United States Patent [19]

Shatzkin

[11] **3,840,254**

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[54] **PERFECT BINDING**

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[52] **U.S. Cl.** **281/21,** 156/272

[51] **Int. Cl.** **B29c 19/02,** B42d 1/00

[58] **Field of Search** 156/272, 273; 281/21

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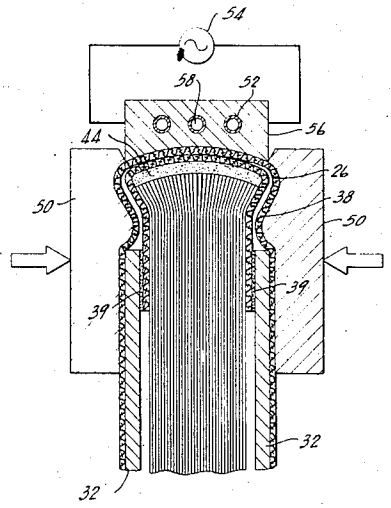
Primary Examiner—J. H. Wolff

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[57] **ABSTRACT**

An improved technique for relieving distortion producing stresses in the binding adhesive applied to perfect bound book bodies of the rounded type. Such stresses tend to destroy the rounded shape of the body. The technique utilizes a hot melt adhesive having dispersed therein particles of a magnetically or dielectrically heatable susceptor. After rounding the signatures, the adhesive is exposed to a indirect energy field to remelt the adhesive and relieve shape distorting stresses induced in the adhesive by the rounding of the body.

16 Claims, 10 Drawing Figures



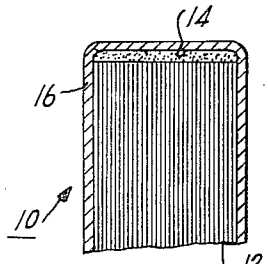


Fig. 1

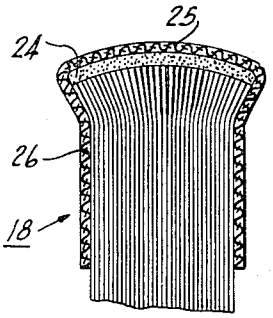


Fig. 2A

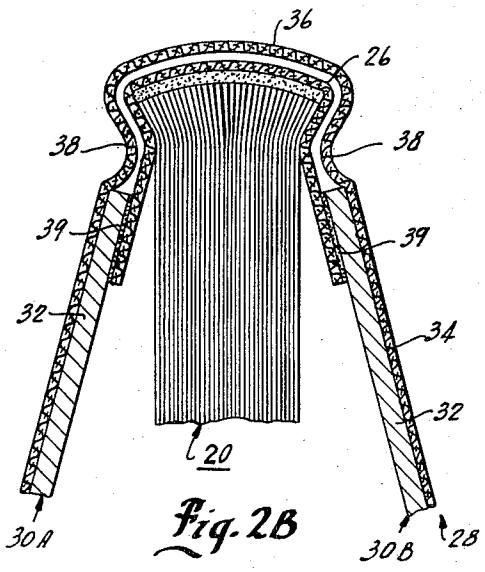


Fig. 2B

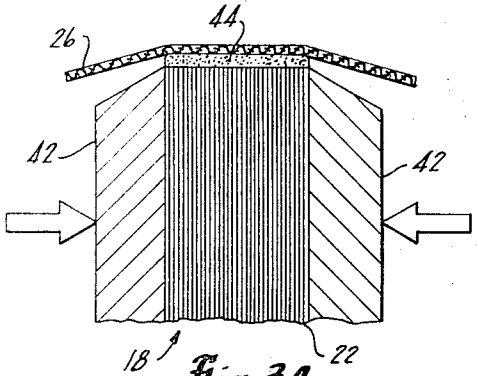


Fig. 3A

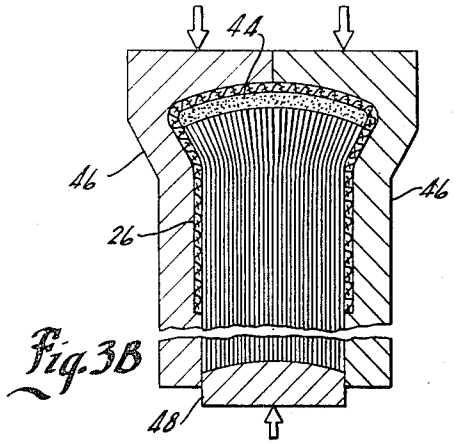


Fig. 3B

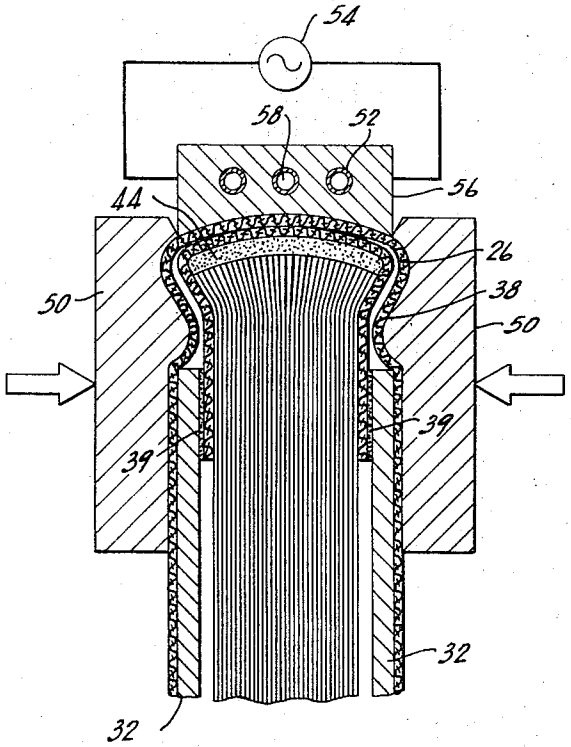


Fig. 3C

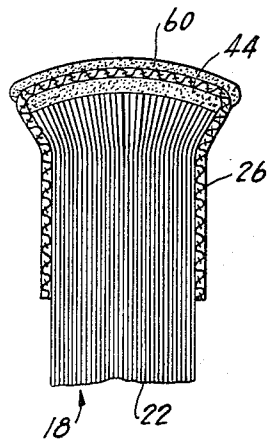


Fig. 4A

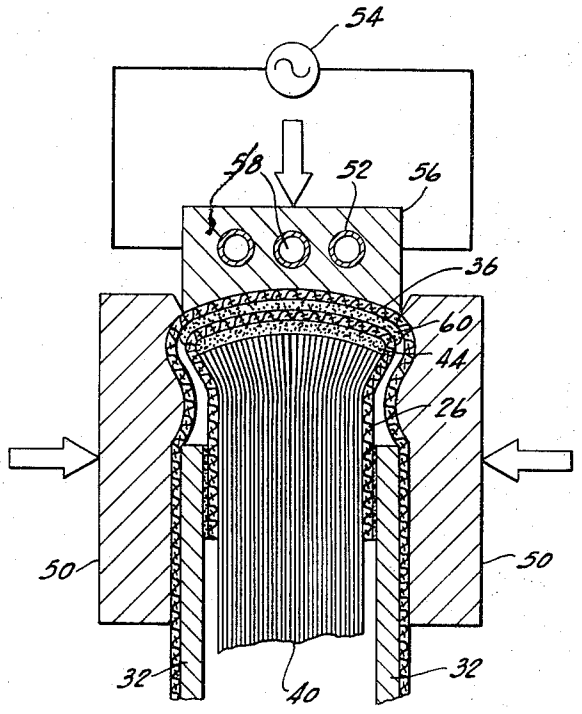


Fig. 4B

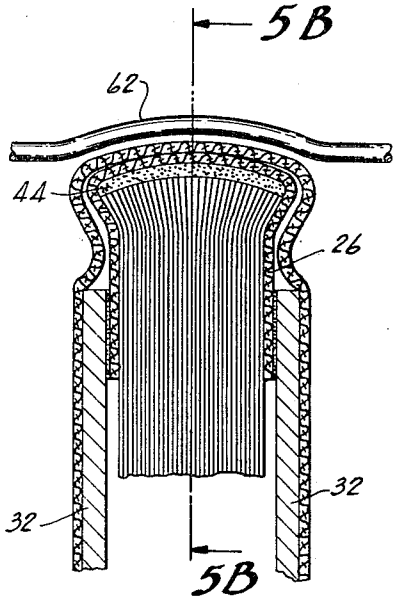


Fig. 5A

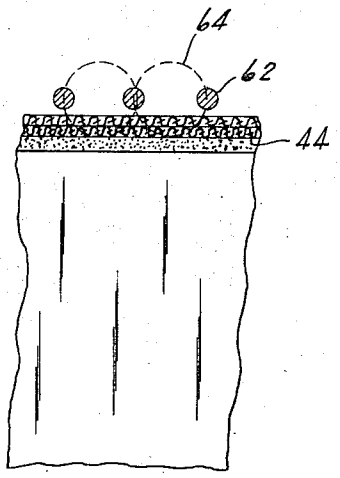


Fig. 5B

PERFECT BINDING

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to improvements in the "perfect binding" method of book binding and to books produced thereby. The invention more particularly relates to a technique for providing rounded book elements bound by the perfect binding method. A perfect binding is sometimes referred to in the art as a "patent binding."

2. Description of the Prior Art

The perfect binding method has been used for many years in the binding of "paperback books." These books are formed by initially gathering the individual leaves, i.e., two page signatures, or the conventional sixteen leaf signatures. The gathered signatures are jogged and clamped in a binder. There the back edges or backbone of the signatures may be trimmed and/or roughened. An adhesive is applied to the backbone to fasten the signatures together. At the same time, the cover of the book is placed on the backbone and retained there by the adhesive, thus forming the completed book.

The perfect bound book described above is to be contrasted with the conventionally bound or "hard cover" book having a case comprised of front and rear covers hinged along a spine. In conventional hard cover books, the signatures are sewn together to form a body which is affixed to the case at the hinge joints of the latter. The backbone of the signatures is usually not affixed to the spine of the cover.

While the perfect binding method is less expensive than conventional binding, in the past, the strength of a perfect binding has been far below that of a conventional binding. Use of the perfect binding method has thus been restricted to books designed for light service or those of a disposable nature. The paperback books mentioned above are typical of such books.

However, steady improvement in the quality of binding adhesives and methods of application has resulted in perfect bound books which have greatly improved binding strength. This has led to the use of perfect binding in textbooks, instruction manuals, and the like.

The low cost features of the perfect binding method have further led to attempts to apply this method to hard cover books. In summary, these attempts have comprised forming the hard cover book body as though it were a perfect bound book and then affixing, or "casing-in," the body so formed inside the hard covers at the cover hinge joints.

One significant difference between the usual perfect bound books and hard cover books is that, in perfect bound books, the signatures normally form a rectangular parallelepiped whereas in hard cover books, the backbone of the body must be convexly curved in order to facilitate joinder of the body to the case, formation of the cover hinge, and subsequent use of the bound book. The front edge of the body is correspondingly concavely curved and this configuration of the book body is considered by book publishers and book manufactures to be indispensible in hard cover books. The convex-concave shape of the body is formed by a curved pusher bar applied to the front edges of the solid rectangular stack of signatures. In the case of a perfect bound book body, the shaping of the signatures, termed "rounding," occurs after the adhesive has been applied to the body signatures.

In addition to having the necessary strength, adhesives used in perfect binding methods must also possess a high degree of resiliency in order both to permit deformation of the body into the desired convex-concave shape and to allow the bound book to be opened. This resiliency of the adhesive tends to cause a perfect bound book body to return to the same unrounded or squared up state in which the adhesive was applied to the backbone of the body. The reversion from the round to the squared up state may be seen as an example of "plastic memory" in the adhesive which may be very pronounced in the high strength adhesives required in hard cover book bodies. The roundness of a perfect bound book body thus tends to disappear with time after the book has left the bindery. Due to the importance attributed to rounding of the book body in the trade and the need for the curved form of the body during the useful life of the book, this loss of rounding is exceedingly undesirable and has prevented realization of the economies obtainable by application of the perfect binding method to hard cover books.

Several methods have been devised to overcome this problem. One solution is described in U.S. Pat. No. 3,292,951 to Schoenberger. In this method, the signatures are temporarily glued together with an inexpensive glue in the squared up form. The body is then pushed into the rounded state and the temporary glue removed, as by milling or wire brushing the backbone of the body. High strength adhesive, such as a hot melt, is applied to the body to bind the signatures together and the body is cased in the hard cover. Since the binding adhesive is applied to the body after rounding, any tendency for the adhesive to square up the body is eliminated. However, this method is both expensive and time consuming.

Another, simplier method is to remelt the hot melt adhesive after the body has been rounded into the desired shape. While remelting destroys the tendency of the resilient adhesive to return the body to the squared up form, the procedure is messy if done prior to casing-in. Some signatures may not be re-glued as the adhesive resolidifies and there is still some tendency for the signatures to revert to the squared-up form because the hold of the adhesive, which over the short term retains the rounded shape, has been released. If remelting is done after casing-in, as by applying a heated platen to the spine of the case, the slow heat transfer through the material of the spine and the air gaps therein and the possible degradation of the spine material by the heat render this method unsatisfactory.

The loss of body rounding and the inability of prior art processes to provide a rapid, inexpensive method of preventing same have heretofore prevented realization of the economies obtainable in applying the perfect binding method to hard cover books.

SUMMARY OF THE PRESENT INVENTION

It is, therefore, the object of the present invention to provide a rapid, inexpensive perfect binding technique for forming rounded perfect bound book portions, such as book bodies. Book portions formed by the technique of the present invention are permanently rounded and possess no tendency to revert to the squared-up condition, thereby making such portions suitable for inclusion in hard cover books.

Another object of the present invention is to provide an improved perfect binding technique which permits the body and case of the book to be formed in the normal manner, and which follows, in so far as is possible, the steps of conventional book binding methods, thereby permitting the use of existing book binding equipment.

The technique of the present invention provides a highly efficient and economical means for providing permanently rounded perfect bound book portions and hard cover books incorporating such portions. The present invention thus permits attainment of the advantages and benefits attendant the use of the perfect binding method in hard cover books.

The present invention contemplates the use of a signature bonding agent, or adhesive, capable of assuming a stress relieving state responsive to exposure to indirectly applied energy. The bonding agent may typically be a high strength hot melt adhesive having dispersed therein particles of a susceptor susceptible to heating by a high frequency magnetic or electric field. After rounding the bound signatures, the bonding agent is exposed to the field to relieve any shape distorting stresses induced in the bonding agent by the rounding of the body. The stress relieving step is preferably carried out during the casing-in or building-in of the book when both the body and the case are held together, as by clamps applied to the cover hinge.

The bonding agent stress relief obtainable by the technique of the present invention is extremely rapid. To even greater advantage is the fact that the stress relieving step may be carried out after the body is cased in the cover with no loss of speed or efficiency. This feature results from the use of indirectly applied energy. Since only the bonding agent susceptor is heated by the magnetic or electric field, the possibility of heat degradation of the case is eliminated.

The resulting books and portions thereof are strongly bound due to the use of the high strength adhesive, and are characterized by the retention of rounded body shape throughout the useful life of the book due to the absence of shape distorting stresses in the high strength adhesive.

The present invention is applicable to both loose back and tight back hard cover books. In the former, the backbone of the body is separated from the spine of the case, while in the latter the body backbone is affixed to the case spine.

DESCRIPTION OF THE DRAWING

FIG. 1 is a partial plan view of a paperback book showing a perfect binding incorporated in this type of book.

FIG. 2A is a partial plan view of a perfect bound book body suitable for casing in a hard cover case, the body being shown after rounding and backing.

FIG. 2B is a partial cross sectional view of a book including a rounded perfect bound book body of the type shown in FIG. 2A in a hard cover case.

FIG. 3A is a partial plan view of an initial step in making a perfect bound book body.

FIG. 3B shows the step of rounding the book body so as to render it suitable for incorporation in a hard cover book.

FIG. 3C is a partial cross sectional view of a cased-in book in binding clamps showing the step of relieving stresses in the body binding to prevent reversion of the book body to the squared up shape shown in FIG. 3A.

FIG. 4A is a partial plan view of a perfect bound book body suitable for casing in a hard cover case to form a book having a tight back.

FIG. 4B is a partial cross sectional view of a cased-in book in binding clamps and the technique of the present invention applied to the binding of a book of the tight back type.

FIG. 5A is a partial cross sectional view of a cased-in book in binding clamps showing an alternate form of the stress relieving step.

FIG. 5B is a partial cross sectional view taken along the line 5B-5B of FIG. 5A.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is shown therein paperback book **10** bound by the perfect binding method commonly used for this type of book. Paperback book **10** includes signatures **12** which are glued along the back edges thereof by layer **14** of an adhesive. Cover **16** of flexible cardboard is affixed to the spine of book **10** by the adhesive layer **14.**

FIG. 2A shows the principles of the perfect binding method employed in the binding of a body **18** for hard cover book **20** shown in greater detail in FIG. 2B. Body **18** includes signatures **22** which are bound together along the back edges thereof by layer **24** of resilient adhesive. The back edges of signatures **22** are rounded so that the backbone **25** of body **18** is convexly curved. Body **18** thus resembles, in form, book bodies bound by conventional methods such as sewing. In accordance with the usual practice in the trade, the rounding of body **18** takes place after adhesive layer **24** has been applied to the back edges of signatures **22.** The resiliency of adhesive layer **24** is such as to permit this alteration in body shape without destroying the adhesion of layer **24** through the generation of internal stresses in the adhesive layer.

A piece of heavy paper or fabric **26,** commonly termed crash, super, or stretch cloth, is affixed to adhesive layer **24** and the back edges of signatures **22** for fastening body **18** to the hard cover case.

As shown in FIG. 2B, case **28** of book **20** includes front cover **30*a*** and rear cover **30*b*** each of which is formed of board **32** covered with buckram cloth **34.** Buckram cloth **34** connects the boards at spine **36.** A groove **38** formed in the buckram cloth at either edge of the spine permits the covers to hinge on the spine. Crash **26** is affixed to the inside of covers **30*a*** and **30*b*** by glue **39** to retain body **18** in case **28** and thus form book **20.** As backbone **25** of body **18** is not joined to the inside of spine **36** of case **28,** book **20** is of the loose back type.

The foregoing description and accompanying graphic representation in FIG. 2 of hard cover book **20** having perfect bound book body **18** is somewhat simplistic for purposes of explanation. It will be appreciated that end papers and other elements may often be found in the completed book. However, unless suitable precautions are taken, the internal stresses generated in the adhesive layer during rounding of the book body causes the roundness to tend to disappear with time after the book leaves the bindery.

The method of the present invention prevents such reversion to the squared up state by incorporating a

stress relieving step which eliminates the internal stresses in the adhesive layer. More specifically, the present invention provides for the elimination of such internal stresses by the use of indirectly applied energy. By the term "indirectly applied" it is meant that the energy responsible for relieving internal stresses in adhesive layer is applied through the medium of a radiant field, rather than directly, as for example, by the application of a heated platen. Typically, the radiant fields may be high frequency electric or magnetic fields.

The stress relief characteristics necessary for successful practice of the present invention may be obtained through use of a bonding agent formulated by selecting a thermoplastic adhesive carrier and dispersing therein a material susceptible to heating by the indirectly applied energy. Upon exposure to the indirectly applied energy, the susceptible material, or "susceptor," elevates the temperature of the carrier to the point of plasticity, thereby causing dissipation of any internal stresses in the carrier. Plasticity of the carrier may be characterized by the molten or near molten state of the carrier.

The susceptible material is preferably particulate in form and is incorporated in the carrier in quantities sufficient to produce the desired heating action. This is typically 10 to 30 per cent by weight with respect to the carrier and may range as high as 50 per cent by weight. The susceptor may be responsive to indirect application of energy in the form of a high frequency alternating magnetic field, in which case, the susceptor could consist of fine particles of a metallic oxide such as Fe_3O_4, Fe_2O_3, and CrO_2. Gamma Fe_2O_3 has been found to be particularly suitable for use in the method of the present invention. The unique utility of the aforesaid classes of material resides in the ability of the members to retain their heat generating characteristics even when submicron in size. The use of such small particles facilitates their dispersion in the carrier and does not significantly alter other properties of the carrier, such as adhesiveness or viscosity. Particle sizes as small as 0.01 microns have been used. Particle sizes may range up to 20 microns, or larger. Metal particles may also be used.

In the alternative, the susceptor may be responsive to a high frequency electric field in which case a dielectricly heatable substance, such as polyvinyl chloride, may be used.

The carrier for the particulate susceptor may be a hot melt composition or plastisol of some suitable formulation, including a wide variety of synthetic resins. Preferably, the carrier should have the property of rapid melting responsive to temperature elevation and rapid resolidification upon the cessation of heating. Such carriers are often said to have short "open time." Because of the dispersion of the heat generating susceptor in the carrier, the latter may consist of high strength, high melting temperature hot melt compositions not heretofore usable in the perfect binding method.

By proper selection of the ingredients for the bonding agent, the carrier itself may be susceptible to heating by the indirectly applied energy. For example, an adhesive polymeric compound susceptible to dielectric heating may be used as the carrier. In such cases, the necessity for the dispersion of a particulate susceptor material in the carrier is eliminated.

In the method of the present invention, signatures **22** are gathered and jogged into an unbound, squared up assemblage. Signatures **22** may be two page signatures, i.e., single leaves, or may be multi-leaf signatures, such as a plurality of leaves having a common center fold. Signatures **22** are clamped together, as by clamps **42** shown in FIG. 3A and a layer **44** of a bonding agent formulated as described above, is applied to the backbone of the signature assemblage to form body **18** Crash **26** may also be applied at this time during the lining step of the book binding process.

After signatures **22** are bound together by bonding agent layer **44**, body **18** is removed from clamps **42** and rounded. This may be done by the apparatus shown diagrammatically in FIG. 3B. Body **18** is pressed into form **46** by pusher bar **48** to provide the desired convexity to backbone **25** of body **18.** The rounding of body **18** causes a deformation of bonding agent layer **44** which is temporarily accommodated by the appearance of internal stresses in layer **44.**

Glue **39** is then applied to the outer marginal surfaces of crash **26** and rounded body **18** is inserted in case **28.** The components are placed in a building-in machine shown diagrammatically in FIG. 3C. The building-in machine includes a pair of clamps **50** which are applied to the cased-in book **20** to cause glue **39** to join crash **26** to the inside of front cover **30*a*** and rear cover **30*b*.** Clamps **50** also assist in the formation of cover hinges **38.**

The bonding agent in layer **44** is then exposed to the indirectly applied energy, as by applying a radiant field to spine **36** of book **20.** In the instance in which the susceptor in the bonding agent is heatable by an alternating magnetic field, such a field may be established by coils **52,** shown in cross section FIG. 3C, energized by the current of high frequency alternating current source **54.** Alternating current source **54** may typically operate in a frequency range of from 0.4 to 5,000 megahertz with a frequency range of 2 to 30 megahertz being typical for a conventional helix coil. Coils **52** may be mounted in coil support **56** which is movable into abutment with spine **36** to assist in forming the spine and to expose bonding agent layer **44** to the magnetic field of the coils.

The magnetic field of coils **52** generates heat in the susceptor of the bonding agent and elevates the temperature of the bonding agent carrier to plasticity, as by melting, thereby dissipating the internal stresses generated during rounding of body **18** and destroying any tendency of bonding agent layer **44** to return body **18** to the squared up shape. The application of the magnetic field causes rapid heating of bonding agent layer **44.** Times on the order of 0.1 second are common.

As soon as the stresses in layer **44** have been dissipated, the layer may be returned to the firm state as by resolidifying the bonding agent carrier. High frequency source **54** is disconnected from coils **52** to terminate generation of the magnetic field. As noted, supra, the bonding agent is normally formulated for rapid resolidification properties. These properties may be assisted by circulating coolant in coil passages **58.** The coolant also serves to eliminate any possibility of coil support **56** scorching or degrading buckram cloth **34** of case **28.**

Completed book **20** may then be removed from buildingin machine clamps **50** and the binding operation is complete.

The method of the present invention may also be used to advantage in books having a so called "tight back" in which the spine of the case is affixed to back-

bone **25** of body **18.** For this purpose, an additional layer **60** of the bonding agent may be applied to the outside of crash **26** so that the body **18,** at the completion of the rounding step, is formed as shown in FIG. **4**A. Layer **60** may contain the same type of bonding agent as is found in layer **44** used to hold signatures **22** together.

Body **18** having adhesive layer **60** along the exterior of crash **26** is inserted in building-in machine clamps **50** and coil support **56** is brought into abutment with spine **36.** Coils **52** are energized from high frequency source **54** to apply a magnetic field to layers **44** and **60** and melt the bonding agent. The melting of layer **44** dissipates the internal stresses in the bonding agent tending to square up the body. The melting of layer **60** initiates the bond between crash **26** and the inner surface of spine **36.** The resolidification of layer **60,** when coils **52** are deenergized, secures this bond. Pressure may be applied by coil support **56** to spine **36** of tight backbone **40** to assist in the bond between crash **26** and spine **36.**

During the manufacture of either loose backbone **20** or tight backbone **40** the bonding agent may be initially applied to the signature assemblage in the molten form. The bonding agent may be melted by conventional means prior to application to the assemblage and applied by a brush or other liquid applicator to the signature backbone. In the alternative, the bonding agent may be melted by exposure to indirectly applied energy. Or, the bonding agent may be applied to granular form and melted to the adhesive state by exposure to indirectly applied energy such as the magnetic field produced by coils **52.** The bonding agent may also be applied to the signature backbone in the form of a tape which is subsequently melted by the indirectly applied energy. In all such cases, the bonding agent is rendered plastic by exposure to a selected form of indirectly applied energy to dissipate the internal stresses generated in the bonding agent by the rounding of book body **18** subsequent to the initial application of the bonding agent.

In FIG. **5**A and FIG. **5**B, the use of a dielectrically heatable bonding agent is shown. As noted, supra, such a bonding agent may be provided by dispersing a dielectrically heatable substance, such as polyvinyl chloride, in an appropriate carrier or may be provided by selecting a carrier which itself is susceptible to dielectric heating by a high frequency electric field.

In applying the radiant energy to the spine **36** of book **20,** a high frequency electric field is established by a plurality of oppositely charged, spaced rods **62** which establish electric field **64** between adjacent rods, as shown in FIG. **5**B.

A further modification of the present invention lends cost, aesthetic and other advantages to book body **18.** Through recent advances in book binding technology it is now feasible to apply one type of adhesive to one portion of the book backbone and another type of adhesive to other portions of the backbone. This may be done by adhesive printing techniques. With such techniques, the bonding agent capable of stress relief may be applied across backbone **25** in one or more strips extending in a direction running from front cover **30***a* to back cover **30***b*. The strips may be located inwardly from the top and bottom edge of body **18** so that they cannot be seen when the book is in use. At the remaining portions of backbone **25,** conventional adhesives are applied.

After the rounding of body **18,** the strips of the bonding agent are exposed to indirectly applied energy to relieve the shape distorting stresses. The strips so treated would then be sufficient to hold body **18** in the rounded condition even though the conventional adhesive suffered from plastic memory. Since the strips of stress relieving adhesive are located toward the center of backbone **25,** the user sees only the conventional adhesive. A book body so formed is thus ordinary in outward appearance while at the same time loss of rounding is avoided.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. A method of forming a rounded book body of the perfect bound type having one or more signatures and characterized by an absence of shape-distorting stresses in the binding, said method comprising the steps of:

gathering the signatures to form a generally squared assemblage having a backbone;

applying a bonding agent to the backbone of the signature assemblage to bind the signatures together, said bonding agent comprising an adhesive carrier capable of assuming a thermally induced stress relieving state of plasticity having dispersed therein a particulate ferromagnetic susceptor selected from a class consisting of Fe_2O_3, Fe_3O_4 and CrO_2;

thereafter rounding the squared bound signature assemblage to curvedly shape the assemblage backbone, said deformation generating stresses in the bonding agent tending to restore the squared shape of the assemblage; and

exposing the bonding agent to an alternating magnetic field to heat the particulate susceptor and place the agent in the stress relieving state of plasticity to relieve the shape distorting stresses generated in the bonding agent by the rounding of the signature assemblage.

2. The method according to claim **1** including the step of applying pressure to the bound signature assemblage after rounding and during exposure of the bonding agent to hold the signature assemblage in the rounded state.

3. The method according to claim **1** wherein the carrier is capable of melting upon the application of heat thereto and wherein the step of exposing the bonding agent is further defined as heating the carrier to the molten state by means of the particulate susceptor to place the agent in the stress relieving state.

4. The method according to claim **3** wherein said bonding agent is applied to the backbone of the signature assemblage in the molten form and is allowed to solidify prior to rounding the bound signature assemblage, exposure of the bonding agent remelting the carrier to place the agent in the stress relieving state.

5. The method according to claim **1** further defined as including the step of forming the bonding agent by dispersing the susceptor a thermoplastic carrier prior to application to the signature assemblage.

6. The method according to claim 5 wherein the step of forming the bonding agent is further defined as dispersing up to 50 percent by weight of susceptor material in the carrier.

7. The method according to claim 5 further defined as dispersing up to 30 percent by weight of susceptor material in the carrier.

8. The method according to claim 5 wherein the step of forming the bonding agent is further defined as dispersing particles of susceptor material having a minimum particles size of 0.01 microns in the carrier.

9. The method according to claim 1 further defined as exposing the bonding agent to a magnetic field having a frequency of from 0.4 to 5,000 megahertz.

10. The method according to claim 1 wherein the bonding agent is applied to the backbone of the signature assemblage in a non adhesive state and is subsequently exposed to an alternating magnetic field to bind the signatures together.

11. The method according to claim 10 wherein the bonding agent is applied on dry form and is subsequently melted to bind the signatures together.

12. The method according to claim 10 wherein said bonding agent is applied in granular form to the backbone of the signatures.

13. The method according to claim 10 wherein the bonding agent is applied in the form of a tape to the backbone of the signature assemblage.

14. The method according to claim 1 wherein the bonding agent is applied to a portion of the backbone of the signature assemblage and conventional adhesive is applied to other portions of the backbone.

15. The method according to claim 14 wherein the bonding agent is applied in at least one strip across the backbone of the signature assemblage.

16. The method according to claim 15 wherein the strip of bonding agent is applied inwardly from the other edges of the book body.

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