

Feb. 26, 1974

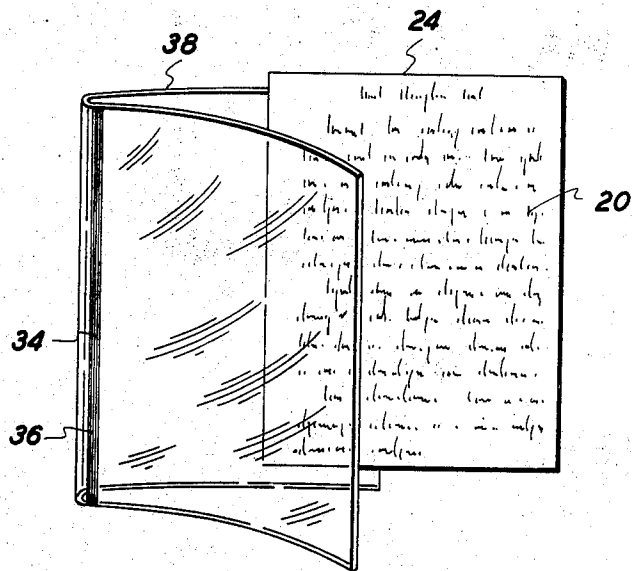
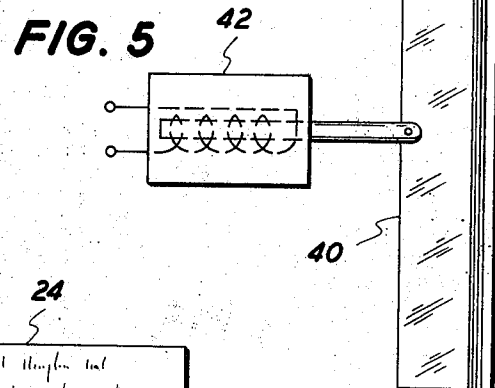
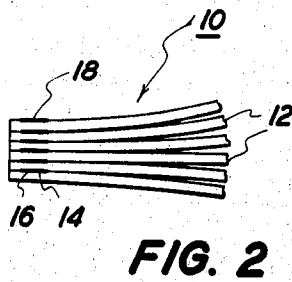
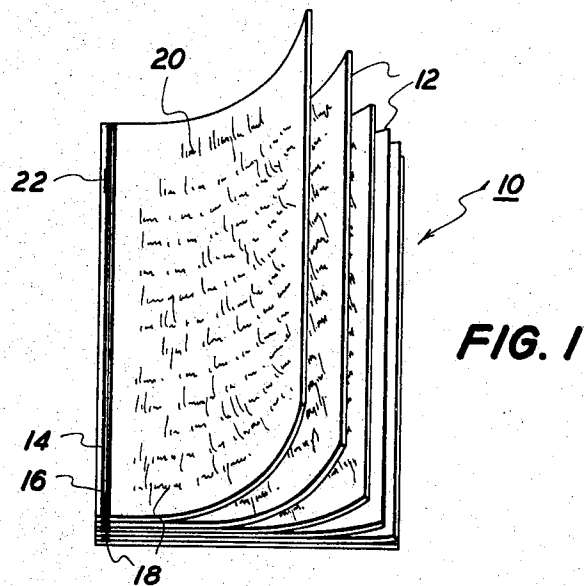
G. P. TAILLIE

3,794,550

SHEET BINDING

Filed Aug. 25, 1972

3 Sheets-Sheet 1



Feb. 26, 1974

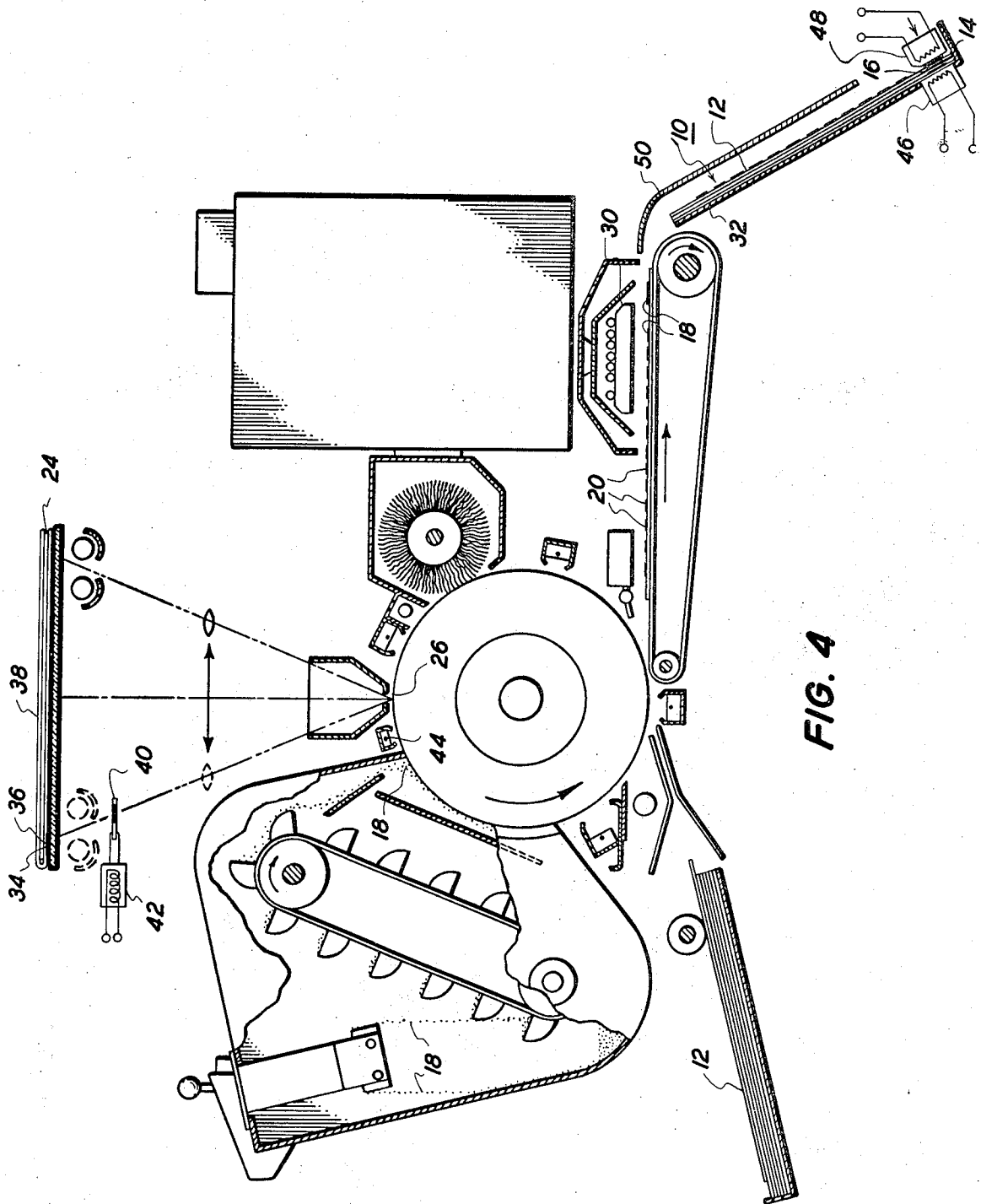
G. P. TAILLIE

3,794,550

SHEET BINDING

Filed Aug. 25, 1972

3 Sheets-Sheet 2



Feb. 26, 1974

G. P. TAILLIE

3,794,550

SHEET BINDING

Filed Aug. 25, 1972

3 Sheets-Sheet 3

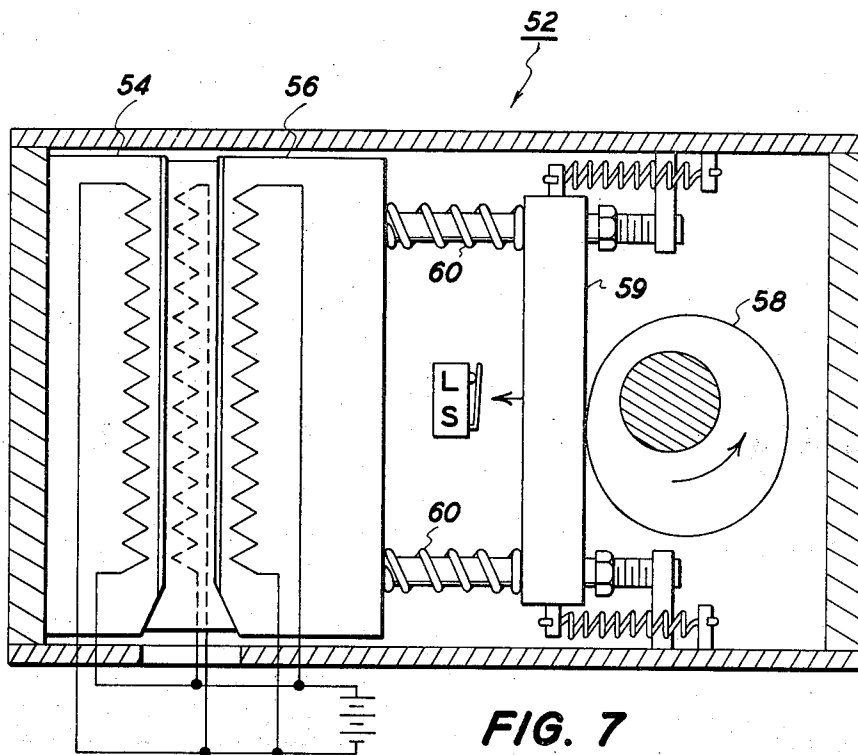


FIG. 7

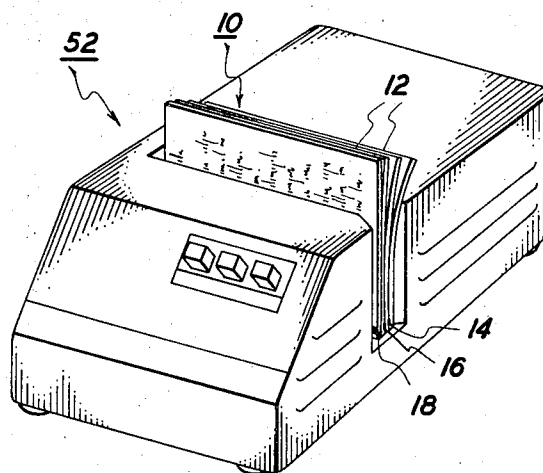


FIG. 6

1

3,794,550

SHEET BINDING

Gordon P. Taillie, Rochester, N.Y., assignor to Standard Oil Company, Chicago, Ill.

Filed Aug. 25, 1972, Ser. No. 283,676

Int. Cl. B32b 3/00, 7/14

U.S. Cl. 161-147

18 Claims

ABSTRACT OF THE DISCLOSURE

Sheet binding where the printing medium itself is the sheet binder. In a xerographic process, high density areas of the toner are provided at desired binding areas. These toner binding areas may then be subsequently refused between adjacent overlaying sheets to provide bound stacks without requiring any separate or additional binding materials.

Copending application, Ser. No. 298,980, filed Oct. 19, 1972, by Rodger H. Eichorn, with the same assignee, claims subject matter disclosed but not claimed, herein.

The present invention relates to a very simple and economical method of binding two or more indicia bearing sheets together by providing on the sheets additional minor high density areas of the same indicia imparting material in areas of desired binding, where the sheets are subsequently stacked and the additional indicia imparting material commonly fused between adjacent sheets at the binding areas to fasten the sheets together.

Sheet binding is one of the oldest known arts, and numerous methods and apparatus are known in the art for permanently or temporarily securing sheets together. Many of these, of course, are only economically suited for high priced or high volume commercial printing operations. There is a long standing need for improved sheet fastening means for localized, simple, and inexpensive binding of, for example, stacks of two to fifty pages.

This need has been greatly increased by the widespread use of xerographic equipment, where large numbers of printed sheets are produced by relatively unskilled personnel in non-commercial printing operations. The demand for simplicity and economy in these applications has continued to retain conventional metal staples as the primary fastening means. This is in spite of the fact that stapling, riveting or other sheet binding means requiring penetration of the sheet creates stress points in the sheets which encourage sheet tearing and inadvertent sheet removal. So does any sharp edges on the staples or rivets. Further, the pull-off strength of the top and bottom sheets in any stack fastened in this conventional manner is limited by the strength of the sheet over only the small areas directly underlying the heads of the staple or rivet.

Thus, it is clear that a sheet binding method which provides inter-sheet adhesion over a much larger binding area than staples or rivets, and which does not require any sheet penetration or sharp edges, is greatly preferable. Various adhesive bonding methods have been developed which have suitable binding strengths but they have not achieved widespread utilization in many low volume binding applications, apparently because they are not sufficiently simple and economical in comparison to metal staples or rivets. They require the supplying, handling and containment of separate adhesive materials, and require separate adhesive application steps in addition to the normal indicia printing steps. Examples from the adhesive binding are shown in U.S. Pats. Nos. 2,579,488; 2,831,706; 2,898,973; 3,026,228 and 3,502,532. Some of these utilize chemicals similar to those found in xerographic toners, but they are not toners or inks. Other examples of adhesive sheet welding with heat and/or pressure, by pre-coating the sheet with clear plastics or

2

other separate binding materials, are discussed in the September 1971 issue of "Book Production Industry," pp. 53-55, which discusses U.S. Pat. No. 3,560,290.

It has been known that in certain situations xerographic toners become tacky, softened or liquified. U.S. Pats. Nos. 2,638,416; 2,788,288; 2,917,460; 3,053,688; 3,262,806; 3,268,332 and 3,488,189 are examples of patents noting these toner characteristics. These characteristics are conventionally utilized for fixing the desired indicia onto individual sheets. Or they may be used for transferring images from one web to another, as in "strip out" imaging processes, e.g. U.S. Pat. No. 3,275,436. However, printing inks and toners are carefully selected and prepared to avoid and prevent any inter copy sheet adhesion as soon as possible after the copy sheet printing is accomplished, because this would seriously interfere with normal printing operations and is considered highly disadvantageous in the art. Thus, toners or printing inks are not considered in the art as adhesives, and, in fact, inter-sheet adhesive properties are carefully avoided by ink or toner formulators.

In spite of, and contrary to the teachings of the art, the present invention teaches that a secure inter-sheet binding may be achieved utilizing only the conventional and commercially available printing indicia itself as the sole sheet binding agent, rather than adhesives or other separate bindings. Fusible xerographic toners have been found to be particularly suitable. By the term "fusible" (as used herein in connection with the indicia imparting material, such as xerographic toner) is meant a material which in its normal ambient state is non-adhesive (non-tacky), but is rendered sufficiently tacky for sheet adherence temporarily by heat or solvent vapors or pressure or some combination thereof. The desired toner material here is one that is refuseable, i.e. easily rendered adhesive at least a second time, at any time after its initial fusing. Some examples of fusible and refuseable xerographic toner compositions are disclosed in U.S. Pats. Nos. 3,609,082; 3,577,345; 3,590,000 and Re. 25,136. Suitable refuseable xerographic toners are commercially available world-wide from the Xerox Corporation and its subsidiaries, and are already present in their existing xerographic copying and duplicating machines.

The method and article of sheet binding disclosed herein overcomes the structural disadvantages of metal rivets and other penetrating bindings discussed above. It provides strong and sheet tear-resistant bindings having a larger binding area. The method of the invention enables the use of existing ink or toner supply, dispensing and sheet applying apparatus already available in the printing apparatus, and without requiring any modifications or additional processing in the printing operations. The only additional step required for the present process is a simple and non-critical refusing operation which can be performed at any time in conjunction with, or subsequent to, the indicia printing operation, and in any location. This refusing may be accomplished by various inexpensive and simple or commercially available apparatus. For example, the stack to be bound may be simply clamped at the binding area between a pair of heated pressure platens. Thus, it may be seen that the present process is particularly suitable for local sheet binding in offices or other existing xerographic machine locations.

The exemplary embodiment described hereinbelow discloses the incorporation of the process of the invention in an otherwise conventional exemplary xerographic process and apparatus. Accordingly, said processes and apparatus need not be described in detail herein, since various printed publications and patents and publicly used machines are available which teach details of various suitable exemplary electrophotographic and xerographic structures, materials and functions to those skilled in the art. Some ex-

amples are disclosed in the books *Electrophotography* by R. M. Schaffert, and *Xerography and Related Processes* by John H. Dessauer and Harold E. Clark, both first published in 1965 by Focal Press Ltd., London, England, and the numerous patents and other references cited in these books. All of these references are hereby incorporated by reference herein are the above cited references from the adhesive binding art, for their showings of various sheet assembling, clamping and heating apparatus which may be utilized in the final steps of the present process. Accordingly, the present specification is specific to those details of the embodiment which represent a departure from the prior art, and further desired detailed description will be provided by the above references.

Further objects, features and advantages of the present invention pertain to the particular steps and details whereby the above-mentioned aspects of the invention are attained. Accordingly, the invention will be better understood by reference to the following description and to the drawings forming a part thereof, which are substantially to scale, wherein:

FIG. 1 is a perspective view of a document of bound sheets in accordance with the present invention;

FIG. 2 is a magnified cross-sectional partial view of the binding area taken along the line 2—2 of FIG. 1;

FIG. 3 is a perspective view of a transparent overlay with an optical mask, retaining an original as shown, for producing binding areas in xerographic copies of the original in accordance with the present invention;

FIG. 4 is a cross-sectional simplified plan view of an otherwise conventional xerographic machine showing several modifications which can be provided thereon for producing the process of the invention;

FIG. 5 is an enlarged top view of an optical mask which may be utilized in the apparatus of FIG. 4;

FIG. 6 is a perspective view of an exemplary fusing apparatus for the process of the invention, shown with an exemplary stack of sheets inserted therein; and

FIG. 7 is a simplified top view of the principal operating components within the apparatus of FIG. 6.

Referring to the drawings, there is shown in FIGS. 3-7 some examples of apparatus for performing the sheet binding processes of the invention. It will be appreciated that various steps of the process can also be performed manually or by other apparatus, including that disclosed in the previously cited references.

FIGS. 1 and 2 show one example of a completed article of manufacture in accordance with the present invention. Specifically there is shown a securely edge bound stack 10 of individual paper sheets 12. The sheets 12 are bound only at a binding area 14. This binding area 14 extends in a stripe along, or closely adjacent to, the entire left hand edge of all of the sheets 12 in the stack 10. This stripe is wider than approximately 5 millimeters. The binding areas are preferably located at the same position on each of the sheets 12, so that with the sheets 12 aligned overlying one another, the binding areas 14 are also so aligned. Each binding area 14 is substantially continuously covered and occupied by a corresponding high density area 16 of fusible xerographic toner 18. Preferably each sheet 12 has at least one such high density area 16. The toner 18 of this high density area 16 is the same toner 18 as provides the indicia 20 on the sheets 12, and it is preferably provided in the same step and at the same time as the imaging of the indicia 20.

As may be seen particularly from the magnified cross-sectional view of FIG. 2, the inter-sheet binding consists solely of the high density areas 16 of toner 18 being commonly fused between immediately adjacent sheets 12 at the binding area 14. It may be seen that the toner 18, which was initially prefused into the binding areas of the individual sheet 12, is additionally refused into the sheet immediately above or below it. The toner is refused into all

of the sheet surfaces in the case of conventional porous paper, as shown, to form a strong interlocking bond.

The strength of the inter-sheet bond is a function of the area, density, and degree of fusing of the xerographic toner between adjacent sheets. By increasing these parameters the inter-sheet bond can be made substantially stronger than the tear resistance of the sheet material itself. Correspondingly however, by reducing one or more of these parameters in the binding process there can be provided an inter-sheet bond which is sufficient to normally retain the sheets together, but yet which allows removal of individual sheets without sheet tearing, i.e., a pad type of binding can be provided wherein one or more sheets can be pulled off the stack neatly, with the separation occurring at the respective inter-sheet toner bond.

It will also be noted that the stack 10 may be additionally bound by conventional staples, rivets or other mechanical fastening means, as shown by exemplary staple 22 in FIG. 1. If done in the binding areas, this provides a binding which is far stronger than such conventional mechanical binding means can provide in themselves. This is because when such mechanical fasteners penetrate the sheets in the stack only within the fused binding areas, they are not limited by their normal stress concentrations and small area sheet strength limitations. The stack area around the area of fastener penetration is bonded together and reinforced by the refused toner and strongly resists sheet tearing as a unit. These advantages similarly apply if apertures through the sheets are desired at the binding areas for ring binding or the like. It will be appreciated that combinations with mechanical fastenings means are not required and that the present process can provide sufficient binding strength to be the sole binding means for permanent binding.

The binding area 14 of FIGS. 1 and 2 is a contiguous single edge binding area. However, it will be appreciated that the binding area may be in only one corner of the sheets, for example, or there may be several separate binding areas rather than a single one.

Referring to FIG. 4, there is shown therein by way of example, one type of conventional xerographic apparatus. The process of the invention may be performed thereon utilizing this apparatus in its conventional mode of operation. Thus, an indicia bearing original 23 here is conventionally optically imaged onto a charged photoreceptor surface 26 to form an electrostatic image of said indicia thereon. This electrostatic indicia image is conventionally developed by attracting an electrostatically attractable and fusible xerographic toner 18 to said electrostatic image which attracted toner 18 is then fused onto the desired copy sheets 12. (As is well known, in certain other types of xerographic processes using photosensitive treated paper, the charged photoreceptor is integral the copy sheet.) The fusing of all of the toner 18 onto the copy sheet is accomplished by a conventional fusing operation 30 in the xerographic apparatus. The completed image copy sheets 12 are then deposited at the output in a catch tray 32 or other suitable sheet receptor which provides assembly of the copy sheets in an overlying stacked uniform relationship.

Considering now FIGS. 3-5, there are illustrated thereon examples of differences in otherwise conventional xerographic sheet processing which enable the sheet binding process of the invention to be accomplished. They are merely exemplary, and numerous other means will be apparent to those skilled in the art. FIG. 3, illustrates an optical mask 34 which functions as an overlay to the indicia bearing original during imaging in the apparatus of FIG. 4, or other xerographic apparatus. The optical mask 34 is here provided by an opaque area 36 on an otherwise fully transparent clear plastic jacket 38 into which the original 24 is simply inserted. The opaque area 36 corresponds in proportion, size, location and area to the desired binding area 14 on the copy sheet. (With a one-to-one reduction it will be identical.)

The opaque area 36 is located on the side of the jacket 38 which is between the original and the photoreceptor; i.e., in the optical path therebetween. Thus, in the xerographic imaging process there is thereby formed an intense additional electrostatic charge image on the minor area of the photoreceptor which corresponds to the desired binding area on the copy sheet. This additional image is in addition to the electrostatic indicia image, and is formed at the same time and by the same apparatus. Accordingly, in the same operation in which toner 18 is attracted to the electrostatic indicia image, the high density area 16 of toner is attracted to the additional minor image area and additionally imparted to the copy sheet at the binding area 14. This additional toner area is fused along with the indicia in the conventional fusing operation 30. The optical mask 34 is preferably dimensioned so as to provide a high density area 16 of toner on the copy sheet of the dimensions previously discussed.

FIGS. 4 and 5 illustrate a different type of optical masking operation to achieve the same result of forming the high density area 16 of toner at the binding area 14. This optical mask 40 is shown in an enlarged top view in FIG. 5, and in position in a side view in FIG. 4. The exemplary mask 40 is a plate reciprocally movable in and out of the optical path between the original 24 and the photoreceptor at one edge thereof. When so inserted, it functions in the same manner as described above for the optical mask 34. It may be inserted manually or by an automatic apparatus such as the electrical solenoid 42 shown.

It has been additionally found that both the optical masks 34 and 40, while preferably substantially fully opaque, are preferably finely optically apertured. That is, they are preferably made up of a multiplicity of small opaque areas separated by small transparent spaces in between. In the case of a desired binding area 14 in the form of a stripe or band as illustrated, the optical mask is preferably made up of a multiplicity of closely spaced opaque lines. Preferably these lines are approximately .05 to 5 millimeters (.002 to 1/4 inch) wide and are spaced apart by approximately .05 millimeter (.002 to .003 inch or slightly greater), whereas as previously discussed, the entire band is preferably wider than approximately 5 millimeters (1/4 inch). The providing of an optical mask in this configuration takes advantage of, and utilizes for the purpose of the invention, the phenomenon of "edge development" in electrophotography. This phenomenon per se is well discussed in the previously cited text references and accordingly need not be discussed herein. The result of a mask of this apertured configuration with edge development is a much higher toner concentration over what would otherwise be the interior of solid areas. Thus, much higher overall toner density is provided in the desired binding areas than would be provided by a solid area mask. Closely spaced dots rather than lines may also be used for the same purpose. Cross-hatching has proven effective.

An alternative method by which the desired optical mask may be provided in the path between the original and the photoreceptor is to simply preprint a dark area on the original. As a further alternative, the copy sheets themselves may be preprinted with sufficient toner in the desired binding areas. These methods of course require an additional step unless preprinting is required for other reasons.

Another way of forming the additional electrostatic image needed to provide the high density toner binding area or areas is further illustrated in the apparatus of FIG. 4. An exemplary additional corotron 44 or other suitable charging apparatus is shown adjacent the photoreceptor in the path of the photoreceptor after its initial charge has been received. By briefly applying a voltage to this additional corotron 44, an additional electrostatic image may be formed electrically (non-optically) by

electrically changing the charge on the selected minor additional area of the charged photoreceptor. This method, of course, requires more apparatus than the simple optical masks described above. However, this apparatus is well known and available in the art.

Considering next the exemplary ways in which the high density binding areas 14 of toner 18 on the individual sheets 12 are bound together to form an integral stack 10, as previously described the sheets are assembled together in a directly overlying relationship in a position in which they are to be bound. It is not essential that all of the binding areas directly overlie one another although this is preferable. At the catch tray 32 of FIG. 4 there is provided an exemplary pair of pressure platens or dies 46 and 48 located at the lower end of the catch tray where one edge of the sheets commonly abuts a stack stop. They comprise here one fixed heated platen 46 and one movable heated platen 48, located respectively at opposite sides of the stack 10. The platens 46 and 48 provide refusing for binding between adjacent sheets by heating the stack at the binding area 14 sufficient to render the high toner density area 16 on the sheets (only at the binding areas) sufficiently tacky to adhere between adjacent sheets, while simultaneously pressing the binding areas 14 together under pressure between the platens 46 and 48. The platen 48 is moved with pressure down against the top on the stack. This pressure is sufficient to remove air spaces between the sheets at the binding areas, and to provide good inter-sheet toner transfer, including improving the flow of toner from its carrier sheet into the adjacent sheet surface. The heating is continued until the toner on at least one sheet is softened sufficiently to adhere to the next adjacent sheet for each of the number of sheets being bound. Preferably, the stack 10 is further held between the dies for a time period after the heating is terminated sufficiently to allow the toner to substantially re-solidify by cooling.

The platens 46 and 48 are shown here with schematic representations of conventional electrical heating coils in the platen surfaces to provide the refusing heat. However, it will be appreciated that numerous other fusing means and processes may be utilized including those described in the above-cited references.

While, as described above, all of the sheets to be bound in a single stack may be first assembled together and bound simultaneously in a single binding/refusing step, other variations are possible. For example the refusing process may be repeated for each individual sheet to be bound. One way this may be accomplished is for the binding area of the uppermost sheet in the stack to be radiant heated to maintain the toner therein sufficiently adhesive, the next sheet for the stack to be individually placed on the stack with a binding area contacting the stack, and this single additional sheet to be bound to the stack by downward movement of the platen in synchronism with the addition of the sheet. By repeating this step for each additional sheet, as many additional sheets as are desired may be bound to the same stack without requiring heating of the entire stack. Correspondingly, or in combination, individual sheets may be added and bound to the stack one at a time by rendering or maintaining the toner area on the added sheet sufficiently tacky during the time that it is added to the stack and clamped by the platen thereon. A thermal shield 50 extending from the fusing operation 30 down over the catch tray 32 is illustrated here by way of an example for effecting the latter step by maintaining the toner area 16 warm and tacky from the original fusing operation 30 for the brief time needed to place it over the stack and press it down thereon.

FIGS. 6 and 7 illustrate the exterior and interior details respectively of a further exemplary apparatus 52 for performing the final refusing step for binding described above. As may be seen from FIG. 6, the apparatus 52 is designed to accept the stack 10 of sheets 12 vertically

downwardly therein and to align the lower edges thereof for binding as a single bound stack. As may be seen from FIG. 7 this may be accomplished by a relatively simple apparatus 52 comprising a stationary platen 54 operated against by an opposing moving platen 56. The moving platen 56 is driven under pressure to compress together the binding areas 14 of the stack 10 by a rotatably driven cam 58. The cam 58 causes a cam follower 59 to reciprocate, and it in turn moves the moving platen 56 through coil compression springs 60. The springs 60 restrict the amount of force which can be applied to the moving platen 56, and thereby prevent jamming of the machine. However, an increased thickness of the stack 10 will cause greater compression of the springs 60 and therefore a desired greater compression force to be applied to the stack. Electrical heating elements as shown may also be provided here to heat the platens. Additional heating means can also be provided in the bottom surface against which the stack abuts. The above described apparatus 52 is for the purpose of providing the application of both heat and pressure for stack binding. It will be appreciated that depending on the type of xerographic toner selected, that pressure alone may be sufficient, or that vapor or other known fusing methods may be provided. It will also be appreciated that numerous other apparatus may be utilized, such as pressure dies in the form of continuous rollers, etc. Further, pressure can be, but need not necessarily be, applied before, while, or after the toner is heated.

Any type of original image indicia may be utilized with the present process, whether hard copy, microfilm, microfiche, graphic, or alpha numeric, since the binding process does not interfere in any way with the normal indicia imaging or printing except at the selected binding areas. Likewise, almost any copy paper may be utilized. For example, the present process may be utilized to provide bound demand-printed paper copies of microfilm reports, texts or the like. It is especially suitable for direct on-line binding of pre-collated output sets from high speed machines.

For microfilm or other reversal image input, it will be appreciated that an opaque image mask will not be suitable. In this case the additional image area for toner binding can be provided by additional light sources imaged through apertures corresponding to the above-described masks. The above-described method utilizing the corotron 44 or the like can also be used.

It will also be noted that either one or both of the immediately adjacent (overlying) binding areas may have the prefused toner binder areas thereon. If both adjacent surfaces have high density toner areas 16, this will give an even stronger bond since more binding toner 18 is available in the intersheet space, and also since deeper toner penetration of both sheets may have been provided in the original fusing in this manner.

It will also be noted that in situations where there is not an esthetic problem, that it is possible with the present process to print or indicia a number of additional unused binding areas in addition to the binding area which may eventually be utilized. In fact, by printing binding areas on all copies produced, whether intending them to be bound or not, subsequent binding together of any of the sheets may be readily accomplished at any time by completion of only the refusing step of the above-disclosed process. The black binding areas which would be exposed on the unbound copies would not be objectionable in many situations, since they would occupy only a small area of the sheet margin outside of the normal indicia-occupying area. Thus for convenience, it is also possible to completely mask both edges of the original so as to provide a substantial toner area along both edges of the copy sheets. Only the one edge which is clamped and subjected to refusing will be a binding area. There is no binding effect by these further high density areas of toner,

since if they are not refused in the refusing step, they will not bind the sheets together.

Providing binding areas at both sheet edges may be particularly desirable in the case of duplex or pseudo-duplex copying where the desired binding areas may be at alternating sides of the respective sheets. In pseudo-duplex output format, where two sheet folds or material are bound together at every other fold line to provide the individual duplex pages, it may be desirable to place the binding areas on both sides of both edges of each sheet.

In situations where the esthetic factor of exposed black toner areas is a problem, it will be noted that all the binding areas which are bound are not visible except for binding areas exposed on the upper or lowermost sheets of the stack. These can be eliminated simply by insuring that the upper and lowermost sheets to be bound only have binding areas facing the stack.

Several stacks 10 can be simultaneously bound by a modification of the process herein. A large common assemblage of all the sheets for several stacks can be formed, interspersed with one or more sheets having no adjacent inter-sheet binding areas thereon. These interspersed sheets are located between the desired individual bound stacks. The entire assemblage can then be subjected to the toner refusing step. The interspersing sheets will prevent inter-sheet binding to themselves, but not interfere with the binding together of all of the other sheets with toner binding areas. Thus, in a single binding operation, several bound stacks can be simultaneously produced without adhering to one another. Note that these interspersed non-binding sheets can be provided by the last sheet of one stack and the first sheet of the next stack having no binding areas on their outward facing surfaces, which is also desirable esthetically. This elimination of binding areas on selected sheet surfaces can be provided automatically, for example, by programmed actuation of the solenoid 42 to remove the imaging light mask 40 for preselected sheets.

Note that the term "sheet" as used in the specification and claims herein is defined (conventionally) as including both individual cut sheets and also sheet segments of continuous web or fan fold or accordian fold paper or the like, whether burst or unburst. The subject method is applicable to those machines in which the paper is roll fed and is cut or folded into its individual sheets only after the toner has been applied and first fused into the binding areas.

In conclusion, it may be seen that there has been disclosed herein a novel and improved sheet binding method, and a bound stack produced therefrom, having numerous advantages in both simplicity, economy, and fastening security. The exemplary embodiments described herein are presently considered to be preferred; however, it is contemplated that further variations and modifications with the purview of those skilled in the art can be made herein. The following claims are intended to cover all such variations and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A method of binding two or more indicia bearing sheets together comprising the steps of:

applying fusible indicia imparting material to said sheets for indicia purposes;

applying an additional high density area of the same fusible indicia imparting material to the same said sheets respectively at at least one selected minor desired binding area of said sheets;

then assembling two or more of said sheets in an overlying relationship, and

while said sheets are so assembled, fusing said indicia material between said adjacent sheets only at said selected binding areas sufficiently to achieve inter-sheet binding by said high density areas of said indicia imparting material being commonly fused between adjacent sheets at said binding areas.

2. The method of claim 1 wherein said additional high density area is applied simultaneously with said indicia imparting material and by the same process.

3. The method of claim 1 wherein said selected binding area is a small area at an edge of each of said sheets having substantially the same relative location and area on each sheet.

4. The method of claim 1 wherein said indicia imparting material is fusible electrostatically attractable toner and wherein said high density area thereof is imparted with said same toner in the same step.

5. The method of claim 4 wherein said high density area is imparted by inserting an optical mask over the desired high density areas in the indicia imparting process.

6. The method of claim 4 wherein said high density area is formed by electrostatically attracting toner to the binding area on said sheets with an electrical charge separately and specifically applied to said sheets for that purpose.

7. The article of manufacture comprising:

a bound stack of overlying adjacent sheets xerographically imaged by fusible xerographic toner pre-fused therein;

said sheets having additional high density areas of the same xerographic toner pre-fused into at least one minor binding area thereon; and

said binding consisting solely of said high density areas of xerographic toner being commonly fused between immediately adjacent sheets at said binding area.

8. In the process wherein an indicia is imageable onto a charged surface to form an electrostatic image of said indicia thereon, and wherein this electrostatic indicia image is developable by attracting an electrostatically attachable and fusible toner to said electrostatic image, which attracted toner is then fusible onto the desired copy sheet; the improvement comprising the steps of:

forming an intense electrostatic charge image on at least one selected minor area of said surface;

attracting a high density area of the same said fusible toner to said selected minor area;

fusing said high density toner area to said copy sheets at at least one selected minor binding area of said sheets;

assembling two or more of said copy sheets in a stacked relationship; and

while said sheets are so assembled, re-fusing said toner between said adjacent sheets only at said binding areas sufficiently to achieve intersheet binding by commonly fusing said toner between adjacent sheets only at said binding areas.

9. The process of claim 8 wherein said process is xerographic, said surface is a photoreceptor and said electro-

static image is formable thereon by optically imaging through an optical path an indicia bearing original thereon, and wherein said additional electrostatic image is formed simultaneously with the formation of a said electrostatic indicia image by an optical mask inserted in a minor portion of the optical path between said indicia bearing original and said photoreceptor.

10. The process of claim 9 wherein said optical mask is provided by pre-printing an area on the original corresponding to the desired binding area on the copy sheets.

11. The process of claim 8 wherein said additional electrostatic image is formed electrically and non-optically by electrically changing the charge on a selected minor area of said charged surface.

12. The process of claim 8 wherein said re-fusing comprises heating said sheets at said binding areas until the toner on at least one sheet has softened sufficiently to adhere to the next adjacent sheet, and pressing said binding areas of said sheets together under pressure between a pair of dies, said pressure being sufficient to remove air spaces between said sheets at said binding areas.

13. The process of claim 12 wherein said stack is further held between said dies for a time period after said heating is terminated sufficient to allow said toner to substantially re-solidify by cooling.

14. The process of claim 8 wherein said stack is additionally bound by extending mechanical fastening means through said sheets in said stack only within said re-fused binding areas.

15. The process of claim 8 wherein said re-fusing process is repeated for each individual sheet to be bound.

16. The process of claim 8 wherein said re-fusing process is performed once simultaneously on all of the sheets to be bound together.

17. The process of claim 8 wherein said high density toner areas are applied to both sides of said copy sheets.

18. The process of claim 8 wherein the top and bottom sheets of said stack have said high density areas of toner applied only to the sides thereof facing said stack.

References Cited

UNITED STATES PATENTS

3,692,606	9/1972	Miller et al.	156—151
2,324,834	7/1943	Gurwick	270—52

WILLIAM A. POWELL, Primary Examiner

B. J. LEITTEN, Assistant Examiner

U.S. Cl. X.R.

117—17.5, 44, 93.4 A; 156—92, 277, 283, 291, 553; 161—148; 281—21 R

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,794,550 Dated February 26, 1974

Inventor(s) Gordon P. Taillie

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, top, change "Standard Oil Company, Chicago, Illinois" to --Xerox Corporation, Stamford, Conn.--

Signed and sealed this 15th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents