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(54) Improvements in spooling equipment and method of winding wire onto cored spools.

(57) A method and equipment for securing cut wire ends on-the-fly to respective full and empty spools which employs a length of adhesive tape drawn from tape-dispensing units (5, 8) for automatically taping the leading wire end to an empty spool (11b) and the trailing end to wire wound on the full spool (11a).

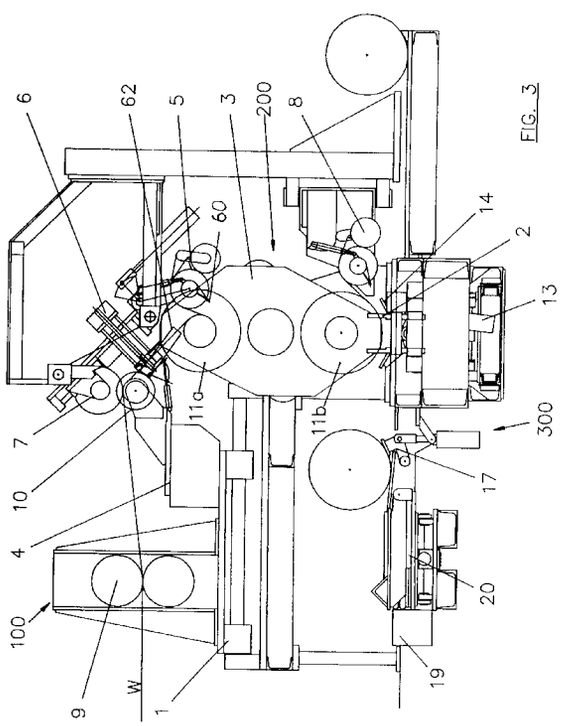

FIG. 3

EP 0 527 047 A1

This invention relates to spooling equipment used for continuously winding filamentary material such as rod or wire (herein for convenience referred to as "wire") in a plurality of layers helically onto spools, each spool having at least a core on which the first layer is wound and preferably also flanking flanges between which the first and all subsequent layers lie.

The output of wire processing equipment is commonly "batched" onto spools presented one after the other at the output end of the equipment, the output wire being transferred from a full spool to a new spool in as continuous a manner as possible to ensure a minimum of disruption in the upstream wire processing. The spooling equipment would normally include automatic means for supplying new spools as required and for removing full spools as they are filled.

Examples of known continuous automatic spooling equipment can be found in GB-A-1152698, GB-A-1367513 and GB-A-1538899. One problem with known continuous automatic spooling equipment resides in the mechanism provided to secure one end of the wire, following cutting thereof, to the full spool and the other end of the cut wire to the core of the following new spool. This invention relates to a simple and reliable method of providing such wire end securements which can be undertaken "on the fly" (i.e. without reducing the output speed of the wire leaving the upstream processing equipment to zero).

Expressed in terms of a method, the present invention relates to a method of continuously winding wire onto cored spools which method comprises filling one spool and then cutting the wire to leave upstream and downstream wire ends on either side of the cut, leading the upstream wire end to a new spool and the downstream wire end to the one spool, which method is characterised in that at least one of the upstream and downstream wire ends is/are secured with adhesive tape respectively to the core of the new spool and/or to the one spool or to the wire wound thereon.

Preferably adhesive tape is used to secure each wire end to the respective spool.

Suitably the tape used is a flexible tape coated on one side with a self-adhesive material, the tape being wound on a reel with the adhesively coated side facing towards the centre of the reel. A plastics tape (e.g. such as that known by the Trade Mark "SELLOTAPE") of a width which is at least 10 times the diameter of the wire is preferred. Tape widths of between thirty and one hundred times the wire diameter are particularly preferred. Suitably tape is applied over more than one quarter of a revolution of the spool and desirably tape is applied over at least one revolution. In the case of securing the trailing wire end to a full spool, typically tape lengths in excess of one revolution, say between two and three revolutions can be used.

Preferably a measured length of wire is wound on each empty spool, passage of the required measured length being used to trigger a spool change operation.

Preferably two separately operable tape-dispensing units are used, one to secure the trailing (i.e. downstream) wire end to the full spool and the other to secure the leading (i.e. upstream) wire end to the new spool, each tape-dispensing unit including a tape reel holder, a tape pressure unit (e.g. a roller) and a tape cutter.

Desirably the input end of the spooling equipment includes a traverse table supporting both a pair of pinch rolls (between which rolls the wire passes) and a wire layering unit used to form the wire helically in layers on the core or on a layer of wire on the core. Preferably means is provided to close the nip between the pinch rolls onto the wire in a withdrawn position of the traverse table and to hold the nip closed during at least part of the advance of the traverse table back towards the full spool. Desirably the layering unit includes one roll of a pair, the other roll of the pair being a pusher roll forming part of a push roll assembly.

Each tape-dispensing unit desirably comprises a support for a reel of adhesive tape, a tape pressure wheel having a soft resilient peripheral surface against which the non-adhesive coated side of tape drawn from the reel can rest and a cutter mechanism to cut the tape after a required length has been drawn off the reel to secure the respective wire end to the spool. Draw off is occasioned automatically when the adhesive side of the tape is pressed against the spool core of an empty spool or the wire turns of a full spool, the tape rapidly accelerating to the required speed of application as the tape pressure wheel is driven without relative slip by the rotating spool or wire.

Suitably the filling spool and a new spool are mounted at 180° positions on a rotatable spool assembly. Conveniently means is provided to automatically feed empty spools one by one to a spindle position of the spool assembly when in a lower of the two 180° positions and to automatically remove full spools also from the lower of the two 180° positions. Suitably a separate tape-dispensing unit is mounted adjacent to each of the spools in the two 180° positions, the upper one of the two tape-dispensing units being used to tape the leading end of cut wire to a new spool which has moved up to the upper of the two 180° positions and the lower one of the two tape-dispensing units being used to tape the trailing end of cut wire to the full spool in the lower 180° position.

D.C. electric or pneumatic rotary motors are preferred to energise the rotating rolls and linear motors (e.g. pneumatic rams) are preferred to move the traverse table, rotate the spool assembly, actuate the tape and wire cutters and move new spools to and remove full spools from the spool assembly in a smoothly sequenced operation.

In a further aspect of the invention, spooling equipment comprises a rotatable spool assembly rotatably supporting a filling spool and an empty spool,

means to feed wire to the filling spool, means to rotate the spool assembly to move the filling spool away from a winding position when the filling spool is full and concomitantly to move the empty spool into the winding position, means to cut wire to discontinue wire supply to the filling spool following its move from the winding position and means to secure one end of the cut wire to the full spool and the other end of the cut wire to the empty spool, which equipment is characterised in that at least one tape-dispensing means is provided to secure wire to the full spool and/or empty spool by lengths of adhesive tape applied respectively with the ends of the cut wire.

One embodiment of wire spooling equipment according to the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a plan of the equipment seen from above,

Figure 2 is an end view of the equipment in the direction of the arrow A in Figure 1,

Figure 3 is a side view of the equipment in the direction of the arrow B in Figure 1,

Figure 4 is a side view of a tape-dispensing unit on an enlarged scale, and

Figure 5 is a partial section on the line V-V of Figure 4.

Referring first to Figure 3, wire W enters the spooling equipment from the left from processing equipment not shown. The processing equipment could be effecting a reduction in cross-sectional area and/or cross-sectional shape of wire, heat-treating wire, chemically treating wire, coating wire, twisting wire or supplying wire from a larger source package for repackaging in smaller spool-type packages.

The spooling equipment basically comprises input control equipment (generally designated 100) mounted on a traverse table 1; spool support equipment (generally designated 200) comprising a rotatable spool assembly 3 carrying both a filling spool 11a and an empty spool 11b; a layering traverse mechanism 4 for moving in the axial direction of each spool during winding-on of the wire onto the filling spool 11a; a wire cutter 6 and upper and lower tape-dispensing units 5 and 8.

To ensure automatic supply of new spools to, and removal of full spools from, the support equipment 200, spool handling equipment 300 is provided which includes a spool trolley 13, a lift table 14, a turntable 20 and spool stops 17 and 19.

Central to the working of the equipment is the construction of the units used to tape each cut wire end to the respective spool. One of these is shown in some detail in Figures 4 and 5.

Referring to Figures 4 and 5, a roll 50 of adhesive tape (e.g. self-adhesive tape known under the trademark SELLOTAPE of 50 mm width) is frictionally engaged on a tape holder 51 which is turnably mounted on a spindle 52 carried by a tape arm 53.

The arm 53 is pivotally mounted on a lever 55 which supports bearings 56 for a tape pressure wheel 57 having a soft rubber tyre 58 around its periphery. Turnably mounted on the bearings 56 is a cutter arm 59 carrying a serrated tape cutter 60. The arm 59 is linked to an operating cylinder 61. Attached to the lever 55 is a tape end control flap 54.

A hold-down spring is provided between the spindle 52 and the arm 55 to keep the tape roll 50 pressed against the tyre 58 and the line of action of this spring is marked by the chain line 63 in Figure 4.

The tape leaving the roll 50 passes over approximately one half of the circumference of the tyre 58 to the end held against the tyre 58 by the end control flap 54. The adhesive side of the tape faces outwards as it passes around the wheel 57.

When the exposed adhesive side of tyhe tape held against the tyre 58 is pressed against an empty or full rotating spool, the motion is transferred to the pressure wheel 57 through the tape. The tyre 58 ensures good contact on an uneven surface thus allowing the wire to indent the wheel 57 giving wide contact. Contact is maintained until the desired length of tape has been drawn off the spool 50, around the wheel 57 and onto the spool requiring taping. When the required length of tape is in place, the assembly 5 is moved clear of the spool and the tape cut/advance cylinder 61 is activated to cut the tape. The tape cutter 60 is returned to the park position shown in Figures 4 and 5. The cut end of tape remains adhering to the control flap 54 thus ensuring the tape is left partly around the wheel 57 ready for the next wire end taping application.

When the wire W is cut, a pusher roll 7 driven by a d.c. electric or air motor drives a traverse pulley 10 round and the wire forward onto the empty spool after the wire cutter has operated and moved through the wire path. The pusher roll 7 is rubber covered to give grip onto the wire.

The operation of the spooler equipment will now be described.

On a signal that the measured length of wire W has been wound onto spool 11a, the traverse table 1 withdraws from its "run" position shown in Figure 3 moving to the left into a cut-changeover position. When fully withdrawn, a pivot lock 2 releases the spool assembly 3 which then rotates (clockwise in Figure 3) through 180°. During this rotation, the traverse mechanism 4 moves to its cut-changeover position and parks. The pivot lock 2 re-engages, the top tape-dispensing unit 5, wire cutter 6, the pusher roll 7 and the lower tape-dispensing unit 8 are moved into position. The pinch rolls 9 are closed and the pusher roll 7 is closed onto the wire traverse pulley 10. When the wire cutter 6 is triggered, the d.c. electric or air motors driving the pinch rolls 9 and pusher roll 7 are started and the tape-dispensing units are advanced to

contact the wire on the now-lowermost spool 11a and a wire guide 62 moves into position to lead wire approaching the spool 11b to the core of that spool, the upper tape-dispensing unit 5 moving slightly slower than the lower tape-dispensing unit 8 to allow the cut end of the wire to pass down to the full spool. After two to three revolutions of the respective spool, each tape-dispensing unit is withdrawn. As this happens a tape cutter 60 in each tape-dispensing unit moves to cut the tape. The pinch roll and pusher roll drives are stopped and the rolls retracted from the wire, the upper tape-dispensing unit 5, the wire cutter 6, the pusher roll 7 and the lower tape-dispensing unit 8 are moved back to their original parking positions. The wire cutter 6 is then reset for the next operation. The traverse table 1 is moved back to its forward "run" position and the traverse is restarted so that spooling of wire continues on the new spool 11b.

With the spool trolley 13 in the "in" position, the lift table 14 is raised up to the spool with the table in a "mid" position. A tailstock pintle 15 is unlocked and a pintle drive 16 is latched in. Position sensors are required to signal which unit is in place and to control both the drive and the pintle lock. The lower pintle is withdrawn and when fully withdrawn, the spool trolley moves to its outer position to draw the spool off the headstock pintle. The spool table is lowered and when in the "down" position it is tilted to the unload side, allowing the full spool to roll off to be arrested by the full spool stop. When this is tripped, the spool table tilts back over to the loading position, the load spool stop 17 is then lowered allowing an empty spool to roll onto the table 14. When the sensor signals that the spool is in place, the table swings back to the mid position and the load spool stop 17 rises. The spool table then rises to a predetermined height (the spool size can be selected by a switch manually or automatically by sensors at the load spool stop position). With the spool raised, the trolley 13 is moved to the in position carrying the spool onto a headstock pintle 18. The tailstock pintle 15 is then driven in through a torque limiting device. A sensor detects when the screw stops turning and switches off the motor, applies a lock, unlatches the drive, and lowers the lift table 14. On the appearance of a "lift table down" signal and a "load spool stop empty" signal, the spool ramp stop 19 lowers, to allow one empty spool to advance onto the turntable 20. With the spool on the turntable, the table rotates through 90° and the back edge rises to roll the spool onto the load spool stop 17. The table 14 then lowers and rotates back to the spool ramp position.

A number of modifications are possible with regard to details of the design of equipment and one such would be to incorporate a wire-speed control device upstream of the traverse mechanism 4 (e.g. in place of the pinch roll unit or as an adjunct to the pinch roll unit).

Claims

1. A method of continuously winding wire (W) onto cored spools (11a, 11b) which method comprises filling one spool (11a) and then cutting the wire to leave upstream and downstream wire ends on either side of the cut, leading the upstream wire end to a new spool (11b) and the downstream wire end to the one spool (11a), **characterised in that** at least one of the upstream and downstream wire ends is/are secured with adhesive tape respectively to the core of the new spool (11b) and/or to the one spool (11a) or to the wire wound thereon.

2. A method according to claim 1, **characterised in that** adhesive tape is used to secure each wire end to the respective spool.

3. A method according to claim 1 or 2, **characterised in that** a flexible tape coated on one side with a self-adhesive material is used, the tape being wound on a reel (50) with the adhesively coated side facing towards the centre of the reel and in that the tape has a width which is at least ten times the diameter of the wire, preferably between thirty and one hundred times the diameter of the wire (W).

4. A method according to any one preceding claim, **characterised in that** tape is applied over more than one quarter of a revolution of the spool and desirably tape is applied over at least one revolution.

5. A method according to any one preceding claim, **characterised in that** a measured length of wire (W) is wound on each empty spool, passage of the required measured length being used to trigger a spool change operation.

6. A method according to claim 2 or any claim dependent thereon, **characterised in that** two separately operable tape-dispensing units (5, 8) are used, one unit (5) to secure the downstream wire end to the full spool (11a) and the other unit (8) to secure the upstream wire end to the new spool (11b), each tape-dispensing unit including a tape reel holder (51), a tape pressure unit (57) and a tape cutter (60).

7. Spooling equipment for wire (W) comprising a rotatable spool assembly (3) rotatably supporting a filling spool (11a) and an empty spool (11b), means (100) to feed wire to the filling spool (11a), means to rotate the spool assembly (3) to move the filling spool (11a) away from a winding position when the filling spool (11a) is full and conco-

mitantly to move the empty spool (11b) into the winding position, means (6) to cut wire to discontinue wire supply to the filling spool (11a) following its move from the winding position and means (5, 8) to secure one end of the cut wire to the full spool (11a) and the other end of the cut wire to the empty spool (11b), **characterised in that** the wire end securing means is at least one tape-dispensing means (5, 8) provided to secure wire to the full spool (11a) and/or empty spool (11b) by lengths of adhesive tape applied respectively with the ends of the cut wire.

8. Spooling equipment according to claim 7, **characterised in that** the input end of the spooling equipment includes a traverse table (1) supporting both a pair of pinch rolls (9) and a wire layering unit (4) used to form the wire helically in layers on the core or on a layer of wire on the core.

9. Spooling equipment according to claim 8, **characterised in that** means is provided to close the nip between the pinch rolls (9) onto the wire in a withdrawn position of the traverse table (1) and to hold the nip closed during at least part of the advance of the traverse table (1) back towards the full spool (11a).

10. Spooling equipment according to claim 8 or claim 9, **characterised in that** the layering unit (4) includes one roll (10) of a pair, the other roll (7) of the pair being a pusher roll forming part of a push roll assembly.

11. Spooling equipment according to any one of claims 7 to 10, **characterised in that** the or each tape-dispensing unit (5, 8) comprises a support (51) for a reel (50) of adhesive tape, a tape pressure wheel (57) having a soft resilient peripheral surface (58) against which the non-adhesive coated side of tape drawn from the reel (50) can rest and a cutter mechanism (60) to cut the tape after a required length has been drawn off the reel (50) to secure the respective wire end to the spool.

12. Spooling equipment according to any one of claims 7 to 11, **characterised in that** the filling spool (11a) and a new spool (11b) are mounted at 180° positions on a rotatable spool assembly (3), means (300) being provided to automatically feed empty spools one by one to a spindle position of the spool assembly (3) when in a lower of the two 180° positions and to automatically remove full spools also from the lower of the two 180° positions, a separate tape-dispensing unit being mounted adjacent each of the spools in the two 180° positions, the upper one (5) of the two tape-dispensing units being used to tape the leading end of cut wire to a new spool which has moved up to the upper of the two 180° positions and the lower one (8) of the two tape-dispensing units being used to tape the trailing end of cut wire to the full spool in the lower 180° position.

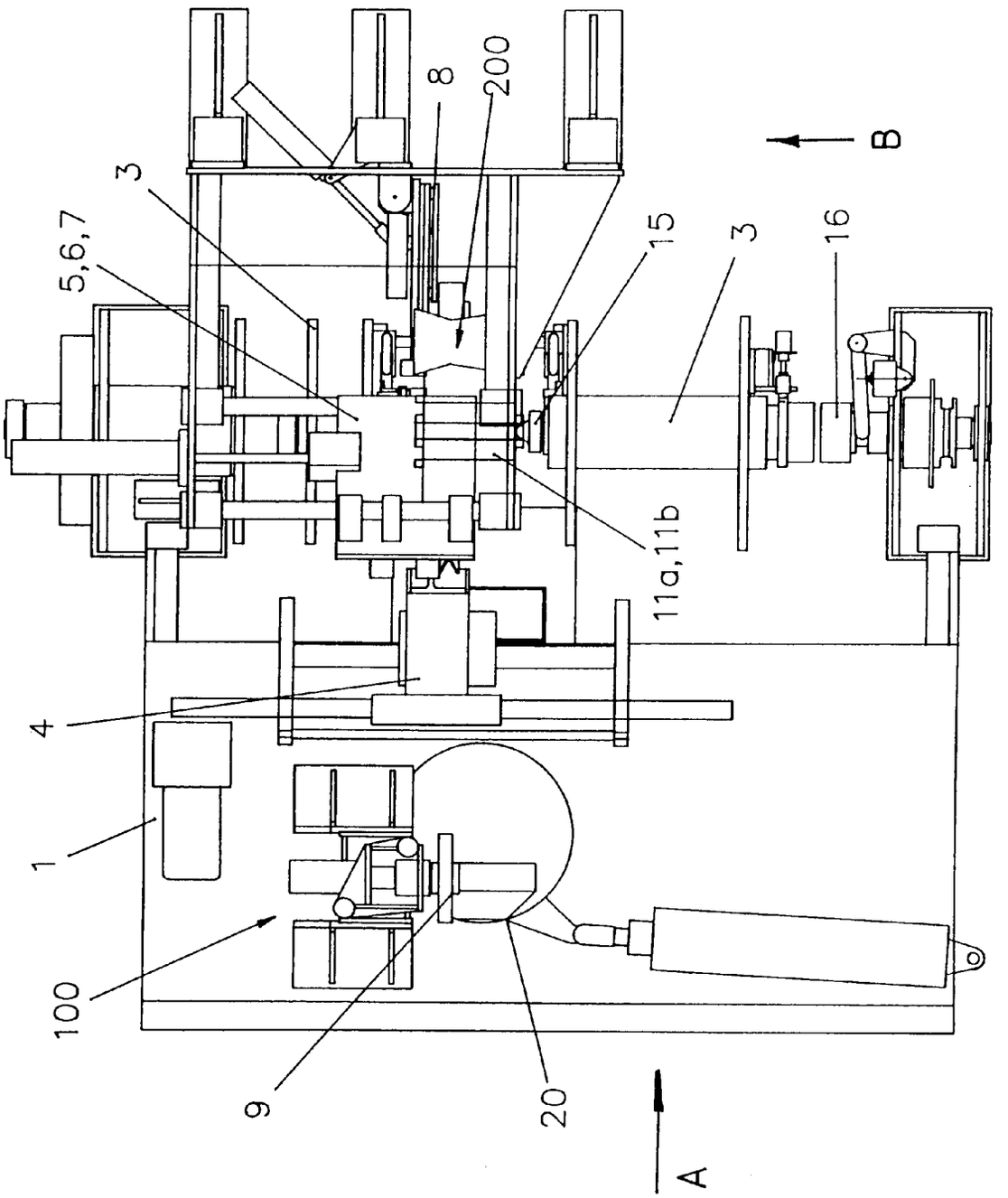

FIG. 1

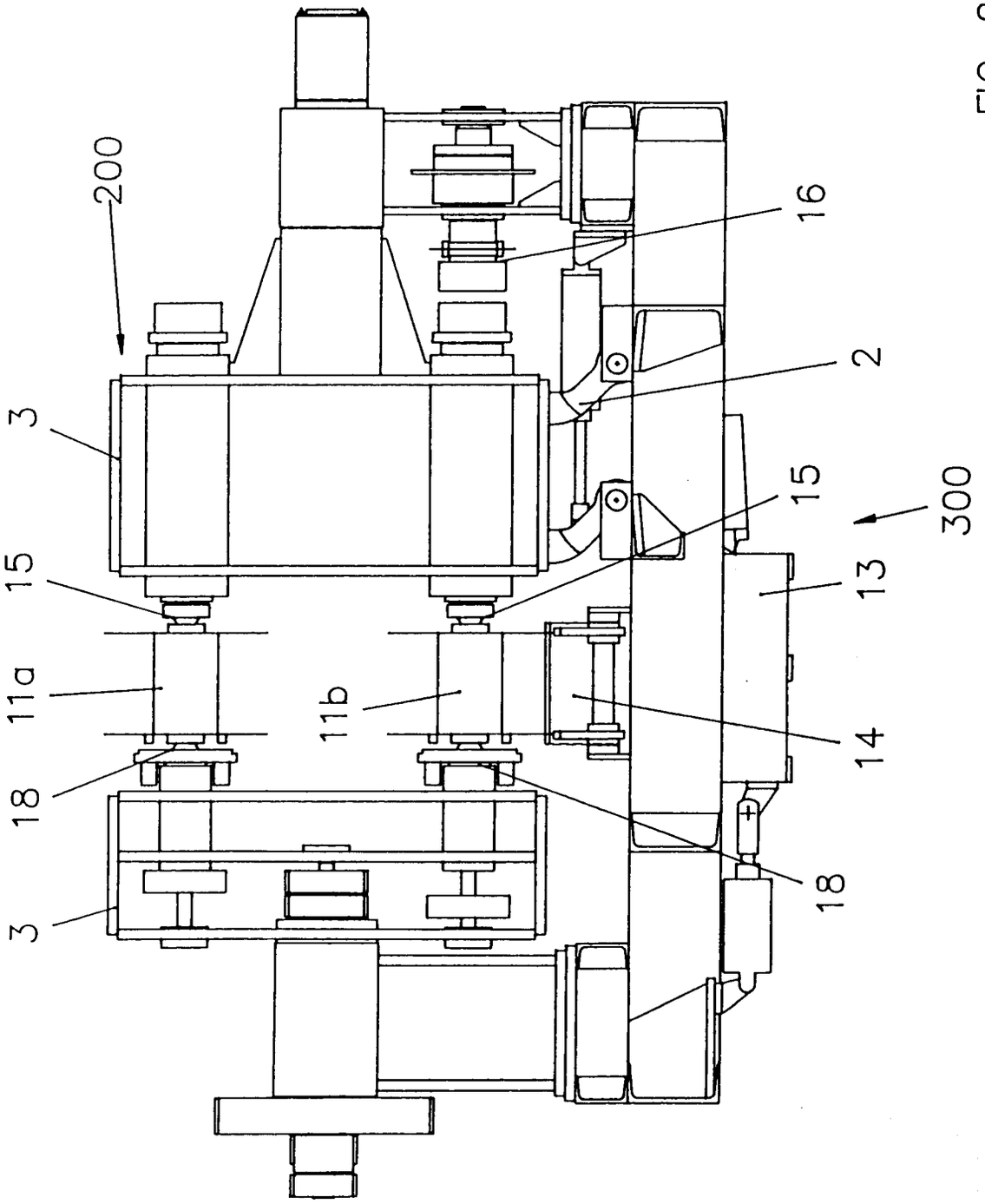

FIG. 2

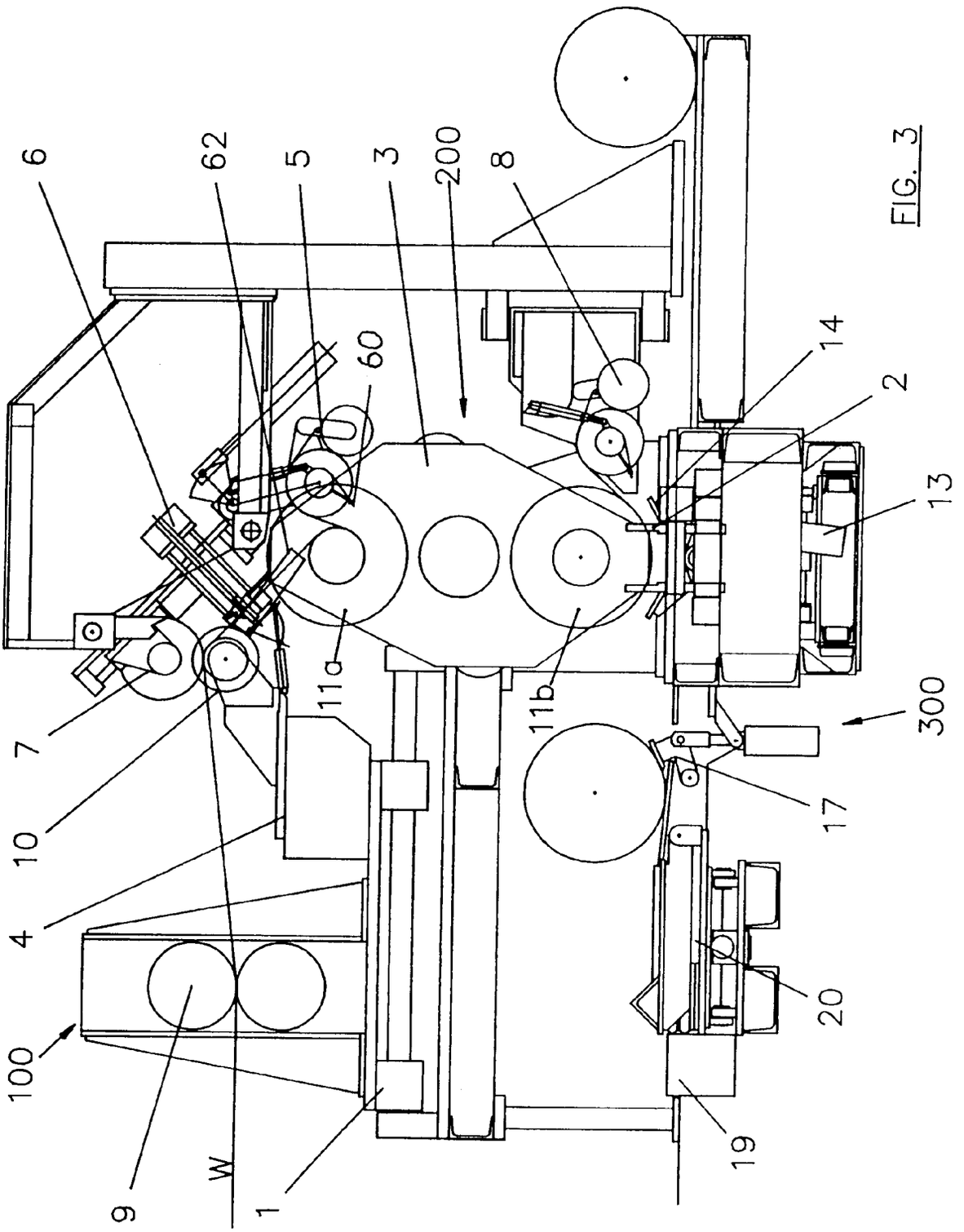

FIG. 3

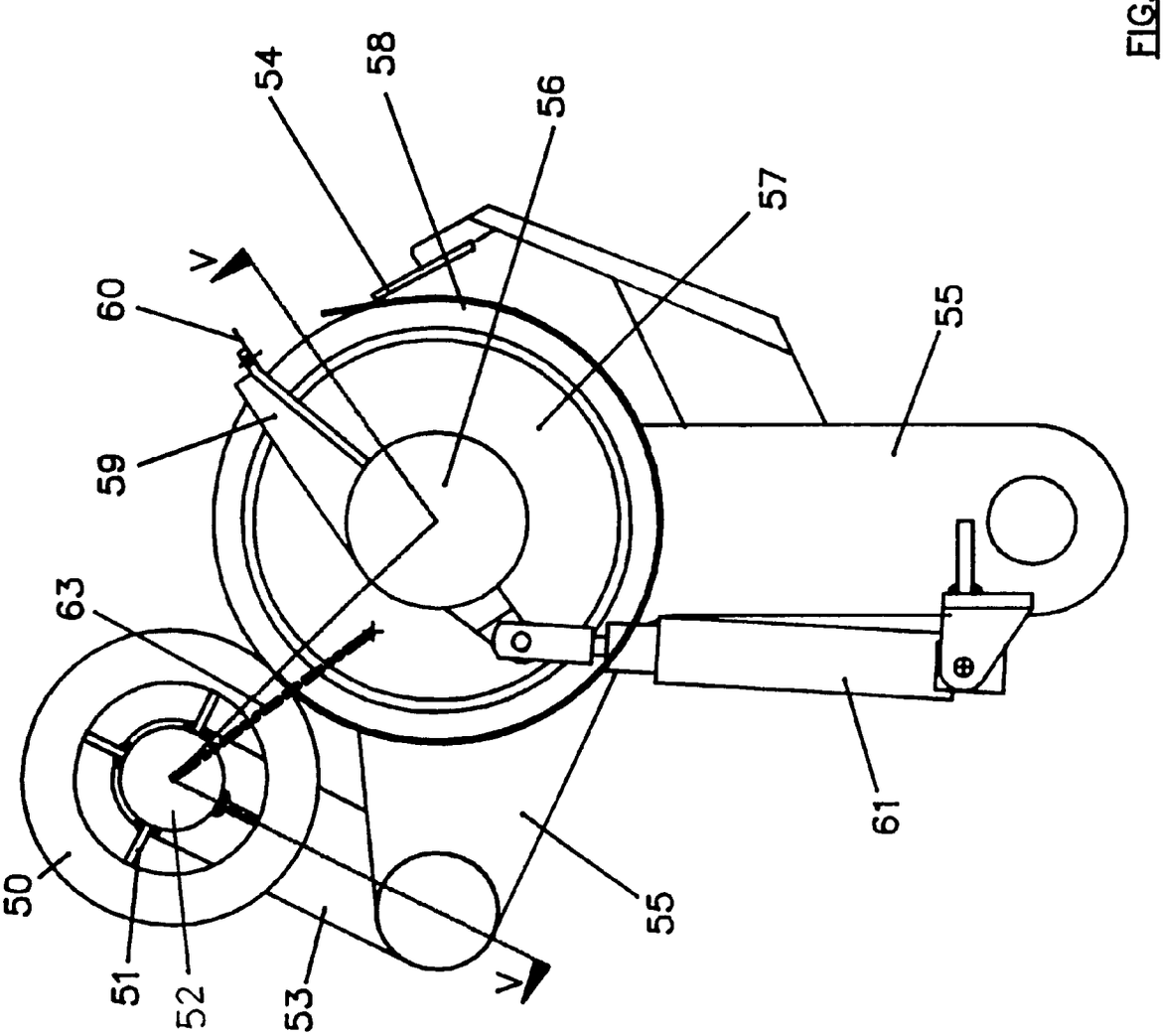

FIG. 4

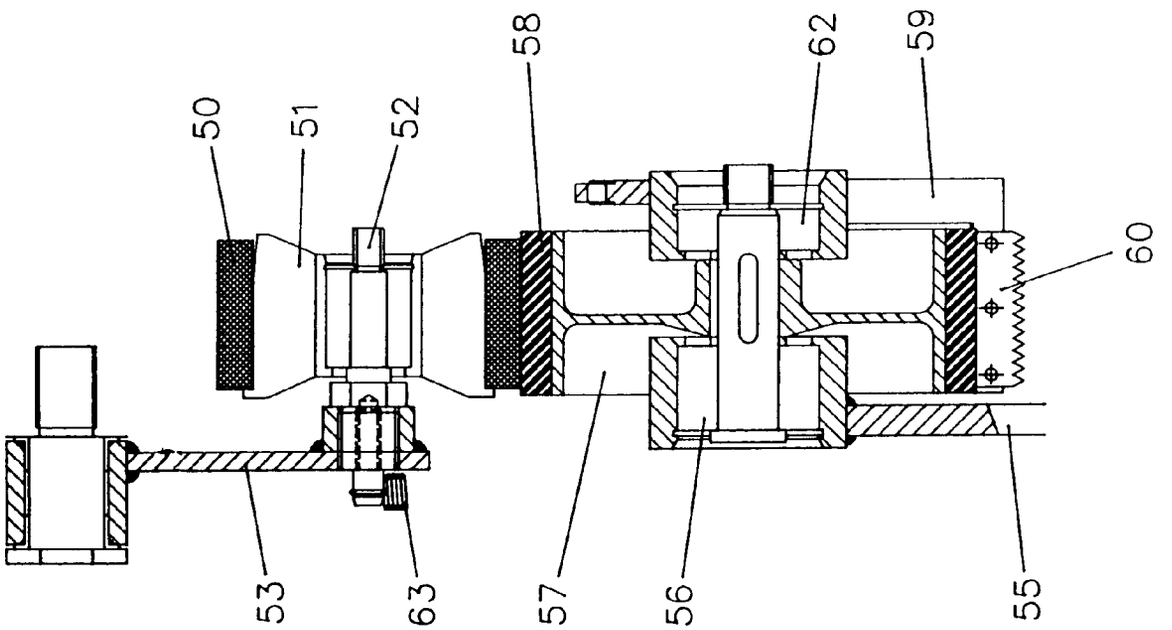

FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 92 30 7162

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-3 420 459 (V.G.PETERS) * column 3, line 32 - column 4, line 63 *	1,5,7	B65H65/00 B65H67/048
A	EP-A-0 142 813 (S.A.M.P. S.P.A. MECCANICA DI PRECISIONE) * page 13 - page 16 *	1-4,11	
A	US-A-3 701 491 (W.B.BROWN) * column 6, line 25 - column 8, line 7 *	1,5,7	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13 NOVEMBER 1992	GOODALL C.J.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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