United States Patent

[11] 3,608,801

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[22] Filed **Apr. 16, 1970**
Continuation of 726,788, May 6, 1968 and a continuation-in-part of application Ser. No. 566, 609, July 20, 1966, now abandoned.
[45] Patented **Sept. 28, 1971**

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[54] **WEB TRANSPORT SYSTEM**
6 Claims, 7 Drawing Figs.

[52] U.S. Cl. **226/74,** 226/172
[51] Int. Cl. **G03b 1/30**
[50] Field of Search 226/5, 6, 74, 75, 172

[56] **References Cited**

UNITED STATES PATENTS

3,209,972 10/1965 Benbow 226/74

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858,501 1/1961 Great Britain 226/74

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ABSTRACT: A belt system for controlling the speed of advance of line-hole-punched copy forms wherein upper and lower belts are arranged on opposite sides of the punched web, the lower belt having pins projecting through the line holes into registering openings in the upper belt. The belts are arranged on pulleys so that the upper run of the lower belt slopes away from the web before reversal.

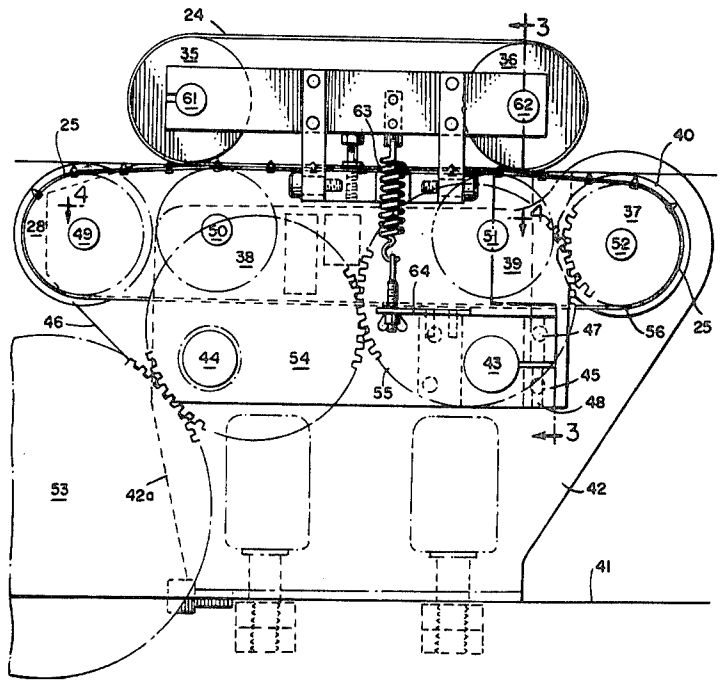

FIG. 1

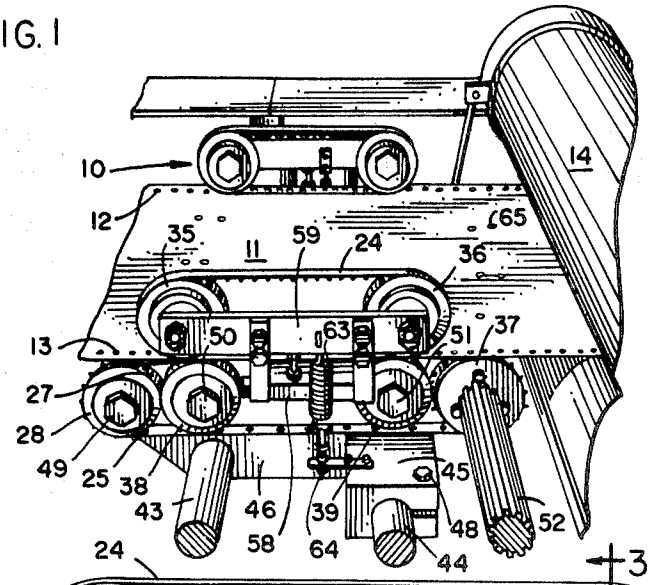

FIG. 2

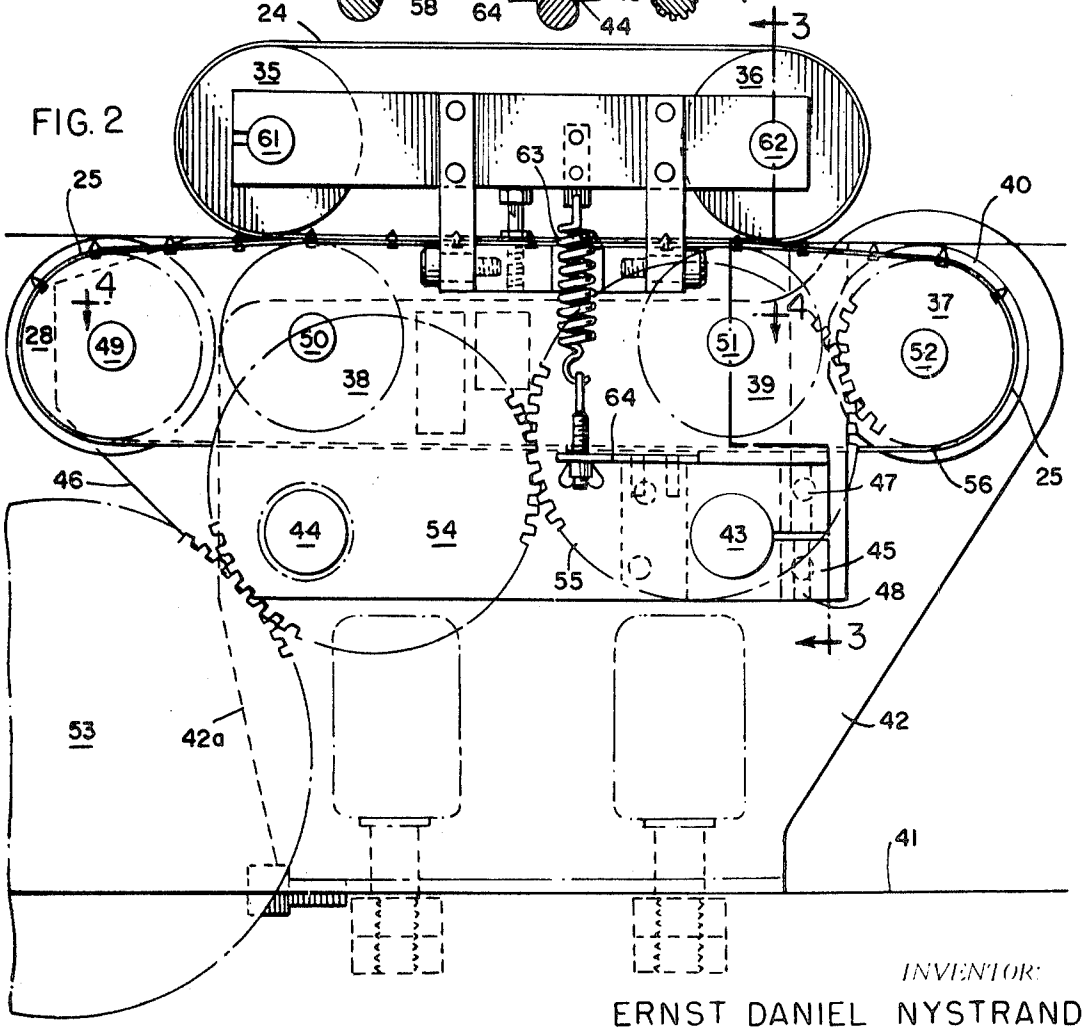

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FIG. 3

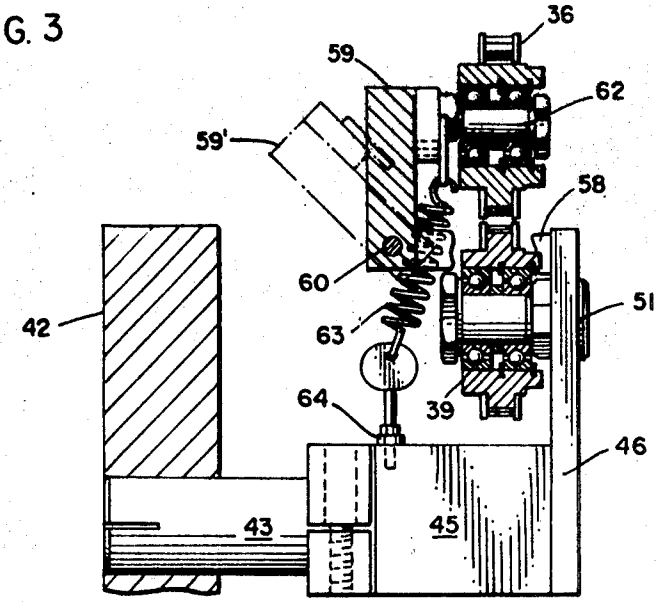
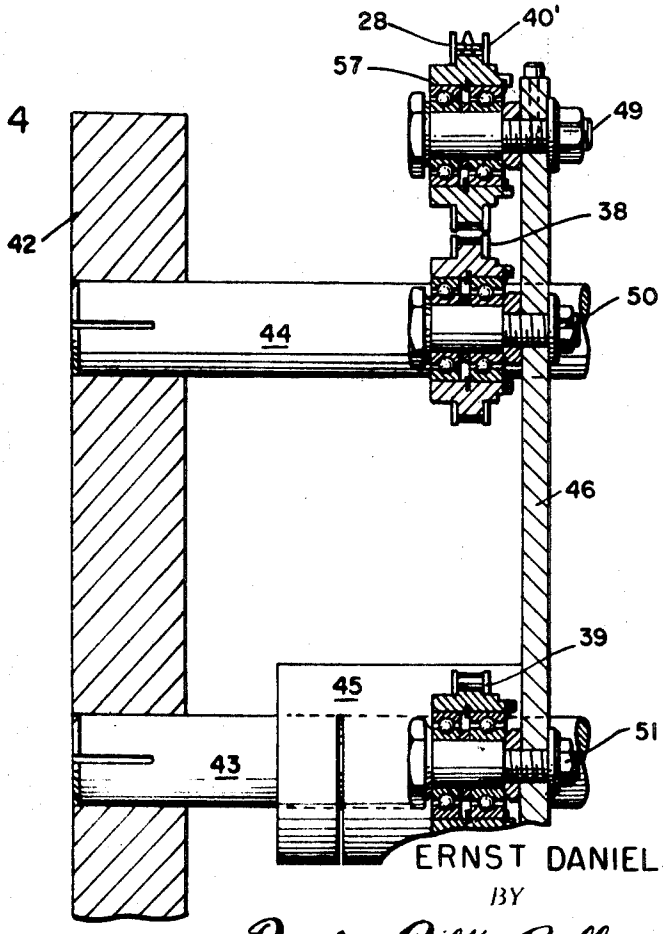


FIG. 4



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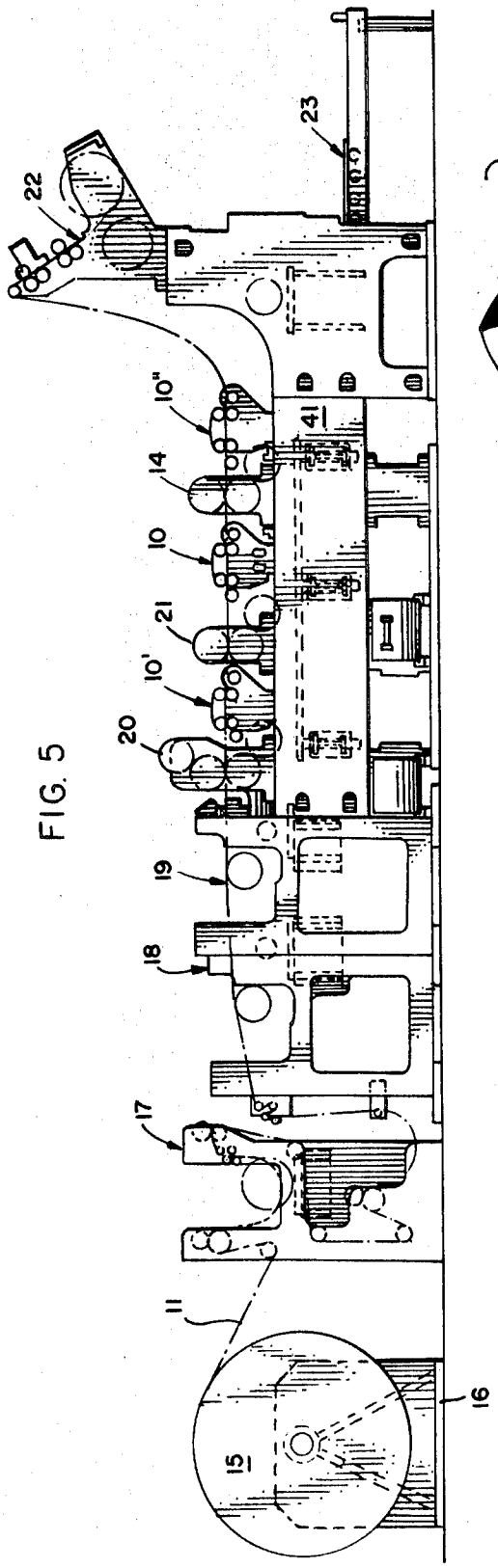

FIG. 5

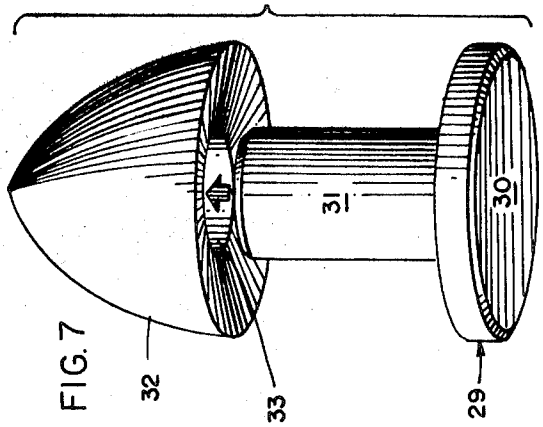

FIG. 7

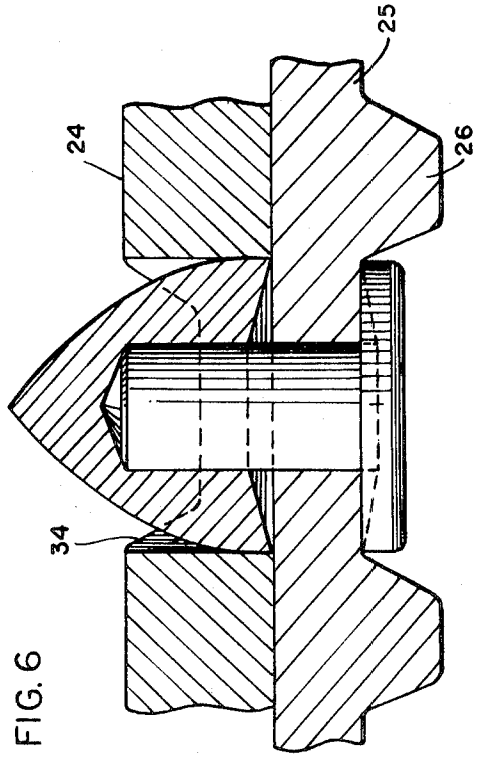

FIG. 6

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WEB TRANSPORT SYSTEM

It is a continuation in part of my copending application Ser. No. 566,609, filed July 20, 1966. and now abandoned, and is a continuation of Ser. No. 726,788, filed May 6, 1968, and now abandoned.

BACKGROUND OF THE INVENTION

This invention has to do with line-hole-punched copy paper. More particularly, it deals with a means for advancing such paper and, as such, constitutes an improvement upon the U.S. Pat. No. 3,069,155 to James B. Fulk.

The copy paper with which the invention is concerned is used in business machines. Such machines may read out, i.e., print, very rapidly and for this purpose have means for engaging a line of holes along a longitudinal edge of the paper. Exemplary of such paper is a web which may be zigzag folded, and which has a width of 14⅞ inches. Along at least one side it will have a line of holes each five thirty-second inch in diameter located one-fourth inch in from the marginal edge with the holes separated from one another by a distance of one-half inch (all dimensions being to the hole centers).

To produce paper which is useful for copy forms, it is necessary not only to create the line of holes, but additionally perform other operations such as perforating transversely, equipping the web with file holes, zigzag folding—all in addition to printing. Anyone of these operations has, in the past, resulted in stressing the web, particularly where the pins of the advancing belts engage the same. As a consequence, even with single-width webs, speeds have been drastically limited. However, with the teaching of the invention, I now find it possible to increase the speed of operation of machines making such copy paper from speeds of the order of 500 feet per minute to speeds upwards of 1,500 feet per minute.

In the past, when speeds upwards of 500 to a 1,000 feet per minute were employed, the holes became distorted so that later, when the forms were employed in business machines, there was missing the requisite accuracy for print out due to the enlarged or otherwise distorted line holes.

It is therefore an object of the invention to provide a novel mechanism for making copy forms suitable for business machines and more particularly, one that does not result in linehole distortion. In brief, the invention achieves this through a unique geometry in the pin-belt-advancing unit.

DETAILED DESCRIPTION

The invention is described in conjunction with an illustrative embodiment in accompanying drawing, in which:

FIG. 1 is a fragmentary perspective view of that portion of a copy-form-manufacturing machine which features the advancing unit with which the invention is particularly concerned;

FIG. 2 is a fragmentary side elevational view of the apparatus seen in FIG. 1 and somewhat enlarged relative thereto;

FIG. 3 is a fragmentary sectional view seen along the sight line 3—3 of FIG. 2;

FIG. 4 is a fragmentary sectional view such as would be seen along the sight line 4—4 of FIG. 2;

FIG. 5 is a side elevational view of a copy-form-manufacturing machine employed herein to illustrate the preferred environment for the inventive advancing unit;

FIG. 6 is a fragmentary sectional view through a portion of the coacting pin belts employed in conjunction with the advancing unit; and

FIG. 7 is an exploded perspective view of a pin assembly of the character seen in FIG. 6.

Reference is initially made to FIG. 1 wherein the numeral 10 designates generally a web-advancing unit employed to move, i.e., advance, a web 11. The web 11 has a row of line holes 12 along one edge and a second row 13 along the other edge. It will be appreciated that in the ordinary practice, two web-advancing units 10 will be employed where there are two rows of line holes at 12 and 13. In the particular environment pictured in FIG. 1, the web 11 is seen advancing toward a perforator 14.

GENERAL ENVIRONMENT

Reference is now made to FIG. 5. At the extreme left is seen a jumbo roll 15 of paper which is mounted on an unwind stand 16 so as to provide the web 11. The web 11 passes through a feed mechanism 17 and then through printing units 18 and 19 ultimately reaching the line hole punch 20. Thereafter, the web is advanced under the control of an advancing unit 10′ which is substantially identical to the unit previously described in connection with FIG. 1. Following its engagement with the advancing unit 10′, the web passes through a file-hole punch unit (which places holes transversely across the web for the purpose of filing). Thereafter the web 11 engages the advancing unit 10 and in sequence thereafter, the perforator 14, another advancing unit 10″, a folder 22 and ultimately a delivery mechanism 23.

BELT DETAILS

On the same sheet of Drawing with FIG. 5 are seen the details of the pin belts, as at FIGS. 6 and 7. In FIG. 6, the numeral 24 designates the upper belt (see also FIGS. 1 and 2). The numeral 25 designates the lower belt which is cogged as at 26. The cogs 26 of the belt 25 cooperate with the cogs 27 of the gear 28 in FIG. 1. It will be appreciated that all of the gears or pulleys are toothed or cogged, the reference hereinbefore being for the ease of explanation.

The numeral 29 designates generally a pin which projects through the lower belt 25 and consists of a head 30 integral with a shank 31. The remaining assembly of the pin belt includes a lug 32 apertures as at 33 so as to receive the shank 31—as by a press fit. For example, with reference to the illustration given wherein line holes five thirty-second inch in diameter are employed along the rows 12 and 13, the lug 32 at its base has a diameter of five thirty-second inch. The overall height of the lug 32 is also advantageously five thirty-second inch being constructed of cold-drawn steel and with the exterior of the lug 32 being developed by a 3/16-inch radius.

The belts 25 and 26 are capable of very high speeds, do not stretch, require no lubrication, are quiet and can bend around very small pulleys. They also can be made very accurately. The pins may be molded in the belts or assembled as shown. The pins fit snugly in the line hole so as to distribute the force needed to advance the web over as large an area as possible. The upper belt 24 presses downwardly against the pin-equipped belt to provide a frictional assist. The top belt does not require a separate synchronized drive but may be driven by the pins of the lower belt as shown. It can be appreciated that if the belts were pressed against each other without pins, there would be a slight backward creep of the paper and if the pins alone were used, there would be distortion and tearing of the line holes. The combination of both solved these problems. Furthermore, it is essential that the paper web travel in a straight line through the various units so that different thicknesses of material may be used without jeopardizing the exact draw required. For this, I employ a specific geometry of belting as developed by the various pulleys and which will now be described.

BELT GEOMETRY

Referring again to FIG. 1 (also FIG. 2), the numeral 35 designates the top rear pulley while the numeral 36 designates the top front pulley, "front" being employed in the same sense of being further advanced along the machine. As indicated previously, the rearmost pulley is designated 28 while the foremost pulley is designated 37. Two intermediate lower pulleys are provided as at 38 and 39 (proceeding in the direction of web advance). The foremost pulley 37 is equipped with enlarged flanges as at 40 to provide an additional insurance against the web following the pins at the exit from the unit 10. By placing the pulleys as illustrated, I am able to have snugly

fitting pins enter and leave the line holes at high speeds without distorting and tearing the line holes. The pins enter and leave the web at a slight angle by virtue of the elevation of the topmost portion of the pulleys **38** and **39** relative to the topmost portions of the pulleys **28** and **37**, respectively.

The placement of the upper pulleys **35** and **36** relative to the lower intermediate pulleys **38** and **39** is preferably as shown. The pulleys of the top belt **24** are positioned slightly outside of the pulleys **38** and **39**. This is in order to eliminate the effect of minor runout in the pulleys and thickness variation in the belts. If the pulleys **36** and **39**, for example, were vertically aligned, runout of either or both of these pulleys could cause disadvantageous pinching of the web. The arrangement shown wherein the centers of the generally vertically aligned pulleys are offset also permits slight wrinkles in the web as well as splices of the web to go through without difficulty.

DETAILS OF SUPPORTING STRUCTURE

For the purpose of supporting the foregoing advancing units, I provide a main frame on the machine as at **41** (see FIG. **5** as well as FIG. **2**). Extending upwardly from the main frame **41** is a subframe **42** for each unit, i.e., one for each side of the machine. The unit **42** (as seen in FIG. **2**) rises upwardly from the frame **41** at the right-hand lower portion of FIG. **2** and proceeds upwardly around the pulley **37**, then to the left and down ward as at **42***a* to the main frame. The subframe **42** serves to support two cross-shafts **43** and **44**. These can be clearly seen in the lower portion of FIG. **1** as well as in FIG. **4**. Mounted on the cross-shaft **44** is a clamp block **45** which in turn carries a vertically oriented plate **46**. The plate **46** can also be seen in perspective view in FIG. **1** and it is upon the plate **46** that all of the pulleys except **37** are supported. The plate **46** can be moved transversely of the machine frame so as to accommodate different widths of web. The plate **46** is secured to the block **45** by means of bolts **47** (designated only in FIG. **2**) while the clamping block **45** is anchored in a desired location upon the shaft **43** by means of a tightening bolt **48** (see also FIG. **1**).

To accommodate the mounting of the various pulleys, I provide a series of stub shafts (see particularly FIGS. **2** and **4**) at **49**, **50** and **51** which rotatably support the pulleys **28**, **38** and **39**, respectively. The lower foremost pulley **37** is fixed to a splined shaft **52** which also is supported in the subframe **42**. Thus, when the clamping block **45** is moved along the cross-shaft **44** to reposition the plate **46**, the pulley **47** can be moved longitudinally on the shaft **52** to be maintained in alignment.

Power to the unit is provided by means of a main gear **53** (see the lower left-hand portion of FIG. **2**). This is transmitted through intermediate gears **54** and **55** to a driven gear **56** which is fixed to the shaft **52**. All other pulleys are of the idler type, being equipped with bearings as at **57** relative to the pulleys **28** (see FIG. **4**). Also, I provide the lower (entering) pulley **28** with with exaggerated flanges as at **40'** corresponding to the construction of the pulley **37** with its enlarged flanges **40**.

The upper pulleys **35** and **36** are also supported from the plate **46** but by virtue of an arm **58** (see FIGS. **1** and **3**). The arm **58** carries in pivotal fashion a bracket **59** about a horizontal pivot shaft **60**. This permits the bracket **59** to be pivoted outwardly to the dotted line position designated **59'** in FIG. **3**. The bracket **59** is equipped with stub shafts **61** and **62** (see particularly FIG. **2**) for the purpose of rotatably supporting the pulleys **35** and **36**, respectively. An "overcenter" spring **63** is interconnected between the bracket **59** and an arm **64** on the block **45** so as to maintain the bracket **59** in either of the two indicated positions (see FIG. **3**).

OPERATION

In the operation of a machine for producing business forms, a generally planar path is defined between longitudinally spaced apart converting units or mechanisms. Such mechanisms illustrated as at **20**, **21** and **14**. Between these longitudinally spaced-apart mechanisms, I provide a web-advancing unit with the upper and lower belts thereof arranged so that the ends of the lower belt adjacent run diverge slightly at the run ends—as can be quickly appreciated from a consideration of FIG. **2**. In the illustration given, this is of the order of 2°–3°. I achieve this through the use of of a plurality of pulleys associated with each of the endless belts **24** and **25**. As pointed out previously, I prefer to have the pulleys associated with the respective belts spaced longitudinally of each other so that, for example, the pulley **36** does not contact the belt **24** at the same point that the pulley **39** contacts the belt **25**.

Where the web of is of substantial width, I prefer to employ two sets of advancing units (as shown). Also, in the illustration given, the width of the web **11** accommodates the provision of file holes as at **65** in FIG. **1**. Best results are obtained where the endless belts **24** and **25** are constructed of substantially unelongated, flexible, elastomeric material and equipped with transverse ribs or cogs—this being true particularly of the pin-equipped belt **25**. The upper system belt may or may not be equipped with the transverse ribs. By virtue of confining the web between the belts **24** and **25**, there is not only provided a fine degree of control of advance of the web, but the portions of the belts around the pins and holes serves to confine the web **11** and thereby avoid any distortion of the longitudinally spaced-apart openings.

While in the foregoing specification a detailed description of an embodiment of the invention has been set down for the purpose of explanation, many variations of the details herein given may be made by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. In a machine for producing business forms, an elongated frames, a pair of longitudinally spaced-apart converting mechanisms on said frame defining a substantially planar path therebetween, means for feeding a web to said frame for travel in said path, and pin belt means between said mechanisms for engaging a line of holes along one edge of said web for advancing the same, the improvement wherein said pin belt means comprises a pair of endless belts disposed along each longitudinal edge of said web with each pair arranged in coplanar relation perpendicular to the web plane and with adjacent runs of said pairs of belts being in contacting relation to confine said web, one of said belts of each pair being equipped with outwardly projecting pins, the other of said belts of each pair being equipped with hole sized and arranged to receive said pins, each of said belts being entrained over a plurality of pulleys with at least one of the pulleys associated with the pin-equipped belts being driven and arranged to dispose the adjacent run ends at a minor acute angle to said planer path whereby said pin-equipped belts diverge from said path at the ends of said adjacent runs, the other pulleys of said plurality of pulleys being idlers; means operatively associated with said frame and said pairs of belts for positionably moving said pairs of belts laterally whereby webs of different widths are accommodated in said machine; and plate and bracket means movably mounted on said frame for supporting said idler pulleys independently of the driven pulleys.

2. The machine of claim **1** in which said plate and bracket means includes a bracket pivotally mounted on a plate, said plate being mounted on said frame for lateral positioning thereon, and spring means interconnecting said plate and bracket for maintaining said bracket in one of two operational positions relative to said plate.

3. The machine of claim **1** wherein said pin belt is trained over a plurality of pulleys including one driven pulley, a first pair of run-defining pulleys for routing said pinned endless belt into frictional engagement with said web, and a second pair of pulleys located remotely from said run and causing said pinned belt to define a minor acute angle therewith, and said apertured belt is trained on a plurality of idler pulleys, a pair of which defines a web-engaging run adjacent to the run of said pin belt and extending beyond either longitudinal side thereof.

4. In combination, an elongated continuous paper web having a series of equally spaced apertures along at least one marginal edge thereof; and advancing mechanism for advancement of said web in a common plane comprising first and second endless belts disposed respectively above and below said web for simultaneously frictionally engaging the same along said apertured marginal edge, one of said belts defining a plurality of projection pins for snugly fitting into said apertures of said web and the other belt defining a plurality of apertures sized and arranged to snugly receive said pins after passing through the web apertures whereby when said pins of said belt are received in the apertures of the other belt, said belts will travel together, idler pulley means for mounting one of said belts to provide a run adjacent one surface of said web, and driven pulley means for mounting the other of said belts to provide a run adjacent the other surface of said web, said belts pressing against said web over a major portion of said runs, the pulley means receiving the pin belt being arranged to define a web-engaging run which is slightly offset relative to the web-engaging run of the apertured belt whereby webs of various thicknesses may be accommodated, said pulley means receiving the pin belt being further arranged to diverge the end portions of said pin belt adjacent the web-engaging run thereof at minor acute angles whereby said pins are eased through said web apertures and said first belt apertures prior to full frictional engagement of said webs by said belts and the pin belt is eased from frictional engagement with said apertured belt prior to the end of the web-engaging run of the latter and said pins are thereafter eased out of their associated web apertures.

5. The combination of apertures 4, wherein said paper web is provided with a plurality of spaced apertures on each marginal edge and said machine is equipped with a second of said advancing mechanisms for advancing said web on its second set of marginal apertures.

6. The combination of claim 5, wherein the pulley means receiving said pin belt includes a pulley downstream of the point of egress of said web and provided with a peripheral flange to support said web and thereby facilitate disengagement of said web from said pins.