined length and decreasing the length of each successive layer on each support to form ends to each said package having a predetermined taper, doffing said packages successively when complete, and immediately starting the winding of a fresh package on each support when the package thereon has been doffed, the improvement which comprises the steps of simultaneously increasing the rate of decrease of the length of each successive layer for all the packages, when the first package is doffed, so as to reduce the angle of taper formed at the ends of the fresh packages while doffing is taking place, increasing the length of the layer being wound to said predetermined length when all of said packages have been doffed, and then decreasing the rate of decrease in the length of successive layers on each package so as to resume the formation of ends having said predetermined taper.

7. Method as claimed in claim **6** in which said elongate material is a synthetic plastic tape.

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