A method of and apparatus for continuously forming a printed web into stitched signatures for binding into a book. A set of traveling, interleaved printed webs has a continuous open loop stitch formed along its longitudinal center line with the connecting thread on one surface of the webs and the loops projecting from the opposite surface. A narrow line of adhesive is applied to the projecting loops and the immediately adjacent surface of the webs and dried to fix the loops to the web, after which the webs are folded along the longitudinal center line with the loops projecting from the outside of the fold and the folded web and thread are then cut into signature lengths.
METHOD OF AND APPARATUS FOR FORMING A PRINTED WEB INTO STITCHED SIGNATURES

BACKGROUND OF THE INVENTION

A constant problem in the handling of multipage signatures in a book binding operation is the control of the interleaved sheets which form the signature so that the sheets do not slip either longitudinally or laterally with respect to one another. The problem exists with all types of paper, but is particularly severe with coated papers of the type that are used for high grade book printing and especially for fine color reproductions.

In addition, there has been a long existing need in the printing and binding industry for a binding method for cased books which is quicker and less expensive than Smyth sewing. The need is for a way to bind books at the speed of patent binding, with the books having the opening characteristics of a Smyth sewn book.

Therefore, there has been no simple, inexpensive method for achieving either of the above results, and in particular for achieving them on line at the very high speeds at which present day printing and binding operations are conducted.

SUMMARY OF THE INVENTION

In accordance with the present invention, printed webs from a high speed rotary press which are slit longitudinally and superposed in registration are continuously stitched longitudinally in web form, after which the web is longitudinally folded along the line of stitching and the folded web and thread are cut into signature lengths. Preferably the stitches are locked to the web with adhesive before or while the web is folded.

In accordance with the invention, open loop stitches are used of the kind disclosed in Kitcat U.S. Pat. No. 2,541,367. Adhesive is then applied to the stitching and to the surface of the web along the line of pierced holes which are formed in the web as the stitching occurs, and the adhesive is rapidly dried to lock the stitching to the multi- ply web before or while the latter is longitudinally folded on a former board folder with the loops projecting out from the fold. Ideally the adhesive is applied along the connecting thread portion of the loop stitches where it is inside the fold; but because of the need for conserving floor space and to avoid smearing the adhesive on the former board it is more practical to apply the adhesive along the line of the loops so it is not against the former board during folding.

The apparatus for performing the stitching consists of a drum over the surface of which the webs pass, and the drum has a central circumferential line of radially extending needles with bifurcated tips that have prongs spaced longitudinally of the drum. A thread supply and guide means lays a single thread in the needle bifurcations, so that when the needles pierce the web, loops of thread are left projecting from the outer surface of the web. The needles are radially mounted in the drum and project from the drum surface for the smallest distance which will, nevertheless, leave adequate loops of thread to receive the adhesive for locking the thread to the web.

THE DRAWINGS

FIG. 1 is a schematic plan view of the apparatus of the invention;
FIG. 2 is a side elevational view of the apparatus of FIG. 1;
FIG. 3 is a perspective view of a 16-page signature produced in accordance with the method and apparatus of the invention;
FIG. 4 is a fragmentary sectional view on an enlarged scale taken substantially as indicated along the line 4—4 of FIG. 3;
FIG. 5 is a fragmentary central sectional view of the stitching drum on an enlarged scale;
FIG. 6 is a fragmentary sectional view on an enlarged scale taken substantially as indicated along the line 6—6 of FIG. 5; and
FIG. 7 is an elevational view of a stitching needle viewing the needle of FIG. 6 from the left hand side.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, and referring first to FIGS. 1 and 2, the apparatus of the present invention includes a set of guide rollers, indicated generally at 10, including a roller 11 for a first paper web W1 and a roller 12 for a second paper web W2 which have passed through a high-speed rotary printing press (not shown) in the form of a single wide web which is slit longitudinally to form the two webs W1 and W2, and said webs are then guided by preliminary rollers (not shown) to the relative positions illustrated in FIG. 2. The two webs are superposed as seen in FIG. 2 and pass between rollers 13 and 14 which guide them onto a former board or angle bar 15 which continuously folds the superposed webs W1 and W2 so that a multi-ply web W3 has a folded margin 16 and an open margin 17 after it has passed over the former board 15 and between crimping rollers 18 and 19 which also serve to guide it into a stitching area in alignment with stitching apparatus, indicated generally at 20.

The stitching apparatus 20 includes a stitching drum 21 which is provided with a central, circumferential line of generally radially extending needles 22. The stitching apparatus also includes a thread supply 23 and thread guide means 24 that includes guide rollers 25 and 26 to guide a thread T into operative relationship with the needles 22.

Referring now to FIGS. 5 to 7, the stitching drum 21 includes two drum halves 27 and 28 which have parallel discs that flank a central metal disc 29 to which a needle-carrying ring 30 is secured by means of countersunk machine screws 31. The needle-carrying ring 30 may be made in any desired number of separate ring segments; and as seen in FIG. 6 each ring segment is provided with radial needle bores 32 and intersecting fastening bores 33 that extend longitudinally with respect to the drum. The inner end portions of the needle bores 32 are threaded to receive adjustable needle stops 34; and the intersecting bores 33 are threaded to receive needle locking screws 35.

Each of the needles 22 includes a cylindrical shank 36 one side of which is provided with a longitudinal locking groove 37 which receives a chamfered threaded 35a of the locking screw 35. The needle has a tip 38 which is very thin circumferentially of the drum 21 and which is provided with a bifurcated tip 39 so that it has prongs 40 spaced longitudinally of the drum and defining a thread receiving groove 41.

In an operating prototype of the apparatus the needles 22 are fabricated from C-1095 music wire or equivalent having a hardness of 50-55 C Rockwell or equivalent. Such music wire has a diameter of 0.094 inch (3/32 inch nominal diameter). The thin tip 38 is
reduced to a thickness of 0.025 inch. The groove 41 and the inclined faces of the prongs 40 are radiused, as are the tips of the prongs.

For stitching of a typical 16-page signature (a web W3 of four plies) the stop screws 34 are so positioned that the needles have the bottom of the grooves 41 located one-eighth to one-fourth inch radially outwardly from the surface of the needle-carrying ring 30. The needle drum is 22 inches in diameter. To minimize tearing of the web during stitching, the web speed is halfway between the surface speed of the drum and the tip speed of the needles.

As seen in FIGS. 5 and 6, the thread T is guided into the needle grooves 41 so that as the multi- ply web W3 passes over the stitching drum 21 in contact with the needles 22 the needles pierce spaced holes H in the multiply web W3 and simultaneously push spaced segments of the thread T through the holes H to form loops L. Thus, when the web W3 leaves the stitching drum 21 it has a continuous longitudinal open loop stitch 42 (FIG. 4) with loops L that project from one surface of the multi- ply web W3 and connecting thread Tc on the other surface of the web. The open loop stitch 42 is formed along the longitudinal center line of the web W3 so that when the web is subsequently folded along the line of stitching the abutting edges opposite the line of stitching are in register.

Referring again to FIGS. 1 and 2, the web W3 with the line of stitching 42 passes around a guide roller 43 and between guide rollers 44 and 45 to a former board 46 which has an apex 47 aligned with the line of stitching 42 so as to fold the web longitudinally along said line into a web W4 which passes between a pair of crIMPING rollers 48 and carrier rollers 49 to cutting cylinders 50 that cut the folded web W4 and the loop stitch 42 into signature lengths S (FIG. 3).

In order that the loop stitch 42 may not pull out, it is locked to the multi- ply web W3, either ahead of or at the former board 46, the latter arrangement being illustrated in the drawings. In FIG. 1, 50 is an adhesive applicator which continuously applies a very thin line of adhesive to the loops L and the immediately adjacent area of the web W3, and 51 is a high-speed adhesive drier such, for example, as a battery of high intensity infrared heat lamps.

The severed signatures S form a shingled stream on a delivery conveyor 52 which preferably feeds them directly into a stacker.

The foregoing detailed description is given for clearness of understanding only and no unnecessary limitations should be understood therefrom, as modifications will be obvious to those skilled in the art.

We claim:

1. A method of continuously forming a printed web into stitched signatures for binding which comprises the steps of:

   providing a run of thread;

   laying said run of thread along the path of travel of a longitudinal line of a multi-traveling web which is in planar orientation;

   continuously in a single operation piercing spaced holes seriatim in said web along said longitudinal line and simultaneously pushing a segment of said run of thread through each of said pierced holes to form an open loop stitch with the run of thread between loops on one surface of the web and the loops projecting from the other surface;

   thereafter continuously folding said web along said longitudinal line so the stitch loops project from the outer side of the fold;

   then applying adhesive to the thread and to the adjacent web in a manner to lock the thread to the web;

   and finally cutting the folded web and thread into signature lengths.

2. The method of claim 1 in which a plurality of webs are first continuously superposed in register with one another and longitudinally folded to provide a fold, and in which the stitches are formed through the superposed and folded webs in spaced relationship to the fold.

3. Apparatus for continuously forming a printed web into stitched signatures for binding, said apparatus comprising, in combination:

   guide roller means about which a multi- ply printed web moving at a given linear speed passes after leaving a printing press;

   a stitching drum adjacent said guide roller means, said drum being provided with a central circumferential line of radially extending fixed needles with bifurcated tips that have prongs spaced longitudinally of the drum, said needles projecting a short distance radially from the drum and being aligned with a longitudinal line of a web on said guide roller means;

   means for driving the drum so that it has a predetermined surface speed and the needles have a correspondingly greater tip speed;

   means for controlling said given linear speed of the web so that it is substantially halfway between the surface speed of the drum and the tip speed of the needles;

   a thread supply and thread guide means to lay a single run of thread in said bifurcated tips, said web passing in contact with said drum so the needles in a single operation pierce spaced holes seriatim along said longitudinal line and simultaneously push a segment of said run of thread through each of said holes to form an open loop stitch with the run of thread between loops on a first surface of the web and the loops projecting from the second surface;

   means for applying adhesive to the thread, and to the adjacent web, in a manner to lock the thread to the web;

   means for folding the web continuously along said longitudinal line with the stitch loops projecting from the outer side of the fold;

   and means for cutting said web and thread into signature lengths.

4. The apparatus of claim 3 in which the web folding means comprises a former board which contacts the same surface of the web as does the stitching drum, said former board having an apex aligned with said longitudinal line of the web.

5. The apparatus of claim 3 which includes means between the stitching drum and the web folding means for applying adhesive to said thread and to the immediately adjacent portion of the web, and means for immediately drying said adhesive to lock the thread to the web.

6. The apparatus of claim 5 in which the adhesive applying means contacts the surface of the web which is opposite the surface that contacts the stitching drum.

7. The apparatus of claim 3 in which the guide roller means comprises a plurality of spaced guide rollers on
which a plurality of superposed and longitudinally folded webs are guided into alignment with the stitching drum.

8. The apparatus of claim 3 in which the line of needles is on the longitudinal center line of the web.

9. Apparatus for continuously forming a printed web into stitched signatures for binding, said apparatus comprising, in combination:

- guide roller means about which a multi-ply printed web moving at a given linear speed passes after leaving a printing press;
- a stitching drum adjacent said guide roller means, said drum having a broad cylindrical surface provided with a central circumferential line of radially extending fixed needles with bifurcated tips that have prongs spaced longitudinally of the drum said needles projecting a short distance radially from the drum and being aligned with a longitudinal line of a web on said guide roller means;
- means for driving the drum so that it has a predetermined surface speed and the needles have a correspondingly greater tip speed;
- means for controlling said given linear speed of the web so that it is substantially halfway between the surface speed of the drum and the tip speed of the needles;
- a thread supply and thread guide means to lay a single run of thread in said bifurcated tips, said web passing in planar contact with said broad cylindrical surface of the drum so the needles in a single operation pierce spaced holes seriatiom along said longitudinal line and simultaneously push a segment of said run of thread through each of said holes to form an open loop stitch with the run of thread on a first surface of the web and the loops projecting from the second surface;
- means for applying adhesive to the thread, and to the adjacent web, in a manner to lock the thread to the web;
- means for folding the web continuously along said longitudinal line with the stitch loops projecting from the outer side of the fold;
- and means for cutting said web and thread into signature lengths.

10. A method of continuously forming a printed web into stitched signatures for binding which includes the steps of:

- guiding a traveling multi-ply web in planar orientation through a stitching area;
- continuously in a single operation piercing spaced holes seriatiom along a longitudinal line of said traveling multi-ply web in said stitching area and simultaneously pushing a segment of a continuous run of thread through each of said pierced holes to form an open loop stitch with the run of thread between loops on one surface of the web and the loops projecting from the other surface;
- thereafter continuously folding said web along said longitudinal line so the stitch loops project from the outer side of the fold;
- then applying adhesive to the thread and to the adjacent web in a manner to lock the thread to the web;
- and finally cutting the folded web and thread into signature lengths.

11. The method of claim 10 in which a plurality of webs are first continuously superposed in register with one another and longitudinally folded to provide a fold and in which the stitches are formed through the superposed and folded webs in spaced relationship to the fold.

12. The method of claim 10 in which the open loop stitch is formed along the longitudinal center line of the web.

* * * * *