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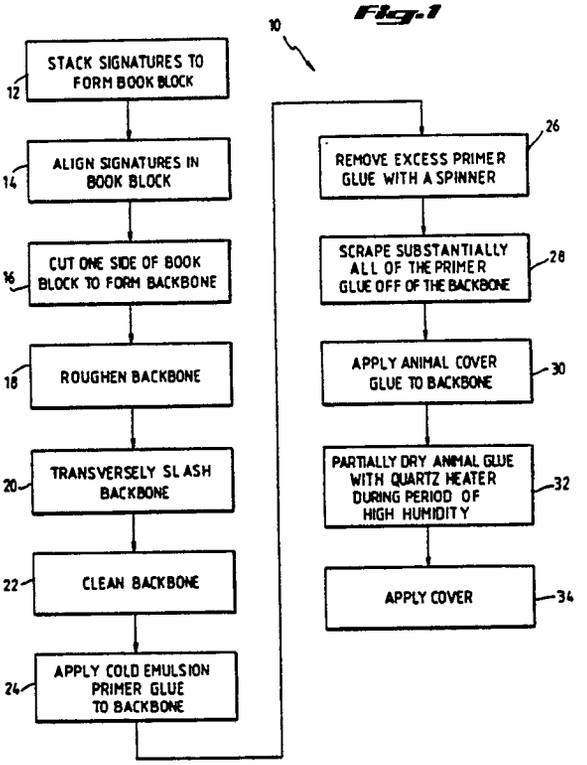
(54) Book Binding Process.

(57) It is desirable to provide a book binding process which effectively binds coated and uncoated paper together, while retaining the advantages of low temperature glues, such as animal glues and cold emulsion glues. However, animal glue does not adhere well to coated paper stock nor does animal glue adhere well to a cold emulsion primer adhesive. Therefore, the present book binding process includes applying a coating of cold emulsion primer adhesive to a roughened and slashed backbone of a book block to bind the pages in the book block together, and, then, removing the coating of cold emulsion primer adhesive, preferably by scraping. The scraped backbone is relatively clean, so that a coating of animal glue will adhere well to the backbone. The coating of animal glue acts as a cover adhesive which binds a cover to the backbone of the book block.

Fig.1



EP 0 420 130 A2

BOOK BINDING PROCESS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to book binding, and more particularly to a process which bonds both coated and uncoated signatures using low temperature glues.

2. Description of the Related Art

Modern book binding processes which mass produce bound books or catalogues are essentially fully automated, with the exception of minor human handling requirements. Large printing machines print information onto large paper webs which are cut and folded to form signatures. Since a finished book may require several signatures, the signatures are stacked or compiled to form a book block. Typically, fork lifts or automatically guided vehicles transport the signatures from the printing machine to a signature compilation machine where operators load the signatures into appropriate stacking stations. The signature compilation machine sequentially stacks the proper signatures on top of one another to form a plurality of identical signature blocks.

Once the signature blocks have been formed the signatures in each block must be bound together by a suitable process. One popular process binds the signatures with a layer of primer adhesive. Prior to the application of primer adhesive, however, one edge of each signature block is cut to form a spine or backbone surface acceptable for the receiving the primer adhesive. This cutting operation is performed by passing each consecutive signature block through a saw which is aligned to cut off a portion of the block. Typically, the surface of the cut backbone surface is also roughened by passing each signature block by a rotating "rougher" blade. Roughening yields an absorptive surface which maximizes the adhesion properties of the primer adhesive.

The primer adhesive is usually applied to each suitably prepared backbone by brushing, spraying or rolling until the primer adhesive coats and penetrates the roughened backbone. The primer adhesive is then set, i.e., at least the top layer of adhesive is dried, by air drying or by subjecting the backbone to a heat source. Once the primer adhesive is set, a cover adhesive is applied in a similar fashion to the backbone of each signature block. Book covers are brought into register with the cover adhesive on the backbones, and the adhesive binds the book covers to the respective signature blocks. The covered signature blocks are then automatically trimmed, and the finished books are ready for packaging and shipment.

While the above-described process seems simple and straight-forward, many factors influence the quality of books produced by similar automated processes. One particular problem concerns the incompatibility of different types of adhesives and the effectiveness of adhesives on different types of paper.

For instance, telephone directories and catalogs, heretofore, have been made almost exclusively with uncoated paper products. Animal glues adhere quite well to uncoated paper stock, so animal glues are used for both the primer and cover adhesives in the process described above. Books bound with animal glues have excellent repulping value, and, thus, paper mills pay a premium price for paper shavings which contain only animal glue adhesives. Animal glues are usually applied at low temperatures (under 150 ° F), so there animal glue is generally safe to handle and apply. However, animal glues can be undesirably affected by humidity and temperature, and books bound with animal glue tend to display a limited life. Moreover, animal glues do not adhere well to coated paper stock, and, therefore, are usually not used in any process where coated stock must be bound. If animal glue is used to bind coated paper, the life of the book is severely limited to no more than a few months assuming occasional use of the book.

One gluing process which generally follows the steps of the above-described process uses an emulsion primer glue to bond the signatures together and a hot melt cover glue to bond the cover to the signature block. These glues adhere very well to both coated and uncoated paper stock, and produce high quality, long-lasting books. However, paper shavings which contain hot melt glue have very low repulping value, and emulsion and hot melt glues are more expensive than animal glues. Hot melt glues are also applied at temperatures of about 350 ° F, and, therefore, are more hazardous to handle and apply than animal glues. Furthermore, the drying of the emulsion primer layer limits the production rate because the hot melt cover glue cannot be effectively applied until the layer of emulsion primer glue is dry. In an effort to increase throughput using this type of process, gas dryers are used to dry the emulsion layer. Unfortunately, the use of gas dryers create fire concerns.

Another type of gluing process, which is similar

to the process previously described, uses only a single application of glue to bind the signatures together and to bind the covers to the signature blocks. This process is referred to as a "one shot hot melt" process. A layer of hot melt glue is applied to the backbone of the signature blocks using a glue pot, for instance. Then, before the hot melt adhesive is allowed to dry, the book cover is adhered to the backbone. While this process creates a durable book using any type of paper stock, it also suffers from many of the disadvantages discussed in the previous paragraph.

Advertisers are increasingly using catalogs and telephone directories to promote their goods and services. Since glossy, coated paper captures the attention of consumers better than uncoated paper, coated inserts and signatures are currently being included in the signature blocks of books which previously used only uncoated paper. Therefore, it is desirable to provide a book binding process which effectively binds coated and uncoated paper together, while retaining the advantages of low temperature glues, such as animal glues and cold emulsion glues.

However, as set forth above, animal glue does not adhere well to coated paper stock. Cold emulsion adhesive does adhere to coated stock to provide a sufficient bond, and paper shavings having cold emulsion adhesive thereon have a good repulping value. Unfortunately, animal glue does not adhere to cold emulsion adhesive, so attempts to use a cold emulsion primer adhesive with an animal glue cover adhesive have proven futile.

The present invention is directed to overcoming one or more of the problems as set forth above.

SUMMARY OF THE INVENTION

It is the primary object of the present invention to provide a book binding process which effectively binds both coated and uncoated paper stock.

It is an important object of the present invention to provide a book binding process in accordance with the primary objective which does not use hot melt adhesives.

It is another object of the present invention to provide a book binding process which yields paper shavings having good repulping value.

It is yet another object of the present invention to provide a book binding process which does not use a heater to dry the adhesives.

It is still another object of the present invention to provide a book binding process which uses only low temperature glues.

It is a further object of the present invention to provide a book binding process which produces long-lasting, high quality books.

In accordance with the present invention, a method of applying adhesives to the backbone of a book block is provided which allows a cold emulsion primer adhesive to be used with an animal glue cover adhesive. First, the backbone of a book block is roughened to form a backbone surface suitable for the application of adhesives. Next, the backbone surface is transversely slashed, and a coating of primer adhesive, preferably cold emulsion adhesive, is applied to the backbone surface for binding pages in the book block together. Then, substantially all of the primer adhesive is removed from the backbone surface, preferably by passing the surface by at least one scraper. Once the backbone surface is clean, a cover adhesive, preferably animal glue, is applied to the backbone surface for binding a cover to the backbone surface of the book block.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

Fig. 1 is a flow diagram describing the book binding process of the present invention;

Fig. 2 is a diagrammatic illustration of the book binding apparatus of the present invention;

Fig. 3 is a perspective view of a book block;

Fig. 4 is a perspective view of the primer glue pot and scrapers of the present invention; and

Fig. 5 is a perspective view of the cover glue pot of the present invention.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and will be described in detail herein. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Refer initially to Fig. 1 which illustrates a book binding process using a flowchart 10, and to Fig. 2 which diagrammatically illustrates a book binding

apparatus 100.

The process, and apparatus which performs the process, will be discussed beginning with the stacking of printed and folded signatures. Since a finished book may require several signatures, the signatures are stacked or compiled to form a signature block as set forth in step 12. A signature compilation portion 102 of the apparatus 100 sequentially stacks the proper signatures, one top of another, to form a plurality of identical signature blocks.

The stacking operation is performed by loading the appropriate signatures into their respective receptacles 104a-d, and feeding the signatures one at a time onto a conveyor 106. First, a signature in receptacle 104a is feed onto the conveyor 106. As the conveyor 106 moves the signature to receptacle 104b, a signature from receptacle 104b is fed onto the top of the signature deposited by receptacle 104a, and another signature from receptacle 104a is fed onto the conveyor 106. When the two stacked signatures move to receptacle 104c, a signature from receptacle 104c is fed onto the top of the first two signatures, a signature from receptacle 104b is fed onto the second signature deposited by receptacle 104a, and receptacle 104a feeds another signature onto the conveyor 106. This sequential stacking operation continues until the requisite number of signature have been stacked to form a signature block. While only four receptacles are illustrated, clearly a fewer or greater number may be used depending on the number of signatures required to form each signature block.

Once the signature blocks have been formed, in the next step 14, the signatures in each block are aligned for further processing. Since further processing requires that the alignment of the signatures within each block be maintained, the aligned signature blocks are transferred to a clamping conveyor 108 (Fig. 2.). Spring actuated clamps 110 on the conveyor 108 grip each signature at about point A for transport through various processing apparatus which will form the signature block into a finished book.

As illustrated in Fig. 3 and in accordance with step 16, one edge of each signature block 40 is cut to form a spine or backbone surface 42. This cutting operation is performed by passing each consecutive signature block 40 through at least one saw 112 which is aligned to cut off a portion of the block 40. Preferably, three Comstock and Wescott ten-toothed dustless saws are consecutively aligned for making a proper cut in each signature block. The first two saws are right handed and the last saw is left handed to insure an even cut.

Next, as set forth in step 18 of the flowchart 10, the surface of the cut backbone surface is roughened by passing each signature block by a rotating "rougher" blade 114. Roughening yields an absorptive surface acceptable for the receiving a coating of primer adhesive and which maximizes the adhesion properties of the primer adhesive. Preferably, two Comstock and Wescott rougher spindles are located directly after the third saw. The rougher spindles have 72 teeth with a 1° to 5° tooth angle, and the spindles rotate at about 3000 r.p.m.

When the signature blocks contain coated stock, it is also preferable to transversely "slash" the backbone of the signature block before applying a primer adhesive. Slashing produces grooves 43 which run from the first signature to the last signature in the block 40. Since coated stock does not absorb glue as readily as uncoated stock, the transverse grooves 43 provide a path into which glue seeps so that coated stock can be securely bound together. Therefore, step 20 is performed by a slasher 114, which is preferably mounted on the second rougher spindle. If the coated stock is in the middle portion of the signature block, two slasher teeth are mounted near the center of the radius of each rougher. However, if the coated stock is on one of the ends of the signature block, two additional slasher teeth are mounted at the outer radius of the rougher.

To clean the backbone 42 before the application of a primer adhesive, one or more brushes 116 are located after the rougher/slasher 114. The backbone cleaning step 22 removes paper dust so that the dust will not contaminate the primer adhesive. Preferably, the conveyor 110 moves the signature blocks into contact with a straight brush and a rotary brush The dust removed by the brushes is withdrawn from the apparatus by a vacuum.

Next, as set forth in step 24, a primer adhesive is applied to each suitably prepared backbone by passing each backbone through a glue pot 118, as shown in Fig. 4. The primer adhesive is a polyvinyl acetate co-polymer emulsion adhesive, such as WB-1791 which may be purchased from the H.B. Fuller Company, 2400 Energy Park Drive, St. Paul, Minnesota 55108. The primer adhesive is applied at ambient temperature, and preferably has a low viscosity of about 500 centipoise. The glue pot 118 is a straight wheel pot which preferably includes three glue-applying stainless steel wheels 120,122,124, as shown in detail in Figs. 4 and 5.

The three glue-applying stainless steel wheels 120,122,124 rotate clockwise as shown by the arrows on the wheels in Fig. 4. The direction of book travel is shown by the arrow 125, so the upper surface of each of the wheels 120,122,124 is rotating in the same direction as book travel. The lower surface of each wheel 120,122,124 is immersed in a bath of the cold emulsion primer adhesive which is held within a vat 126. As the wheels rotate

through the glue bath, glue becomes attached to the wheels. Doctor blades 128,130,132 remove glue from their respective wheels 120,122,124 so that a predetermined thickness of glue remains on the wheels. Signature blocks which pass over the glue-covered wheels 120,122,124 contact a portion of the glue on each wheel, thus transferring a portion of the glue to the backbone of the signature blocks. Three glue-applying wheels are used to accurately control the amount of glue being applied to the backbones of the passing signature blocks.

Since the use of cold emulsion adhesives and animal glue do not reduce the value of paper shavings produced during book binding processes, animal glue will be used to attach covers to each signature block bound by the cold emulsion adhesive. However, animal glue does not bond to cold emulsion adhesives. Therefore, in accordance with steps 26 and 28, substantially all of the cold emulsion adhesive applied to the backbone is removed prior to the application of the animal cover glue.

A spinner wheel 134 removes a portion of the cold emulsion adhesive as the backbone of each signature block passes over the spinner wheel 134. The spinner wheel 134 is located in the glue pot 118 downstream from the three glue-applying wheels 120,122,124. Unlike the glue-applying wheels, the spinner wheel 134 is not immersed in the glue bath. Instead the spinner wheel 134 rotates in the opposite direction from the wheels 120,122,124, and removes a portion of the cold emulsion adhesive from the backbone of each signature block. A doctor blade 136 removes the cold emulsion adhesive from the spinner wheel 134, and directs the removed adhesive down into the glue bath.

To effectively remove the remaining cold emulsion adhesive from the backbone of each signature block at least one scraper 119 is positioned downstream from said spinner wheel 134. Preferably, a straight-bladed scraper 138 removes the majority of cold emulsion adhesive from the backbone of each passing signature block. The straight-bladed scraper 138 is adjusted so that the blade of the scraper just contacts the backbone of each passing signature block. The contact should be sufficient for removing the glue but should not damage the backbone. Advantageously, straight-bladed scraper 138 is positioned above a container (not shown) so that the removed adhesive drips off of the scraper and into to the container.

Downstream from the straight-bladed scraper 138, at least one "tucker" scraper 140 removes cold emulsion adhesive from the sides of the signature block near the backbone. The tucker scraper 140 includes two metal fins 140a,140b which are angled in the direction of book travel, one on each side of the passing signature blocks. Since there is very little adhesive on the sides of the signature block, adhesive removed from the sides also falls into the container.

To ensure that substantially all of the cold emulsion adhesive is removed from the backbone of each signature block, a V-shaped scraper 142 is positioned downstream from the tucker scraper 140. The V-shaped scraper 142 contacts the backbone of each passing signature block, and removes most of any remaining glue from each backbone.

To prevent the backbones of the signature blocks from flaring out during the scraping operations, a pair of side rails or "wings" 144a,144b are positioned on each side of the passing signature blocks. The side wings 144a,144b slightly compress the signatures within each block together as the signature blocks pass between them. Preferably, the side wings are positioned above at least the spinner wheel 134 and the straight-bladed scraper 138, because these mechanisms tend to promote flaring of the backbone. The wings are not as useful above the tucker scraper 140 and the V-shaped scraper 142, because these scrapers tend to compress the signatures in each block together.

After the cold emulsion primer adhesive has been removed from the backbone of each signature block, the conveyor 108 moves the consecutive signature blocks to a cover glue pot 146, as set forth in step 30. The cover glue is an animal glue, such as WB-1481 which may be purchased from the H.B. Fuller Company, 2400 Energy Park Drive, St. Paul, Minnesota 55108. The cover glue is applied at about 130° F to about 160° F, and preferably has a viscosity of about 20,000 centipoise to about 40,000 centipoise. The desired viscosity of the animal glue depends on the thickness of the signature block. It has been found that glue having a viscosity of about 20,000 centipoise works well for thin blocks of about 1/4 inches to about 1/2 inches in thickness, while glue having a higher viscosity of about 30,000 centipoise produces a stronger bond for thicker signature blocks.

The glue pot 146 is a straight wheel pot which preferably includes two glue-applying stainless steel wheels 148,150, as shown in detail in Fig. 5. The two glue-applying stainless steel wheels 148,150 rotate clockwise as shown by the arrows on the wheels. The direction of book travel is shown by the arrow 152, so the upper surface of each of the wheels 148,150 is rotating in the same direction as book travel. The lower surface of each wheel 148,150 is immersed in a bath of animal glue which is held within a vat 154. As the wheels rotate through the glue bath, glue becomes attached to the wheels. Doctor blades 156,158 remove glue from their respective wheels 148,150 so that a predetermined thickness of glue remains on the wheels. Signature blocks which pass over the

glue-covered wheels 148,150 contact a portion of the glue on each wheel, thus transferring a portion of the glue to the backbone of the signature blocks.

A pair of wings 160,162 cooperates with the first wheel 148 in order to apply a glue bead to the edges of each passing backbone, and also guide each successive signature block into the cover glue pot 146. A groove 164,166 in each respective wing 160,162 causes glue on the rotating wheel 148 to form a raised ridge. The ridges of glue are spaced apart from one another by about the thickness of the signature blocks which are being processed. As each signature block passes over the wheel 148, the ridge of glue is applied to the edges of the backbone. The ridge of glue forms a glue bead which effectively bonds the edges of each backbone to an applied cover.

The second glue-applying wheel 150 carries a greater thickness of animal glue than does the first wheel 148. A portion of the glue is applied to the entire backbone surface of each signature block as it passes over the wheel 150 and contacts the glue.

A spinner wheel 163 removes a portion of the animal glue from the backbone of each signature block as the backbone of each signature block passes over the spinner wheel 163. The spinner wheel 163 is located in the glue pot 146 downstream from the two glue-applying wheels 148,150. Unlike the glue-applying wheels, the spinner wheel 163 is not immersed in the glue bath. Instead the spinner wheel 163 rotates in the opposite direction from the wheels 148,150, and removes a portion of the animal glue from the backbone of each signature block to ensure that there is a predetermined thickness of glue on the backbone of each signature block. A doctor blade 165 removes the excess animal glue from the spinner wheel 163, and directs the removed glue down into the glue bath or into a container.

Next, in accordance with step 32, the signature blocks are passed over a heater 168 which partially dries the applied cover glue. Usually, the heater is only used when the cover glue has been applied in an environment having a high humidity.

The final step 34 of the gluing process brings the covers into register with the cover adhesive on the backbones, and the adhesive binds the book covers to the respective signature blocks. This step is carried out by a cover applicator 170 which is downline from the heater 168. The covered signature blocks are then automatically trimmed, and the finished books are ready for packaging and shipment.

Claims

1. A method of applying adhesives to the backbone of a book block, comprising the steps of:
roughening said backbone to form a backbone surface for the application of adhesives;
transversely slashing said backbone surface;
applying a primer adhesive to said backbone surface for binding pages in said book block together;
scraping substantially all of said primer adhesive from said backbone surface; and
applying a cover adhesive to said backbone surface, said cover adhesive being adapted to bind a cover to said backbone surface of said book block.

2. The method, as set forth in claim 1, wherein said primer adhesive seeps into said transverse slashes to bind pages in said book block together.

3. The method, as set forth in claim 1, wherein said step of scraping includes:
using at least one straight-bladed scraper to remove a portion of said primer adhesive from said backbone.

4. The method, as set forth in claim 1, wherein said step of scraping includes:
using at least one V-shaped scraper to remove a portion of said primer adhesive from said backbone.

5. The method, as set forth in claim 1, wherein said step of scraping includes:
using at least one side scraper to remove said primer adhesive from the edges of said backbone.

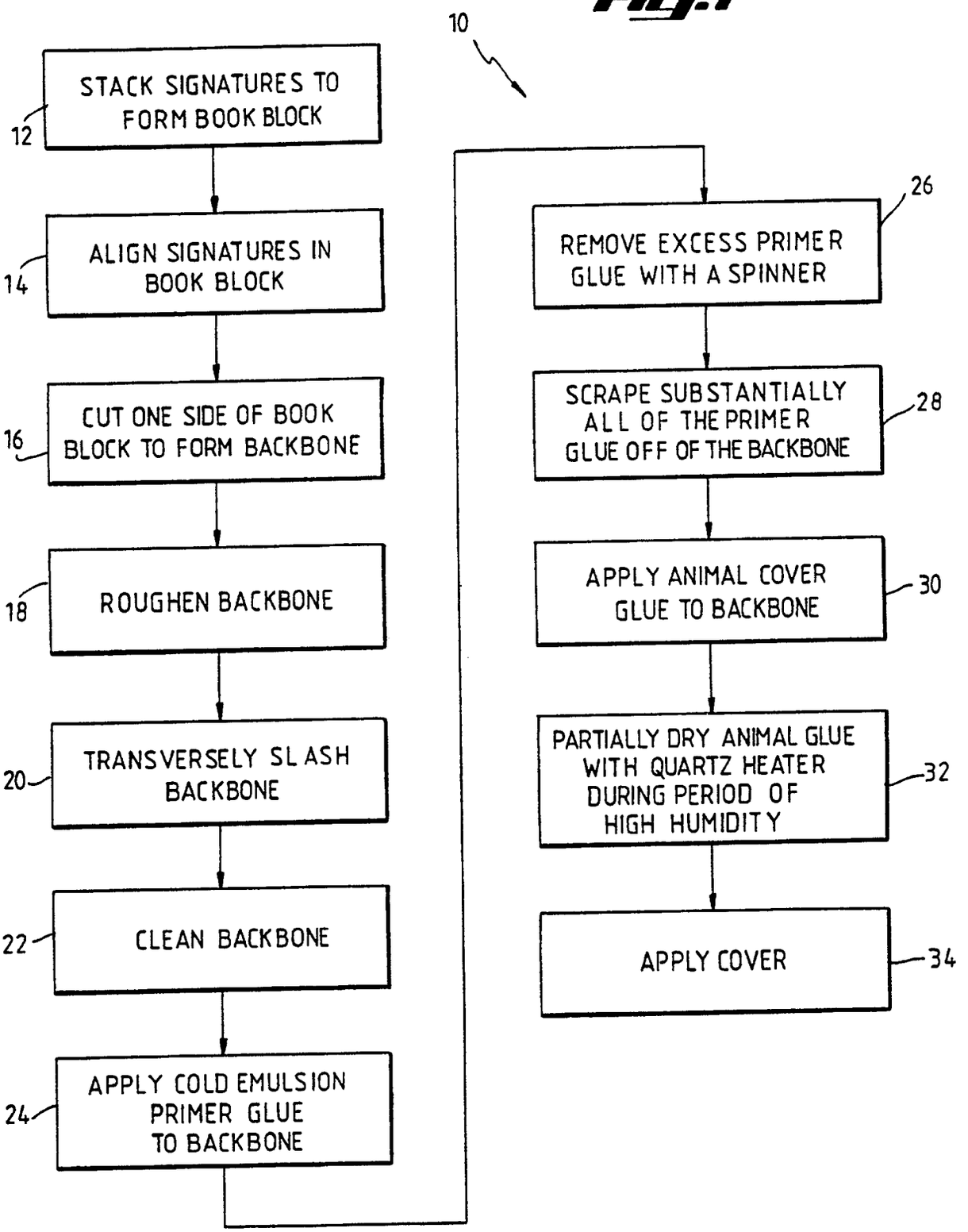
6. The method, as set forth in claim 1, wherein said step of scraping includes:
using at least one straight-bladed scraper to remove a portion of said primer adhesive from said backbone;
using at least one V-shaped scraper to remove a portion of said primer adhesive from said backbone; and
using at least one side scraper to remove said primer adhesive from the edges of said backbone.

7. The method, as set forth in claim 1, wherein said second step of applying includes:
forming two beads of cover adhesive on the edges of said backbone.

8. The method, as set forth in claim 1, wherein said primer adhesive is a polyvinyl acetate co-polymer emulsion adhesive.

9. The method, as set forth in claim 1, wherein said cover adhesive is an animal glue.

Fig.1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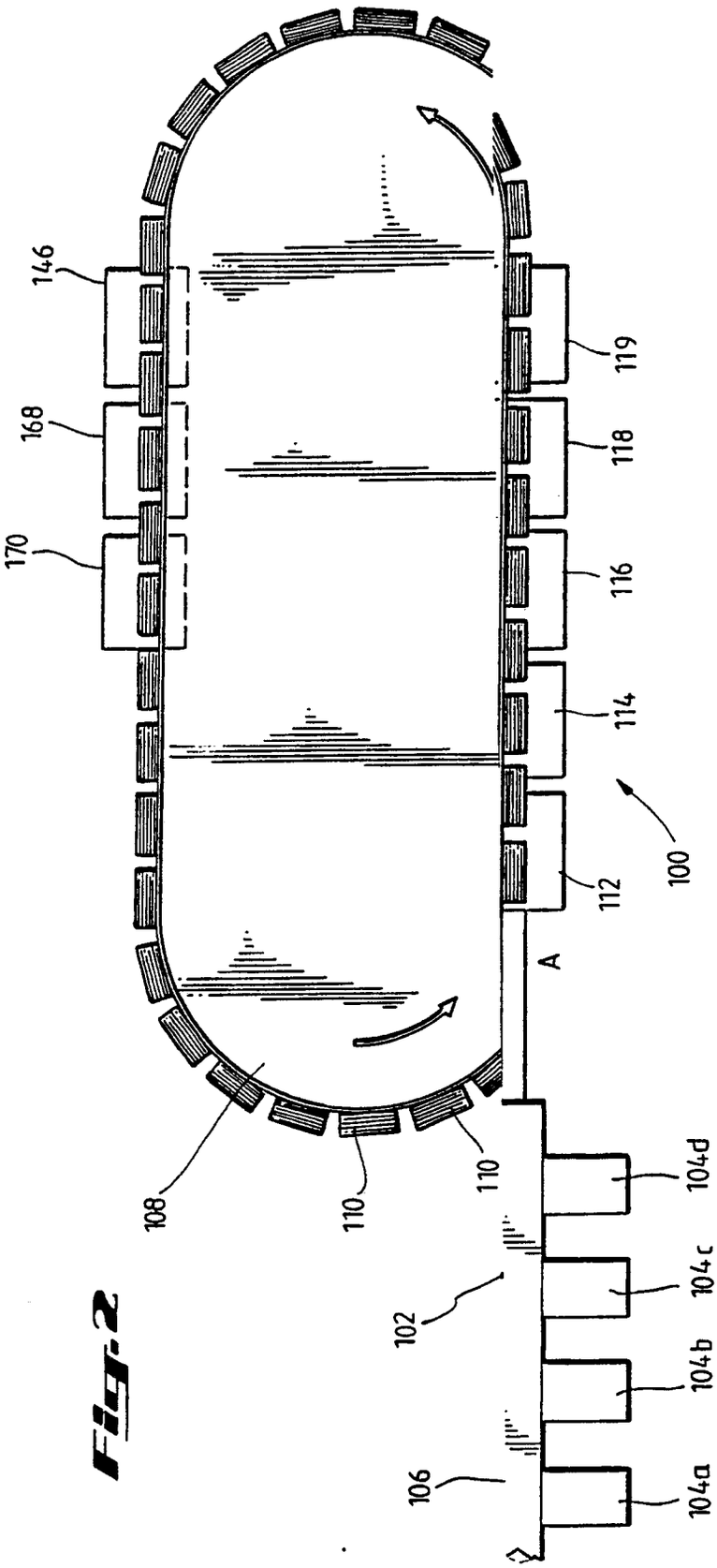
STACK SIGNATURES TO FORM BOOK BLOCK
12
ALIGN SIGNATURES IN BOOK BLOCK
14
CUT ONE SIDE OF BOOK BLOCK TO FORM BACKBONE
16
ROUGHEN BACKBONE
18
TRANSVERSELY SLASH BACKBONE
20
CLEAN BACKBONE
22
APPLY COLD EMULSION PRIMER GLUE TO BACKBONE
24
REMOVE EXCESS PRIMER GLUE WITH A SPINNER
26
SCRAPE SUBSTANTIALLY ALL OF THE PRIMER GLUE OFF OF THE BACKBONE
28
APPLY ANIMAL COVER GLUE TO BACKBONE
30
PARTIALLY DRY ANIMAL GLUE WITH QUARTZ HEATER DURING PERIOD OF HIGH HUMIDITY
32
APPLY COVER
34


146
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104d
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Fig. 2

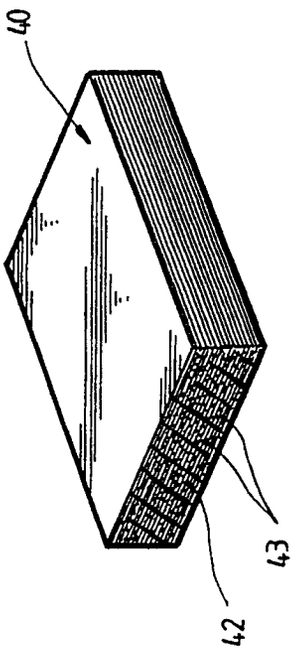
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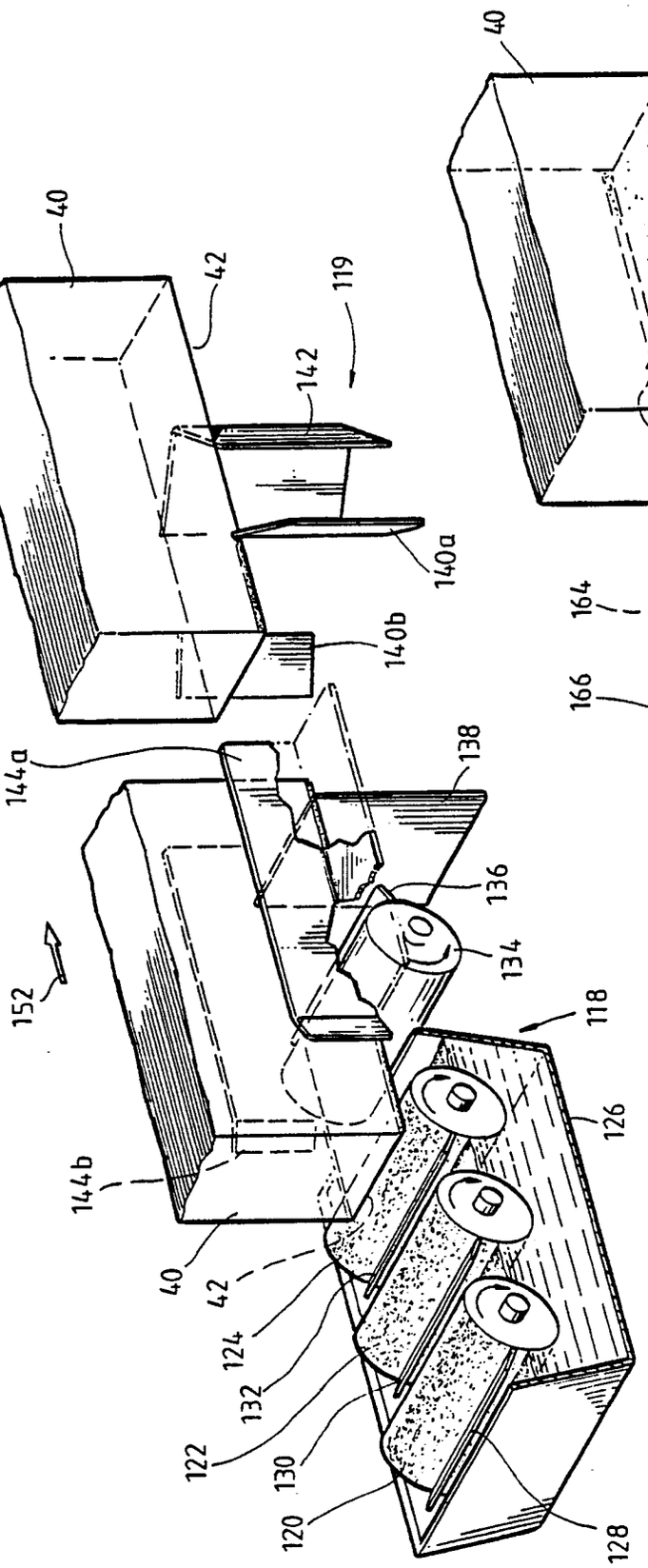
Fig. 3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144a
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144b
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Fig. 4

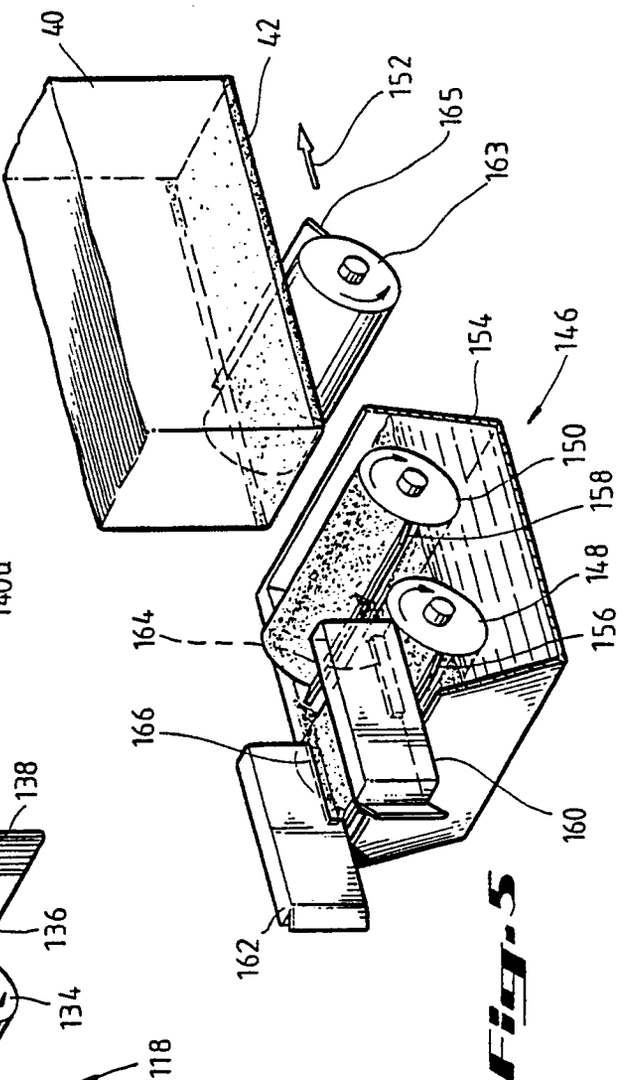
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Fig. 5