# United States Patent [19]

**Maynard et al.**

[11] **3,768,801**

[45] **Oct. 30, 1973**


[54] **APPARATUS AND METHOD FOR MAKING MULTIPLE PLY SETS**


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[52] **U.S. Cl.** ..... **270/53,** 83/346

[51] **Int. Cl.** ..... **B42b 1/02**

[58] **Field of Search** ..... 270/37, 52, 53; 83/341, 343, 346; 93/8



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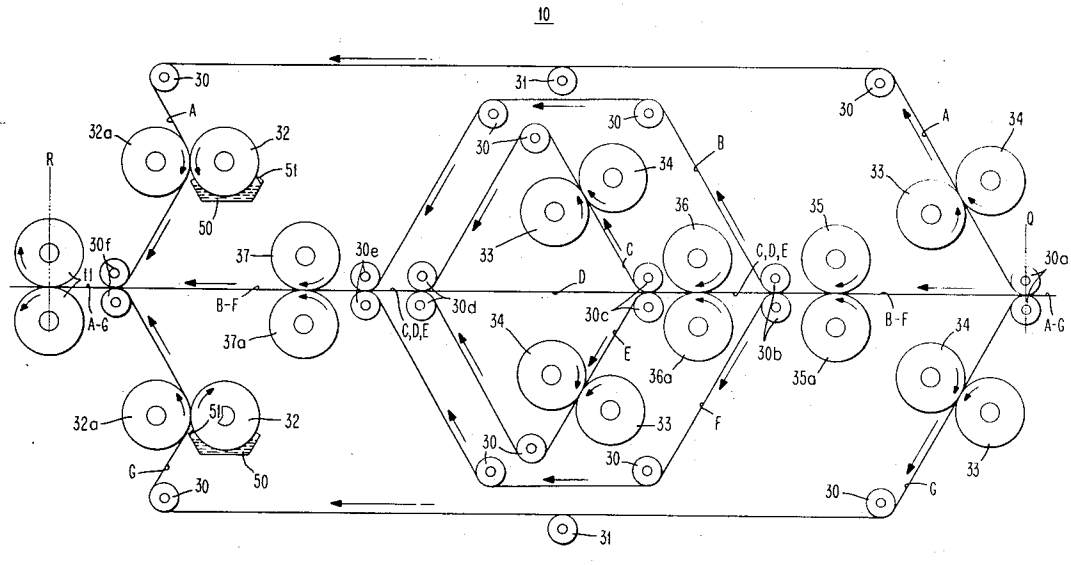
[57] **ABSTRACT**

Multiple ply sets having a primary (record) portion and a discardable (stub) portion are made by performing selected work operations concurrently with one set of tooling in a plurality of superposed webs. The webs are then diverted into paths of predetermined differing lengths, remerged, then severed into multiple ply sets. The differing path lengths assure that the manifestation of the selected work operations will be in the primary portion in those plies where it is desired (e.g., a thumb notch for carbon sheets) but effectively shifted into the discardable (detachable stub) portion in those plies (e.g., card or paper slip) where it is tolerable though not particularly desirable. This enables a significant reduction in number of work stations, and hence in equipment cost, set-up and maintenance time, overall machine size, and in-process web length.

Some work operations are performed by pairs of rotary tool cylinders, each independently orientable in a predetermined number of rotative positions to provide a plurality of different combinations of rotative positions for performing correspondingly different work operations from one side or the other side of a web as it passes between said cylinders.


**7 Claims, 5 Drawing Figures**



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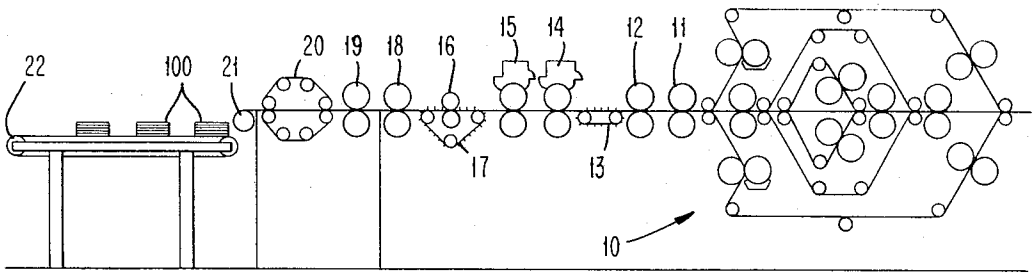


FIG. 1

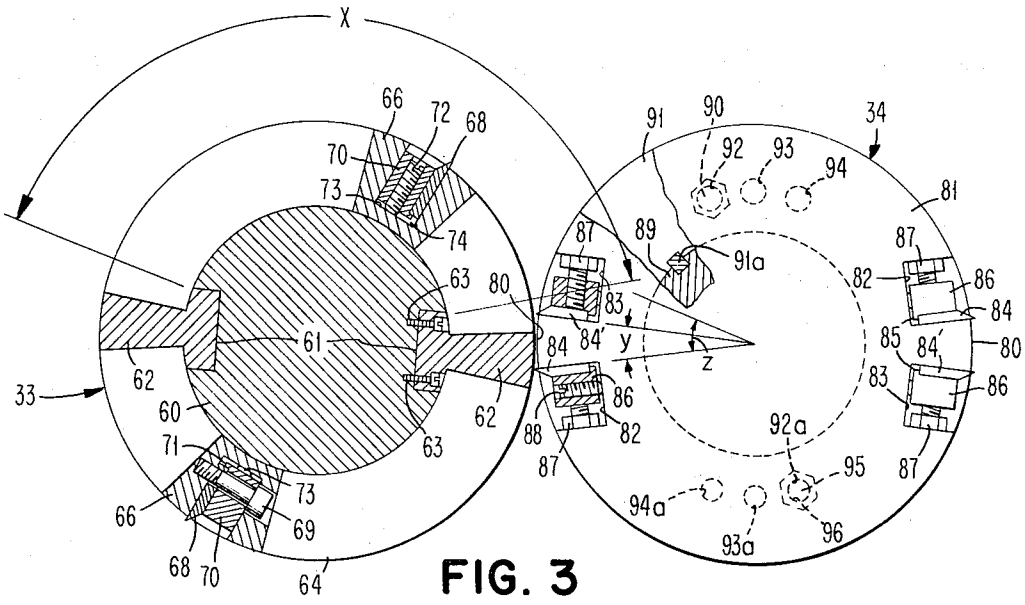


FIG. 3

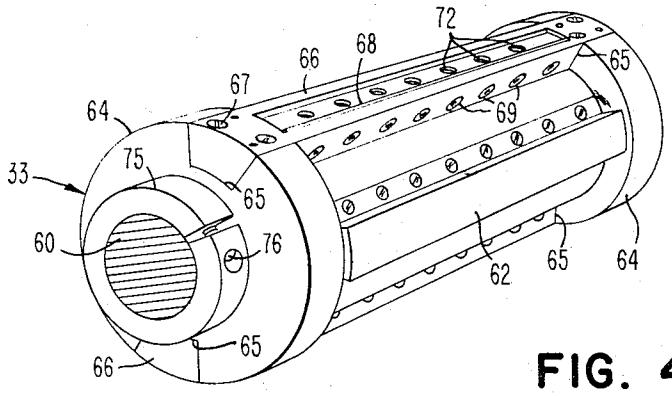


FIG. 4

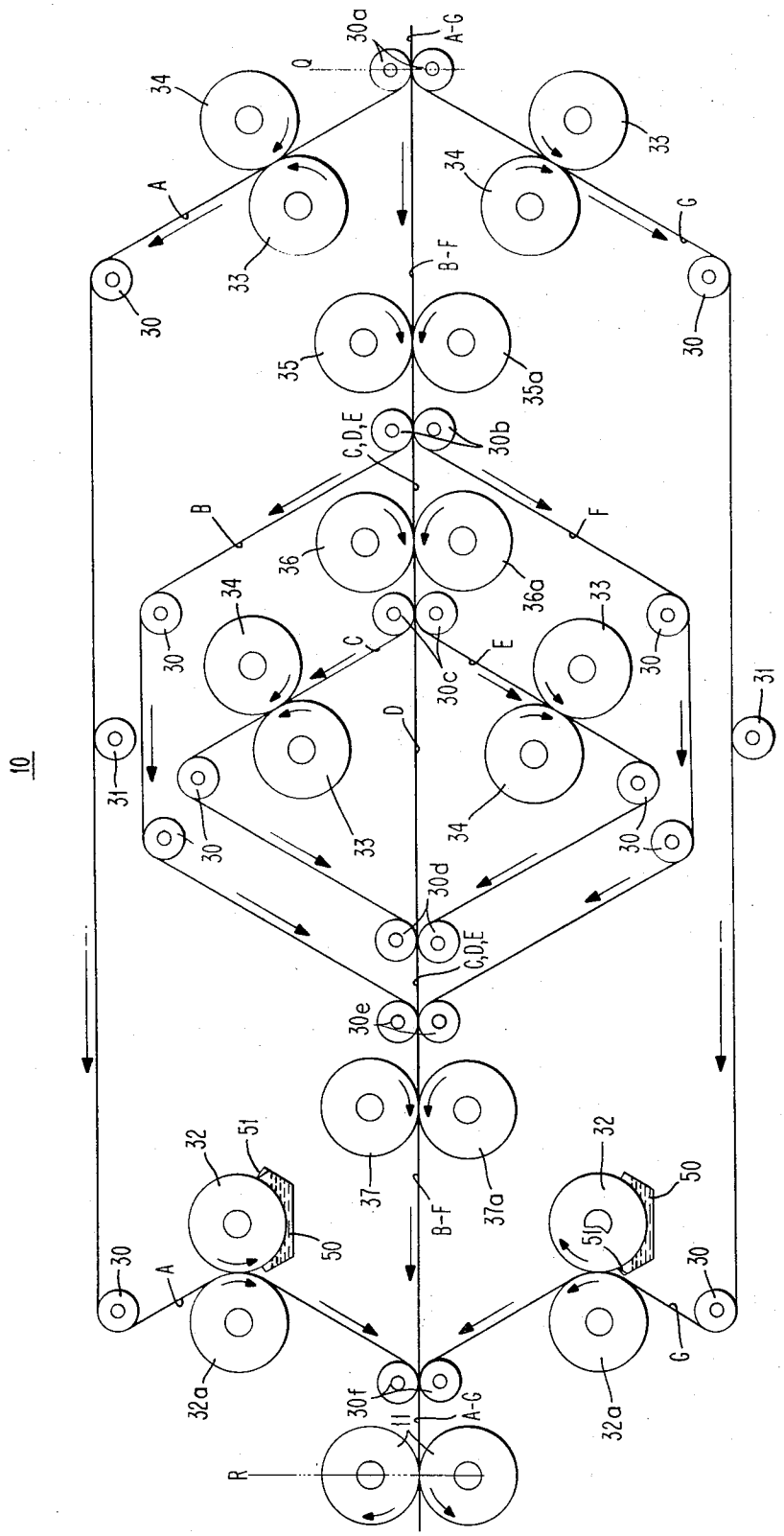
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FIG. 2

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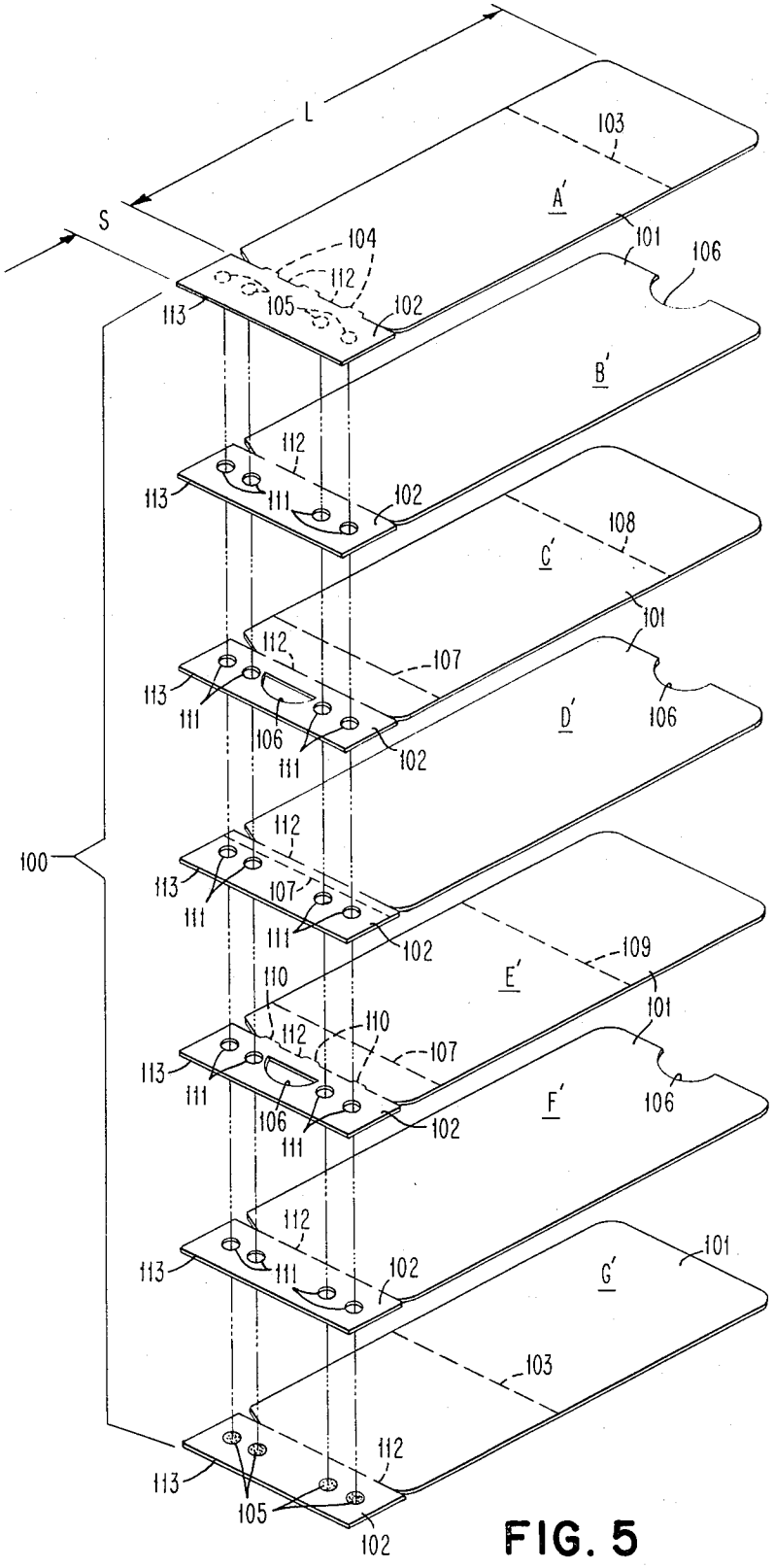


FIG. 5

# APPARATUS AND METHOD FOR MAKING MULTIPLE PLY SETS

This invention relates to apparatus and methods for manufacturing multiple ply sets from webs of paper, cardstock, carbon paper, translucent paper, carbonless paper, or the like, and relates more particularly to an apparatus and method wherein a single set of tooling performs a work operation concurrently in a plurality of moving webs that are later displaced relative to each other, remerged and severed into discrete sets.

## BACKGROUND OF THE INVENTION

One common method of making multiple ply sets is to advance a plurality of webs individually in parallel past a series of work stations at which only those particular work operations that are actually desired are performed on the webs involved. This method requires a considerable number of work stations, and hence equipment, space and in-process web length. To reduce equipment and space requirements, multiple ply sets have also been made by passing webs of similar type as superposed groups through respective series of work stations, then rearranging the webs by use of turn bars or winding, unwinding and collating to provide the desired strata of plies of the various types before severing the webs into discrete multiple ply sets.

There is a need for a relatively inexpensive and reliable apparatus and method that will provide multiple ply sets at minimum cost by minimizing the number of work stations, in-process web length, set-up and maintenance time.

## SUMMARY OF THE INVENTION

Most multiple ply sets have stub portions, header portions, or other discardable portions that serve only a minor function like retaining the plies connected. Applicants have found, according to the invention, that manufacturing cost for such sets can be reduced significantly by performing in a group of superposed webs a work operation that is actually desired in only some of said webs; whereupon the webs of said group are advanced in paths of differing length, and then remerged and severed into discrete multiple ply sets. The path lengths are preselected to cause the manifestation of the work operation to appear at the proper location in those sets where it is desired, but to be shifted to the discardable portion in the remaining plies where it is tolerable but not desired or required.

The apparatus according to applicants' invention thus differs from that disclosed in U.S. Pat. No. 2,307,142, wherein the work operation is one that is desired and required in all webs, but at different longitudinal positions on webs having no discardable portions.

Cost is further reduced by providing versatile work stations including pairs of rotary tool cylinders at opposite sides of at least one of the web paths; at least one of these cylinders is orientable in a plurality of rotative positions to perform any one of a number of different work operations from either or both sides of a web.

Other objects and advantages will become apparent from the following more detailed description of the invention and from the following drawings wherein:

FIG. **1** is a schematic elevational view of an apparatus embodying the inventions;

FIG. **2** is a schematic view, to enlarged scale, of a portion of the apparatus shown in FIG. **1**;



FIG. **3** is a longitudinal sectional view, to further enlarged scale, of a versatile work station embodied in the apparatus shown in FIG. **2**;

FIG. **4** is a perspective view of the work station shown in FIG. **3**; and

FIG. **5** is an exploded view of a multiple ply set made by the apparatus of FIG. **1**.

## DESCRIPTION

The invention is illustrated as being embodied in the apparatus partially shown in FIG. **1** and adapted to make so-called grain long sets of the type shown in FIG. **5**. This apparatus comprises unwind sections and printing sections (not shown) in which webs A–G are successively unwound from respective supply reels and then each printed upon individually in respective rotary printing presses. Webs A–G then advance in superposed relation into a processing station **10** at which they are separated, scored, cross-perforated, thumb-notched, glue-hole punched and adhesive is applied intermittently at preselected longitudinal positions, in the manner presently to be described.

As they leave the processing station **10**, the webs A–G are remerged and fed superposed between impactor rolls **11** that press the webs A–G together at said preselected locations to set the adhesive. Then punch rolls **12** punch pin feed line holes in the webs to receive the pins of a pin feed tractor **13** that draws all webs through the apparatus at a predetermined constant speed. Tractor **13** advances the webs, still superposed, to numbering stations **14, 15** for crash numbering the webs in longitudinal and/or transverse directions. Then, the webs (if multiple set widths wide) are slit into single set widths by a slitter **16** as they are advanced by pin feed tractor pin **17** to a score unit **18** and cut-off unit **19** at which the webs A–G are finally severed into discrete multiple plies A′–G′ to provide face-up grain long sets **100** (see FIG. **5**). A pair of juxtaposed endless belts **20** receive the series of side-by-side arranged single-width sets as they leave the cut-off rolls and advance them into cam-opened clips on a drum **21**. This drum, like a drier drum on a rotary press, moves the sets through an arcuate path and then releases them, inverting the sets in the process to cause them to be stacked face down on an endless delivery belt **22** that conveys them to an off-load station.

The apparatus heretofore described, except for processing station **10**, may be of any suitable type heretofore proposed. According to the invention, and as best shown in FIG. **2**, processing section **10** comprises a plurality of driven tendency rolls **30**, support idler rolls **31**, glue units including adhesive-applying gravure cylinders **32** and associated impression cylinders **32*a***, cross-perforation units **33**, and shovel punch units **34**. As illustrated, section **10** also comprises a thumb notch cylinder **35** and associated die cylinder **35*a***; a special stub score cylinder **36** and associated impression cylinder **36*a***; and a glue hole punch **37** cylinder and associated die cylinder **37*a***. For sake of illustration webs A, E are considered to be of cardstock; webs B,D,F, of carbon or other transfer material; and webs C,G of paper, to provide the so-called four-part set shown in FIG. **5** and comprising two card plies A′,E′, two paper plies C′, G′, and three interleaved carbon plies B′,D′,F′.

Each tendency roll **30** has laterally spaced collars or flanges with beveled facing sides to maintain one or more of the webs A–G in lateral registration as the

webs are guided around such roll or through the channel defined between two such rolls. Each tendency roll **30** is driven by suitable means (not shown) at a constant speed approximately 5 percent less than the predetermined constant speed at which the webs A–G are drawn through the apparatus by pin feed tractor **13.** This maintains each web under a desired minimum degree of tension to minimize variation in running registration, but does not create the excessive drag on the webs such as would occur if the rolls **30** were idlers that had to be driven by the webs.

Rolls **31** support the webs A, G from drooping or festooning along the relatively long horizontal portions of their respective auxiliary paths.

Each gravure cylinder **32** is rotated partially immresed in a trough **50** of liquid adhesive. As its immersed surface leaves the adhesive, it is wiped by a doctor blade **51** which removes adhesive except in those areas where the cylinder is etched. As cylinder **32** continues to rotate into contact with web A or G, as the case may be, the adhesive is applied to such web in the pattern prescribed by the etched areas, while such web is backed up by the corresponding impression cylinder **32***a*.

As best shown in FIGS. **3** and **4**, each cross-perforation unit **33** comprises a shaft **60** having two oppositely arranged flat-bottomed recesses **61.** Suitably inset in each recess **61** is an anvil element **62** that is secured to shaft **60** by countersunk screws **63.** Elements **62** are thus diametrically opposite. Each projects radially from the periphery of shaft **60** and extends fully across the web feed path. Slidably encircling shaft **60** outboard of elements **62** are two rings **64** (FIG. 4), each having a pair of diametrically opposite sector-shaped recesses **65** in its periphery. A wedge-shaped blade-carrying member **66** is inset flush into each recess **65,** and suitably secured to both rings **64,** as by screws **67.** Each member **66** carries a cross-perforating blade **68** that extends qcross the entire web feed path intermediate rings **64.** Each of the plurality of shoulder bolts **69** passes through a common spacer block **70** and corresponding slot in blade **68** and is screw-threaded into a corresponding bore in member **66** to clamp the blade to the member at spaced points along the member. Block **70** has a lip or ledge **71** on which the radially innermost end of the blade rests. Between the bolts **69** are a series of adjusting screws **72** that extend radially toward a surface **73** defining the base of spacer-block-accommodating recess **74.** In assembly, bolts **69** are first adjusted to lightly, but not rigidly, retain blade **68;** then shaft **60** is rotated to radially seat the blade by moving it past and in contact with anvil surface **80** of unit **34;** then with the inner end of screws **72** contacting surface **73,** each screw is adjusted to position the blade radially as desired; whereupon bolts **69** are tightened to rigidly clamp the blade.

It will be apparent from the foregoing that the diametrically opposite blades **68** revolve in unison about shaft **60** and can be positioned at any rotative position within the limits of an arc *x* defined by lateral contact of member **66** with one or the other of the elements **62.** Rings **64** are laterally secured to split hubs **75** that encircle shaft **60;** by tightening screws **76,** these hubs and hence the rings, members **66** and blade **68** can be clamped to the shaft, thus enabling the blades to be firmly positioned anywhere within arc *x* and thus to correspondingly adjust the relative location along the web which a cross-perforation will be made by each blade **68** as and when such blade forces the web against either of two anvil surfaces **80** of a corresponding shovel punch unit **34.**

Each shovel punch unit **34** comprises a cylinder **81** having two sets of diametrically opposite recesses **82, 83** arcuately offset a slight angle relative to each other and extending inwardly from and between the respective complementary peripheral surfaces **80** of the cylinder. Inset in each of the oppositely arranged recesses **82** is a shovel punch score blade **84** that, like blade **68,** extends across the entire web feed path. Each blade **84** rests on a lip **85** of a spacer block **86** and is laterally clamped to cylinder **81** at axially spaced points therealong by a plurality of shoulder bolts **87.** Each bolt **87** (unlike bolt **69**) is withdrawn from the common block **86** to spread the blade and bolt to effect clamping of the blade. Radial positioning of each blade **84** is, however, adjustable by a radially extending adjusting screw **88** carried by block **86** and operative in the same manner as screw **72.**

A shovel punch score blade **84'** is clamped in desired position within each recess **83** by bolt **87,** screw **88** and block **86,** in precisely the same manner as already described in connection with recess **82.** The only difference is that blade **84'** makes a shovel punch that is different from that of blade **84.**

As illustrated, cylinder **81** is rotatable on a shaft **89** and adapted to be oriented and locked by any suitable means in any one of three rotative positions relative to the shaft. In the embodiment illustrated, this locking means comprises a bullet-nosed pin **90** that is carried by a collar **91** locked by a key **91***a* to shaft **89.** Pin **90** is normally spring biased (e.g., by a leaf spring, not shown) to project into one of three position-defining bores **92, 93, 94** in the adjacent end face of cylinder **81;** however, it is retractable against such spring bias to permit manual rotation of the cylinder relative to the collar and shaft to enable selection of a different rotative position. To firmly lock cylinder **81** in selected rotative position, a locking screw **95** is preferably provided which passes through hole **96** in collar **91** and is screw threaded into one of three bores **92***a*, **93***a*, **94***a* diametrically opposite the corresponding position-defining bores **92,93,94,** respectively; this screw must, of course, be loosened and withdrawn from bore **92***a*, **93***a*, or **94***a* to enable orientation of the cylinder in a new rotative position by pin **90.**

As illustrated in FIG. **3,** pin **90** and screw **95** extend into bores **92,92***a*, respectively, to so orient the cylinder **81** on shaft **89** that as a web passes between units **33** and **34,** it will be pinched between the blades **84** and anvil element **62** and thus scored according to the shovel punch configuration of blades **84.** If, however, it is desired to score a web according to the configuration of blades **84'**, screw **95** and pin **90** should be retracted; then cylinder **81** should be rotated counterclockwise on shaft **89** through an arc *y;* and finally pin **90** and screw **95** should enter bores **93,93***a*, respectively, to position and lock the cylinder in the position in which blades **84** are shown in FIG. **3,** and in which blades **84'** will cooperate with anvil element **62** to punch the desired score.

If no shovel punch score is desired in a web, cylinder **81** is appropriately rotated counterclockwise through an arc *z* from the position in which it is shown in FIG. **3** and then positioned and locked by pin **90** and screw

95 in bores 94,94*a*, respectively. Under this circumstance, the blades 84 and 84′ will have been rotated far enough past anvil elements 62 so that the outer edge 86a of block 86 in recess 83 will be opposite elements 62 as the shafts 60,89 of units 33,34, respectively, rotate in unison. Each edge 86*a* is recessed sufficiently relative to the associated blade 84′ to provide a clearance space between it and the corresponding element 62 sufficiently wide to enable a web to pass therethrough without any work operation being performed thereon.

On the other hand, if no cross perforation is desired, rings 64 of cross perforation unit 33 are rotated and locked by screws 76 in a position where cross perforation blades 68 will enter recess 82 or 83 at points spaced circumferentially from the blades 84, 84′ rather than pinching the web against anvil surfaces 80.

Thus, this versatile work station comprises at least one selectively positionable rotary tool cylinder (81) and at least one member (66) rotatively positionable on a rotary tool cylinder (60) to provide two cooperating rotary tool units having a plurality of different combinations of independently selectable rotative positions to provide a variety of desired combinations of work operation. This desirably reduces in-process web length, equipment cost, and maintanance time.

The thumb notch cylinder 35 is merely a rotary punch cylinder having a semicircular punch element that mates with an appropriate die hole in die cylinder 35*a*.

Special stub score cylinder 36 may be identical with cross perforation unit 33, but with a blade that cuts either a similar or a different cross perforation pattern; and the impression cylinder 36*a* may merely be a hard anvil cylinder of constant outside diameter. Glue hole punch cylinder 37 comprises a plurality of punches arranged to provide a desired pattern of glue holes in webs B–F when they pass between said cylinder and its associated die cylinder 37*a*.

It should be noted that all the cylinders are driven at angular velocities which assure that when the respective blades strike their associated anvil surfaces or the punches enter their associated die surfaces their speeds will by synchronized with the aforementioned predetermined constant speed at which the tractor 13 advances the superposed webs A–G.

## OPERATION

In operation, assume that the webs A–G have been printed upon and are now entering processing station 10 as a superposed group A–G. As these superposed webs pass between tendency rolls 30*a*, the two outermost webs A,G are directed into separate auxiliary paths that diverge at substantially equal angles from straight-line main path. Further downstream along the main path, after webs B–F pass between another set of tendency rolls 30*b*, the then outer webs B,F are directed into separate auxiliary paths that also diverge at substantially equal angles from the straight main path. Finally, still further downstream along the main path, after webs C,D,E pass between still another set of tendency rolls 30*c*, the remaining outer webs C,E are directed into separate auxiliary paths that likewise diverge at substantially equal angles from the main path through which the single carbon web D now passes temporarily until the webs are remerged in reverse sequence; i.e., webs C,E rejoin D and pass between tendency rolls 30*d*, then webs B,F rejoin C,D,E and pass between tendency rolls 30e, and finally webs A,G rejoin webs B–F and pass between tendency rolls 30*f*, whence all seven webs A–G pass in superposed relation into the nip of impactor rolls 11. During their movement along the main and respective auxiliary paths, various work operations are performed on the webs either separately or concurrently in order to provide multiple ply sets 100 of the type illustrated in FIG. 5.

As illustrated, each set 100 comprises a plurality of plies A′–G′ each having a main or indicia-receptive record portion 101 and a stub or other discardable portion 102 that has a minor function (e.g., interconnecting plies into a detachable set). As shown in FIG. 2, in the respective auxiliary feed path for each of the webs A and G is a set of units 33, 34 and downstream thereof a glue unit 32. The rotative positions of blades 68 and of these units 33 are adjusted, in the manner heretofore described, to provide cross perforations 103 at the respective longitudinal points indicated in FIG. 5; whereas the cylinders 81 of the respective units 34 are rotatively positioned, in the manner also hereinabove described, so that a shovel punch 104 of the configuration prescribed by blades 84 will be provided in the cardstock web A, but no shovel punch will be provided in web G as it passes between the units 33, 34 because such punches are not desired in paper plies like G′. The glue units apply to the inner side of webs A and G a glue pattern 105 (see FIG. 5) corresponding to the etched pattern on the adhesive applying gravure cylinder 32.

Meanwhile, semicircular thumb notches 106 (FIG. 5) will be punched simultaneously in webs B–F as they proceed along the straight main feed path and through the nip of thumb notch cylinder 35 and its die cylinder 35*a*. After carbon webs B and F are diverted into their respective auxiliary feed paths, the special stub score cylinder 36 and its die cylinder 36*a* will provide a special score, such as a special or additional cross perforation 107, in the webs C,D,E at a suitable location; whereupon, as illustrated in FIG. 2, the outer webs C and E are diverted from the remaining carbon web D and past respective sets of units 33,34.

The units 33,34 in the feed path of paper web C are adjusted to provide a cross perforation 108 of either of the types possible with blades 84 or 84′, but no shovel punch, as none is desired. On the other hand, the units 33, 34 in the feed path for cardstock web E are adjusted to provide both a cross perforation score 109 and a shovel punch 110. Meanwhile, carbon web D moves along the straight feed path without any special work operation being performed thereon.

After webs B–F have remerged, glue hole punch cylinder 37 in cooperation with its die cylinder 37*a* will punch glue holes 111 simultaneously in these webs in a pattern identical with that of the glue pattern 105; this is so that after all webs A–G remerge and pass through the impactor rolls 11, the adhesive applied to the outer webs A,G will be forced into the holes 111 in the intervening webs to interlockingly but detachably connect said webs at longitudinally spaced points.

According to an important feature of the invention, the lengths of the main web path and respective auxiliary paths through the processing station 10 are predetermined in the following manner. Assume that each set 100 has a total length L (see FIG. 5) of which S represents that of discardable stub portion 102. Assume

further that all feed path lengths are measured between points Q and R (i.e., between the web-engaging points on tendency rolls **30**a and the nip of impactor rolls **11**).

Under these assumed conditions, the lengths of the main feed path (which is followed exclusively by web D) and of the auxiliary feed paths followed by web A,B,F,G, will be integral multiples of L; but the length of the respective auxiliary paths followed by webs C and E will be an integral multiple of L, plus a preselected constant distance that is preferably somewhat less than, but in no case exceeds, the dimension S. Since the paths traversed by webs C and E will thus be slightly longer than an integral number of set lengths L, the manifestations of the work operations performed in these webs will have effectively been shifted said preselected constant distance backward in those webs at the instant the superposed webs A–G are severed by cut-off unit **19**; note that score unit **18** makes a final stub score **112** (see FIG. **5**) at the same time cut-off unit **19** severs the webs along an edge **113** to form the discrete sets **100**.

As a result of this shift of webs C and E, the thumb notches **106** in corresponding plies C′, E′ of each set **100** will have been effectively shifted from the trailing edge of the set (see plies B′,D′,F′ in FIG. **5**) back into the stub portion **102** of the immediately succeeding set; and the special stub score **107** in plies C′,E′ will have been effectively shifted from stub portion **102** (see ply D′) back into the leading part of the main portions **101** of the same set.

It will thus be seen that, in accordance with the invention, manifestations of work operations simultaneously performed in a plurality of webs can be shifted either into or from what later becomes discardable portion **102** of a multiple ply set **100** so that said manifestations will appear in the main portions **101** only of those plies in which it is actually desired.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be apparent that various changes may be made in the method and apparatus without departing from the spirit, scope and teaching of the present invention. Accordingly, the method and apparatus herein disclosed are to be considered merely as illustrative, and the scope of the invention is to be limited only as specified in the claims.

What is claimed is:

**1.** Method of manufacturing from a plurality of webs a multiple ply set in which each ply of the set has a primary portion and a discardable portion, comprising the steps of:

performing with a single set of tools concurrently on a group of webs while they are in superposed relation a selected work operation to produce a manifestation actually desired in only some of the webs of the group,

directing at least one of the webs of the group into a path of different length than that of the others, and then remerging them to cause the manifestation of the work operation in each such one web to become displaced a preselected amount relative to that in the other webs,

transversely scoring the remerged webs concurrently with a single set of tools to create one transverse boundary between the primary portion and discardable portion, and

transversely severing the remerged webs concurrently with another single set of tools to cut the webs into discrete sets of superposed plies along a line defining the other boundary between said primary and discardable portions in succeeding discrete sets, the particular webs so displaced and said preselected amount of displacement being such as to cause the manifestation to be present in the primary portion in those plies where it is desired and in the discardable portion in the remaining plies where it is tolerable.

**2.** The method according to claim **1**, wherein the work operation is performed on said group at any of a plurality of locations displaced longitudinally along the web feed path,

one location selected to cause the manifestation to appear in the primary portion of the plies severed from the non-displaced webs, and in the discardable portion of the plies severed from the displaced webs, and

another location selected to cause the manifestation to appear in the discardable portion of the plies severed from the non-displaced webs, and in the primary portion of the plies severed from the displaced webs.

**3.** The method according to claim **1**, including the step of

providing tooling that is prepositionable into different combinations of rotative positions to perform any one of a plurality of different selectable additional work operations on at least some of the webs while they are directed into such paths of different length.

**4.** Apparatus for manufacturing from a plurality of webs discrete multiple ply sets in which each ply of the set comprises a primary portion and a discardable portion, said apparatus comprising

means for performing at least one selected work operation concurrently on a group of the webs while they are in superposed relation,

means for thereafter directing at least a certain web of the group along a path of a length different from that of others of the group to cause the manifestations of the work operations in such certain web to be longitudinally displaced a predetermined amount relative to that in said others,

means for thereafter remerging the webs into superposed relation,

means for scoring the webs concurrently in a direction generally transversely of the web feed direction to create a line of demarcation between the primary and discardable portions and, through such longitudinal displacement of each such certain web, cause the manifestation to be physically present at one side of such line in each such certain web and at the other side of such line in the other webs, and

means for thereafter severing the webs into discrete sets of superposed plies, such that the manifestation of the work operation will be present in one of the portions of each such certain web and be present in the other portion of each other web.

**5.** Apparatus according to claim **4**, including

means for drawing all the webs through the apparatus at a predetermined constant speed, and

tendency rolls in each such path driven at about 5 percent less than said constant speed to maintain

each web under a desired minimum degree of tension to minimize variation in running registration.

6. Apparatus according to claim 4, wherein at least one pair of rotary tool cylinders are disposed at opposite sides of at least one of said webs, at least one such cylinder being independently orientable in a predetermined number of rotative positions to provide a plurality of different selectable combinations of rotative positions for performing correspondingly different work operations from one side or the other side of such web.

7. Apparatus according to claim 6, wherein at least one of the tool cylinders of each pair has relieved portions that in one of said combination of rotative positions is positioned opposite a blade member carried by the other cylinder to provide a clearance gap at the nip sufficient to enable passage of the web without scoring.

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