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Whitesell et al.

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[54] **CONTINUOUS BUSINESS FORMS**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 22,513, March 25, 1970, abandoned.

[52] **U.S. Cl.** **270/53,** 156/290, 156/324, 270/39, 270/41, 270/43, 282/12

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

[58] **Field of Search**..... 270/10–11, 53, 37–40, 41–44; 282/11.5, 12; 156/290, 324, 553

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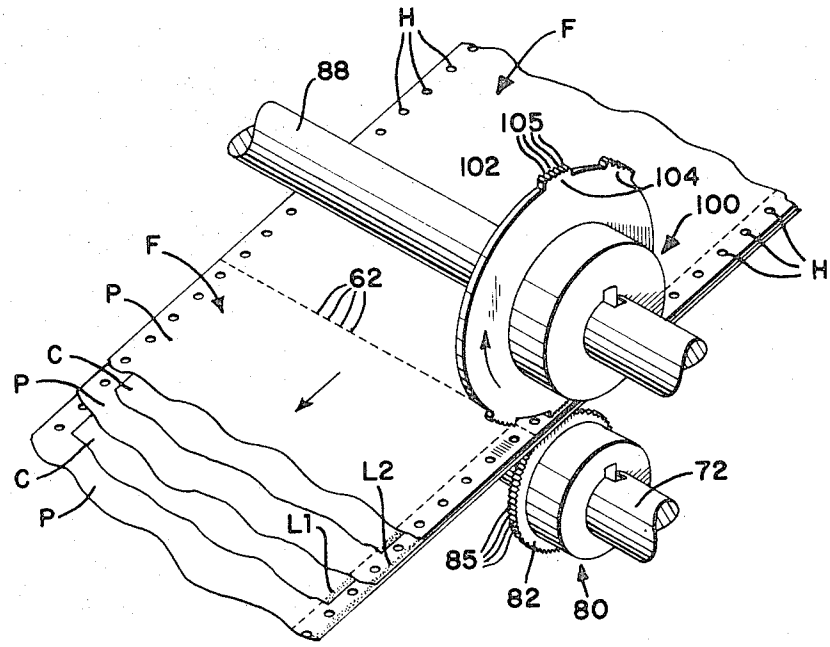
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[57] **ABSTRACT**

Successively connected business forms are produced by feeding a plurality of paper webs and interleaving carbon webs from corresponding supply rolls into overlying relation and gluing together corresponding longitudinal edge portions of the webs. Lines of cross-perforations are formed in the overlying webs at longitudinally spaced intervals, and the edge portions of the webs are bonded or welded together across or adjacent each line of cross-perforations by a plurality of transversely extending impressions of intermeshing fibers which prevents relative longitudinal shifting of the webs when the webs are zig-zag folded before the glue sets. Preferably, the impressions are located at the fine longitudinal glue lines joining the paper webs to provide fast drying of the glue.

7 Claims, 9 Drawing Figures



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SHEET 1 OF 3

FIG-1

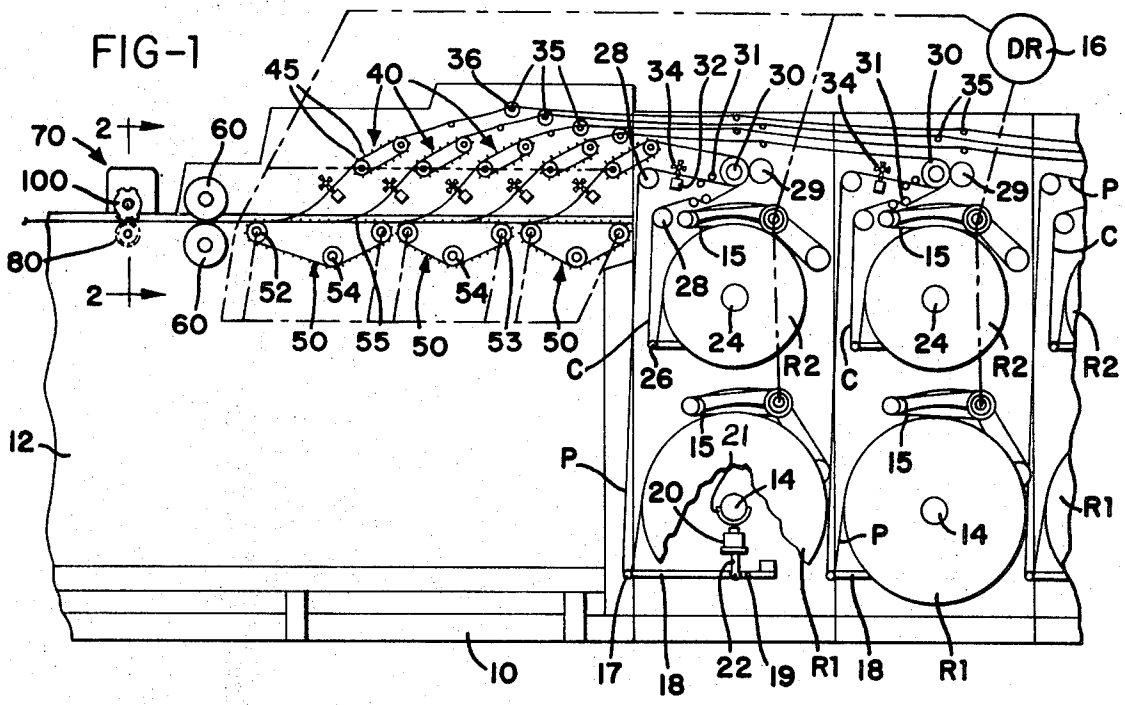
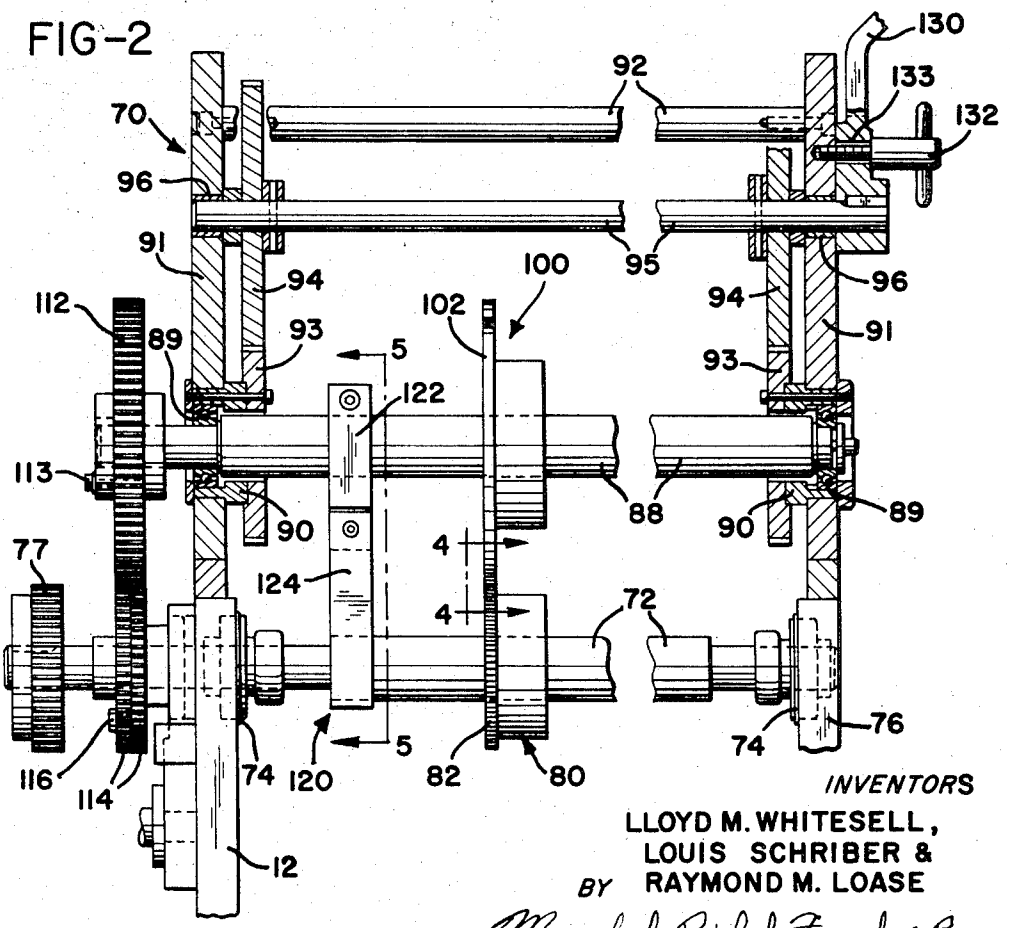


FIG-2



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FIG-3

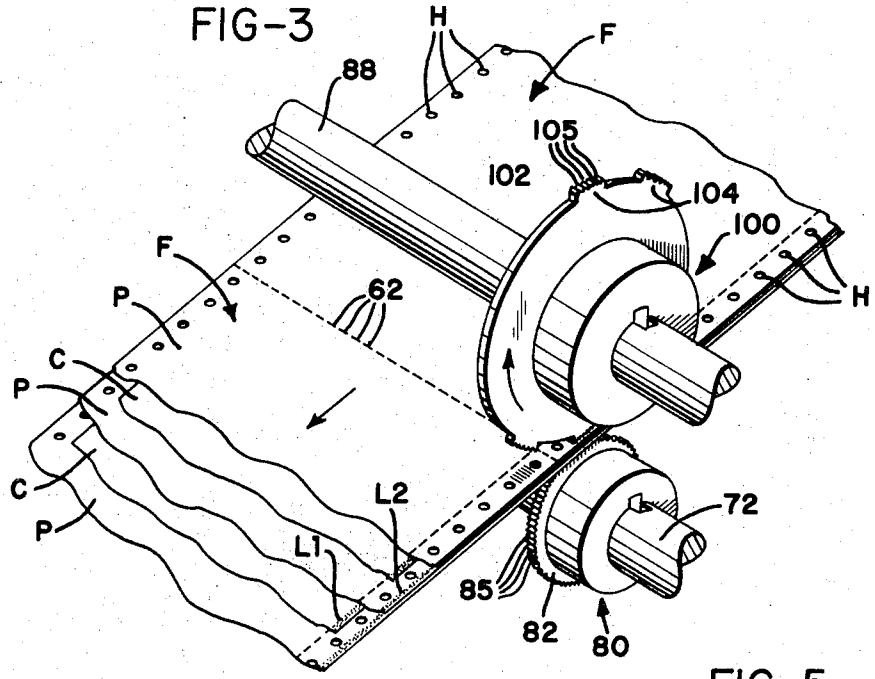


FIG-5

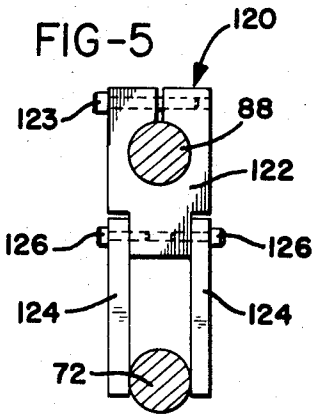


FIG-4

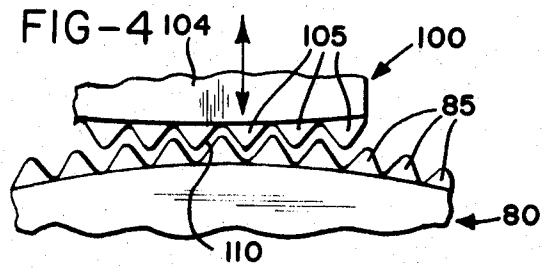


FIG-7

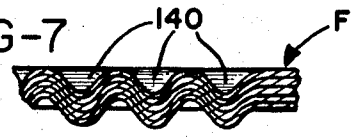


FIG-8

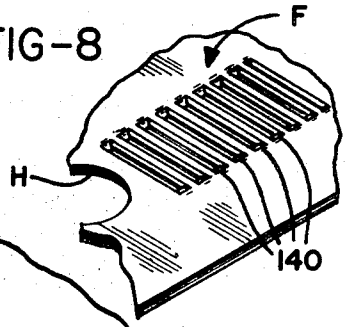


FIG-6

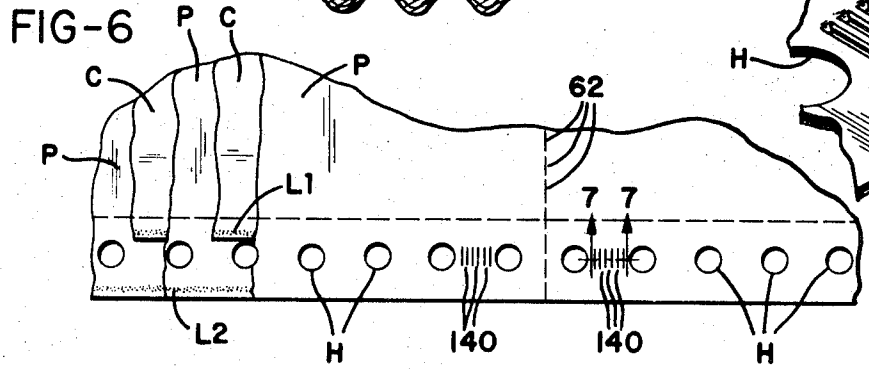
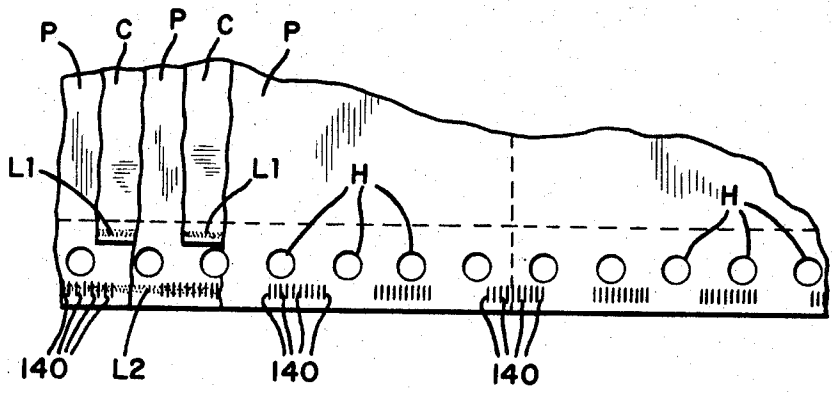


FIG-9



CONTINUOUS BUSINESS FORMS

RELATED APPLICATION

This application is a continuation-in-part of abandoned application Ser. No. 22,513, filed Mar. 25, 1970, and assigned to the same assignee as the present invention.

BACKGROUND OF THE INVENTION

In the production of continuous business forms on a collating machine of the type generally disclosed in U.S. Pat. No. 3,303,083 which issued to the assignee of the present invention, the clean edge portion of each carbon web is usually secured by a gluing operation to the corresponding edge portion of the overlying paper web, and the edge portions of the paper webs are secured together by either continuous glue lines or by longitudinally spaced glue spots. The assembled webs are then cross-perforated along lines located at longitudinal spaced intervals to convert the assembled webs into successively connected multiple copy business forms. Frequently, the continuous forms are zig-zag folded along the lines of cross-perforations so that the continuous forms may be conveniently stored and shipped within a suitable carton, ready for feeding into a business machine.

The production of continuous business forms in the above manner presents one particular problem, especially when the forms are produced at a high rate of speed. That is, if the assembled webs are zig-zag folded before the glue sets, the folding causes relative longitudinal shifting among the webs, and the webs then become bound by glue in this shifted relation. When the webs are unfolded as they are fed into a business machine, a problem of "tenting" or the formation of laterally extending ridges occurs in the outer webs at each fold or line of cross-perforations. Occasionally, these ridges cause the continuous forms to jam the business machine so that the machine must be stopped. The shifting of the webs also produces misalignment of the sprocket or feed holes in the assembled paper webs, which sometimes prevents positive driving engagement between the webs and the drive sprockets in the business machine.

In an attempt to overcome this "tenting" problem, a fast drying glue has been used so that the glue sets before the webs are zig-zag folded and while they are being fed in a straight path. However, a fast drying glue is not only difficult to handle, but it must be applied under extremely fine control so that the marginal edge portions of the collated webs do not become too stiff for smooth folding within a zig-zag folding machine. Furthermore, even the fastest drying glue requires that the webs be fed in a straight path for a substantial distance before folding the webs to assure that the glue has dried. This straight run of the webs significantly increases the length of the collating machine and the corresponding floor space required by the machine.

SUMMARY OF THE INVENTION

The present invention is directed to the production of continuous business forms and particularly to an improved form and the method and apparatus for producing the form in a manner which substantially eliminates the problem of "tenting" of the forms when they are unfolded from a zig-zag folded condition. In accordance with a preferred embodiment of the invention, a plurality of preprinted paper webs and interleaved carbon webs are fed from corresponding supply rolls into overlying relation. The clean marginal edge portion of each carbon web is secured to the overlying paper web by fine glue spots or a fine continuous glue line, and the adjacent corresponding marginal edge portions of the paper webs are also secured together by fine glue spots or a continuous glue line. As an alternative, each paper web may be glued to the clean edge of its adjacent carbon web which, in turn, is glued to the next paper web.

The assembled carbon and paper webs with their edge portions glued together are fed between cross-perforating rolls to provide longitudinally spaced lines of cross-perforations within the webs, thereby dividing the webs into successively connected multiple copy business forms. The longitudinal edge portions of the paper webs which are glued together are then fed between a set of impacting rolls which effectively bond or weld the paper webs together across or adjacent each of the lines of cross-perforations. The impacting rolls weld or pressure bond the paper webs together by a plurality of laterally or transversely extending parallel impressions causing intermeshing of the fibers of the paper webs. The impressions adjacent each line of cross-perforations are effective to prevent relative longitudinal shifting of the webs when the webs are zig-zag folded and thereby eliminate the problem of "tenting" when the webs are subsequently unfolded. Preferably, the impressions are located on the glue line joining the paper webs so that the larger area and the broken up fibers of the impressions increase the drying rate of the glue.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary schematic elevational view of a collating machine for producing continuous business forms in accordance with the invention;

FIG. 2 is a fragmentary section taken generally on the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary perspective view of a continuous business form being welded together in accordance with the invention;

FIG. 4 is an enlarged fragmentary section taken generally on the line 4—4 of FIG. 2;

FIG. 5 is a fragmentary section taken on the line 5—5 of FIG. 2;

FIG. 6 is a fragmentary plan view of two adjacent business forms constructed in accordance with the invention;

FIG. 7 is an enlarged fragmentary section taken generally on the line 7—7 of FIG. 6;

FIG. 8 is a fragmentary perspective view of the welded portion of the webs; and

FIG. 9 is a view similar to FIG. 6 and showing a modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The collating apparatus shown in FIG. 1 includes an elongated base 10 from which extends a vertical frame or wall 12. A series of horizontally arranged parallel spindles 14 are cantileveredly supported by the frame

wall 12 for free rotation and receive corresponding rolls R_1 of paper webs P each having longitudinally spaced marginal perforations or feed holes H (FIG. 3). In a conventional manner, each roll R_1 is rotated or unwound by a surface engaging endless belt 15 supported by a pivoted frame and connected to a main drive 16. Each belt 15 is driven slightly faster than the speed of the paper in the machine so that slightly more paper than necessary tends to feed into the machine.

Each paper web P is directed from its roll R_1 around a tension or dancing rod 17 supported by a counterbalanced arm 18 having a pivot axis 19. A pneumatic brake 20 is mounted on the wall 12 under each of the spindles 14 and includes a brake shoe 21 which is adapted to engage the spindle 14. Each brake 20 also includes an actuator rod 22 which is pivotally connected to the corresponding arm 18 at a point close to the pivot axis 19. When the tension in one of the webs P begins to drop below a predetermined value, the corresponding dancer rod 17 moves downwardly and causes the corresponding brake shoe 21 to apply pressure against the corresponding spindle 14 so that the drive belt 15 slips a little on the surface of the roll. As a result, each paper web is fed at a constant feed rate from its corresponding roll depending on the demand from the machine.

A series of freely rotatable spindles 24 are cantileveredly supported by the wall 12 directed above the spindles 14 and supports rolls R_2 of carbon webs C which are narrower in width than the paper webs P so that the edges of the carbon webs will be spaced inwardly of the feed holes within the paper webs as shown in FIG. 3. Each of the rolls R_2 is driven in a manner similar to the rolls R_1, that is, by a surface engaging endless belt 15 connected to the drive 16. Each carbon web C is directed from its roll R_2 around a corresponding tension or dancing rod 26 which is supported in the same manner as each of the tension rods 17 and is effective to control a corresponding pneumatic brake 20 as described above for each of the spindles 14.

Each of the paper webs P is directed upwardly from the corresponding tension rod 17 around a driven roller 28, between snubbing or guide rods 31 and then to a roller 30. Each carbon web C is directed upwardly from its tension rod 26 around a driven roller 28, then between guide rods 31 to join the corresponding paper web P under the adjacent roller 30. A glue applicator 32 is positioned adjacent each of the rollers 30 except for the end roller which carries the top copy of the set of forms, and each applicator includes a discharge nozzle supported below a rotating brush 34 having angularly arranged groups of bristles.

The inner marginal edge portion of each paper web P is directed between the nozzle and brush of the corresponding glue applicator 32 to receive longitudinally spaced glue spots for securing the paper web P to the clean edge portion of the adjacent carbon web C at the roller 30. As an alternative to spot gluing, by using a brush with full bristles or by stopping the rotation of each brush 34 with one group of bristles located directly over the corresponding nozzle, or by using a flexible shoe, a fine continuous line L_1 (FIG. 3) of glue is applied to the corresponding paper web P. Instead of gluing the marginal edge portions of each set of paper and carbon webs with the glue applicators 32, the edge portions of the webs may be attached by longitudinally spaced and longitudinally extending crimps produced by the cooperation of circumferentially spaced projecting prongs on a crimping wheel 29 and circumferentially extending grooves within the adjacent roller 30.

The sets of attached paper and carbon webs P and C are directed generally horizontally from the rollers 30 by a series of cantileveredly supported guide rods 35 and axially adjustable collars 36 to a corresponding series of horizontally spaced and sloping endless feed conveyors or belts 40. The belts 40 are driven at a common speed by the main drive 16, and each feed belt 40 has outwardly projecting longitudinally spaced pins 45 which engage the feed holes H within the paper webs P.

A series of endless pin conveyors or feed belts 50 are positioned in alignment below the feed belts 40, and each belt 50 is directed around end drive sprockets 52 and 53 and an adjustable idler sprocket 54. The upper runs of the belts 50 lie in a horizontal plane, and a platform 55 is supported adjacent the belts 50 so that its upper surface is generally coplanar with the upper runs of the belts 50. The pins of each of the belts 50 project above the upper surface of the platform 55, and each of the sprockets 52 and 53 is driven by the main drive 16.

As mentioned above, each assembled set of paper and carbon webs are either crimped together by the corresponding crimping wheel 29 or glued together by the corresponding glue applicator 32. The web set is then directed to the corresponding feed belt 40 by one or more stationary guide rods 35 which maintain the web sets in vertically spaced relation. The adjustable collars 36 are mounted on some of the guide rods 35 to maintain alignment of the paper webs P between the rollers 30 and the feed belts 40.

A glue applicator 32 is positioned below each of the feed belts 40 for applying fine marginal glue spots or a continuous glue line L_2 (FIG. 3) to paper webs P just before the webs are fed onto the feed belts 50 and the platform 55 in overlying relation. The inner marginal edge portions of the assembled paper and carbon webs are fed by the belts 50 between a set of perforation cylinders 60 which form longitudinal spaced lines of cross-perforations 62 (FIG. 3) within the assembled webs to define a series of successively connected forms F (FIG. 3) each having a plurality of paper sheets with a plurality of carbon or transfer sheets interleaved therebetween. As mentioned above, the longitudinally spaced feed holes H within each paper web are engaged by the feed belts 40 which effectively pull the webs over the guide rods 35 and from their corresponding rolls.

In accordance with the present invention, a paper welding apparatus or device 70 is positioned adjacent the cross-perforation cylinders 60 to receive the collated webs while they are being fed along a horizontal plane defined by the upper runs of the pin conveyors or belts 50. Referring to FIG. 2, the paper welding device 70 includes a transversely extending shaft 72 which is rotatably supported beneath the path of the collated webs by a set of bearings 74 retained within the rear frame wall 12 and a parallel forward wall member 76. The shaft 72 is driven in timed relation with the feed belts 40 and 50 through a gear 77.

An impacting gear or wheel 80 is mounted on the shaft 72 and includes a circular plate 82 having an outer surface defined by peripherally spaced V-shaped teeth 85 (FIG. 4) which extend axially of the wheel 80 in the general form of spur gear teeth or straight knurls. The wheel 80 is located on the shaft 72 so that the teeth 85 are positioned under the path of the feed hole H within the inner marginal edge portions of the assembled paper webs P. A shaft 88 is positioned directly above the shaft 72 in parallel relation and is rotatably supported by anti-friction bearings 89 mounted within eccentric bores formed within sleeves 90. The sleeves 90 are rotatably supported within bores formed within vertical wall members 91 mounted on and forming extensions of the corresponding wall members 12 and 76. The wall members 91 are rigidly connected by a tie rod 92. A gear 93 is secured to each sleeve 90 and meshes with a corresponding gear 94 mounted on a cross shaft 95 rotatably supported by bearings 96 retained within the wall members 91.

A impacting gear or wheel 100 is mounted on the shaft 88 directly above the wheel 80 and includes a circular plate 102 with circumferentially spaced projections 104 (FIG. 3). Each projection 104 includes a plurality of axially extending generally V-shaped teeth 105 each having the same cross-sectional configuration as the teeth 85 on the wheel 80. As shown in FIG. 4, the side surfaces of each tooth 85 and 105 converge or taper slightly toward the tip of the tooth, and the wheels 80 and 100 are positioned to define a generally uniform gap or space 110 between the interfitting teeth 85 and 105. The width of the space 110 is determined in accordance with the overall thickness of the assembled paper and carbon webs as will be explained later.

The uniform spacing between the teeth 85 and 105 is maintained by driving the shaft 88 in precise timed relation with the shaft 72. This drive arrangement is obtained through a spur gear 112 which is mounted on the inner end of the shaft 88 and is secured for adjustment by a screw 113. The gear 112 is driven by split gears 114 mounted on the shaft 72. A screw 116 extends through an arcuate slot in one of the split gears 114 and is threaded into a hole within the other gear to provide for relative rotation between the split gears 114 to eliminate any backlash between the gears 112 and 114.

As indicated above, the spacing between the teeth 85 on the wheel 80 and the teeth 105 on the wheel 100 may be infinitely varied by rotating the shaft 95 which produces common rotation of the eccentric bearing sleeves 90 to change the spacing between the shafts 72 and 88. The angular relationship between the shafts 72 and 88 is temporarily maintained, when the spacing between the shafts is changed, by a yoke member 120 (FIGS. 2 and 5) which includes a block 122 secured to the shaft 88 by a clamping screw 123. A pair of pivotable arms 124 are secured to the block 122 by screws 126 and are adapted to straddle the shaft 72 to prevent rotation of the shaft 88 when it is being adjusted relative to the shaft 72 which is temporarily locked by a sets screw (not shown). Once the adjustment between the teeth is made, screws 113 and 116 are loosened, permitting the removal of backlash between gears 112 and 114 in both directions, thus maintaining the angular relation between shafts 72 and 88. This retains the uniform spacing of teeth 85 and 105. Then arms 124 are pivoted 90° and shaft 72 is released to provide for rotating the shaft 88 in timed relation with the shaft 72. As shown in FIG. 2, the shaft 95 may be rotated to change the spacing between the teeth 85 and 105 by manually pivoting a lever 130 secured to one end of the shaft 95. After the lever 130 is set, it is retained in position by a locking screw 132 which extends through an arcuate slot 133 formed within the lever 130 and is threaded into a hole formed within the adjacent wall member 91.

In operation, after the plurality of paper webs P and the interleaved carbon webs C are collected and assembled on the upper runs of the pin conveyors or belts 50 and are fed between the cross-perforating rolls 60, the marginal edge portions of the paper webs which receive the glue line L_2 are fed between the impacting wheels 80 and 100 as shown in FIG. 3. When the edge portions of the webs are simultaneously engaged by the teeth 85 on the wheel 80 and the teeth 105 on the wheel 100, the teeth produce laterally or transversely extending parallel impressions 140 (FIGS. 6–8) having a corrugated cross-sectional configuration. The tapered side surfaces of the teeth 85 and 105 produce sloping ends on the impressions 140 and prevent shearing of the paper webs. While not shown, rotating brushes may be used to assure that the teeth 85 and 105 remain clean.

The substantial impacting pressure exerted on the paper web between the teeth 85 and 105 is effective to cause intermingling of the paper fibers. As shown in FIG. 3, the projections 104 having the teeth 105, are arranged on the plate 102 of the wheel 100 so that a plurality of impressions 140 are impacted within the paper web on opposite sides of each line of cross-perforations 62 and between the adjacent feed holes H. It is to be understood, however, that the groups of impressions 140 may be spaced at regular intervals and with uniform spacing along the edge portions of the assembled paper webs instead of having only two groups of impressions 140 on opposite sides of each line of cross-perforations 62.

Referring to FIG. 9 which shows a modification of the invention, the groups of impressions 140 are uniformly spaced at regular intervals along the longitudinal edge portions of the paper webs P, but are located outboard of the feed holes H directly on or overlying the glue lines L_2. This location of the impressions 140 provides for faster drying of the glue as a result of the increased surface area of the paper webs and the break up of the paper fibers within the impressions. That is, the break up of the fibers increases the porosity and moisture absorption ability of the paper webs so that the moisture in the glue is more quickly absorbed into the paper webs. As shown, one of the groups of impressions 140 extends across each line of cross-perforations 62.

From the drawings and the above description, it is apparent that continuous business forms produced in accordance with the invention provide desirable features and advantages. For example, by bonding or welding the marginal edge portions of the paper webs together with fine lines L_2 of glue and with the longitudinally spaced groups of impressions 140, the continuous strip of successively connected forms F can be zigzag folded along the lines of cross-perforations 62 immediately after the webs have passed between the im-

pacting wheels **80** and **100**. That is, the transversely extending impacted impressions **140** are effective to prevent longitudinal shifting of adjacent webs when the webs are zig-zag folded and before the glue forming the glue line L_2 sets. Thus when the webs are unfolded, and the forms are fed into a business machine, there are no significant "tents" along the lines of cross-perforations **62** to cause jamming of the machine. In addition, by preventing longitudinal shifting of the webs, the impressions **140** are effective to maintain precise registration of the feed holes H in the assembled paper webs, thereby substantially reducing the chances of the paper webs riding over the drive sprockets for the webs in the business machine.

As mentioned above, the invention also provides for adjusting the spacing between the teeth **85** and **105** without changing the relative angular orientation of the impacting wheels in order to accommodate assembled webs of different thicknesses. The adjustment feature also enables the impacting wheels **80** and **100** to be precisely set to assure a firm impact on the webs by the teeth **85** and **105** and thereby produce impressions **140** which are effective to lock the webs together and prevent longitudinal shifting of the webs when they are zig-zag folded. Another feature is provided by the use of the split gears **114** for driving the gear **112** mounted on the shaft **88**. When it is desired to change the spacing between the impacting wheels **80** and **100**, the shafts **72** and **88** are locked as previously described, and the gears **112** and **114** are released by unloosening the screws **113** and **116**. After the arm **124** of the alignment device **120** are pivoted to their positions shown in FIG. **5**, the shaft **88** is adjusted by rotating the lever **130**. After the spacing between the teeth **85** and **105** is determined, the split gears **114** are rotated to eliminate any backlash in the driving engagement with the gear **112** so that the angular orientation between the wheels **80** and **100** is precisely maintained after the arms **124** are pivoted to their retracted positions.

While the groups of impressions **140** shown in FIG. **6** are located between the glue lines L_1 and L_2 and between the sprocket or feed holes H, the impressions **140** may be superimposed over the glue line L_2 which attaches the adjacent edge portions of the paper webs P as shown in FIG. **9**. As mentioned above, the latter location of the impressions **140** significantly reduces the time required for the glue to dry since the impressions increase the porosity and surface area of paper webs for absorbing the glue. Furthermore, the combined binding power of the glue line L_2 and the impressions **140** is substantially greater than the binding power of either the glue line or impressions.

While the strips of successively connected business forms and the method and apparatus herein described for producing the forms, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms, methods and apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In apparatus for continuously producing successively connected business forms each having multiple interconnected copies, comprising means for rotatably supporting a plurality of rolls of paper webs, means for feeding said paper webs from the corresponding supply rolls into overlying relation along a predetermined path, means for corss-perforating the overlying said webs along longitudinally spaced lines to define the successively connected said forms, and means for applying adhesive to at least one marginal edge portion of said webs to connect said webs together, the improvement comprising impacting wheels located on opposite sides of the overlying webs and having impacting teeth operative on the webs to form longitudinally spaced groups of impressions extending transversely within the same said marginal edge portion of the overlying said webs adjacent to each side of the cross-perforations, said impressions being effective to lock said webs against relative longitudinal shifting during zig-zag folding of said webs about the cross-perforations, means supporting said wheels for rotation in correlation to movement of the overlaid webs, and means for maintaining a predetermined space between said wheels to cause a pressure bonding of the webs by said impacting teeth.

2. Apparatus as defined in claim **1** wherein both said impacting wheels having V-shaped teeth in spaced groups about their circumference, and said wheels are spaced to cause intermeshing of said V-shaped teeth.

3. An improved method of continuously producing successively connected business forms each having multiple copies, comprising the steps of feeding a plurality of paper webs from corresponding supply rolls into overlying relation, cross-perforating the overlying said webs along longitudinally spaced lines to define the successively connected said forms, applying glue to at least one edge portion of said webs for securing the webs along their edges, moving the same edge portion of said webs between opposed closely spaced wheel members having impacting teeth and maintaining the spacing of said wheel members to cause pressure bonding of the webs in groups of small corrugated impressions extending transversely of the webs at longitudinally spaced intervals to cause intermingling of the fibers of the adjacent webs, said wheel members being rotated in timed relation to the movement of said webs so as to arrange said impressions adjacent opposite sides of said cross-perforations to lock said webs against relative longitudinal shifting in response to zig-zag folding of said webs.

4. The method defined in claim **3** wherein said impressions are formed directly overlying the glued parts of said edge portion of said webs to promote the adhesive action of the glue.

5. A continuous strip of successively connected business forms adapted to be zig-zag folded, comprising a plurality of paper webs disposed in overlying relation, a plurality of cross-perforations located at longitudinal spaced intervals along said webs and defining said forms, said webs being glued to each other along at least one of their respective marginal edge portions, a plurality of longitudinally spaced groups of impressions extending transversely within the same said marginal edge portion of said webs and located adjacent opposite sides of said cross-perforations, said groups of impressions being formed by moving the same said marginal edge portion of said webs between impacting wheel members which are maintained closely spaced from said other and have teeth to cause localized pres-

sure bonding of the webs to each other with intermingling of the fibers from adjoining webs, the impacting wheel members operating in timed relation to the movement of said webs to locate said impressions adjacent opposite sides of said cross-perforations, and said impressions being effective to lock said webs against relative longitudinal shifting in response to zig-zag folding of said webs along the cross-perforations.

6. A continuous strip of business forms as defined in claim 5 wherein each group of impressions comprises a plurality of generally V-shaped impressions forming a corrugated cross-sectional configuration in a longitudinal direction of the forms.

7. A continuous strip of business forms as defined in claim 5 wherein at least parts of said impressions are located over the glued parts of said edge portions of said webs.

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