

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 79300561.2

(51) Int. Cl.²: **B 65 H 59/38**
B 65 H 51/22, B 65 H 54/10

(22) Date of filing: 05.04.79

(30) Priority: 06.04.78 GB 1355678

(43) Date of publication of application:
17.10.79 Bulletin 79/21

(84) Designated Contracting States:
CH DE FR GB IT

(71) Applicant: DU PONT OF CANADA LIMITED
P.O. Box 660
Montreal Quebec, H3C 2V1(CA)

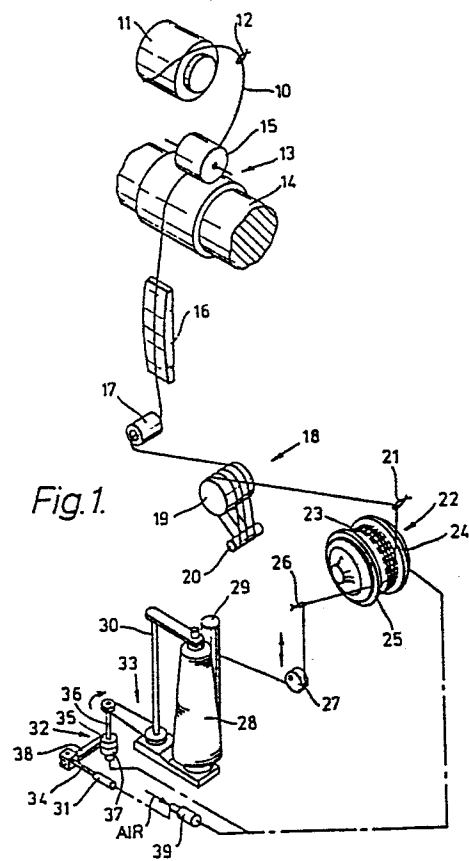
(72) Inventor: Wirsig, Ralph Carl
760 Tacoma Crescent
Kingston Ontario K7M 5C4(CA)

(74) Representative: Ellis, John Clifford Holgate et al,
MEWBURN ELLIS & CO. 70-72 Chancery Lane
London WC2A 1AD(GB)

(54) Method and apparatus for cone winding of yarn from a constant speed source.

(57) A method and apparatus for winding yarn (10) being supplied from a constant speed source directly onto a cone (28) are disclosed. The yarn passes from the source to the cone (28) via a storage device (22), and the speed of rotation of the cone (28) is varied so as to keep the amount of yarn (10) stored within a predetermined range. The storage device (22) includes a drum (23) around which the yarn (10) is wound tangentially and from which the yarn (10) is removed axially. The amount of yarn (10) on the drum (23) is sensed, and the speed of rotation of the cone (28) varied accordingly.

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"Method and apparatus for cone winding of yarn from a
constant speed source"

This invention relates to cone winding of yarns, especially bulked yarns, from a substantially constant speed yarn source e.g. from a false twist texturing device or an air jet texturing device.

5 Bulked yarns i.e. yarns which contain filaments which have been crimped or looped by conventional texturing processes, e.g. by false twist texturing, stuffer box crimp texturing or air jet texturing, may be made from synthetic linear polymers e.g. nylon, polyethylene
10 terephthalate or polypropylene.

In most known processes for the winding on cones of bulked yarns, the yarn is rewound from another yarn package onto the cone so that variations of take-up

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speed between the nose and the base of the cone are automatically compensated for by the varying rate of unwinding from the first package. For a number of years there has existed a need for a method for taking bulked
5 yarn from a substantially constant speed source and winding it up directly on a cone winding device. Recently Z. Wroclawski et al in U.S. Patent 4 019 691, issued April 26, 1977, disclosed a method in which yarn is fed at a constant speed from a work station and is
10 stored temporarily in a transit receptacle comprising an upper yarn holding chamber and a lower suction chamber attached to a source of vacuum. From the transit receptacle the yarn is wound onto a cone at a variable, controlled speed by a drive element which contacts the
15 cone at a point. A momentary degree of filling of the yarn holding chamber is measured and the speed of winding is controlled by displacing the cone to change the position of its point of contact with the driving element in response to the measured degree of filling of yarn in
20 the holding chamber to maintain a substantially constant degree of filling therein. This method has the disadvantage of requiring a considerable consumption of energy to maintain continuously a vacuum in the suction chamber of the transit receptacle.

25 It has now been found that the above disadvantage may be overcome and yarn from a substantially constant speed yarn source may be wound up on a cone winding device by taking the yarn from the constant speed source;

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storing the yarn temporarily on a yarn storage device having a yarn storage drum which is adapted to have the yarn wound tangentially thereon and to have the yarn removed axially therefrom; and feeding the yarn from the
5 yarn storage device to the cone winding device.

Accordingly, the present invention provides a method for winding yarn supplied from a substantially constant speed source onto a cone, in which the yarn is fed from the substantially constant speed source to a
10 yarn storage device, and is wound onto the cone from the yarn storage device, the amount of yarn stored on the yarn storage device being measured and the winding speed of the cone being varied in accordance with the said amount or yarn stored so as to keep the said amount of yarn
15 stored between a predetermined minimum and a predetermined maximum, and the cone being rotated by friction contact with a driven contact drive roller such that the maximum tangential speed of rotation by the cone results in an average speed of take-up of yarn by the cone which is
20 greater than the speed of take-up of yarn by the yarn storage device, and such that minimum tangential speed of rotation by the cone results in an average speed of take-up yarn by the cone which is less than the speed of take-up of yarn by the yarn storage device, characterised in
25 that the yarn storage device is a yarn storage drum rotating at a constant speed and being adapted to have yarn wound tangentially thereon in the form of yarn wraps and to have yarn removed axially therefrom, and the yarn

is wound tangentially thereon and is removed axially therefrom.

In an embodiment of the process of the present invention the contact drive roller is driven by an electric motor. The step of varying the winding speed of the cone may then comprise altering the characteristics of the electric supply to the motor, as for example alternately shutting off and turning on current to the motor driving the contact drive roller, or alternatively alternately reducing and returning to normal the frequency of current to the motor driving the contact drive roller.

In another embodiment of the process of the present invention, the step of varying the winding speed of the cone comprises moving the surface of the cone slightly away from and back to the surface of the contact drive roller.

In yet another embodiment of the process of the present invention, the step of feeding the yarn at a substantially constant speed to the yarn storage device comprises the yarn being drawn from the constant speed source by the yarn storage device.

In yet another embodiment of the process of the present invention, the substantially constant speed source from which the yarn is supplied is a friction false twist texturing device.

In yet another embodiment of the process of the present invention, the substantially constant speed

source from which the yarn is supplied is an air jet texturing device. The air jet texturing device may comprise an air jet mounted midway up an air jet texturing chest, which has a pool of water in its base and an air vent
5 near its top, the yarn being led under the water before it is led up the chest and through the air jet.

The present invention also provides apparatus for winding yarns being supplied from a substantially constant speed source onto a cone in which there are feed means
10 for feeding the yarn from the substantially constant speed source, means for operating the feed means at a substantially constant speed, a yarn storage device, a cone on which to wind the yarn, a surface contact drive roller for rotating the cone, a driving means for rotating the drive
15 roller, a reciprocating transverse means adopted to traverse the yarn to and fro along the length of the cone as the yarn is wound thereon, and means for detecting the amount of yarn stored on the yarn storage device, co-operating with means for varying the speed of rotation of
20 the cone such that the said amount of yarn stored varies between a predetermined maximum and a predetermined minimum, characterised in that the yarn storage device is a rotatably mounted yarn storage drum, there being driving means for rotating the yarn storage drum at a constant
25 speed and a retarding ring encircling the yarn storage drum, the yarn storage drum being adapted to have yarn wound tangentially thereon to form wraps of yarn on the drum, and to have yarn withdrawn axially therefrom under the retarding ring, to remove wraps of yarn from the drum.

In an embodiment of the apparatus of the present invention, the means for feeding the yarn from the substantially constant speed source and the means for rotating the feed means at substantially constant speed
5 comprise the yarn storage drum and its driving means respectively.

In another embodiment of the apparatus of the present invention, the means for detecting the amount of yarn on the storage drum comprises a tilting disc which
10 encircles the storage drum, spaced apart from the retarding ring, and which is spring biased towards a skew position on the storage drum to advance the yarn wraps towards the retarding ring, the angle formed between the
15 tilting disc and a plane perpendicular to the axis of the drum varying inversely with the amount of yarn on the storage drum.

In yet another embodiment of the apparatus of the present invention the driving means for rotating the drive roller comprises an electric motor. The means for
20 varying the speed of rotation of the cone may then comprise means for altering the characteristics of the electric supply to the motor, as for example means for alternately shutting off and turning on current to the
25 motor for rotating the drive roller, or alternatively means for alternately reducing and returning to normal the frequency of current to the motor for rotating the drive roller.

In yet another embodiment of the apparatus of the present invention, the means for varying the speed of

rotation of the cone comprises means to move the cone slightly away from and back to the surface of the contact drive roller, the drive roller being rotated at a constant surface speed adapted to drive the cone at a mean surface speed that is slightly greater than the surface speed of
5 the yarn storage drum.

The term "mean surface speed" as used herein means the surface speed of the cone at one end of the yarn traverse stroke plus the surface speed of the cone at the
10 other end of the yarn traverse stroke all divided by two.

In yet another embodiment of the apparatus of the present invention, the substantially constant speed source from which the yarn is supplied is a false twist texturing device.

15 In yet another embodiment of the apparatus of the present invention, the substantially constant speed source from which the yarn is supplied is an air jet texturing device. The air jet texturing device may comprise an air jet mounted partway up a substantially vertical
20 air jet texturing chest, the chest comprising a chest cover, a back plate and a water pan, the chest cover being open at its bottom, closed at its top and open at its back to form two vertical back edges therein, the back edges being slideably mounted in the back plate directly
25 over the water pan such that the chest cover is adapted to be moved from an up or open position to a closed or operating position in which the open bottom of the chest cover rests in the water pan, an overflow drain in the water pan, a water inlet through the back plate above the

water pan, an air inlet connected through the back plate to the air jet, an air vent through the back plate near the top of the chest cover, yarn inlet and outlet slots through the water pan and the chest cover above the overflow drain in the water pan, and guide means to conduct the yarn from the inlet slot to a point in the pan below the overflow drain, up the chest from the point below the overflow drain to the jet, and down the chest from the jet to the outlet slot.

10 Embodiments of the present invention will be described in greater detail with the aid of the accompanying drawings in which :

Fig. 1 is a schematic representation of one embodiment of the present invention in which bulked yarn from a constant speed source is wound on a cone, the constant speed source being a friction false twist texturing device;

Fig. 2 is a schematic representation of another embodiment of the present invention in which bulked yarn from a constant speed source is wound on a cone, the constant speed source being an air jet texturing device mounted in an air jet texturing chest;

Fig. 3 is a plan view partially in section of the air jet texturing chest shown in Fig. 2; and

25 Fig. 4 is a sectional view of the air jet texturing chest of Fig 3 viewed in the direction of arrows 4-4.

Referring now to Fig. 1, one embodiment of the process of the present invention will be described. Undrawn or partially drawn multifilament yarn 10 is pulled from a supply package 11 over a yarn guide 12 by feed roll assembly 13, comprising a feed roll 14 and a cot roll 15. From the feed roll assembly 13 the yarn passes to a false twist texturing and drawing stage comprising a heater plate 16, a friction false twist texturing device 17 and a draw roll assembly 18 comprising a draw roll 19 and a separator roll 20. From the draw roll assembly 18, the false twist textured and drawn yarn i.e. bulked yarn passes over a yarn guide 21 to a yarn storage device 22 which comprises a yarn storage drum 23 which is rotated at constant speed by a driving means (not shown). The yarn is wound tangentially on storage drum 23 to form wraps of yarn thereon. A tilting disc 24, which encircles storage drum 23, and which is spring biased towards a skew position thereon tends to advance the yarn wraps along the storage drum 23. An increase in the amount of yarn wraps on storage drum 23 straightens the position of tilting disc 24 (against the spring) such that the angle formed between the tilting disc 24 and a plane perpendicular to the axis of storage drum 23 varies inversely with the amount of yarn wraps on storage drum 23. Yarn is withdrawn axially from storage drum 23 under a retarding ring 25, which provides tension in the yarn.

From the storage device 22, the yarn passes through a yarn guide 26, around an eccentrically mounted rotatable disc 27 and is wound on cone package 28 which is driven

by a contact drive roller 29. Preferably the contact drive roller 29 has a conical surface with a taper angle substantially the same as that of the cone on which cone package 28 is formed. The eccentrically mounted rotatable disc 27 is positioned on a reciprocating traverse means (not shown) which is adapted to traverse the yarn to and fro along the length of the cone package 28 as the yarn is wound thereon. The reciprocating traverse means has a stroke length which decreases as the package 28 builds to form a tapered package. Such a reciprocating traverse means is described in United States Patent No. 4 085 903. The eccentrically mounted rotatable disc 27 imparts a vibratory motion and a sinusoidal pattern to the yarn being wound on the cone package 28 and thus improves the take-off characteristics of the yarn from the cone package 28. It will be appreciated that a reciprocating traverse means other than that described in the aforementioned Patent may be used and that it is not necessary to include the eccentrically mounted rotatable disc 27.

Cone package 28 is supported by a support frame 30 which is rotatable about its shaft. Support frame 30 is spring loaded to hold cone package 28 against contact drive roller 29 with substantially constant force over the full range of package formation. The support frame 30 is adapted to be periodically rotated in a direction opposing the spring by an air cylinder 31, a magnetic clutch system 32 and a sprocket chain system 33. Air cylinder 31 is of a spring return, single acting type and has an air cylinder shaft 34. The travel of air

cylinder shaft 34 is limited by an adjustable mechanical stop (not shown). Magnetic clutch system 32 comprises magnetic clutch upper part 35 which is rotatably mounted on clutch shaft 36 and lower magnetic clutch part 37 which
5 is rigidly connected to clutch shaft 36. Arm 38 is rigidly connected to magnetic clutch upper part 35. Air cylinder shaft 34 is connected to arm 38, one sprocket of sprocket chain system 33 is rigidly connected to clutch shaft 36 and the other sprocket is rigidly connected to
10 the shaft of support frame 30. Air cylinder 31 is connected to an air supply through a solenoid switch 39, which is connected electrically to a microswitch (not shown) inside the storage drum 23. The microswitch is also connected electrically to the magnetic clutch system
15 32 and mechanically to tilting disc 24.

In operation, the contact drive roller 29 is set to operate at a speed such that the average wind-up speed on cone package 28 (i.e. the mean surface speed of cone package 28) is slightly greater than the surface speed of
20 yarn storage drum 23. With this arrangement, the amount of yarn wraps present on storage drum 23 gradually reduces and the angle formed between the tilting disc 24 and a plane perpendicular to the axis of the storage drum 23 increases. When the angle reaches a predetermined maxi-
25 mum the microswitch trips on. With the microswitch on: (1) an electrical signal is immediately sent to lock magnetic clutch upper part 35 to magnetic clutch lower part 37; and (2) after a time delay (induced electronically by means not shown), an electrical signal is sent

to solenoid switch 39 to supply air to air cylinder 31. When air is supplied to air cylinder 31, air cylinder shaft 34 is extended by an amount limited by the mechanical stop. This extension of air cylinder shaft 34 by means of arm 38, clutch shaft 36, sprocket chain system 33 and support frame 30 causes cone package 28 to move slightly away from contact drive roller 29 and hence causes the winding speed of cone package 28 to decrease. As the winding speed decreases the amount of wraps present on storage drum 23 increases and the angle formed between the tilting disc 24 and a plane perpendicular to the axis of storage drum 23 decreases. When the angle reaches a predetermined minimum, the microswitch trips off. With the microswitch off; (1) magnetic clutch upper part 35 is disengaged from magnetic clutch lower part 37 thus permitting the cone package 28 to return to contact with contact drive roller 29; and (2) air cylinder shaft 34 returns to a non-extended position. The above sequence then repeats to give control to the process.

It will be appreciated that with the above described control system the distance which cone package 28 is moved away from contact drive roller 29 is constant (for a given setting of the adjustable mechanical stop on air cylinder shaft 34) and independent of the size of cone package 28.

Optionally the electrical signal from the microswitch when in the on position, may be interrupted in a pulsating fashion by adding appropriate electronics (not shown) to the electrical circuit. This pulsating

electrical signal feature is a means for moderating, and controlling the rate at which the cone package 28 slows down (and thus the rate at which the inventory of yarn on the yarn storage drum 23 increases). In addition with
5 such a pulsating electrical signal feature, there is less disturbance of the laydown pattern of the yarn on cone package 28.

In another embodiment of the present invention, the wind up speed of cone package 28 is varied by alternately
10 shutting off and turning on power to the motor driving contact drive roller 29. Such an embodiment is useful with commercial winding machines which have an individual motor for each contact drive roller. In this embodiment the microswitch inside storage drum 23 trips on and off
15 as described above in response to the amount of yarn wraps on storage drum 23. When the microswitch trips on an electrical signal is sent to shut off power to the motor driving contact drive roller 29 and when the microswitch trips off a signal is sent to turn on power to the motor.
20 It will be appreciated that the electrical signal from the microswitch when in the on position may be interrupted in a pulsating fashion as described above to moderate and control the rate at which the cone package 28 slows down. It will also be appreciated that an electrical signal
25 from the microswitch when in the on position may be used to modify the current to the motor driving the contact drive roller 29 (in such a manner as to drive the motor at a slower speed) instead of to shut the current off completely.

Referring now to Fig. 2, another embodiment of the present invention will be described. Undrawn or partially drawn multifilament yarn 60 is pulled from a supply package 61 over a yarn guide 62 by feed roll assembly 63, comprising a feed roll 64 and a cot roll 65. From the feed roll assembly 63 the yarn passes to a draw roll assembly 66, comprising a draw roll 67 and a separator roll 68. Draw roll 67 may be a stepped roll as shown with a large diameter surface and a somewhat smaller diameter surface or it may be a "non-stepped" roll with a constant diameter over its entire length. The yarn from feed roll assembly 63 passes around the large diameter surface of draw roll 67, over a heater plate 69, around a change-of-direction roll 70 and back to the smaller diameter surface of draw roll 67. Use of the stepped draw roll 67 in this manner as compared with a non-stepped draw roll causes greater relaxation of the yarn 60 to take place as it passes over heater plate 69. From the smaller diameter surface of draw roll 67, the yarn 60 passes to an air jet texturing chest 71.

Details of the air jet texturing chest 71 may be seen in Fig. 3 and Fig. 4. Air jet texturing chest 71 comprises a chest cover 100, a back plate 101, and a water pan 102. An air jet 103 (see Fig. 3) is positioned mid-way up air jet texturing chest 71. Chest cover 100 is closed at its top, open at its bottom and open at its back to form two vertical back edges 104 therein. The back edges 104 are slideably mounted in back plate 101 in two slots 105. Chest cover 100 is positioned directly

over water pan 102 such that the chest cover is adapted to be moved from an up or open position to a closed or operating position in which the open bottom of the chest cover rests in the water pan 102. A water overflow
5 drain 106 is provided in water pan 102. Through the back plate 101 are provided: (1) a water inlet 107 above the water pan; (2) an air inlet 108 connected to air jet 103; and (3) an air vent 109 near the top of the chest cover 100. Yarn inlet slots 110 and 111 and yarn outlet slots
10 112 and 113 are provided through the water pan 102 and chest cover 100, respectively. The yarn 60 enters the air jet texturing chest 71 through slots 110 and 111 and is conducted under the surface of the water in the water pan 102 by an adjustable guide 114. The yarn then passes
15 up the chest to air jet 103, through air jet 103, down the chest to a yarn guide 115 which conducts it out of the air jet texturing chest 71 through outlet slots 112 and 113. Slots 110 and 112 also serve as yarn guides.

Referring again to Fig. 2, the yarn 60 leaving air
20 jet texturing chest 71 passes over a yarn guide 72 to a yarn storage device 73, which comprises a yarn storage drum 74 which is rotated at a constant speed by a driving means (not shown). The yarn 60 is wound tangentially on storage drum 74 to form wraps of yarn thereon. The
25 storage drum 74 operates at a surface speed in the range of from about 12 percent to about 30 percent, and preferably in the range of from about 18 percent to about 25 percent, slower than the surface speed of the smaller diameter surface of draw roll 67 in order to allow the

yarn 60 to become fully textured in the air jet texturing chest 71. A tilting disc 75 which encircles storage drum 74, and which is spring biased towards a skew position thereon tends to advance the yarn wraps along the storage drum 74. An increase in the amount of yarn wraps on storage drum 74 straightens the position of tilting disc 75 (against the spring) such that the angle formed between the tilting disc 75 and a plane perpendicular to the axis of storage drum 74 varies inversely with the amount of yarn wraps on storage drum 74. Yarn is withdrawn axially from storage drum 74 under a retarding ring 76, which provides tension in the yarn.

From storage device 73, the yarn 60 passes through a yarn guide 77 around an eccentrically mounted rotatable disc 78 and is wound on cone package 79 which is driven by a contact drive roller 80. Preferably the contact drive roller 80 has a conical surface with a taper angle substantially the same as that of the cone on which cone package 79 is formed. The eccentrically mounted rotatable disc 78 is positioned on a reciprocating traverse means (not shown) which is adapted to traverse the yarn to and fro along the length of the cone package 79 as the yarn is wound thereon. The reciprocating traverse means has a stroke length which decreases as the package 79 builds to form a tapered package. Such a reciprocating traverse means is described in aforementioned United States Patent No. 4 085 903. The eccentrically mounted rotatable disc 78 imparts a vibratory motion and a sinusoidal pattern to the yarn being wound on the cone package

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79 and thus improves the take-off characteristics of the yarn from the cone package 79. It will be appreciated that a reciprocating traverse means other than that described in the aforementioned Patent may be used and that
5 it is not necessary to include the eccentrically mounted rotatable disc 78.

Cone package 79 is supported by a support frame 81 which is rotatable about its shaft. Support frame 81 is spring loaded to hold cone package 79 against contact
10 drive roller 80 with substantially constant force over the full range of package formation. The support frame 81 is adapted to be periodically rotated in a direction opposing the spring by an air cylinder 82, a magnetic clutch system 83 and a sprocket and chain system 84.
15 Air cylinder 82 is a spring return, single acting type having an air cylinder shaft 85. The travel of air cylinder shaft 85 is limited by an adjustable mechanical stop (not shown).

Magnetic clutch system 83 comprises magnetic
20 clutch upper part 86 which is rotatably mounted on clutch shaft 87 and lower magnetic clutch part 88 which is rigidly connected to clutch shaft 87. Arm 89 is rigidly connected to magnetic clutch upper part 86. Air cylinder shaft 85 is connected to arm 89, one sprocket of sprocket
25 chain system 84 is rigidly connected to clutch shaft 87 and the other sprocket is rigidly connected to the shaft of support frame 81. Air cylinder 82 is connected to an air supply through a solenoid switch 90, which is connected electrically to a microswitch (not shown) inside

the storage drum 74. The microswitch is also connected electrically to the magnetic clutch system 83 and mechanically to tilting disc 75.

In operation, the contact drive roller 80 is set
5 to operate at a speed such that the average wind-up speed on cone package 79 (i.e. the mean surface speed of cone package 79) is slightly greater than the surface speed of yarn storage drum 74. With this arrangement, the amount of yarn wraps present on storage drum 74
10 gradually reduces and the angle formed between the tilting disc 75 and a plane perpendicular to the axis of the storage drum 74 increases. When the angle reaches a predetermined maximum the microswitch trips on. With the microswitch on: (1) an electrical signal is immediately
15 sent to lock magnetic clutch upper part 86 to magnetic clutch lower part 88; and (2) after a time delay (induced electronically by means not shown), an electrical signal is sent to solenoid switch 90 to supply air to air cylinder 82. When air is supplied to air
20 cylinder 82, air cylinder shaft 85 is extended by an amount limited by the mechanical stop. This extension of air cylinder shaft 85 by means of arm 89, clutch shaft 87, sprocket chain system 84 and support frame 81 causes cone package 79 to move slightly away from contact drive
25 roller 80 and hence causes the winding speed of cone package 79 to decrease. As the winding speed decreases the amount of wraps present on storage drum 74 increases and the angle formed between the tilting disc 75 and a plane perpendicular to the axis of storage drum 74

decreases. When the angle reaches a predetermined minimum, the microswitch trips off. With the microswitch off: (1) magnetic clutch upper part 86 is disengaged from magnetic clutch lower part 88 thus permitting the cone package 79 to return to contact with contact drive roller 80; and (2) air cylinder shaft 85 returns to a non-extended position. The above sequence then repeats to give control to the process. The electrical signal may pulsate, as described above with reference to the embodiment of Fig. 1.

The present invention is illustrated by the following examples.

EXAMPLE 1.

A 283 dtex - 68 filament polyester feed yarn was textured and drawn in a false twist texturing and drawing stage and wound up continuously on a cone package. The feed yarn had been spun from molten polyethylene terephthalate and wound up at a speed of 3110 metres/min and hence was partially oriented (drawn), having a break elongation of about 140 percent. The apparatus used to draw, texture and wind the yarn was similar to that shown in Fig. 1 and described hereinabove. The yarn storage device 22 was similar to that described in U.S. Patent 3 648 939 (for feeding yarn to a knitting machine) and available from AB IRO, Box 54, 52301 Ulricehamn, Sweden as Model No.8006. The storage device 22 was modified as follows to permit it to feed yarn to the cone wind up facilities: (1) the eyelet yarn guides were replaced by pigtail guides to permit string-up of a moving thread

line; (2) the inlet yarn guide 21 was moved closer to the surface of the storage drum 23 to prevent retarding ring 25 from falling off the storage drum 23 during string-up; (3) the outlet yarn guide 26 was modified to
5 make it swingable, at its mounting, from an axial position to a position outside the surface of storage drum 23 to facilitate yarn string-up and to permit initial wraps, applied manually with a yarn pick, or automatically, if the tension of the yarn downstream of the storage device
10 22 is reduced, to be retained on the storage drum 23 against the relatively high downstream yarn tension provided by the yarn string-up gun; (4) the electric motor drive for storage drum 23 was replaced by a pulley driven by an external variable speed source; and (5) the on-off
15 microswitch positioned at the mounting of tilting disc 24 which was originally adapted to shut off power to the motor driving storage drum 23 when the angle formed between the tilting disc 24 and a plane perpendicular to the axis of storage drum 23 reached a predetermined minimum. i.e. the
20 number of yarn wraps on storage drum 23 reached a predetermined maximum, was modified to actuate air cylinder 31, magnetic clutch system 32 and sprocket chain system 33 to move cone package 28 slightly away from the surface of contact drive roller 29 when the angle reaches a pre-
25 determined maximum i.e. the number of yarn wraps on storage drum 23 reaches a predetermined minimum. The feed rate of the feed yarn from feed roll assembly 13 was 201 metres/min. Heater plate 16 had a length of 101 cm and was operated at a temperature of 200°C. False twist

texturing device 17 was operated at a speed of 18000r/min. Draw roll assembly 18 was operated at a speed of 350 metres/min to give a draw ratio of 1.74. Yarn storage drum 23 was operated at a speed of 335 metres/min so that the overfeed from draw roll assembly 18 to yarn storage device 22 was about 4.3 percent. Contact drive roller 29 was operated at a surface speed about 1 percent higher than that required to maintain a constant average number of yarn wraps on yarn storage drum 23, when averaged over a period which is long compared with the time taken for disc 27 to make one traverse. The yarn was wound up on a paper cone which had the following dimensions: top diameter 4.45 cm; bottom diameter 6.19 cm; height 34.0 cm; and a cone taper of about $1\frac{1}{2}^{\circ}$. The hardness of the package produced was quite uniform ranging from a Shore Type T-2 hardness of 42 at the top of the cone to 39 at the bottom of the cone.

EXAMPLE II

A 283 dtex - 68 filament polyester feed yarn was textured and drawn in a false twist texturing and drawing stage and wound up continuously on a cone package. The feed yarn had been spun from molten polyethylene terephthalate and wound up at a speed of 3110 metres/min and hence was partially oriented (drawn), having a break elongation of about 140 percent. The apparatus used to draw, texture and wind the yarn was similar to that shown in Fig. 1 and described hereinabove except that draw roll assembly 18 was positioned in front of heater plate 16 and friction false twist texturing device 17, such that

The yarn was first drawn and then false twist textured, the textured yarn being fed directly from friction false twist texturing device 17, over a yarn guide to yarn storage device 22. The yarn storage device 22 was the same as that used in Example I and had the same modifications made thereto. The feed rate of the feed yarn from feed roll assembly 13 was 188 metres/min. Draw roll assembly 18 was operated at a speed of 338 metres/min to give a draw ratio of 1.8. Heater plate 16 had a length of 61 cm and was operated at a temperature of 220°C. False twist texturing device 17 was operated at a speed of 18000 r/min. Yarn storage drum 23 was operated at a speed of 340 metres/min. Contact drive roller 29 was operated at a surface speed about 1 percent higher than that required to maintain a constant average number of yarn wraps on yarn storage drum 23, when averaged over a period which is long compared with the time taken for disc 27 to make one traverse. The yarn was wound up on a cone which had the following dimensions: base diameter 7.15 cm; cone length 29.2 cm; and cone taper $3\frac{1}{2}^\circ$. The package produced was a double taper conical package, which had a uniform package hardness i.e. the Shore Type T-2 hardness was 50 ± 2 throughout the length of the package.

25

EXAMPLE III

A 283 dtex - 68 filament polyester feed yarn was drawn in a drawing stage, air jet textured in an air jet texturing stage and wound up on a cone package in a continuous process. The feed yarn had been spun from

molten polyethylene terephthalate and wound up at a speed of 3110 metres/min and hence was partially oriented (drawn) having a break elongation of about 140 percent. The apparatus used to draw, air jet texture and wind the yarn was similar to that shown in Fig. 2, Fig. 3 and Fig. 4 and described hereinabove. The yarn storage device 73 was the same as yarn storage device 22 (Fig. 1) employed in Example 1 and had the same modifications made thereto. The feed rate of the feed yarn 60 from feed roll assembly 63 was 240 metres/min. Draw roll assembly 66 was operated with the large diameter surface of draw roll 67 at a speed of 408 metres/min to give a draw ratio of 1.70. The smaller diameter surface of draw roll 67 was not used i.e. the yarn passed around change-of-direction roll 70 and back to the large diameter surface of draw roll 67. Heater plate 69 had a length of 61 cm and was operated at a temperature of 200°C. Air jet 103 was operated with an air pressure of 1200 kPa. Yarn storage drum 74 was operated at a speed of 336 metres/min so that the overfeed to the air jet 103 was 21.4 percent. Contact drive roller 80 was operated at a surface speed about 1 percent higher than that required to maintain a constant average number of yarn wraps on yarn storage drum 74, when averaged over a period which is long compared with the time taken for disc 78 to make one traverse. The windup tension before eccentrically mounted rotatable disc 78 was approximately 21 g. The yarn was wound up on a cone which had the following dimensions: base diameter 7.15 cm; cone length 29.2 cm; and cone taper $3\frac{1}{2}^{\circ}$. The package

produced was a double taper conical package with a base diameter of 14 cm. The hardness of the package was very uniform i.e. the Shore Type T-2 hardness was 28 ± 1 throughout the length of the package.

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CLAIMS :

1. A method for winding yarn supplied from a substantially constant speed source onto a cone, in which the yarn is fed from the substantially constant speed source to a yarn storage device, and is wound onto the
5 cone from the yarn storage device, the amount of yarn stored on the yarn storage device being measured and the winding speed of the cone being varied in accordance with the said amount of yarn stored so as to keep the said amount of yarn stored between a predetermined minimum
10 and a predetermined maximum, and the cone being rotated by friction contact with a driven contact drive roller such that the maximum tangential speed of rotation by the cone results in an average speed of take-up of yarn by the cone which is greater than the speed of take-up
15 of yarn by the yarn storage device, and such that minimum tangential speed of rotation by the cone results in an average speed of take-up yarn by the cone which is less than the speed of take-up of yarn by the yarn storage device, characterised in that the yarn storage device
20 is a yarn storage drum rotating at a constant speed and being adapted to have yarn wound tangentially thereon in the form of yarn wraps and to have yarn removed axially therefrom, and the yarn is wound tangentially thereon and is removed axially therefrom.

2. A method according to claim 1 wherein the feeding of the yarn from the substantially constant speed source to the yarn storage device comprises the yarn being drawn from the substantially constant speed source by the yarn storage device.

3. Apparatus for winding yarns being supplied from a substantially constant speed source onto a cone in which there are feed means for feeding the yarn from the substantially constant speed source, means for operating the feed means at a substantially constant speed, a yarn storage device, a cone on which to wind the yarn, a surface contact drive roller for rotating the cone, a driving means for rotating the drive roller, a reciprocating transverse means adopted to traverse the yarn to and fro along the length of the cone as the yarn is wound thereon, and means for detecting the amount of yarn stored on the yarn storage device, co-operating with means for varying the speed of rotation of the cone such that the said amount of yarn stored varies between a predetermined maximum and a predetermined minimum, characterised in that the yarn storage device is a rotatably mounted yarn storage drum, there being driving means for rotating the yarn storage drum at a constant speed and a retarding ring encircling the yarn storage drum, the yarn storage drum being adapted to have yarn wound tangentially thereon to form wraps of yarn on the drum, and to have yarn withdrawn axially therefrom under the retarding ring, to remove wraps of yarn from the drum.

4. Apparatus according to claim 3 wherein the said feed means for feeding the yarn from the said source and the said means for operating the said feed means comprise the yarn storage drum and its driving means, respectively.

5 5. The apparatus according to claim 3 or claim 4 wherein the means for detecting the amount of yarn on the storage drum comprises a tilting disc which encircles the storage drum, spaced apart from the retarding ring, and which is spring biased towards a skew position on
10 the storage drum to advance the yarn wraps toward the retarding ring, the angle formed between the tilting disc and a plane perpendicular to the axis of the drum varying inversely with the amount of yarn wraps on the storage drum.

15 6. A method according to either of claims 1 and 2 or apparatus according to any of claims 3 to 5, wherein the contact drive roller has drive means for rotating it which include an electric motor.

20 7. A method or apparatus according to claim 6 wherein the variation of the winding speed of the cone is achieved by the operation of means which alter the characteristics of the electric supply to the said electric motor.

25 8. A method according to any of claims 1, 2 and 6 or apparatus according to any of claims 3 to 6, wherein the contact drive roller is rotated at a constant speed, so as to drive the cone at a surface speed which causes an average speed of take-up of yarn on the cone which is slightly greater than the speed of take-up of yarn by the storage drum, the variation of the winding speed of

the cone being achieved by the operation of means which move the cone slightly away from the roller, and back again.

9. A method according to any of claims 1, 2 and 6 to 5 8, or apparatus according to any of claims 3 to 8, wherein the said substantially constant speed source is a friction false twist texturing device.

10. A method according to any of claims 1, 2 and 6 to 8 or apparatus according to any of claims 3 to 8, 10 wherein the said constant speed source is an air jet texturing device.

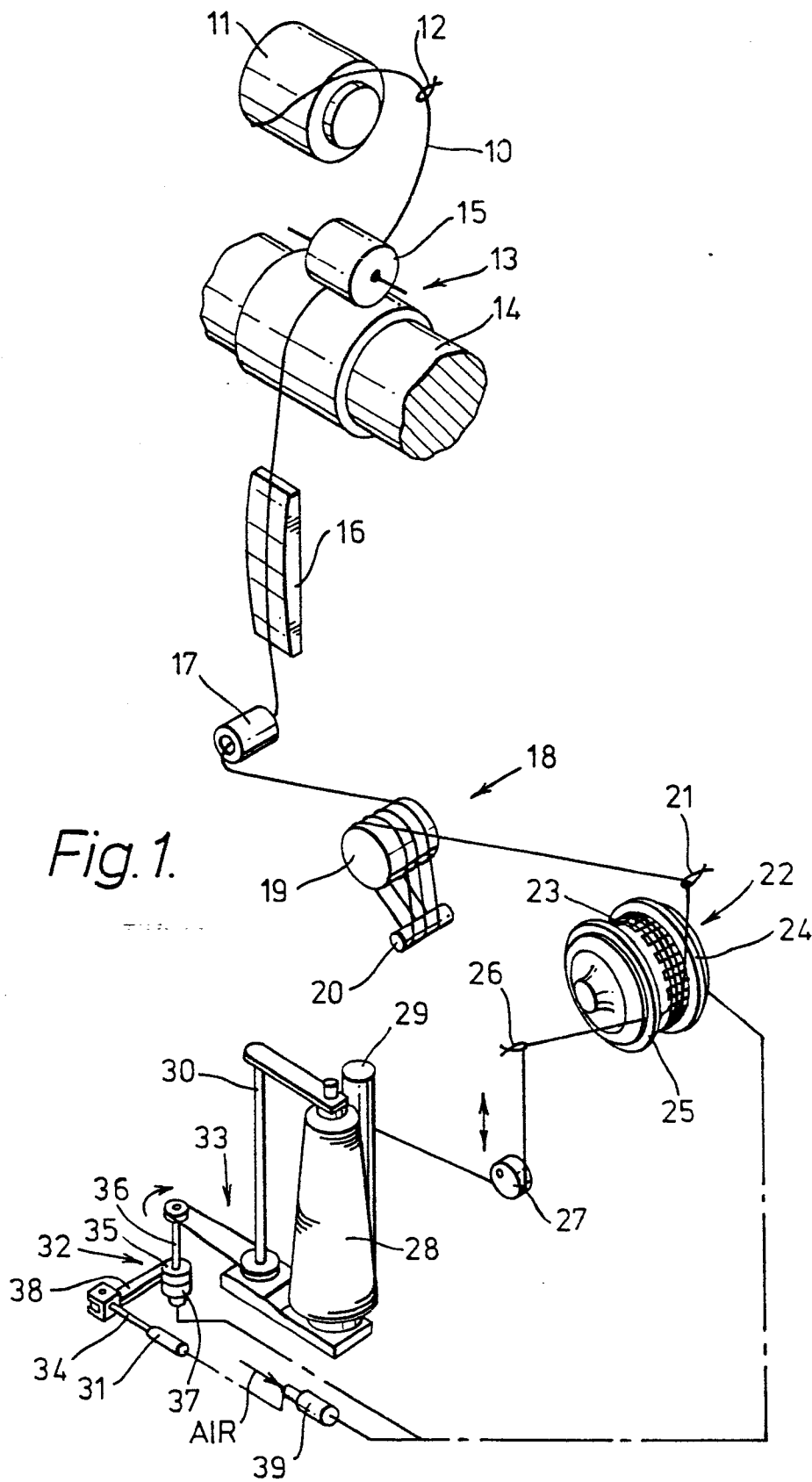
11. A method according to claim 10, wherein the air jet texturing device comprises an air jet mounted midway up an air jet texturing chest, the chest having a pool 15 of water in its base and an air vent near its top, and wherein the yarn is led under the water before it is led up the chest and through the air jet.

12. Apparatus according to claim 10, wherein the air jet texturing device comprises an air jet mounted part- 20 way up a substantially vertical air jet texturing chest, the chest comprising a chest cover, a back plate and a water pan,

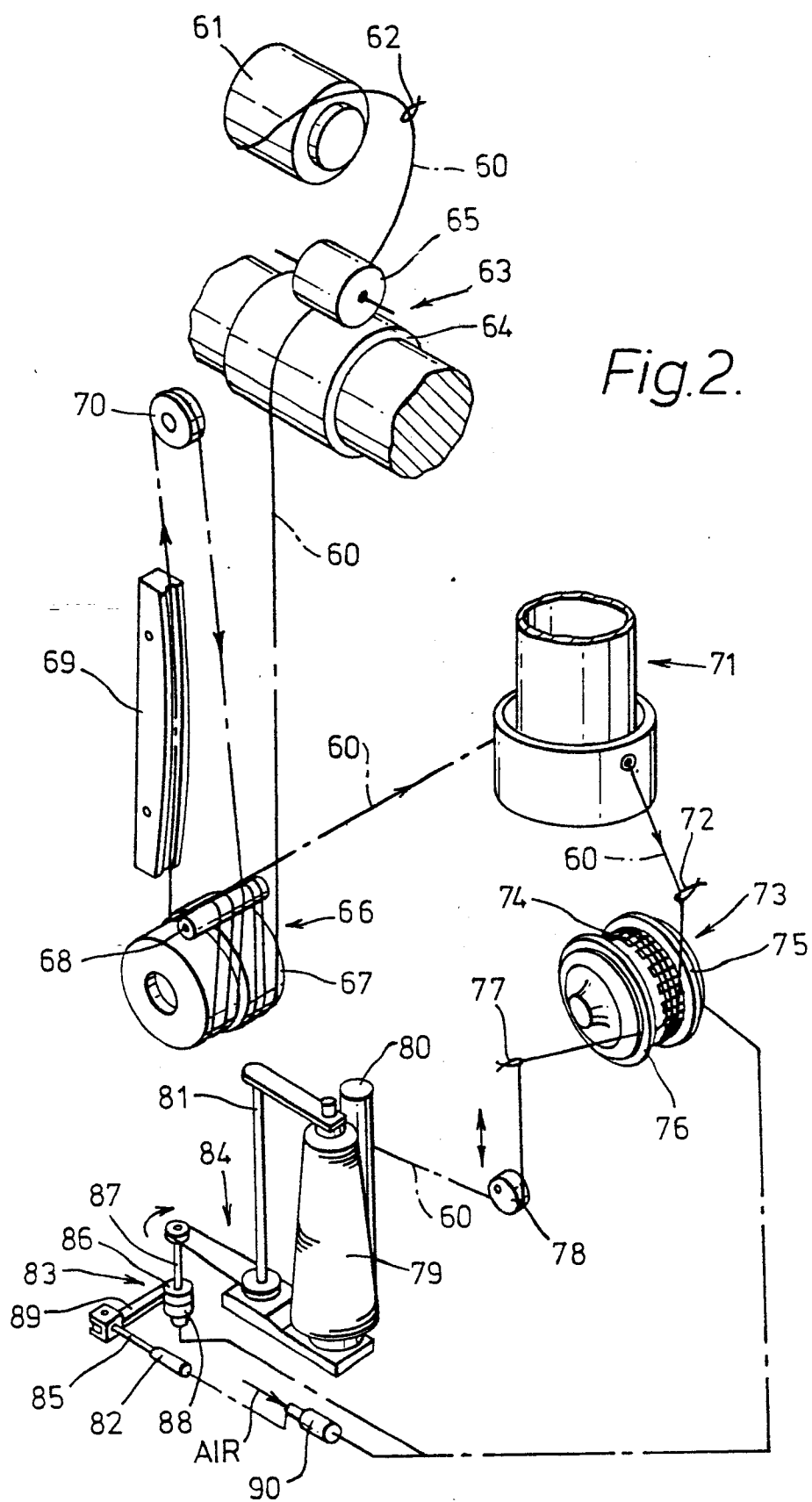
the chest cover being open at its bottom, closed at its top and open at its back to form two vertical 25 back edges therein, the back edges being slideably mounted in the back plate directly over the water pan such that the chest cover is adapted to be moved from an up or open position to a closed or operating position in which the open bottom of the chest cover

- rests in the water pan,
an overflow drain in the water pan,
a water inlet through the back plate above the water pan,
an air inlet connected through the back plate to the air
5 jet,
an air vent through the back plate near the top of the
chest cover, yarn inlet and outlet slots through the water
pan and chest cover above the overflow drain in the water
pan, and
10 guide means to conduct the yarn from the inlet slot to a
point in the pan below the overflow drain, up the chest
from the point below the overflow drain to the jet and
down the chest from the jet to the outlet slot.

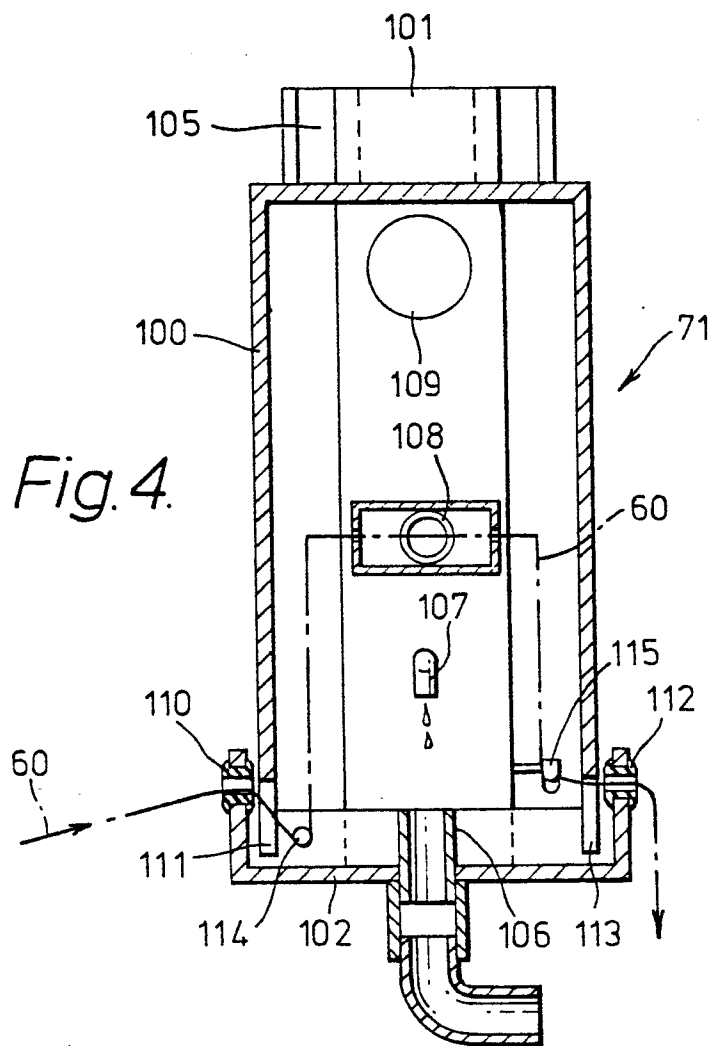
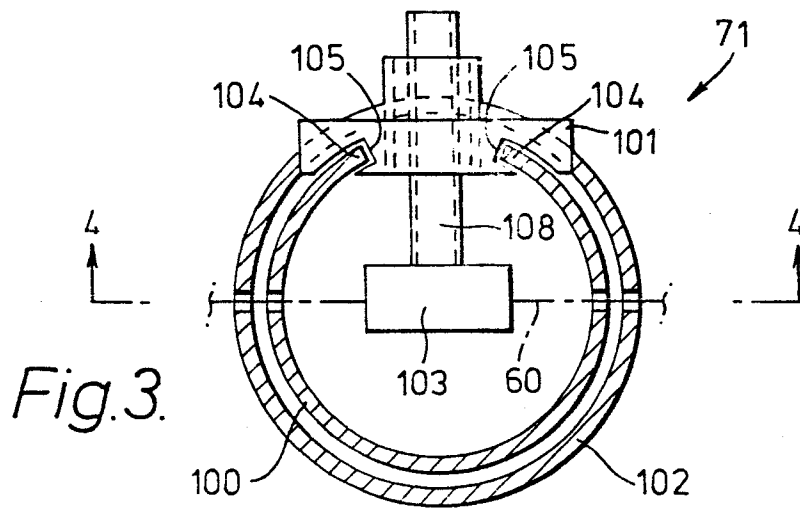
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DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
	<u>DE - A - 2 532 909</u> (BERLINER MASCHINEN-BAU) * page 10, lines 12 to 20; fig. 1 *	1-4	B 65 H 59/38 B 65 H 51/22 B 65 H 54/10
	<u>US - A - 4 019 691</u> (WROCLAWSKI et al.) * column 5, lines 17 to 21 *	1,3	
	<u>DE - A - 1 760 600</u> (ROSEN) * fig. 3,5,8 *	5	TECHNICAL FIELDS SEARCHED (Int.Cl. ³)
	<u>DE - A - 2 353 820</u> (MONSANTO) * page 6, lines 9 to 15 *	9	B 65 H 51/00 B 65 H 54/00 B 65 H 59/00
	<u>US - A - 3 743 202</u> (HOFFSOMMER et al.) * claim 1 *	10	D 02 G 1/00 D 03 D 47/36 D 04 B 15/48
	<u>DE - A - 2 534 234</u> (E.I. DU PONT) * page 5 *	11	
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document
☒	The present search report has been drawn up for all claims		
Place of search	Date of completion of the search	Examiner	
Berlin	21-06-1979	BITTNER	