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FR 002540476 A1

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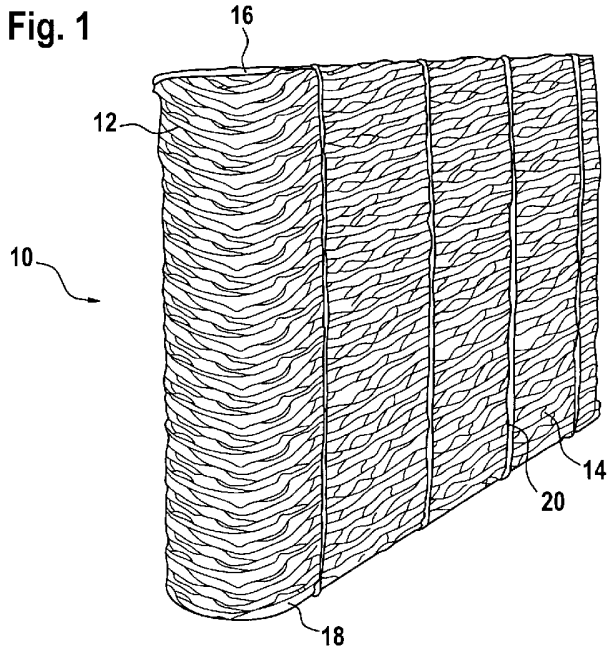
Other: EPODOC, WPI

(54) Abstract Title: **Packaging of cotton sliver**

(57) In a system and method for packaging fiber sliver, for example of cotton, synthetic fiber, or a synthetic fiber blend, a pile 10 of the sliver 32 is deposited, the deposited sliver, between a top member 16 and a bottom member 18 is compressed, and the fiber pile is strapped with the top member 16and the bottom member 18 to form a strapped fiber package The pile 10 is formed by laying the sliver in a pattern of uniform density on the bottom member 18 within a vertical sleeve (30, Figure 2) of oblong cross-section, from the top of which the pile emerges during compression.

Fig. 1



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At least some of the priority details shown above were added after the date of filing of the application.

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Fig. 1

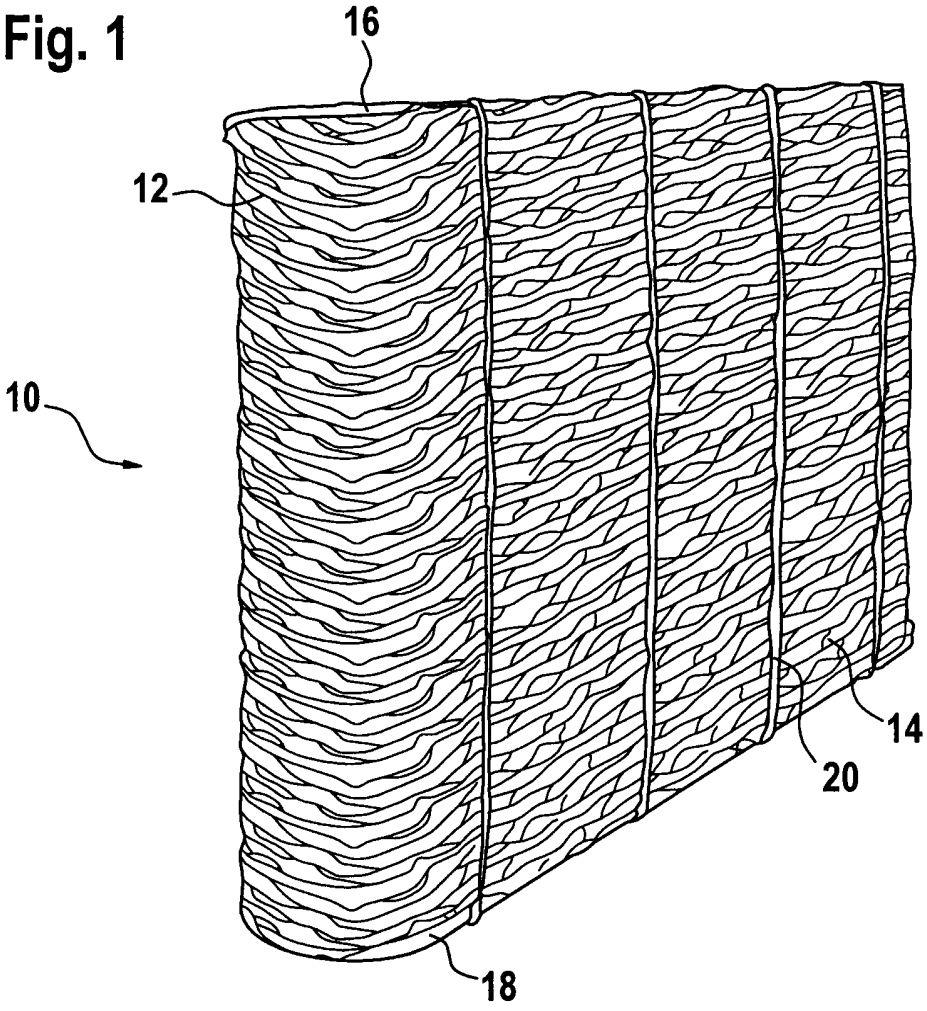


Fig. 1A

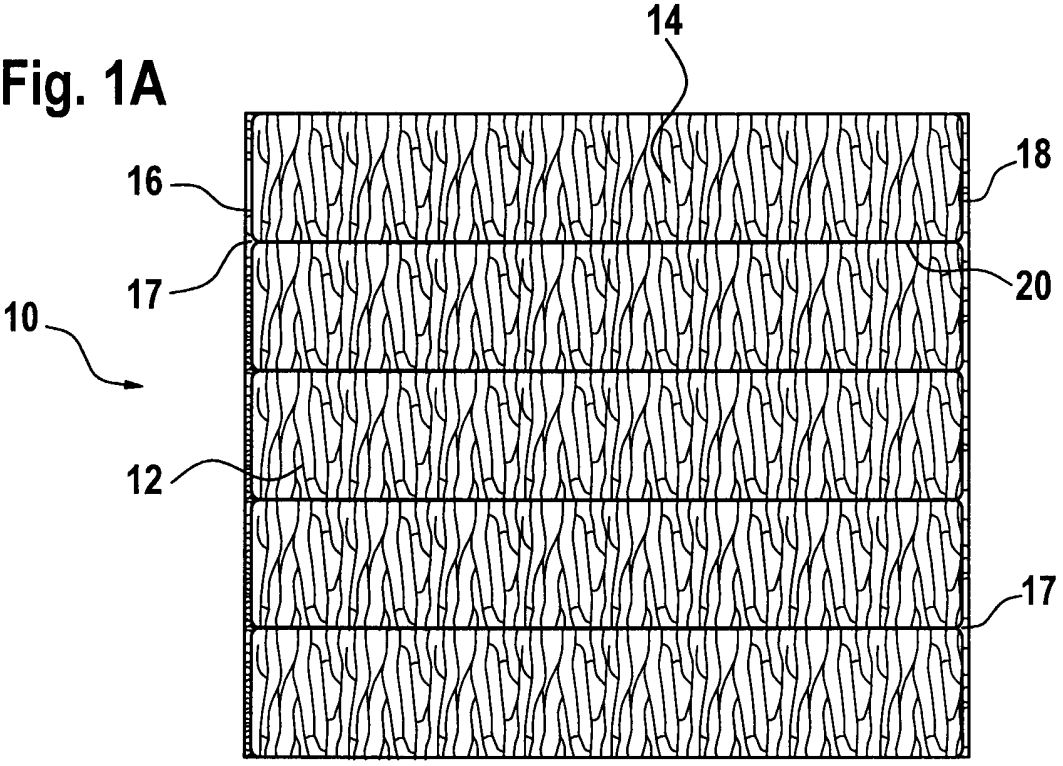


Fig. 2

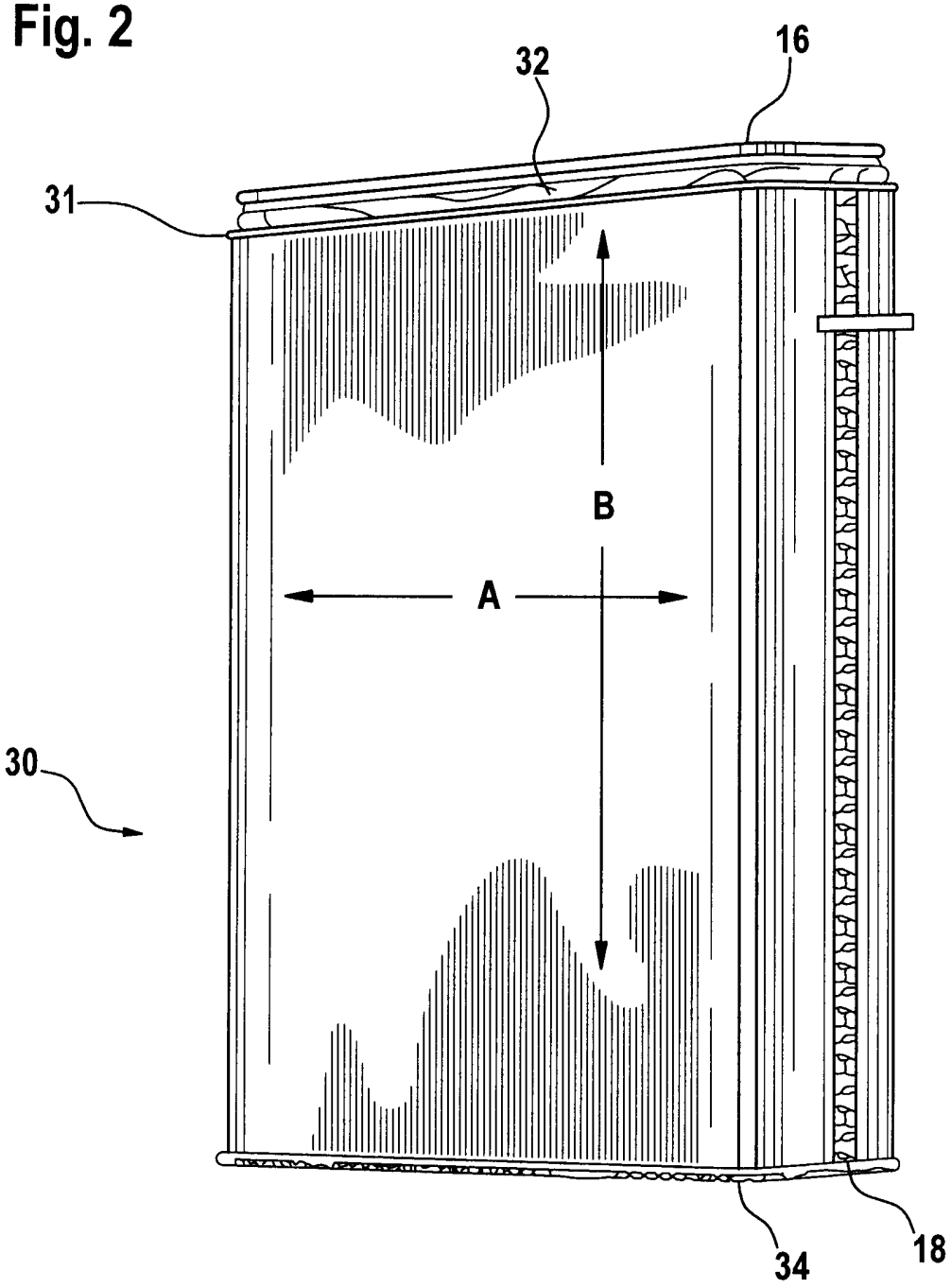
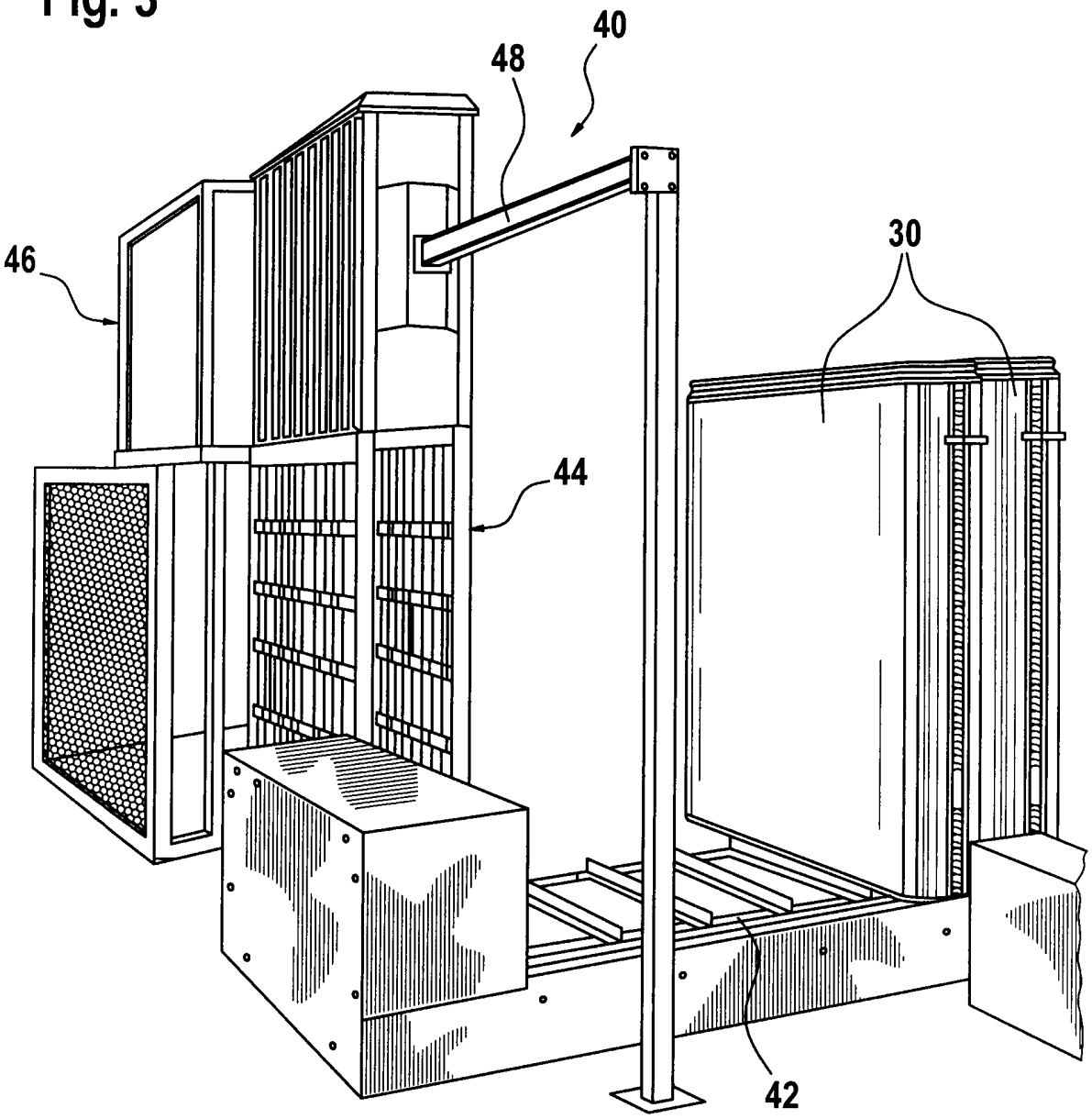


Fig. 3



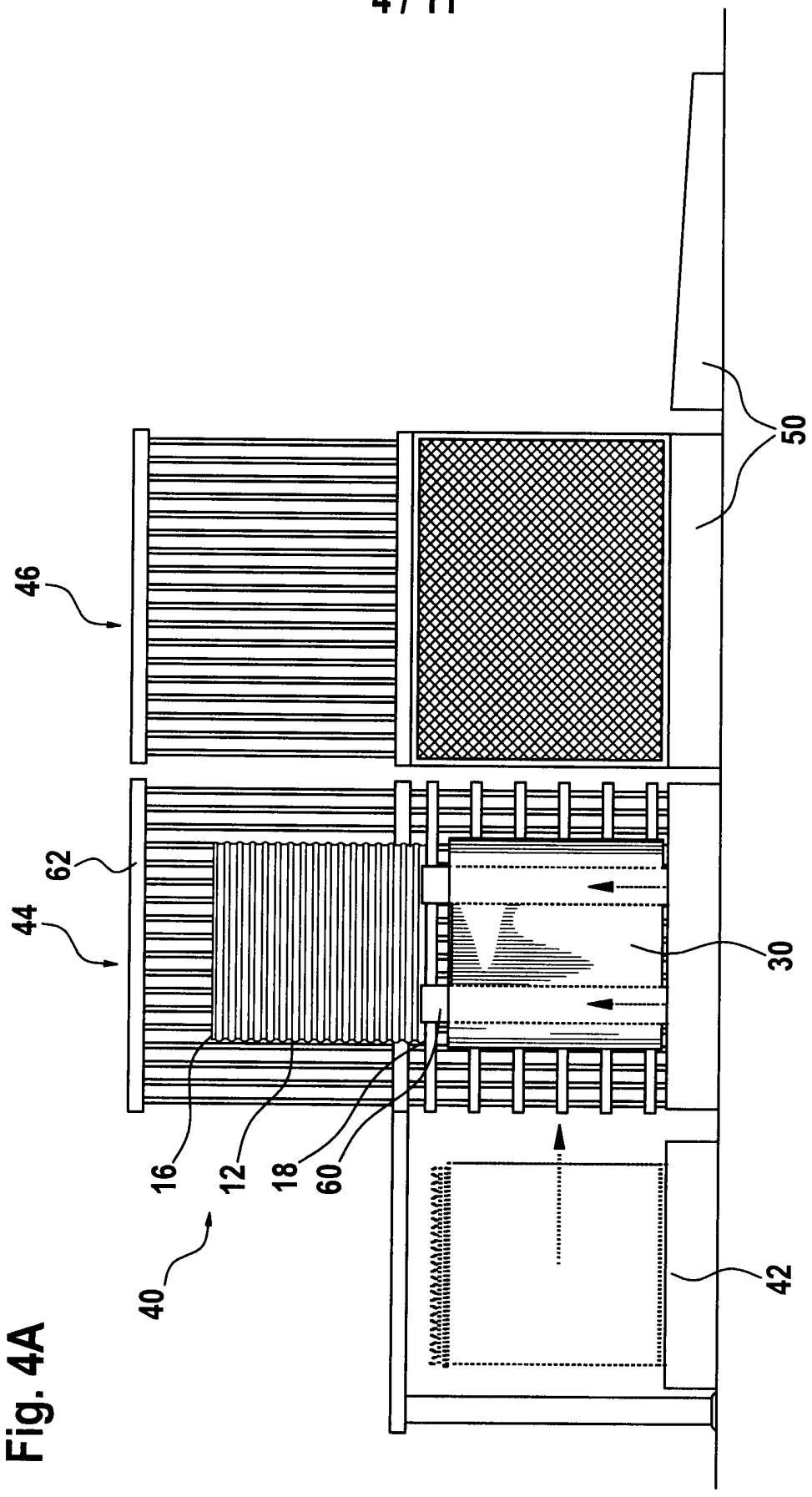


Fig. 4A

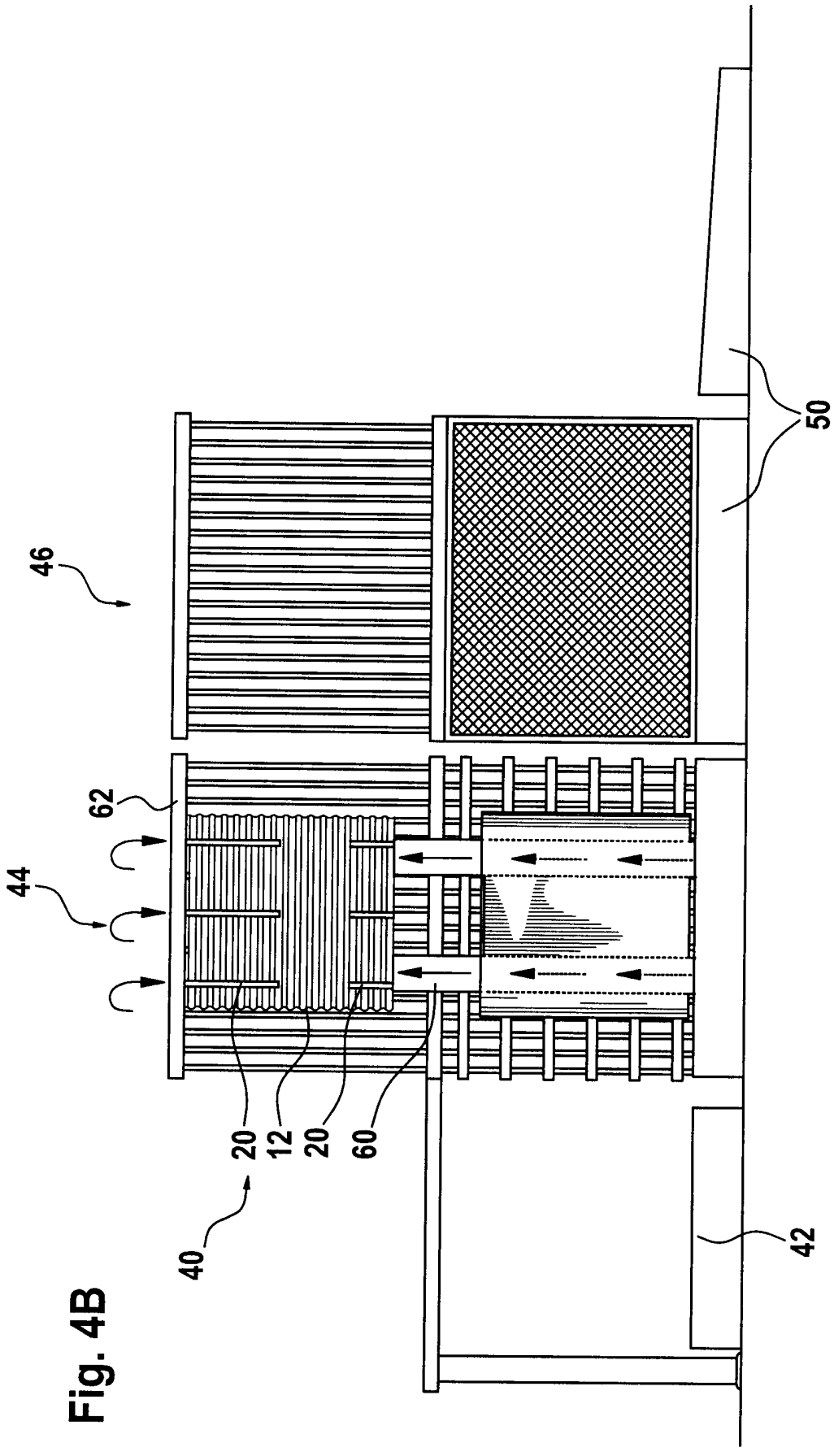


Fig. 4B

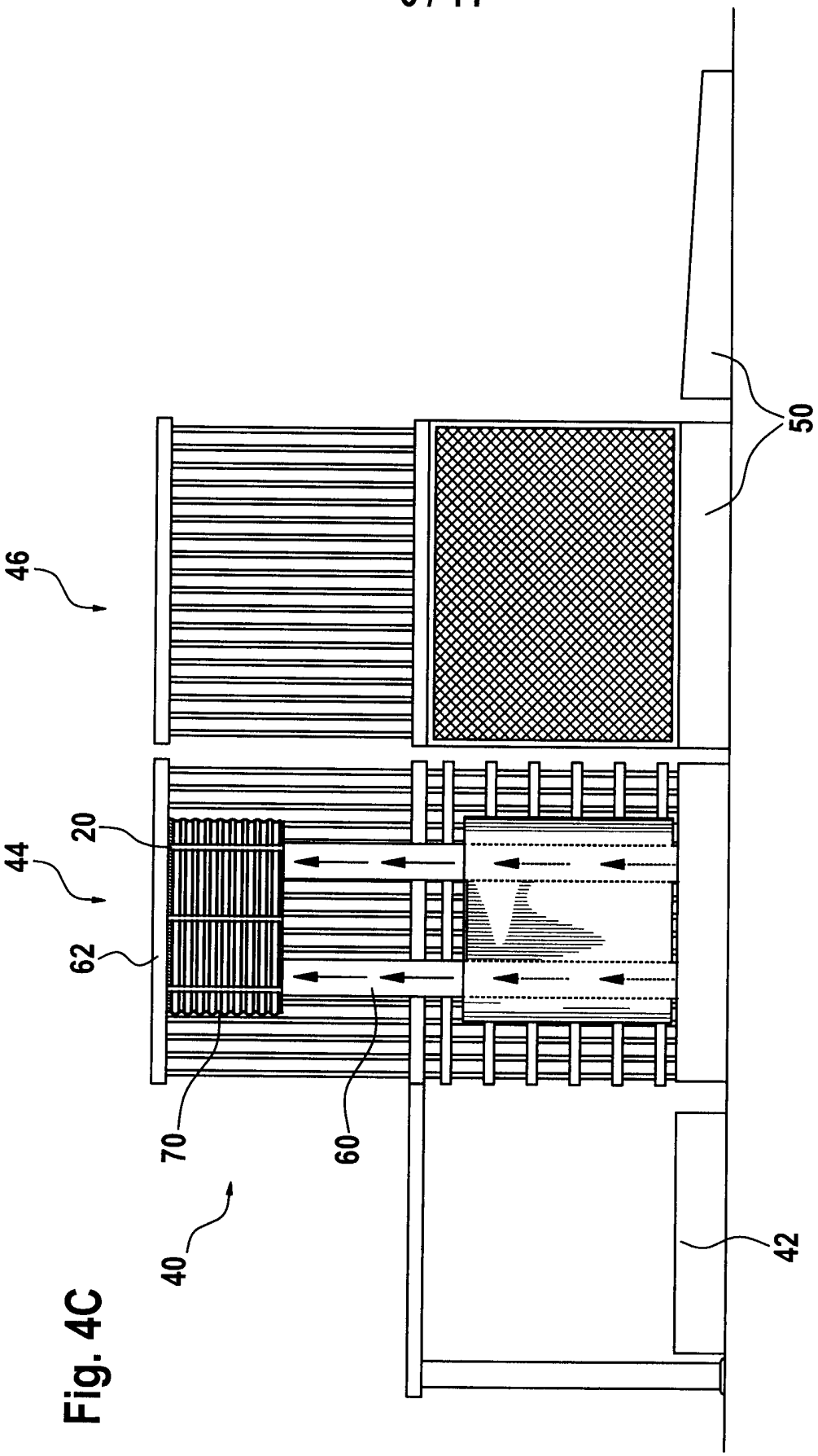


Fig. 4C

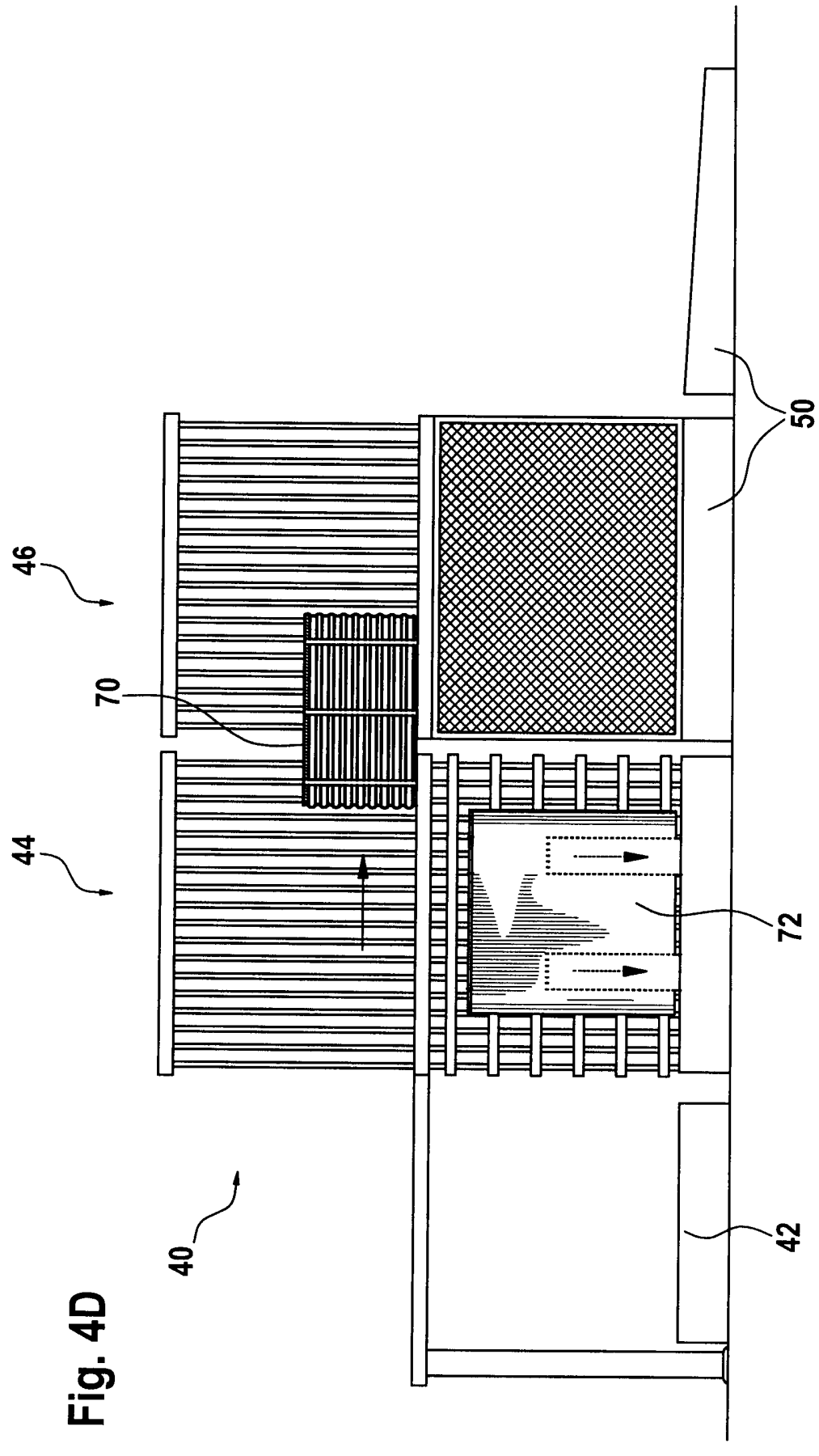


Fig. 4D

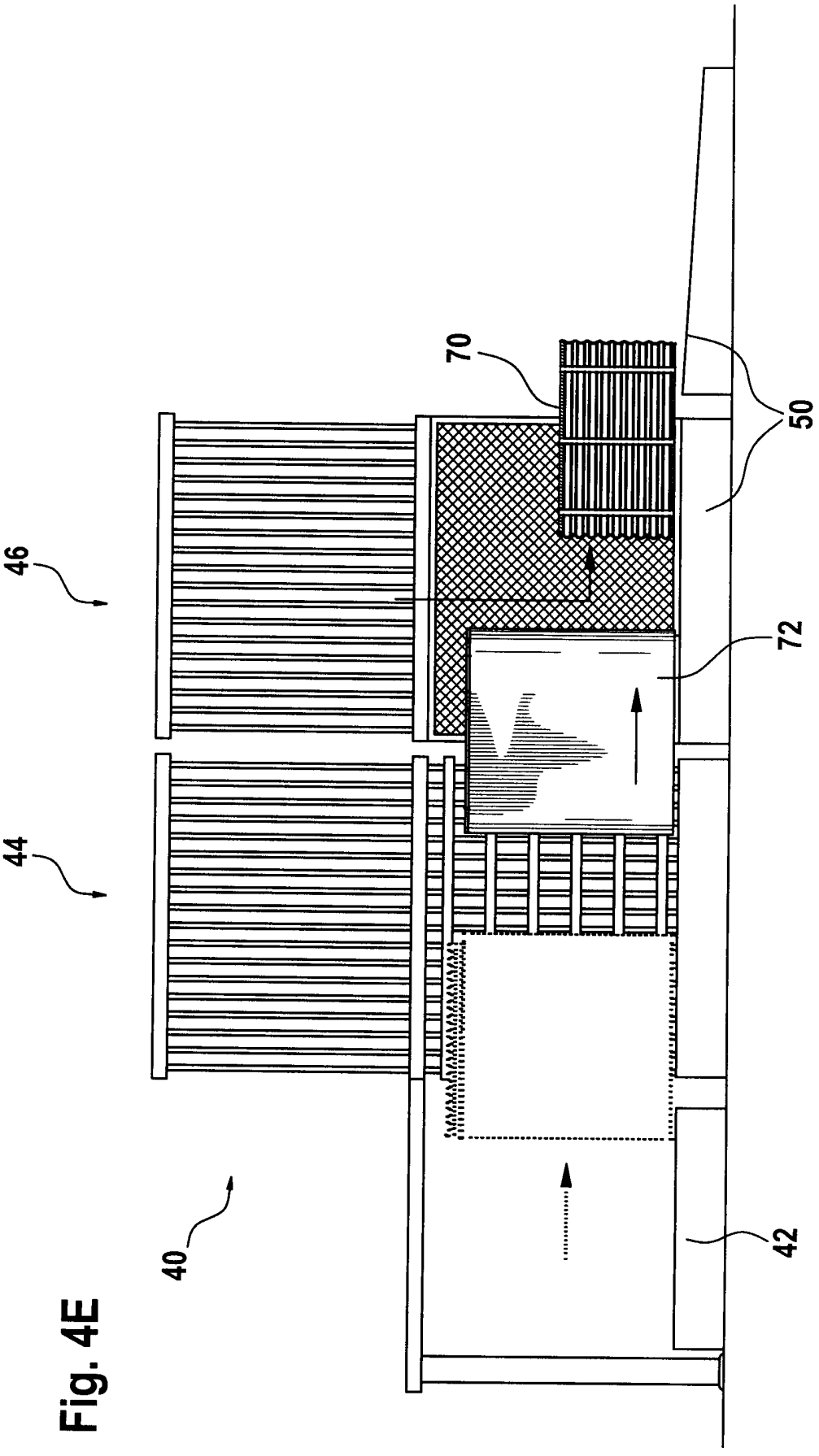


Fig. 4E

Fig. 5

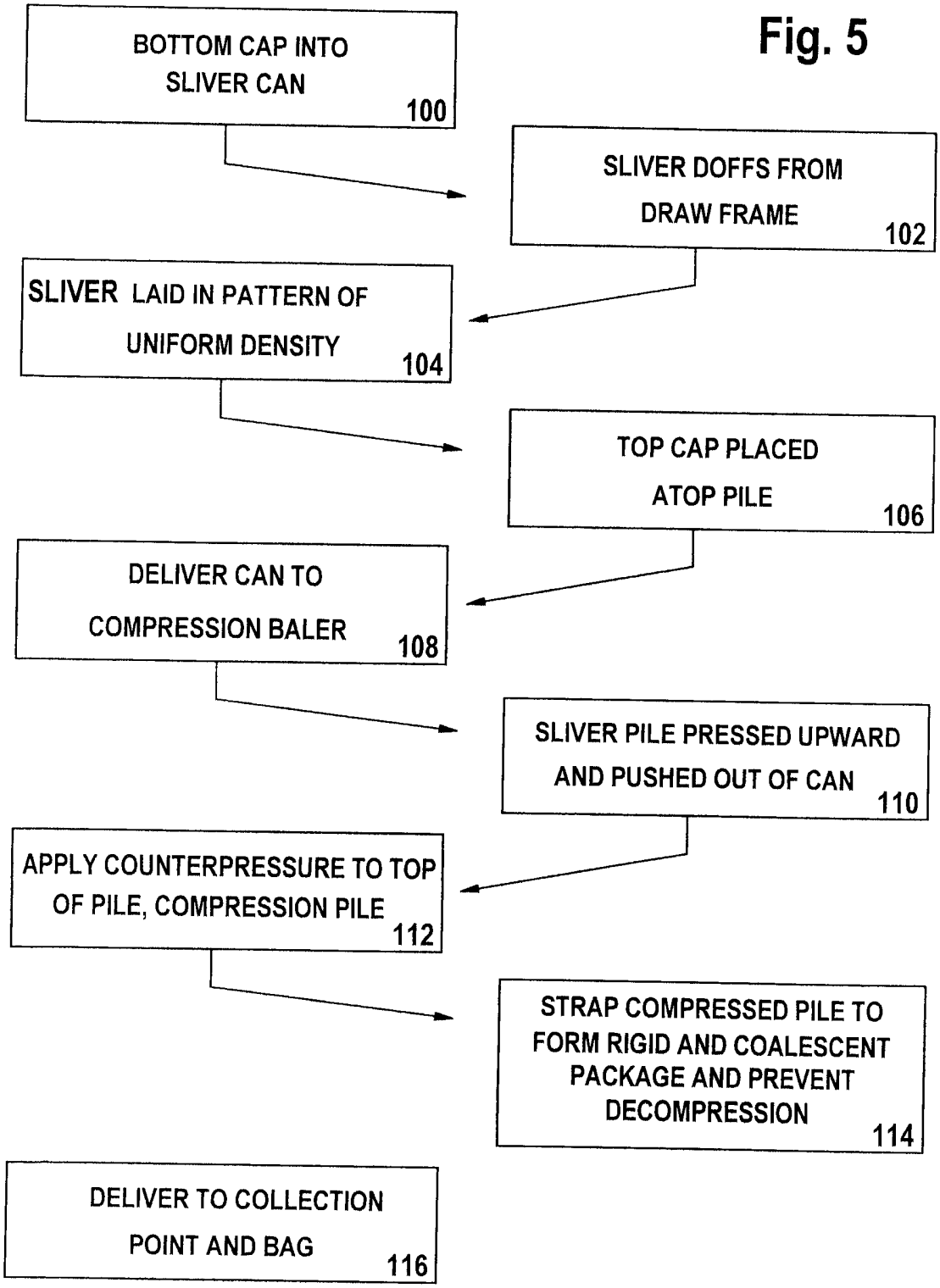

BOTTOM CAP INTO SLIVER CAN
100
SLIVER DOFFS FROM DRAW FRAME
102
SLIVER LAID IN PATTERN OF UNIFORM DENSITY
104
TOP CAP PLACED ATOP PILE
106
DELIVER CAN TO COMPRESSION BALER
108
SLIVER PILE PRESSED UPWARD AND PUSHED OUT OF CAN
110
APPLY COUNTERPRESSURE TO TOP OF PILE, COMPRESSION PILE
112
STRAP COMPRESSED PILE TO FORM RIGID AND COALESCENT PACKAGE AND PREVENT DECOMPRESSION
114
DELIVER TO COLLECTION POINT AND BAG
116

Fig. 6a

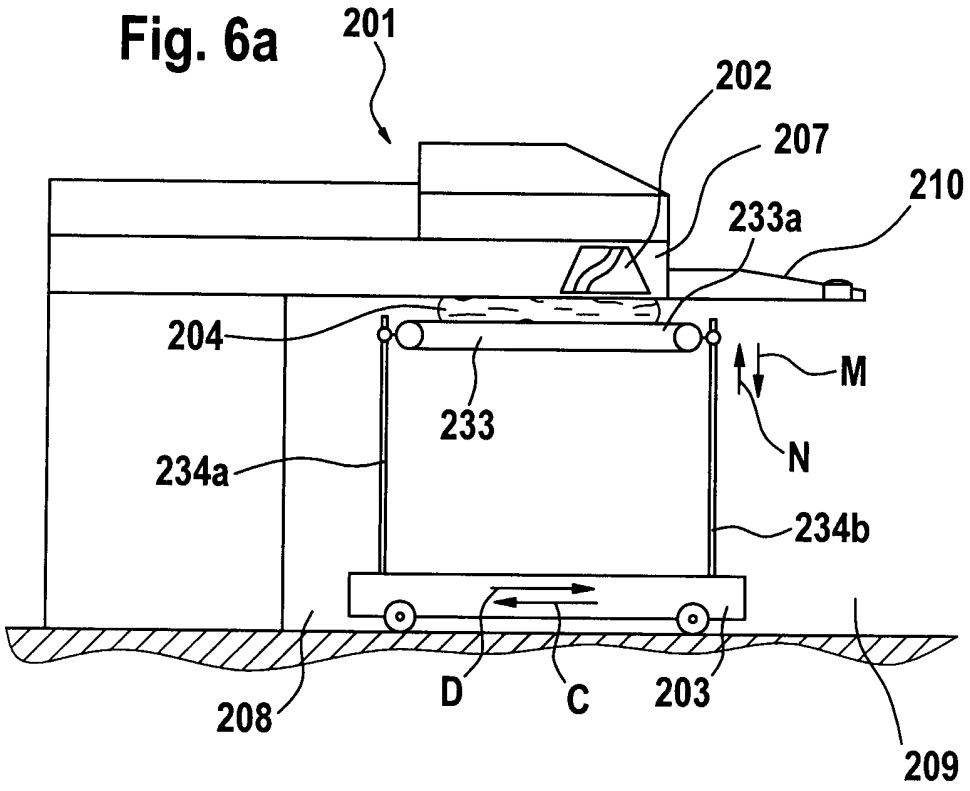

201
202
207
210
233a
204
233
M
N
234a
234b
208
D
C
203
209

Fig. 6b

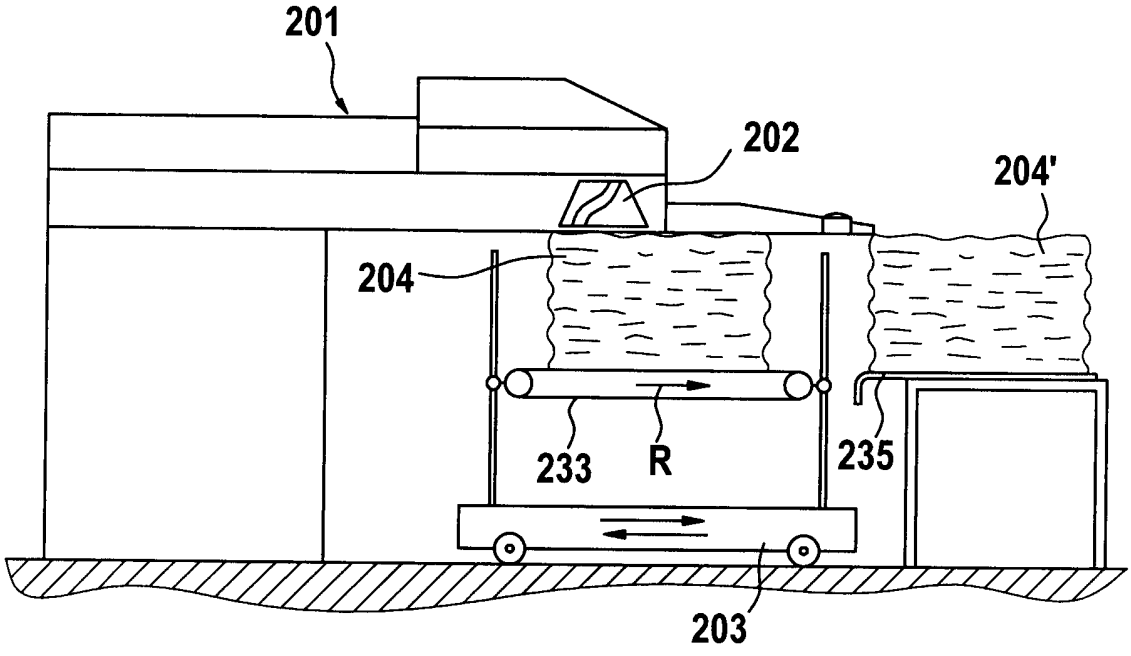

201
202
204'
204
233
R
235
203

Fig. 7

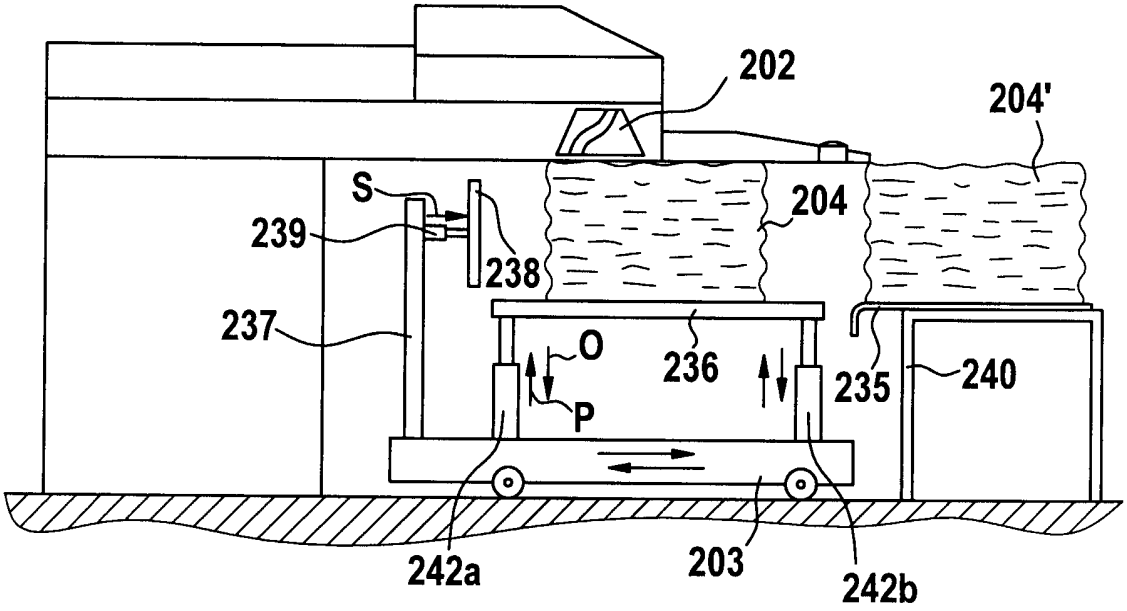
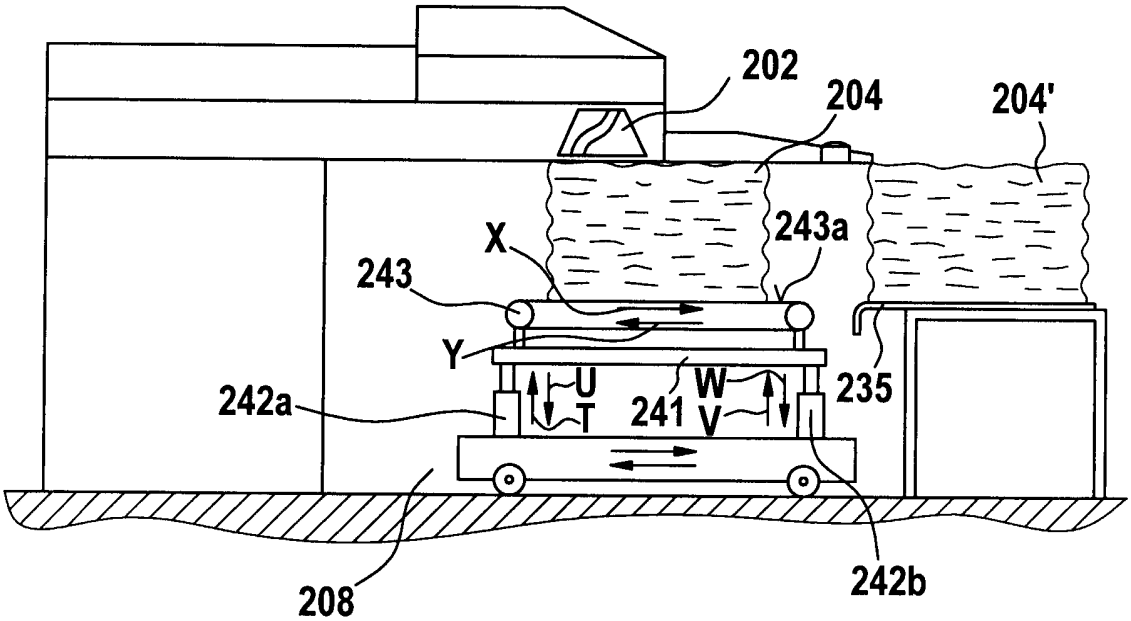

202
204'
S
239
238
204
237
O
236
235
240
P
242a
203
242b

Fig. 8


202
204
204'
243a
X
243
Y
242a
U
T
241
W
V
235
208
242b

SYSTEM AND METHOD FOR PACKAGING COTTON SLIVER

The present invention relates to a system and method for efficiently packaging fiber sliver, for example fiber sliver of cotton and/or synthetic fiber and/or a synthetic fiber blend, for handling and transport.

The process of producing yarns from staple fibers such as cotton or synthetic fiber traditionally includes as an intermediate step, between the opening and cleaning of the staple fiber and the spinning and winding of the yarn, the formation of a loosely coalescent, bulky strand of fibers known as sliver. In sliver, the cotton fibers are generally aligned in lengthwise relation, but the sliver unit does not possess any twist or strength against separation of the fibers, even against its own weight.

As those skilled in the art of yarnmaking will recognise, the quality of the yarn relates directly to the quality of the sliver. For instance, sliver of a uniform thickness and density forms a uniform, consistently strong yarn, while a sliver that has bumps (extra-thick regions) or voids (thinner regions) will form in the first instance a yarn of inconsistent quality. While processes have been developed that enable such imperfections to be cut from a yarn during processing, this is an inefficient process, and it is therefore desirable to minimize imperfections in the sliver. During handling, sliver is particularly susceptible to the introduction of bumps and voids because of its lack of strength and resiliency.

For those reasons, the prevailing conventional view has been that the packaging of sliver is difficult and undesirable, both because of the additional handling and movement of the sliver that would be required, and because the traditional methods of handling sliver did not lend

themselves to a packaging solution. However, this convention stands at odds with modern distributed manufacturing processes. In many cases, it is considered to be more efficient to specialise the functions of a processing plant, such that a portion of the yarnmaking process occurs in one plant, a second portion in another, and a third portion in yet another. However, if a particular function, such as the forming of sliver, is to be specialised into a plant, it is necessary for the sliver to be transported.

Traditionally, sliver is drawn from processed bulk cotton using a draw frame, a card, or a comb, and deposited in circular rows into a cylindrical sliver can made of plastic or another durable material. These sliver cans allow large volumes of sliver to be moved without excessively handling the sliver, but they are expensive and heavy. If the distance to be traversed is small, such as different buildings in a plant complex, then the sliver could be transported in sliver cans without great difficulty. However, if the distance to be traversed is large, such as would make use of over-the-road or overseas transport, then the weight and expense of the cans, the necessity of transporting empty cans, and the minimal density of uncompressed sliver make such transport imprudent and inefficient. Concerning the expense of transporting cotton, generally the determinative factor is not the weight of the material, but the bulk.

Conventional methods of compressing cotton fiber, such as baling, have proven impractical for sliver deposited in conventional cylindrical cans. The reason for this is that the conventional pattern of deposition of sliver into a cylindrical can - essentially concentric circular rows of sliver - does not result in a substantially uniform density of sliver. Specifically, the density of sliver in the

center of the can is higher than the density of sliver near the edge. If sliver in a cylindrical can is compressed to its maximum practical density at the center of the can, then the sliver at the edge is sufficiently compressed to allow the resulting compressed package to be handled. Such compression does not result in a stable package. Compression of the sliver has heretofore been thought to be impractical.

Consequently, the usual practice is to conduct substantially all of the steps by which staple fiber is processed into yarn in the same location. This is, however, an inflexible capital-intensive, and inefficient arrangement in many cases, because of a desire on the part of yarnmakers to conduct some operations, such as cleaning and carding, near the cotton gin (and therefore near the cotton fields), but other operations, such as spinning in an area where labor or equipment costs might be lower.

What is needed is a system for and a method of packaging sliver in a manner that preserves the physical integrity of the sliver while permitting efficient transport in a compressed state, without requiring transport to be made in a sliver can.

In accordance with the aforementioned needs, the present invention includes a method of packaging cotton sliver for transport thereof. The method includes the steps of laying the sliver in a pattern having a substantially uniform first density onto a bottom cap disposed inside a substantially oblong sliver can. A top cap is then placed upon the sliver, and pressure is applied to the top and bottom caps to compress the sliver to a second density substantially higher than the first density. Preferably the pressure applied to the caps is at least 3200 psi and may be considerably higher.

At the second density, the compressed sliver is substantially rigid, solid, and capable of being handled without introducing bumps or voids or otherwise damaging the sliver. In order to retain the sliver at the second density, the compressed sliver and caps are strapped to form a substantially rigid package. The caps are preferably formed of a material, such as corrugated cardboard, fiberboard, or plastic, having a substantial rigidity that is sufficient in combination with the straps to prevent decompression of the sliver package. The caps may also be provided with recesses to locate and accommodate the strapping.

In a further step, the compressed sliver may be driven out of the sliver can as part of or subsequent to the step of compressing the sliver. Optionally, the package may be placed into a protective outer cover.

The present invention also includes a method of packaging a continuous length of cotton sliver for the transport thereof. The method of the invention includes the steps of drawing the sliver from a draw frame and laying the sliver in a pattern having a substantially uniform uncompressed density into a can that has a lengthwise dimension and a widthwise dimension, with the lengthwise dimension being substantially longer than the widthwise dimension. The can is then delivered to a compression baler, and the sliver is pushed upward from the base of the can to compress the sliver, optionally with pressure totalling 3200 psi or more, and to remove it from the can. Straps are applied to the sliver to form a sliver package and to retain the package at a desired compressed density selected to enable handling of the package.

In a further step, top and bottom caps are applied to the top and bottom of the sliver to facilitate compression and retention of compression. The caps are preferably formed of

a material, such as corrugated cardboard, fiberboard, or plastic, having sufficient rigidity, in combination with the strapping, to prevent decompression of the sliver package. The caps may be providing with recesses to locate and accommodate the strapping.

For protection, the package may be placed into a protective bag.

The present invention further includes a system for efficiently packaging cotton sliver for transport thereof The system includes at least an oblong sliver can, a baler apparatus, and a strapping apparatus. The sliver can has a widthwise dimension and a lengthwise dimension substantially greater than the widthwise dimension. The can is configured to receive the sliver deposited through an open top in a uniform density and to permit a pile of accumulated sliver to be pushed upwardly therethrough during packaging.

The baler apparatus includes at least one ram configured to compress the sliver to a desired density through application of a selected pressure to a bottom surface of the sliver pile. The baler apparatus also includes a means, such as a second ram, a block, or any other suitable member, for applying counterpressure to a top surface of the sliver pile.

The strapping apparatus is configured to apply one or more straps to the compressed sliver pile to retain the compressed sliver pole in a compressed condition as a sliver package.

The present invention may also include a draw frame for producing the sliver and for direction the deposition of the sliver into the can. Also included is a conveyor for delivering a loaded can from the draw frame to the baler apparatus.

A further feature of the present invention is means for pushing the sliver package from the baler apparatus. This

means for pushing may include any suitable device for applying a lateral force to sliver package, such as a hydraulic or pneumatic piston or a conveyor.

In a further embodiment of the present invention, a sliver package suitable for efficient transport includes a substantially continuous length of cotton sliver, accumulated into a pile having an oblong footprint and a substantially uniform initial density. The pile has been compressed to a substantially higher, substantially uniform compressed density. A top cap is disposed on top of the pile, and a bottom cap is disposed on the bottom of the pile. The caps each have a footprint substantially the same as the footprint of the pile. A plurality of straps are disposed about the compressed pile and the caps in order to retain the pile in its compressed state.

The invention also provides a system for handling fiber sliver, comprising a sliver delivery device, a sliver receiving means for receiving and collecting the fiber sliver delivered by the delivery device, and a packaging apparatus comprising a device for compressing the collected fiber sliver and a device for applying one or more straps to the compressed sliver pile. In one preferred embodiment, the system is a can-free system, in which the sliver receiving means comprises a receiving surface for receiving fiber sliver delivered by the delivery device in the form of a free-standing sliver pile, and a packaging apparatus comprising a device for compressing the sliver and a device for applying one or more straps to the compressed sliver pile. Further preferred features of that system are set out in dependent claims 29 to 48.

In another preferred embodiment, the system comprises at least one sliver can and means for removing a deposited sliver pile from a said sliver can for subsequent strapping.

The sliver package of the present invention may include a protective cover for the strapped pile. At least one of the caps may be formed of fiberboard, corrugated cardboard, or plastic. The strapped pile is preferably sufficiently rigid to be a coalescent unit.

The invention will be described hereinafter in greater detail with reference to illustrative embodiments shown in the drawings wherein:

Fig. 1 is a general perspective view of a sliver package according to the present invention;

Fig. 1A is a lateral view of a sliver package as in Fig. 1;

Fig. 2 is a perspective view of a loaded sliver an;

Fig. 3 is a perspective view of a packaging system according to the present invention;

Figs. 4A - 4E are a sequence of views showing a compression method according to the present invention; and

Fig. 5 is a schematic flow chart showing a compression method according to the present invention.

Fig. 6a is a diagrammatic side view of an embodiment having, for can-free sliver deposition and as a conveying-away device, a conveyor belt that can be raised and lowered, during the depositing procedure;

Fig. 6b is a diagrammatic side view of the embodiment of Fig. 6a during the conveying-away procedure.

Fig. 7 is a diagrammatic side view of an embodiment having a push device for changing of the sliver pile in an can-free deposition arrangement; and

Fig. 8 is a diagrammatic side view of an embodiment having a lifting device and a relatively long conveyor belt which serves, at the same time, for both movement back and forth during can-free deposition and for conveying-away.

Referring now to the drawings, Figs. 1 and 1A illustrate, respectively in perspective and side view, a sliver package 10 according to the present invention which has been compressed and banded for efficient transport. Sliver package 10 includes a substantially continuous length 12 of cotton sliver accumulated into a pile that has an oblong footprint. The density of the pile of cotton sliver is substantially uniform throughout because the sliver draft 12 has been laid in a pattern of offset loops designed to produce a uniform density as compared to the density produced when sliver is laid with a circular footprint in conventional systems.

In Figs. 1 and 1A, the pile has been compressed to a substantially higher, substantially uniform compressed density such that the sides 14 of the sliver package 10 are sufficiently rigid and coherent as to allow the package to be handled without damaging or disturbing the sliver draft 12 at the sides 14 of the sliver package 10. Because of the uniform density of the sliver pile as it is initially laid (in a process to be described in greater detail below), the pile may be compressed by the introduction from the top and the bottom of a compressive force, which maintains the

uniformity of density of the sliver pile throughout the compression process.

The compressive force is applied, more specifically, to a top cap 16 and a bottom cap 18, which provide rigid surfaces against which the compressive force may be applied. The top and bottom caps 16, 18 are substantially similar and are preferably formed of a material such as fiberboard, corrugated cardboard, plastic, or any other suitable material of sufficient rigidity and durability to survive the compression process and to maintain the sliver package 10 in a compressed state. The top and bottom caps 16, 18 are maintained in their compressed locations by a number of straps or bands 20, formed of fiber-reinforced plastic or another suitable material, which encircle the sliver package 10 (including the caps 16, 18) and maintain the compressive force upon the caps 16, 18 and, by extension, the sliver pile 12.

The strapped sliver package 10 may be provided with a cover of polyethylene or another suitable material in order to protect the sliver from being soiled or damaged in transport. The strapped pile is sufficiently rigid, because of the uniformity of the sliver density and the structural reinforcement presented by the caps 16, 18 and straps, to be a coalescent unit capable of being handled substantially without damage to the sliver. Once the sliver package 10 has been transported to the desired location, it may be unstrapped and allowed to relax, and the sliver draft 12 may be used as normal in further yarnmarking operations.

Referring now to Fig. 2, a sliver can 30 is shown in a perspective view. The sliver can has an open top 31 and has been loaded with sliver 32 drawn from a draw frame (not shown) and laid in a pattern of substantially uniform density to form a pile 12. The sliver can 30, in comparison with conventional cylindrical sliver cans, is oblong, and

this oblong shape allows the sliver 32 to be laid in a pattern of offset circles that permits a substantially uniform density throughout the pile 12. The sliver can 30 is provided with an apertured base 34 that will permit, in an operation to be described later, the sliver pile 12 to be pushed upward and out of the can 30, while still providing sufficient support to retain the sliver pile 12 in the can for short-range transport. As can be seen in Fig. 2, the sliver can has a widthwise dimension A and a lengthwise dimension B that is substantially longer than the widthwise dimension A.

As part of the method of the present invention, a bottom cap 18 having an oblong footprint is placed at the bottom of the sliver can prior to filling, and this bottom cap 18 will form the base of the sliver package that is a product of the method of the present invention. The sliver 32 is then laid in the can 30 on top of the bottom cap 18. The basic elements of the package are completed by the placement of a top cap 16, having the same profile as the bottom cap 18, on top of the full sliver can 30 and the sliver 32 accumulated into the pile 12.

The filled sliver can 30 shown in Fig. 2 is then transported to baler apparatus 40, which is shown in a perspective view in Fig. 3. The sliver can 30 is doffed from the draw frame (not shown) onto a conveyor 42 which is capable of accommodating a number of sliver cans 30 in a queue for processing. Conveyor 42 is directed at the baler apparatus 40, which includes a compression section 44, an elevator section 46, means for pushing the sliver package 10 (such as piston 48), and a second conveyor 50 (Figs. 4A-4E) for delivering the sliver package 10 and the now-empty sliver can 30 to a collection location.

A preferred embodiment of the sections of the baler apparatus 40 are shown in greater detail in connection with

Figs. 4A-4B. Fig. 4A shows a filled sliver can 30 being deposited into the compression area 44. A ram 60 is extended through the apertures in the base 34 of the sliver can 30 and exerts an upward force upon the bottom cap 18 and thus the sliver pile 12, driving the sliver pile 12 upward against a means 62 for applying counterpressure to the top cap 16 and the sliver pile 12, such as rigid plate 62. The compression area 44 is sized to prevent the widthwise expansion and disintegration of the sliver pile 12 as it is removed from the sliver can 30. Consequently, an even pressure, preferred to be about 3600 psi or any other suitable pressure, is applied to compress the sliver pile 12 into a smaller, denser but still uniformly dense, coalescent unit 70 (see Fig. 4C).

As part of the compression process, a set of straps 20 are placed about the sliver pile 12 in order to retain the coalescent unit 70 in its compressed state following compression. In Fig. 4B, these straps 20 are shown extending not quite fully around the sliver pile 12, but as pile 12 is compressed as shown in Fig. 4C, the straps 20 may then reach completely around the sliver pile 12 and may be fastened upon each other in the conventional manner. Because the straps 20 encircle the caps 16, 18 as well, the caps 16, 18 are preferably provided with a corresponding set of recesses 17 (Fig. 1A) that locate the straps 20 in the proper place and ensure that sufficient strapping is in place to prevent the unwanted decompression of the package 70.

In Fig. 4D, the sliver package 70 now rests in the upper portion of the compression area 44, and the empty can 72 rests in the lower portion of the compression area 44. The sliver package 70 in a preferred embodiment is then conveyed by pushing it using a piston 48 or another suitable method to the elevator section 46 and, as can be seen in

Fig. 4E, lowered to the ground level to the conveyor 50 to allow the package 70 to be delivered to a collection point. Likewise, the empty can 72 may be delivered to an empty can collection point for reuse in another iteration of the method of the present invention.

Referring now to Fig. 5, a preferred embodiment of a method according to the present invention is shown in a flow chart illustrating steps in the sliver package-forming process. At step 100, a bottom cap of an oblong profile is placed into a can having a lengthwise dimension and a widthwise dimension, with the lengthwise dimension being substantially longer than the widthwise dimension. In other words, the can is oblong as well. At step 102, the sliver is drawn from a draw frame in the direction of the sliver can. At step 104, the sliver is laid in a pattern having a substantially uniform uncompressed density into the can on top of the bottom cap.

At step 106, a top cap is placed upon the laid sliver pile. As has been noted above, the top and bottom caps are formed of a material of sufficient rigidity, in combination with strapping to be noted below, to prevent decompression of the sliver package. Such materials may include corrugated cardboard, fiberboard, plastic, or any other suitable material. The caps themselves may be provided with recesses for locating the straps.

At step 108, the can is delivered to a compression baler. The sliver pile is then pressed upward, driving it out of the cap, at step 110. Pressure continues to be applied from the bottom; at step 112, counterpressure is applied to the top of the pile, and the pile is thus compressed via the application of at least 3200 psi thereto. At step 114, the compressed sliver and caps are strapped to form a substantially rigid and independently stable package; and the straps retain the package at a desired compressed

density selected to enable handling of the package without damage to the sliver. At step 116, the sliver package is delivered to a collection point and may be bagged or covered for transport.

In the embodiment shown in Figs. 6a and 6b, sliver is delivered by a high-performance draw frame 201 (autoleveller draw frame), for example the HSR 1000 (trade mark) high-performance draw frame made by Trutzschler GmbH & Co. KG of Mönchengladbach, Germany. The fiber slivers, coming from cans (not shown), entering a drawing mechanism, are drawn out therein and, after the exit from the drawing mechanism, are combined to form a fiber sliver. The fiber sliver passes through a revolving plate 202 and is then deposited in a can-free manner as a sliver pile 204 in a ring arrangement on a base, provided on a carriage 203 which moves back and forth in the direction of arrows C and D. The carriage 203 is driven by a controllable drive motor (not shown) which is connected to an electronic control and regulation device, for example a machine control means. Reference numeral 210 denotes a cover plate for the sliver-depositing device (coiler), which cover plate is connected to the supporting plate 207. Reference letter F denotes the work direction (flow of fiber material) in the draw frame, the fiber sliver 204 being deposited by the revolving plate 202 in a substantially perpendicular direction. Reference numeral 208 denotes the depositing area, reference numeral 209 denoting the area to the outside of the depositing are 208.

Fig. 6a shows one end position and Fig. 6b shows the other end position of the carriage 203, which moves back and forth horizontally beneath the revolving plate 202 in directions C, D during deposition of the fiber sliver 204. On the upper surface of the carriage 203 there is arranged a holding apparatus 234a, 234b, for example posts, on which a

conveyor belt 233 is so mounted that its height can be adjusted in the direction of arrows M, N. The sliver pile 204 is deposited on the upper portion 233a of the conveyor belt 233, optionally on a plate (not shown in the drawing) arranged on the upper portion 233a. During sliver deposition, the carriage moves back and forth in the direction of arrows C, D. The sliver pile 204 is likewise moved back and forth beneath the revolving plate 2 in the direction of arrows C. D. After it has reached the end position shown in Fig. 6a, the carriage 203 moves in the direction of arrow D, during which the carriage 203 is accelerated, driven at constant velocity and then braked. After it has reached the end position shown in Fig. 6b, the carriage 203 moves back in the direction of arrow C, during which the carriage 203 is accelerated, driven at constant velocity and then braked. Switching-over between the back and forth movements is accomplished by means of a control device in conjunction with the drive motor, neither of which is shown in the drawings.

Each time an end position is reached, the conveyor belt 233 is adjusted downwards in direction M by about one fiber sliver thickness, for example 10 mm, by means of a drive motor (not shown). Referring to Fig. 6b, when fiber sliver deposition has been completed, the upper portion 233a of the belt is moved in direction R, for example by means of a controlled drive motor (not shown), so that the sliver pile 204^1 is slid onto a substantially level support plate 235 located alongside, for example a transportation tray. That edge of the support plate 235 which faces the carriage 203 may be, for example, bevelled-off, rounded-off or the like. If, as described above, the sliver has been deposited onto a deposition plate (bottom cap 18) received on the conveyor belt 233, the plate together with the sliver pile may be slid onto an adjacent support, which may then if desired

omit the plate 235. A top cap 16 may then be placed upon the top of the sliver pile 204^1 on the support plate 235 (and/or the deposition plate if present), and the sliver thereafter compressed and strapped, for example in the manner described with reference to Figs. 4A to 4E, including the support plate 235 or the deposition plate, if present (acting in each case as bottom cap 18) and the top cap.

The motor is a variable-speed electric motor which drives the carriage 203 in jolt-free or substantially jolt-free manner, that is, smoothly. The velocity between acceleration and braking is constant. By that means it is ensured that the sliver pile 204 remains stable both during movement back and forth within the depositing area 208 according to Figs. 6a and 6b and during movement out from the depositing area 208. The movements are so controlled that a production rate which is as high as possible is achieved, without the sliver pile slipping or, even, tipping over.

In a further embodiment involving can-free deposition shown in Fig. 7, there is arranged on the carriage 203 a lifting platform 236, for example a plate, which can be mounted on holding elements in a manner known *per se*, for example from DE 44 07 849 A1, and adjusted in the direction of arrows O, P. On the carriage 203 there is provided a supporting element 237, for example a post, on which a pushing device 238 is mounted by way of a suitable controlled drive element 239, for example a pneumatic cylinder, spindle drive or the like. Each time an end position is reached, the platform 236 is adjusted downwards in direction P by about one fiber sliver thickness, for example, 10mm. When deposition of the sliver bundle 204 on the surface of the lifting platform 236 has been completed, the pushing device 238 is moved against the sliver bundle 204 in the direction of arrow S so that the sliver bundle

204 is pushed from the lifting platform 236 onto the support plate 235 as a result of direct contact pressure from the pushing device 238. The support plate 235 rests on a stand 240 or the like and can be taken off the surface of the stand 240 together with the sliver pile 204. Optionally, there can instead or as well as support plate 235 be used during deposition a plate (bottom cap) that is received upon the platform 236 during deposition and which can be pushed, together with the sliver pile, onto the stand 240 or onto the support plate 235. A top cap may be placed upon the sliver pile 204^1, and a compressing force may be applied to the sliver pile 204^1 between the top cap and the support plate 235 or the deposition plate (in each case acting as bottom cap 218), followed by strapping of the sliver pile 204^1 with the top cap 204^1 and the bottom cap 218, in the manner described above with reference to Figs. 4A to 4E.

In the embodiment of Fig. 8, there is provided a lifting plate 241, which can be raised and lowered by means of lifting elements 242a, 242b, for example controlled pneumatic cylinders, in the direction of arrows T, U, and V, W. On the surface of the lifting plate 241 there is provided a conveyor belt 243, the belt portions of which can be moved in the direction of arrows X, Y by a drive motor and control means (not shown). During deposition, the upper portion 243a of the belt is moved back and forth in the direction of arrows X, Y beneath the revolving plate 202. After the fiber sliver has been deposited in the form of a sliver pile 204 on the upper portion 243a of the belt, the drive motor is so controlled by the control means that the upper portion 243a of the belt moves the sliver pile 204 out from the depositing area 208 beneath the revolving plate 202 and unloads it onto a support surface 235. Optionally, in analogous manner to that described with reference to Figs. 6A, 6B and 7 above, the sliver may if desired be deposited

onto a deposition plate (bottom cap 18) received on the belt 243, which can then be transferred with the sliver pile to the adjacent support stand 240 (optionally provided with support surface 235). The unloaded sliver pile 204^1 can then be compressed, with the assistance of a top cap, and strapped as described with reference to any of the preceding Figures of the drawings.

Figs. 6A, 6B, 7 and 8 show embodiments in which the sliver is deposited on a surface without the use of a can, that is, the surface upon which the sliver is deposited is substantially unenclosed, in contrast to arrangements in which the sliver is deposited upon a bottom cap that is located in a sliver can. An advantage of such can-free depositing methods that, whilst in the draw frame, a pressure can already be exerted on the sliver pile 204, which is thereby pre-compressed. The use of cans can be dispensed with completely in those embodiments.

In view of the aforesaid written description of the present invention, it will be readily understood by those persons skilled in the art that the present invention is susceptible of broad utility and application. Many embodiments and adaptations of the present invention other than those herein described, as well as many variations, modification, and equivalent arrangements, will be apparent from or reasonably suggested by the present invention and the foregoing description thereof, without departing from the substance or scope of the present invention. Accordingly, while the present invention has been described herein in detail in relation to preferred embodiments, it is to be understood that this disclosure is only illustrative and exemplary of the present invention and is made merely for purposes of providing a full and enabling disclosure of the invention. The foregoing disclosure is not intended nor is to be construed to limit the present invention or

otherwise to exclude any such other embodiments, adaptations, variations, modifications and equivalent arrangements, the present invention being limited only by the claims appended hereto and the equivalents thereof.

Claims

1. A method of packaging cotton sliver for transport thereof, comprising the steps of:

laying the sliver in a pattern having a substantially uniform first density onto a bottom cap disposed inside a substantially oblong sliver can;

placing a top cap atop the laid sliver;

applying pressure to the top and bottom caps to compress the sliver to a second density substantially higher than the first density, whereat the compressed sliver is substantially rigid; and

strapping the compressed sliver and caps to form a substantially rigid package.

2. A method of packaging cotton sliver according to claim 1, further comprising the step of:

driving the compressed sliver out of the sliver can.

3. A method of packaging cotton sliver according to claim 1 or claim 2, further comprising the step of:

placing the package into a protective outer cover.

4. A method of packaging cotton sliver according to any one of the preceding claims, wherein the caps are formed of a material of sufficient rigidity, in combination with the strapping, to prevent decompression of the sliver package.

5. A method of packaging cotton sliver according to any one of the preceding claims, wherein at least one of the caps is formed of corrugated cardboard.

6. A method of packaging cotton sliver according to any one of the preceding claims, wherein at least one of the caps is formed of fiberboard.

7. A method of packaging cotton sliver according to any one of the preceding claims, wherein the caps are provided with recesses to locate and accommodate the strapping.

8. A method of packaging cotton sliver according to any one of the preceding claims, wherein the pressure applied to the caps is at least 3200 psi.

9. A method of packaging a continuous length of cotton sliver for transport thereof, comprising the steps of:

drawing the sliver from a draw frame;

laying the sliver in a pattern having a substantially uniform uncompressed density into a can having a lengthwise dimension and a widthwise dimension, the lengthwise dimension being substantially longer than the widthwise dimension;

delivering the can to a compression baler;

pressing the sliver upward from the base of the can to compress the sliver end to remove the sliver from the can; and

applying straps to the sliver to form a sliver package and retain the package at a desired compressed density selected to enable handling of the package.

10. A method of packaging according to claim 9, further comprising the step of:

applying top and bottom caps to the sliver to facilitate compression and retention of compression.

11. A method of packaging cotton sliver according to claim 10, wherein the caps are formed of a material of sufficient rigidity, in combination with the strapping, to prevent decompression of the sliver package.

12. A method of packaging cotton sliver according to claim 10 or claim 11, wherein at least one of the caps is formed of corrugated cardboard.

13. A method of packaging cotton sliver according to claim 10 or claim 11, wherein at least one of the caps is formed of fiberboard.

14. A method of packaging cotton sliver according to any one of claims 10 to 13, wherein the caps are provided with recesses to locate and accommodate the strapping.

15. A method of packaging according to any one of claims 9 to 14, further comprising the step of:

placing the package into a protective bag.

16. A method of packaging cotton sliver according to any one of claims 9 to 15, wherein the step of pressing the sliver includes applying pressure to the caps to at least 3200 psi.

17. A system for efficiently packaging cotton sliver for transport thereof, the system comprising:

an oblong sliver can having a widthwise dimension and a lengthwise dimension substantially greater than the widthwise dimension, the can being configured to receive the sliver deposited through an open top in a uniform density and to permit a pile of accumulated sliver to be pushed upwardly therethrough during packaging;

a baler apparatus including at least one ram configured to compress the sliver to a desired density through application of a selected pressure to a bottom surface of the sliver pile, and including means for applying counterpressure to a top surface of the sliver pile; and

a strapping apparatus for applying one or more straps to the compressed sliver pile to retain the compressed sliver pile in a compressed condition as a sliver package.

18. A system according to claim 17, further comprising:

a draw frame for producing the sliver and for directing the deposition of the sliver into the can.

19. A system according to claim 18, further comprising:

a conveyor for delivering a loaded can from the draw frame to the baler apparatus.

20. A system according to any one of claims 17 to 19, further comprising:

means for pushing the sliver package from the baler apparatus.

21. A sliver package suitable for efficient transport, comprising:

a substantially continuous length of cotton sliver, accumulated into a pile having an oblong footprint and a substantially uniform initial density, the pile being compressed to a substantially higher, substantially uniform compressed density;

a top cap disposed on top of the pile and having a footprint substantially the same as the footprint of the pile;

a bottom cap disposed on the bottom of the pile and having a footprint substantially the same as the footprint of the pile; and

a plurality of straps disposed about the compressed pile and the caps for retaining the pile in a compressed state.

22. A sliver package according to claim 21, further comprising:

a protective cover for the strapped pile.

23. A sliver package according to claim 21 or claim 22, wherein at least one of the caps is formed of fiberboard.

24. A sliver package according to any one of claims 21 to 23, wherein at least one of the caps is formed of corrugated cardboard.

25. A sliver package according to any one of claims 21 to 24, wherein at least one of the caps is formed of plastic.

26. A sliver package according to any one of claims 21 to 25, wherein the strapped pile is sufficiently rigid to be a coalescent unit.

27. A system for handling fiber sliver, comprising a sliver delivery device, a sliver receiving means for receiving and collecting the fiber sliver delivered by the delivery device, and a packaging apparatus comprising a device for compressing the collected fiber sliver and a device for applying one or more straps to the compressed sliver pile.

28. A system according to claim 27, which is a can-free system, in which the sliver receiving means comprises a

receiving surface for receiving fiber sliver delivered by the delivery device in the form of a free-standing sliver pile, and a packaging apparatus comprising a device for compressing the sliver and a device for applying one or more straps to the compressed sliver pile.

29. A can-free system according to claim 27 or claim 28, further comprising means for placing a top cap onto the sliver pile, the sliver pile being compressed between the top cap and a bottom cap.

30. A can-free system according to claim 29, comprising a member that can act as both the receiving surface and the bottom cap.

31. A can-free system according to claim 29, in which the fiber sliver is received on a first planar member as a receiving surface, and is thereafter transferred as a free-standing sliver pile onto the bottom cap.

32. A system according to any one of claims 28 to 31, in which the position of the receiving means is fixed in the vertical position.

33. A system according to any one of the claims 28 to 31, in which the receiving means is arranged to be raised and lowered vertically.

34. A system according to any one of claims 28 to 31, in which the receiving means is an upper surface of a conveyor belt.

35. A system according to any one of claims 28 to 34, in which the receiving means is a part of a transportation device for moving the deposited sliver.

36. A system according to claim 35, in which the transportation device is a carriage.

37. A system according to claim 35 or claim 36, in which the receiving means is a part of a conveyor belt arranged on the transportation device.

38. A system according to any one of claims 28 to 37, in which the delivery device is a rotary revolving plate.

39. A system according to any one of claims 28 to 38, in which the fiber sliver is arranged to be deposited in rings.

40. A system according to any one of claims 28 to 39, in which the sliver receiving means is movable back and forth horizontally.

41. A system according to any one of claims 28 to 40, comprising mechanical means for displacing the collected fiber sliver from the depositing area.

42. A system according to claim 41, in which the mechanical means is a pushing device or a sliding device.

43. An apparatus according to any one of claims 28 to 42, having a lifting and lowering device provided for the receiving means.

44. A system according to claim 43, in which the lifting and lowering device comprises one or more of:

a hydraulic cylinder, a pneumatic cylinder, a scissors framework, and spring elements.

45. A system according to claim 43 or claim 44, in which the receiving means is a part of a lifting platform.

46. A system according to claim 45, in which the lifting platform is a plate.

47. A system according to claim 45, in which the lifting platform is, on its upper surface, arranged to enhance sliding of the collected fiber sliver.

48. A system according to any one of claims 28 to 47, in which the deposited fiber sliver is arranged to be conveyed away from the depositing area onto a base member.

49. A can-free system according to any one of claims 28 to 48, in which the delivery device is a part of a draw frame.

50. A can-free system according to any one of claims 28 to 48, in which the delivery device is a part of a carding machine.

51. A can-free system according to any one of claims 28 to 48, in which the delivery device is a part of a combing machine.

52. A can-free system according to any one of claims 28 to 51, in which the free-standing sliver pile has an oblong footprint.

53. A system according to claim 27, further comprising at least one sliver can and means for removing a deposited sliver pile from a said sliver can for subsequent strapping.

54. A system according to claim 53, in which the sliver can be compressed before it is removed from the can.

55. A system according to claim 53 or claim 54, comprising means for compressing the sliver after it has been removed from the can.

56. A system according to any one of claims 53 to 55, comprising a bottom cap arranged to be removably positioned within a said can for receiving the deposited fiber sliver.

57. An apparatus for packaging a fiber sliver pile having a top surface and a bottom surface and embraced between a top member and a bottom member, comprising means for applying pressure to at least one of said top member and bottom member for compressing the sliver pile to a desired density and a strapping device for applying one or more straps to the compressed sliver pile to retain the compressed sliver pile in a compressed condition as a sliver package.

58. A system according to any one of claims 27 to 56 or an apparatus according to claim 57, in which the fiber sliver is of cotton and/or synthetic fiber and/or a synthetic fiber blend.

59. A sliver package according to any one of claims 21 to 26, in which the fiber sliver is of cotton and/or synthetic fiber and/or a synthetic fiber blend.

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Application No:	GB0519748.8	**Examiner:**	Stephen Smith
Claims searched:	1-59	**Date of search:**	13 March 2006

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	27, 29, 30, 33, 39-46, 53-58	EP 0320467 A1 (QUALCHIERANI) lines 15-44 of column 1
X	27, 29, 30, 33, 39, 41-46, 53-58	FR 2540476 A1 (SCHLUMBERGER) abstract
X	27, 29, 30, 33, 41-46, 53-58	GB 1166650 A (FILATURE ST LIEVEN) line 72 of page 1 to line 57 of page 2

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

B65B

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI

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