United States Patent

Black

[15] **3,650,207**

[45] **Mar. 21, 1972**

[54] FLAT BED WEB PRESS INDEX AND REGISTRATION

[72] Inventor: **James A. Black,** 13700 Sparta, N.W., Kent City, Mich. 49330

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[21] Appl. No.: **870,720**

Related U.S. Application Data

[62] Division of Ser. No. 617,885, Feb. 23, 1967, Pat. No. 3,499,233.

[52] **U.S. Cl.** **101/115,** 101/228, 226/57, 226/146

[51] **Int. Cl.** **B41f 15/04,** B41f 15/10

[58] **Field of Search** 101/115, 121, 196, 228; 226/56, 57, 58, 146, 147

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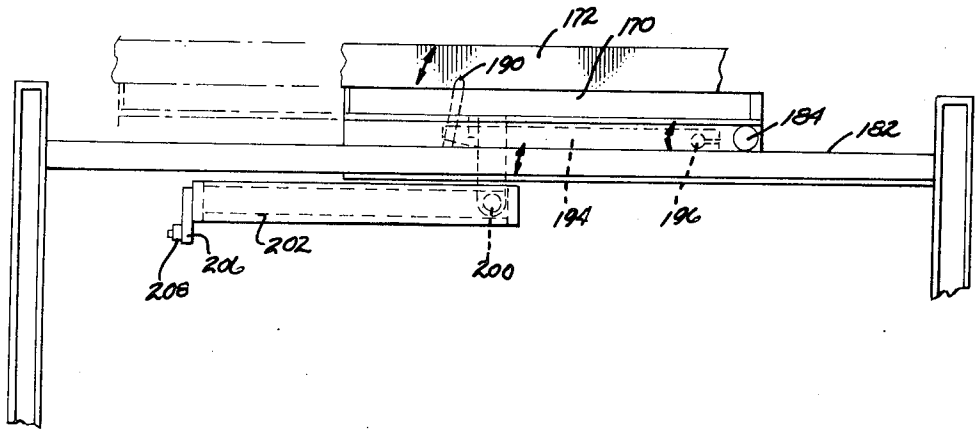
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Primary Examiner—Clyde I. Coughenour
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[57] **ABSTRACT**

Index and registration means for a continuous web printing apparatus having a web indexing apparatus to create index indicia at predetermined intervals along the web and web index register means at each printing station adapted to cooperate with the index indicia to cause momentary registry of the web with each printing unit for accurate printing. Specifically, the web indexing means punches holes in the web and the web index register means at each printing station includes a shiftable projection reciprocally movable toward the web holes to interengage the holes thereby holding the web in position at each printing station.

2 Claims, 17 Drawing Figures



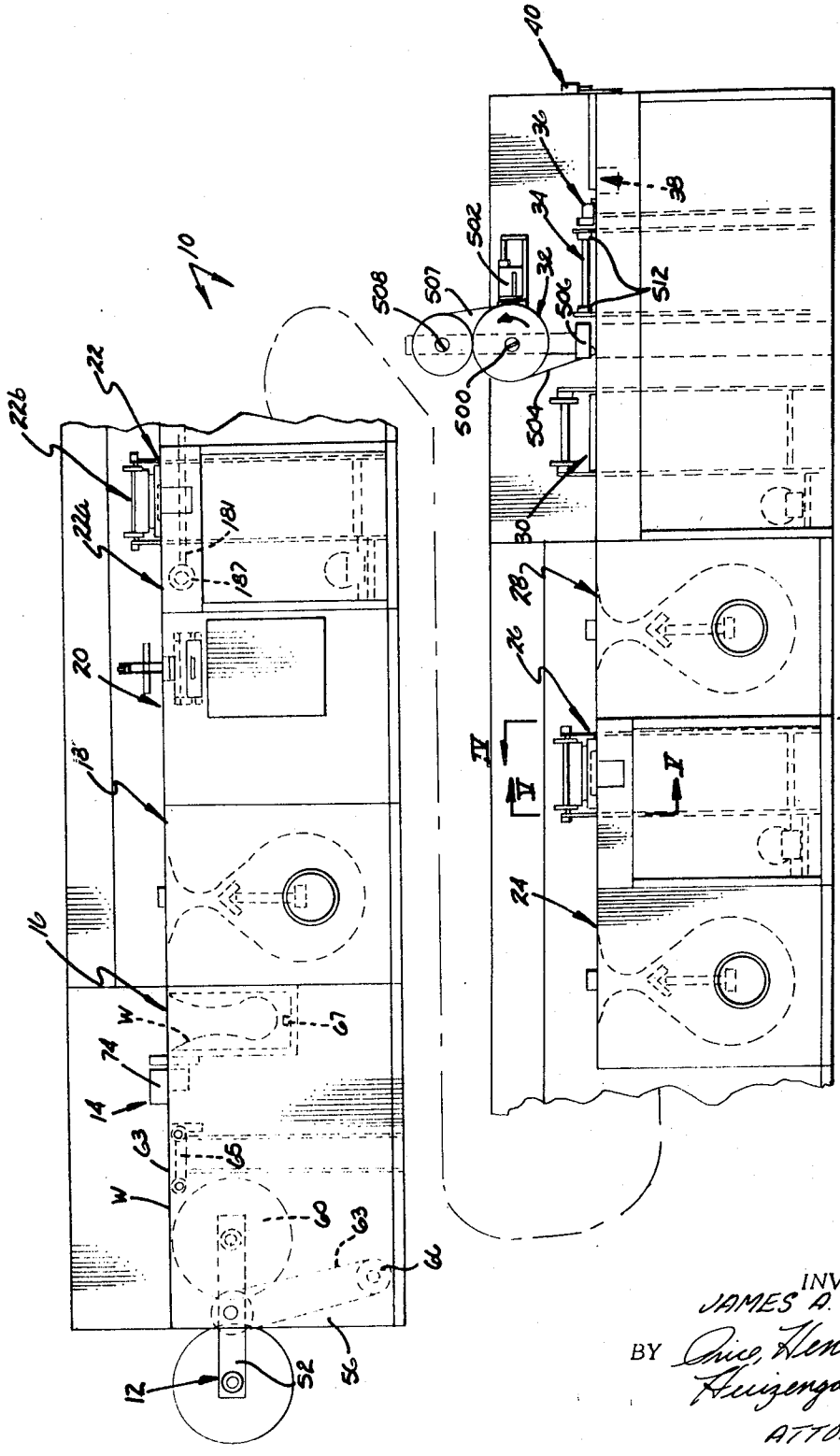


FIG. 1

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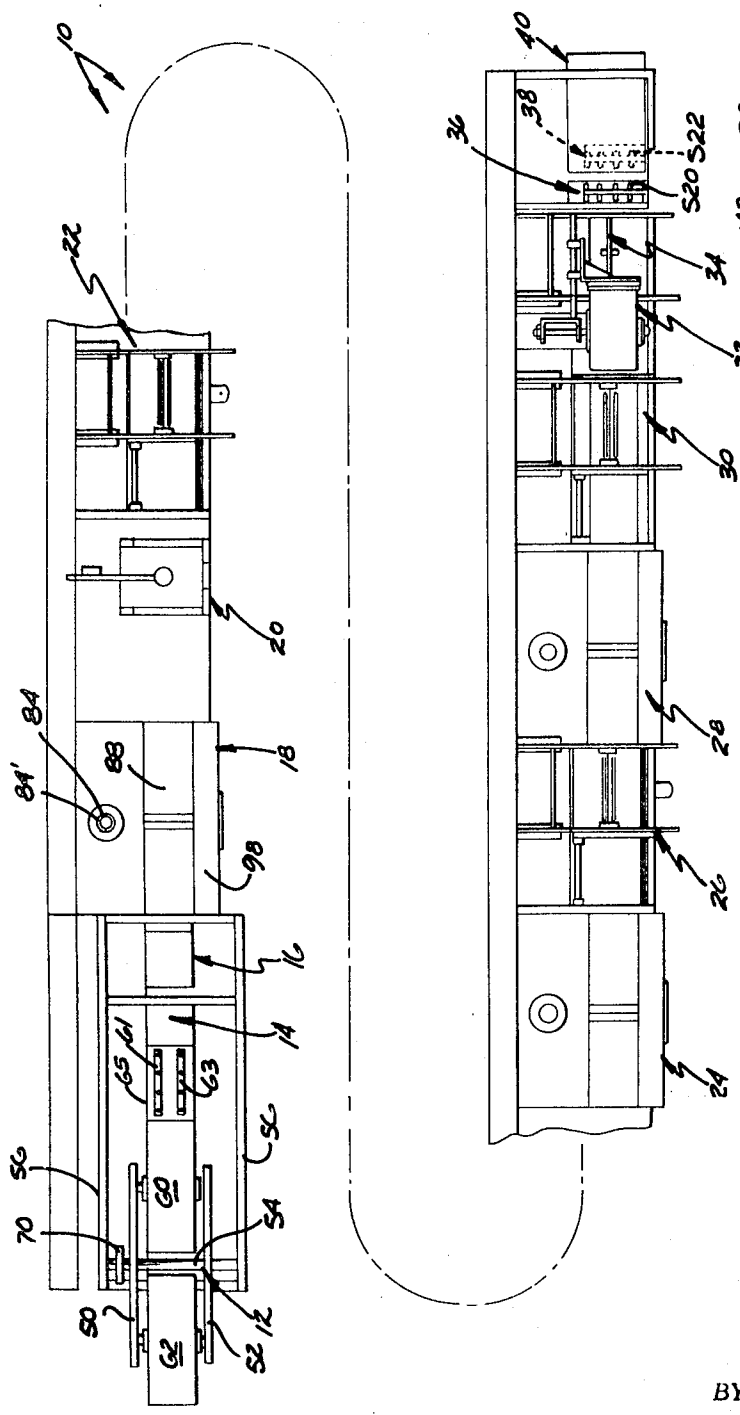


FIG. 2

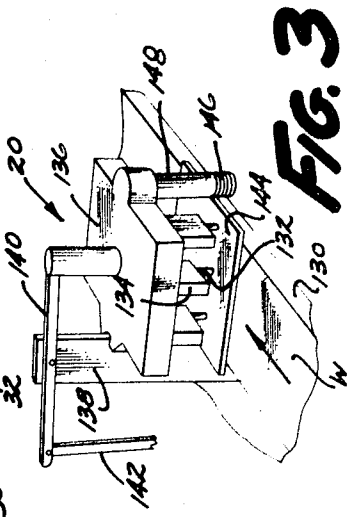


FIG. 3

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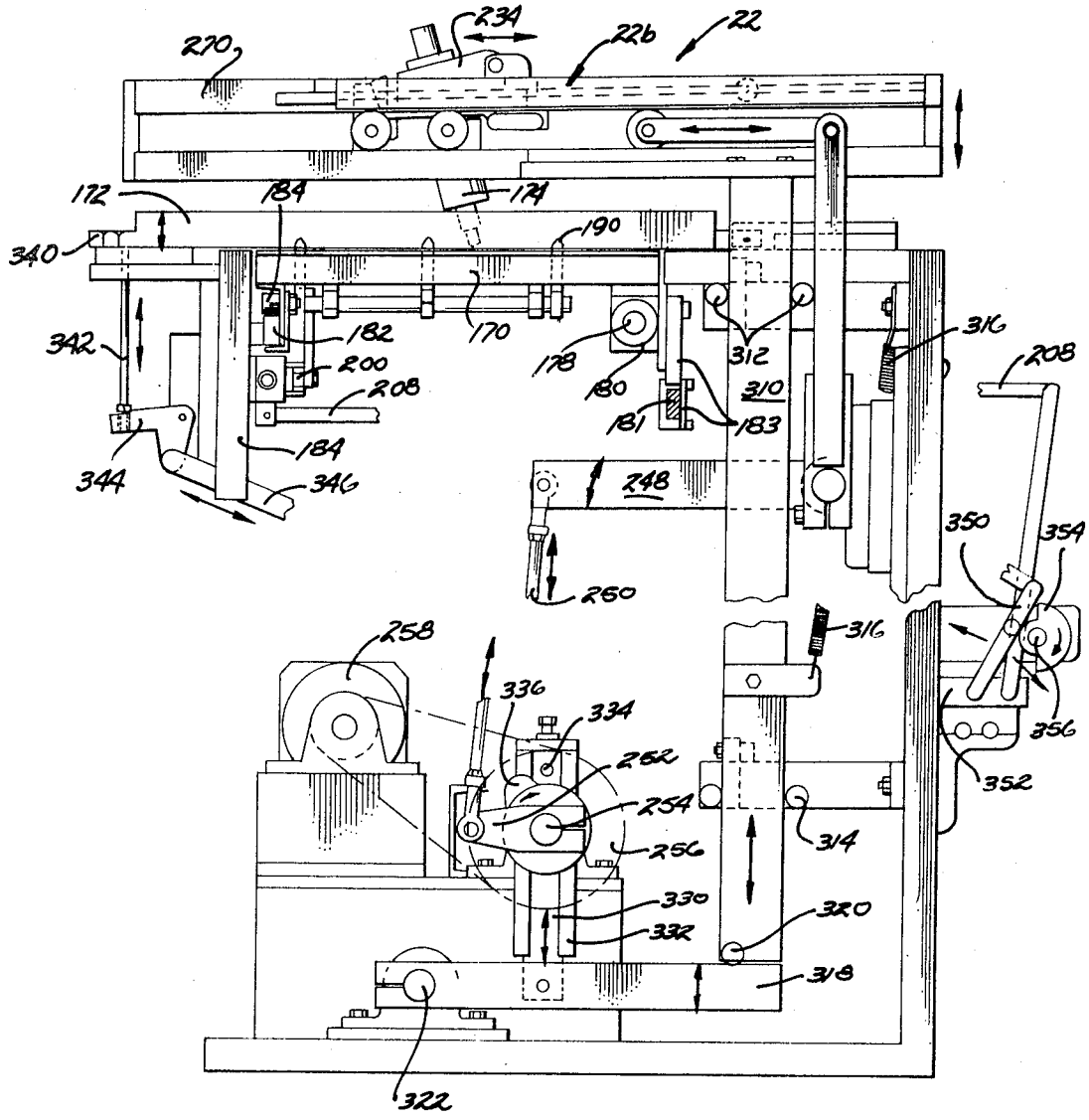


FIG. 4

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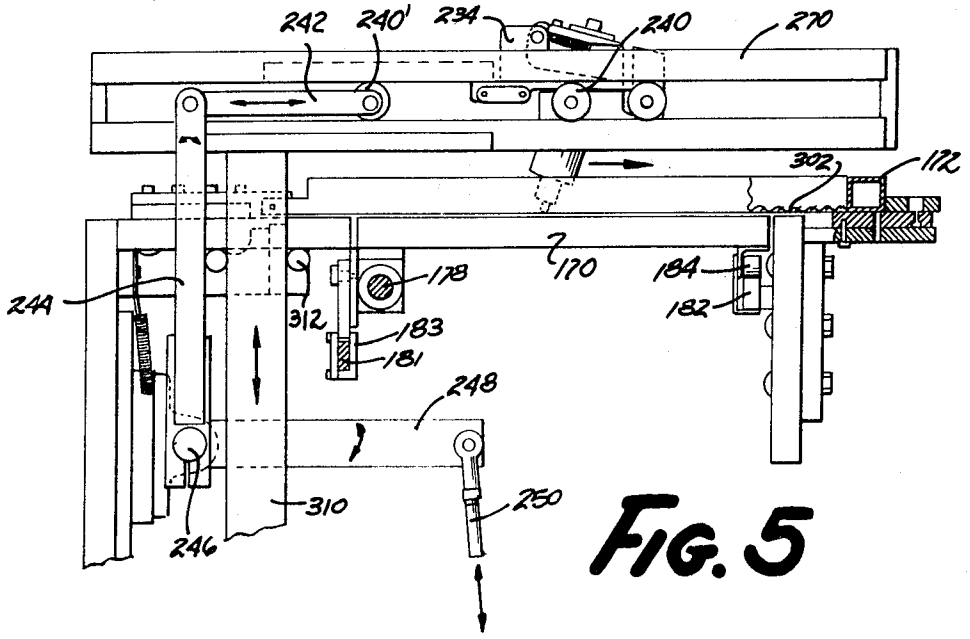


FIG. 5

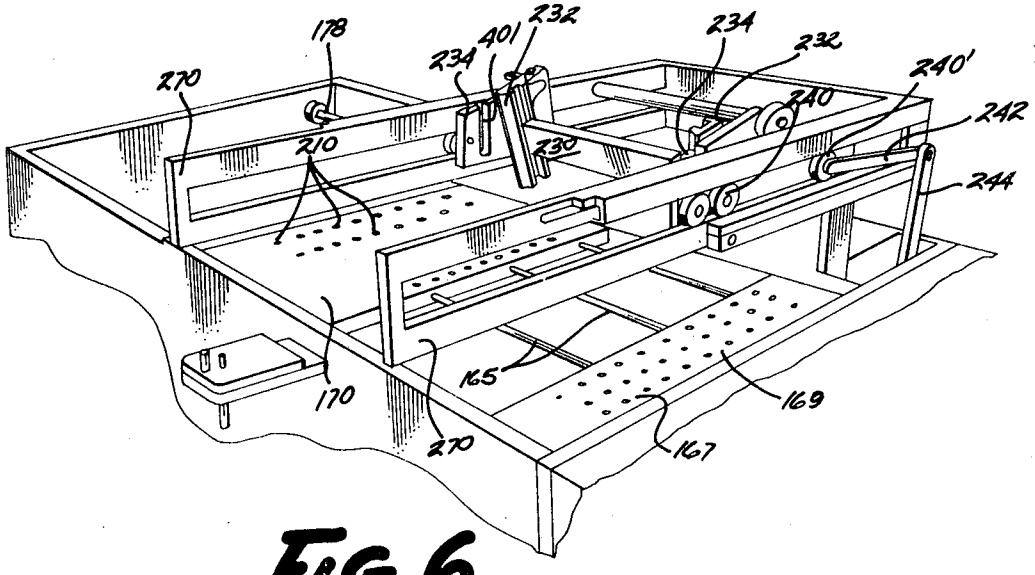


FIG. 6

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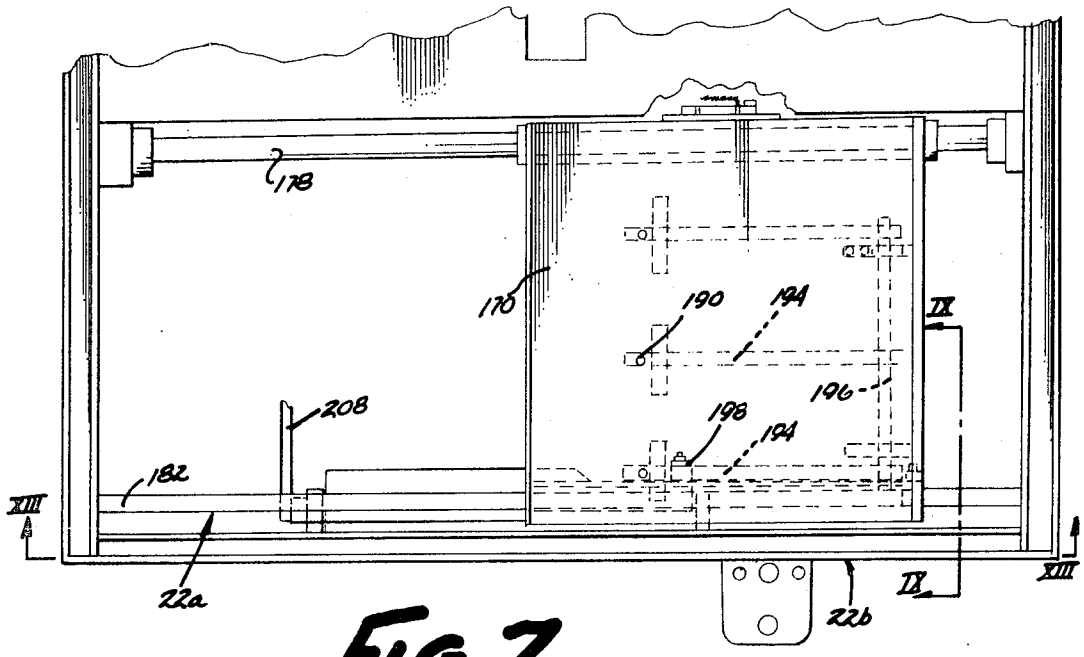

178
170
190
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IX
196
208
198
194
182
XIII
22a
IX
XIII
22b

FIG. 7

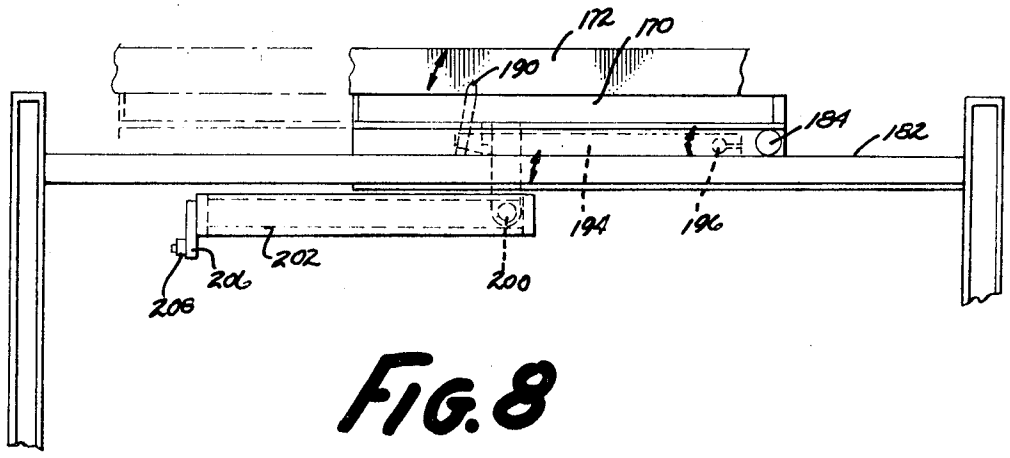

172
170
190
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182
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202
204
200
206

FIG. 8

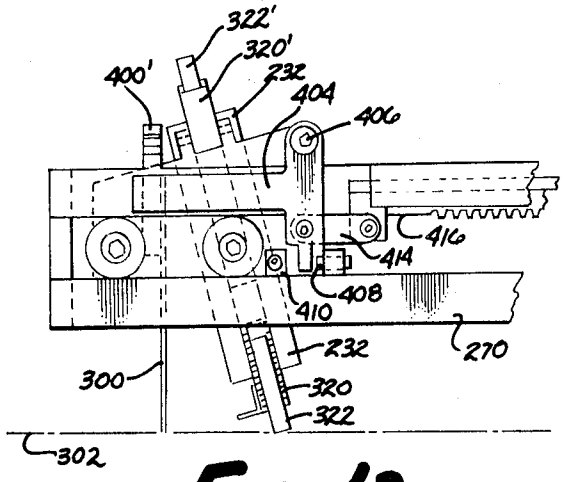


FIG. 12

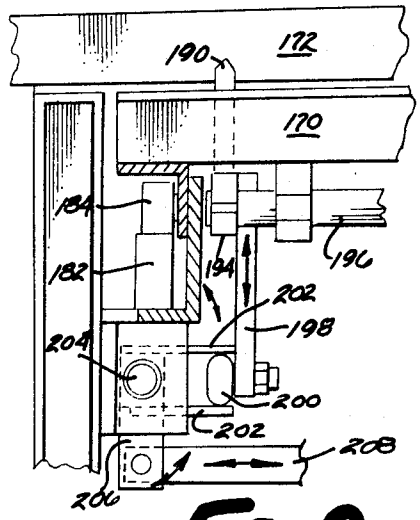


FIG. 9

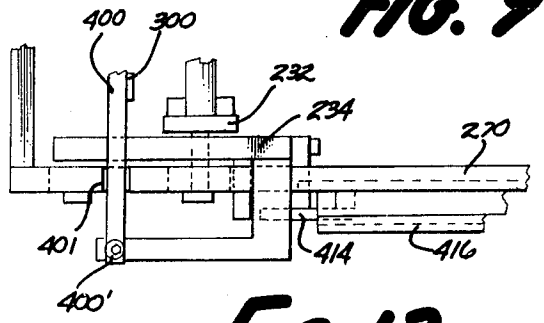


FIG. 13

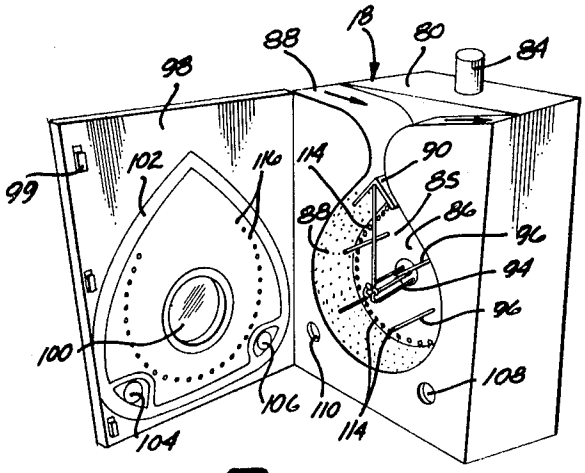


FIG. 14

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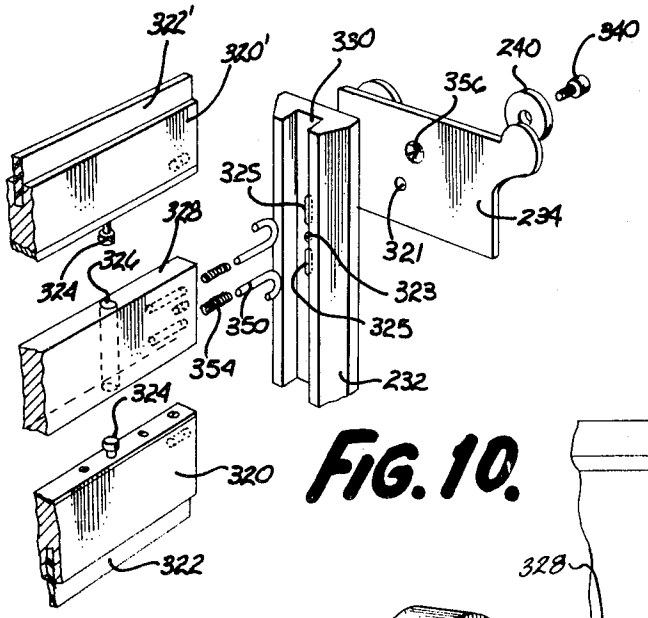


FIG. 10.

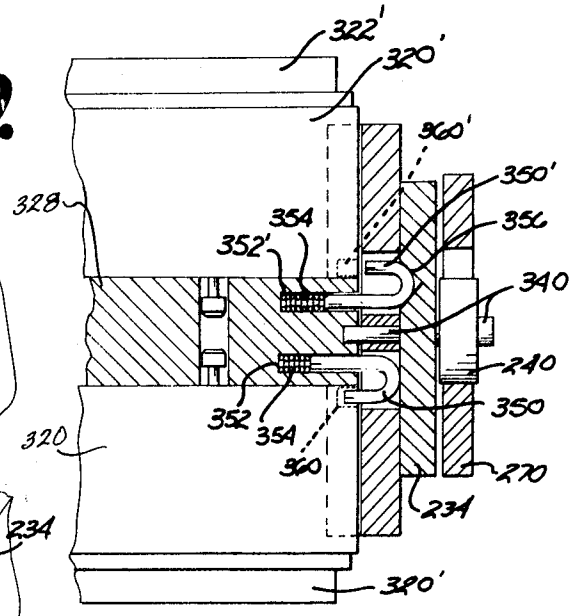


FIG. 11

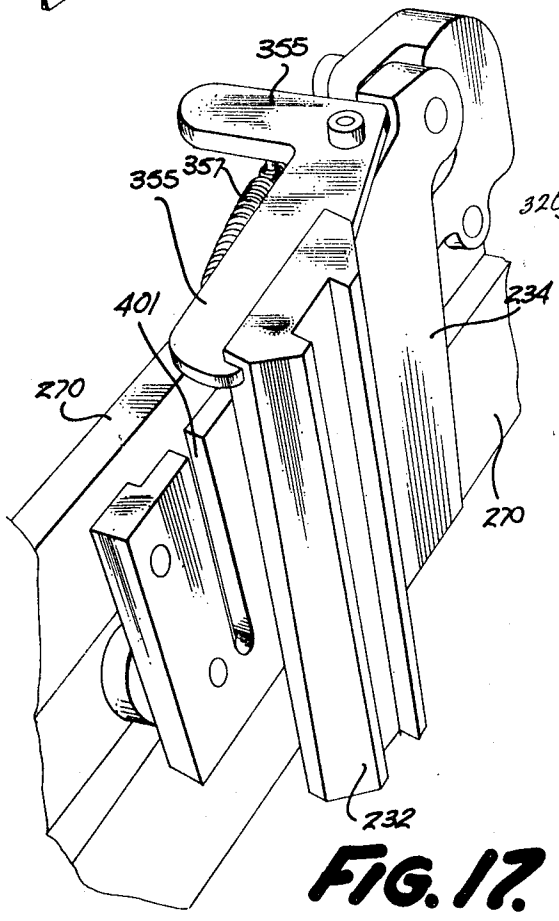


FIG. 17.

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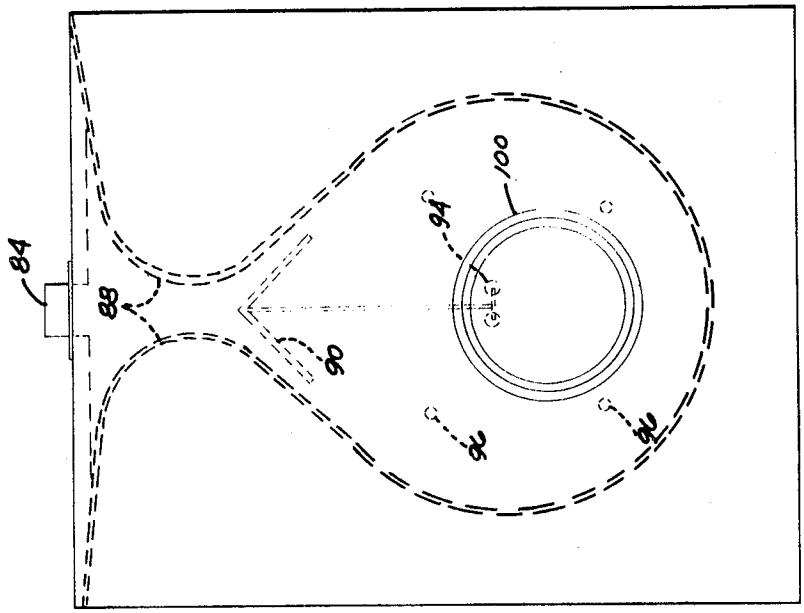


FIG. 16

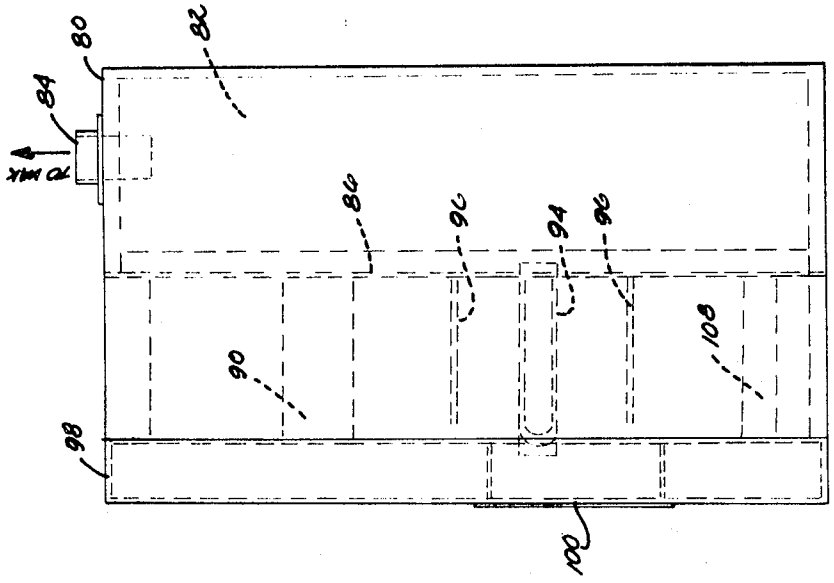


FIG. 15

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FLAT BED WEB PRESS INDEX AND REGISTRATION

This is a divisional application of parent application Ser. No. 617,885, filed Feb. 23, 1967 now U.S. Pat. No. 3,499,233, and entitled Flat Bed Web Press.

This invention relates to a screen printing apparatus and method, and more particularly to a web press apparatus capable of continuous multicolor silk screen printing on a continuous web.

Silk screen printing is relatively complex and expensive in comparison to other printing methods. Still, it is used extensively because of its capacity to produce very high quality prints, and its capacity to accommodate materials and goods in a manner not possible or practical with other printing techniques and apparatus.

One of the greatest contributory expense factors of silk screen printing results from the present necessity of first printing and then drying each sheet item one at a time. This requires a substantial amount of equipment and labor. Since the ink is usually of substantial thickness, large recirculatory dryers are normally employed to handle the separated sheets. If a sheet is to contain more than one color ink, the process becomes very involved since each sheet must be printed with one color at a time, fully dried in a dryer, and then reprinted and redried for each additional color. Moreover, maintaining proper registry of each sheet with each succeeding ink pattern to be printed is extremely difficult, but must be maintained very accurately if acceptable products are to result. As a practical matter, the expense mounts very considerably with each additional color added. Hence, the product is apt to be very expensive unless the number of colors is limited to one or two.

It is a primary object of this invention therefor to provide a novel screen printing apparatus and method enabling automatic, high quality multicolor screen printing.

Another object of this invention is to provide a screen printing apparatus capable of printing several different selected colors in preselected overlapping patterns on individual portions of web stock, while maintaining completely accurate registry of each individual sheet portion with each color, automatically so that only a fraction of the time, expense, and equipment is required compared to that normally required.

Another object of this invention is to provide a novel screen printing apparatus capable of printing on a continuous web of stock.

Another object of this invention is to provide screen printing apparatus capable of accurately printing several colors in preselected patterns on a continuous web of stock, and to do so in a fraction of the time and at a fraction of the expense of known multicolor screen printing equipment and techniques.

Another object of this invention is to provide apparatus capable of successively printing and drying individual colors on a continuous web of stock on a rapid continuous basis, with the number of different colors being practically unlimited. The number and selection of different colors can be varied widely merely by using or passing successive modules of combination printing and drying units.

Another object of this invention is to provide a novel mulitcolor continuous web screen printing apparatus having several print stations operating simultaneously on the web, and having exactly controlled, automatically regulated registry of each segment of the continuous web with each successive print station.

Another object of this invention is to provide a novel screen printing apparatus having a plurality of printer units, wherein each printer unit has complete registry control of the particular web portion being printed by it.

Another object of this invention is to provide a novel continuous web screen printing apparatus wherein each printer unit controls the feed rate of the web stock portion through and from the dryer unit immediately upstream of the printer unit, so that a series of the printer units can be in operation simultaneously.

Another object of this invention is to provide a continuous web screen printing apparatus having dryer units capable of rapid drying and controlled positioning of a continuous web in the dryer, using dynamically flowing drying air, while enabling the printing unit immediately downstream thereof to intermittently draw web portions therefrom without creating significant tension on the web.

Another object of this invention is to provide a novel screen printing unit particularly suited to handle continuous web stock in an accurately controlled reliable fashion, to print selected colors in repeat patterns on successive portions of the web, using a unique reciprocable bed that simultaneously accurately registers and advances stock, and also supports and retains the stock in registry during printing.

Another object of this invention is to provide a printing unit capable of repeat automatic operation on stock fed to it, and allowing substitution of squeegee elements in the printer unit without interrupting the continuous flow of stock through the printer. The printer squeegee assembly is capable of being switched from one squeegee to another in a fraction of a second, between pring strokes, so that continuous web printing will not be interrupted or otherwise adversely affected. Moreover, the squeegee element in the squeegee assembly can be easily replaced without stopping the printer.

Another object of this invention is to provide a novel screen printer squeegee assembly enabling change from one squeegee to another, merely by rotating the assembly to disengage the one squeegee and operably engage the other.

Another object of this invention is to provide a novel squeegee assembly drive apparatus for a screen printing unit, enabling the squeegee to make a print stroke transverse to a continuous web and then to allow the web to advance the printed area through the station without being adversely affected by the squeegee assembly.

Another object of this invention is to provide a novel, continuous feed, printed web dryer, employing dynamic air flow to cause rapid continuous drying of the web and controlled positioning of the web as it is advanced through the dryer.

Another object of this invention is to provide a novel continuous web dryer enabling the web to pass through a curvilinear non-wrinkling path, with its position being constantly controlled by the dynamic drying air itself. Moreover, the web positioning drying air has optimum sweep across the printed surface for reliable rapid drying.

Another object of this invention is to provide a novel continuous web dryer enabling the web to be intermittently advanced therefrom and intermittently fed thereto by dynamic air flow caused by controlled pressure differential, without significant stress being applied to the web.

These and other objects of this invention will become apparent upon studying the following specification in conjunction with the drawings in which:

FIG. 1 is a side elevational view of the novel apparatus;

FIG. 2 is a plan view of the apparatus in FIG. 1;

FIG. 3 is a fragmentary perspective view of the registry punching station of the apparatus;

FIG. 4 is an enlarged elevational view of one of the printers in FIGS. 1 and 2, taken on the plane IV—IV of FIG. 1;

FIG. 5 is a fragmentary elevational view of the apparatus in FIG. 4, viewed from the opposite side, i.e., taken on plane V—V of FIG. 1;

FIG. 6 is a fragmentary enlarged perspective view of the top portion of the apparatus in FIGS. 4 and 5;

FIG. 7 is an enlarged plan view of the apparatus in FIGS. 4 through 6;

FIG. 8 is a partial elevational view of the apparatus in FIG. 7, taken on plane VIII—VIII;

FIG. 9 is a fragmentary enlarged elevational, partially sectionally view of the printing station in FIGS. 7 and 8, taken on plane IX—IX in FIG. 7;

FIG. 10 is an enlarged fragmentary exploded view of an end portion of the novel squeegee apparatus in a printing station;

FIG. 11 is an elevational, partially sectional view of the apparatus in FIG. 10, as assembled;

FIG. 12 is an enlarged end elevational view of the squeegee apparatus in FIGS. 10 and 11, for the printing station;

FIG. 13 is a fragmentary plan view of the apparatus in FIG. 12;

FIG. 14 is a perspective view of one of the drying units in the equipment of FIGS. 1 and 2, shown with the front door open;

FIG. 15 is an end elevational view of the dryer unit in FIG. 14;

FIG. 16 is a front elevational view of the dryer unit in FIGS. 14 and 15; and

FIG. 17 is a prospective view of a latch for locking the squeege assembly in aligned position.

Referring to the drawings, the complete system 10 is composed of a series of cooperative components including a web supply roll stock support means 12, web splicer means 14, slack container means 16, web predryer means 18, web registry index punch means 20, a first printer and dryer combination including printing means 22 and dryer means 24, a second printer and dryer combination including printer means 26 and dryer means 28, and optional units including slip coat applicator 30, laminator means 32, cross slitting means 34, longitudinal slitter means 36, underscoring means 38, and cut off means 40.

As will be understood from the detailed description to follow, not only is the complete system unique, but also the web registry system, the individual printing units, the squeegee assemblies on the printing units, and the dryer assemblies. Two printer and dryer combinations are shown in the illustrative drawings. Actually, the number of printer and dryer combinations may be widely varied to suit a particular installation. Thus, instead of the two shown, a large number of four, eight, 10, more or less, can be employed merely by installing additional combinations in the sequence, or only one need be used. The number employed will depend upon the number of color variations to be obtained. In operation, the web actually is advanced from support means 12, past splicer 14 which is intended to splice the end of one roll with the beginning of another, through temporary slack container 16, and through predryer 18 where initial excess moisture is removed. It then passes through registry index punch means 20 which punches registry holes at a controlled spacing along the web. Then, the web begins its passage through the selected number of printer and dryer combination series to apply the selected patterns in order to obtain the multicolor print stock. The printer units actually determine the rate of feed through this sequence. After printing, and the final drying step, the web may pass through the optional assemblies 30, 32, 34, 36, 38 and 40. The slip coat applicator 30 can apply a protective coating, if desired, and/or laminator means 32 can apply a protective cover sheet. The web can be cross slit with means 34 and/or can be longitudinally slit with slit means 36 and/or can be underscored with means 38. It may then be cut into individual sheets by reciprocating vertical cut off 40, or may be rolled up in a roll, as desired.

It is believed that the entire system can be more readily understood after a detailed description of each of the components thereof. Hence, for convenience and clarity, the components will be described in their sequential relationship.

WEB SUPPORT

The web supply roll support means 12 basically includes a pair of elongated support beams 50 and 52 (FIGS. 1 and 2), arranged parallel to each other on a central transverse pivot shaft 54 mounted to support housing 56. Rotationally mounted between the opposite ends of beams 50 and 52 is a first roll 60 of web stock, removably mounted on a central shaft, and a second roll 62 of web stock removably mounted on another central shaft. The forward roll 60 supplies web stock until it is depleted, at which time the mechanism is rotated 180°, end for end, to bring roll 62 from its inactive position as a spare to the active position for supplying web stock. This rotational action is obtained by rotating shaft 54 with a motor 66 through chain 68 and sprocket 70, the latter being mounted on shaft 54. Thus, the system can be constantly supplied with web stock W even though the individual rolls are depleted. It will be realized that when the exhausted roll is shifted to the spare position, a new roll can be substituted therefor while the system is still operating.

The web is positively advanced from the roll to predryer 18 in accordance with demands of the system. Specifically, an advancing means such as a pair of orificed, pulley mounted recirculating tapes 61 and 63 (FIGS. 1 and 2) are advanced over the slotted upper surface of an evacuated table 65 to pull web W from the roll and advance it to slack control container 16. The motor (not shown) driving tapes 61 and 63 is shut off and on in response to a limit switch 67 in container 16 so that a controlled amount of slack is maintained in the web ahead of predryer 18.

SPLICER

Immediately downstream of the web support means is splicer 14 used to splice the tail end of one web with the new forward end of another web from the next roll, in order to provide a continuous web to the system. The splicer may include suitable temporary holding means such as a vacuum head 74 to hold and align the two ends of web as they are spliced together by adhesion, taping, or the like. Normally, this splicer is disengaged from the web stock, so that the web can constantly move past it without interference from it.

PREDRYER

Dryer assembly 18 is exactly like dryer assemblies 24 and 28 which are employed in combination with printer units 22 and 26. Its function is to remove any excess moisture which the web stock, usually paper, has taken on during storage and shipping. Its use is not always necessary, but is advisable in most instances to bring the moisture within a central range. The dryer assembly 18, and hence dryer assembly 24 and 28, has a construction illustrated most clearly in FIGS. 14 through 16. It has a cabinet housing 80 which forms a specially configurated front chamber 85 and an enclosed rear chamber 82 that communicates with an evacuating means (not shown) through a passage outlet 84. The vacuum source may be a typical exhaust fan, with the amount of vacuum pull being variably by varying out flow with an adjustable damper 84' in passage outlet 84. The front chamber is separated from the rear by a vertical partition 86. This front chamber has an open top and a curvilinear peripheral wall 88 which defines a smooth curvilinear web path from its horizontal entry plane, through a convex shoulder, thence through a continuous concave bottom to reverse its direction from down to up, hence around another convex shoulder to the horizontal exit plane. This curvature includes no sharp bends so that the web can be drawn through the generally bottle-shaped chamber in a smooth fashion by the printer unit downstream of the dryer. The web is held against this periphery by air flow and by a pressure differential created across the web between the inner face of the web and the outer face adjacent the perforate surface 88. The web stock thus enters in the direction indicated by the arrow in FIG. 14, and exits also as indicated by the arrow. The dryer employs dynamic air flow for both web drying and web positioning. Heat is supplied to the moving air in the front chamber by suitable forwardly projecting electrical heating elements such as Calrod units 94. A plurality (four) of protector rods 96 project forwardly at intervals around these heater elements, spaced inwardly from the peripheral curvilinear guide wall to prevent the web from ever being brought into contact with he heater elements should the web be accidentally drawn too tightly in the dryer.

The front chamber is normally closed by a hinged access door 98 which swings between its open position shown in FIG. 14 to its closed position shown in FIG. 15. The door is maintained in its closed relationship by a plurality of magnetic catches 99. This door preferably includes a glass window 100 for observation of the interior of the unit. On the inside face of

the door is a protruding sealing gasket **102** which extends around the entire periphery of the chamber. Gaskets also extend around a pair of air inlets **105** and **106** in the door, which communicate with a cooperative set of air flow passages **108** and **110** respectively that extend to rear chamber **82**. Dynamic air flow through the front chamber is caused by pulling a vacuum on the front chamber via the rear chamber and allowing air to flow in the open top of the chamber. MOre specifically, communication is achieved by a large number of small air flow orifices **114** in partition **86**, located in a pattern around the inner chamber, immediately adjacent the perforate curvilinear surface **88**, and, opposite these orifices, in the same pattern, another series of orifices **116** in the front panel of hollow door **98** to provide communication between this curvilinear chamber and the interior of door **98**. These orifices **116** are also immediately adjacent the curvilinear surface **88** when the door is closed. Negative air pressure is provided to the interior of door **98** by communication of orifices **104** and **106** from the door interior to passageways **108** and **110**, and thus with rear chamber **82** that associates with vacuum outlet **84**. When vacuum is pulled on rear chamber **82**, air flows continuously down through the open top of the front chamber and through the orifices **114** and **116**, to the rear chamber **82** of the cabinet.

This continuous air flow into the front chamber is further directed by an inverted V-shaped air deflector guide **90** that causes the air to diverge after it passes through the narrow necked down portion where the web enters and leaves, along the inner surface of the web. Thus, the air has optimum flow across the surface of the web and out through passageways **114** on the lateral edges of the web. By causing this air flow to occur constantly along the length and across the width of the web as the web passes through the dryer, an excellent rapid, easily controlled drying action occurs while the web is being advanced by the printing unit downstream thereof. Further, the pressure differential across the web, between the incoming atmospheric pressure air and the negative pressure pulled on the orifices and on the back of perforate surface **88** maintains the web adjacent the curvilinear surface.

REGISTRY INDEX PUNCH

For proper operation of the system, very accurate registry must be obtained between each segment of the web to be printed and each successive printing unit. After considerable experimentation, the best and most dependable technique devised was found to-include the control of the web with pins (at each printing station) that project into prepunched holes in the web at spaced intervals therealong. The holes are punched by the unit **20** (FIGS. **1**,**2** and **3**).

This punch means includes a die holder and guide surface **130** over which web W passes and on which it temporarily stops at intervals between intermittent web advancement by the first printing unit **20**. The holes are actually punched by a plurality of (three) punch elements **132** mounted by supports **134** to a vertically reciprocating platen **136** which is guided by column **138**. Platen **136** is depressed by pivotal lever **140** which is also connected to reciprocating link **142**. Suitable power means (not shown) operates link **142**. After the platen is depressed to lower punch elements **132** through orificed guide plate **144**, the platen is then biased upwardly by a spring **146** beneath post **148** which is attached to plated **136**. The holes are punched in the web after the web is drawn taut by the next printing unit **22** downstream thereof, so that the holes have a definite space relationship to the previously punched series of holes that are at the first printing unit. Each printing unit holds the web tight by vacuum and a set of registry pins projecting into the previously punched holes of the previously advanced section of the web as explained hereinafter. Thus, the spacing between the punched holes is exact and controlled.

PRINTER AND DRYER COMBINATION

As explained previously, the complete system includes any selected number of printer and dryer combinations, with the illustrative apparatus showing two such combinations. Also, as noted above, each of the dryer units of the printer and dryer combinations basically has a construction like that described with respect to predryer **18**. The printer units are also basically the same, except that each, in operation, normally includes a different removable silk screen pattern, preselected to apply the particular color of ink at the printing station in a predetermined pattern to the multicolor printed web. Hence, printer unit **22** will be described, with it being understood that unit **26** is basically the same.

The detailed construction of the printer assembly is best illustrated in FIGS. **5** through **13**. Printer assembly **22** includes a web alignment and feed station **22*a*** and cooperative printer station **22*b*** (FIGS. **1**, **7** and **8**). The chief components at the printing station include a web advancing and supporting vacuum bed platen **170** that reciprocates between stations **22*a*** and **22*b***, and the printing apparatus that includes a silk screen stencil frame **172** above the platen, and a transversely reciprocating squeegee supporting carriage **174**.

The vacuum bed platen **170** is slidably mounted on a fixed cylindrical guide shaft **178** (FIGS. **4** and **7**) extending in the longitudinal direction of the web along the length of the back of the two stations. A slide bearing **180** encircles this rod and is fixedly attached along the rear of platen **170**. The front edge portion of bed **170** has an attached follower roller **184** that rides on track **182** (FIG. **4**). This track is affixed to frame member **184** along the front of the printing unit, parallel to shaft **178**. The platen reciprocates from an initial position at station **22*a*** as shown by the dotted lines on the left hand side of FIG. **8** where registry is made with the web stock, to a second position at station **22*b*** beneath the squeegee assembly at the right hand side of the structure in FIGS. **7** and **8**, where the printing actually takes place. When the platen is in station **22*a***, registry is made with the web with vertically reciprocable index pins that move with the platen, specifically by raising register pins **190** up through the end of the platen to fit into the three index holes previously punched by means **20**. These pins are tapered to assure initial insertion into the holes, and have a diameter at the base of the pins equal to that of the holes, to assure exact registry. The pins are shifted upwardly by the special mechanism shown must clearly in FIG. **9**. That is, the lower ends of pins **190** are mounted on a plurality of cantilever arms **194** (FIGS. **7** and **8**) which in turn are mounted on the opposite ends thereof to transverse pivot shaft **196**. The arms and pivot shaft are shifted to provide a vertical movement to pins **190** by vertical shifting of a depending leg **198** affixed to the front most one of cantilever arms **194**. At the lower end of leg **198** is a cam follower **200** fitting within a pivotal cam track **202**. This cam track in turn is mounted on a longitudinal pivot shaft **204**, to which is also affixed depending leg **206**. A link **108** is pivotally connected to leg **206**, and is operably connected to the drive means so that, when it shifts longitudinally in the direction indicated by the arrows in FIG. **9**, it pivots the cam track **202**, to vertically shift cam follower **200**, leg **198**, and thus elevate the alignment index pins. Link **208** is shifted by pivot lever **209** operated by a cam (not shown) on camshaft **356**.

The mounting of the pins on pivotal cantilever arms causes them to move in a large radius arc toward the printing station, so that the inserted pins first draw the web tight, at which time punch **20** reciprocates to form the next set of index holes.

Immediately downstream and adjacent to the printing station **22*b***, and thus to platen **170** when under the printer, is a fixed vacuum bed **169** (FIG. **6**). It is hollow, is connected to a vacuum source, and has orifices **167** to its upper surface. It is actuated after platen **170** reaches the printing station, to help hold web W, and remains activated after the vacuum on platen **170** is released to allow the platen to be returned to the alignment station **22*a***, to hold web W from reversing with the platen.

A pair of web support cables **165** (FIG. **6**), attached to bed **169**, support web W from projecting between held **169** and platen **170** when the latter is spaced from the former. Cables **165** extend through passages in platen **170**.

In the operation of this apparatus, the pins are elevated after the platen has reached the alignment station **22***a*, and are gradually retracted as the platen moves toward the printing station, by shifting the cam track downwardly. Hollow platen **170** is evacuated through a suitable flexible hose connection (not shown) made to its underside, to hold a segment of web. The web is thus initially advanced by both the pin and hole connection and the platen pressure differential. The platen evacuation causes a pressure differential across the web portion due to a plurality of patterned vacuum orifices **210** (FIG. **6**) which extend between the hollow interior of platen **170** and its upper surface. Once the web is in motion, the pins retract and the pressure differential continues to advance it to the printing station. When the platen reaches printing station **22***b*, so that it has carried a particular portion of the web into accurate registry therewith, the drive mechanism for the squeegee apparatus goes into operation.

The advancement of platen **170** occurs simultaneously with advancement of the other printing unit employed by attaching sleeve **180** (FIG. **4**) to a reciprocating drive bar **181** with a clam **183**. Bar **181** extends along the length of the system and is reciprocated by a master rotationally powered cam **187** (FIG. **1**).

Referring now to the squeegee assembly (FIGS. **4** and **6**), it includes a general support member **230** on the opposite ends of which are mounted a pair of slide guides **232** which receive the squeegees in a manner to be described hereinafter, and which are specially pivotally mounted to a pair of carriage plates **234**. To these carriage plates are mounted a plurality of rollers **240** on the forward ends of the carriages, and **240'** on the rearward ends. Attached to rollers **240** on opposite sides of the assembly is a first link **242**, and connected thereto is a second link **244** extending down to a fixed connection on pivot shaft **246** (FIG. **5**). Also connected fixedly to shaft **246** is a cantilever arm **248** which is pivotally secured to a tie rod **250** that has its lower end pivotally connected to a crank **252** mounted on drive shaft **254**. This drive shaft is driven by a belt and pulley connection **256** from motor **258**. Thus, rotation of the drive assembly causes crank rotation, to reciprocate tie rod **250**, pivot lever **248**, and hence reciprocate the squeegee assembly along a pair of cantilevered guide track units **270** transverse to the general orientation of the web. In FIG. **6**, the device is shown with squeegee elements themselves removed so that the other members of the assembly can be more readily illustrated. Also, in FIG. **6** the stencil frame member **172** is removed. The printing stroke occurs during the movement of the squeegee assembly from the back initial position illustrated in FIG. **6**, through the printing step shown in FIG. **5**, to the extended position. On its return stroke, the squeegee assembly is elevated above the sheet so it will not make contact with the stencil screen. During the elevated return stroke however, a flow coater blade **300** having a width equal to the width of the squeegee (FIG. **12**) is allowed to drop to flood coat the excess ink back across stencil screen **302** inside the stencil screen frame. The detailed structure and operation of this flow coater and squeegee mechanism will be described hereinafter.

The vertical shifting of the squeegee assembly is obtained by actually shifting its track assembly **270**. More specifically, referring to FIGS. **4** and **5**, attached securely to the track assembly is a pair of vertically depending supports **310** which are guided in their travel by cam followers **312** and **314** and are partially biased to an upward position by tension spring **316**. The weight of the squeegee assembly end tracks causes this structure to normally remain in a lowered position, however, until elevated by upward shifting of pivot lever **318** engaging a follower **320** on the lower end of supports **310**. Lever **318** is pivotally mounted to a shaft **322** on its opposite end, and pivotally connected to a lift member **330**, which is slidably mounted in guide **332**, and includes a cam follower pin **334** on the upper end thereof. A rotational cam **336** mounted on rotational shaft **254** engages this follower to lift the entire mechanism on a controlled basis. This is arranged such that the squeegee assembly is lowered only during the forward printing pass, and is elevated on the return stroke. The timing of this raising and lowering function is synchronized with the passage of the squeegee assembly since both are driven from the same shaft **254**.

It has also been found advisable to elevate the stencil screen by elevating its frame **172** temporarily after the printing stroke, while the web is being advanced through the printing station. This is done by pushing the front of the stencil screen frame **172** up with a vertically shiftable pin **342**, to pivot it about its rear edge. This lifts the frame front ends up on its alignment pin **340**. Push pin **342** is connected to a bell crank **344** which is in turn pivotally operated by a link **346** connected to a pivot link **350**. This link **350** is pivotally mounted to support **352** and shifted by a rotational cam **354** on a timing cam shaft **356**. This same camshaft also controls the vacuum connection to movable platen **170** and to fixed holding platen **169** through cam operated valves (not shown).

The actual squeegee assembly has a special construction to allow rapid flipover change between one squeegee and another while the unit is in operation. This is important to this equipment since any shut down of the continuous process is detrimental to the entire operation. The device has a spare squeegee unit which extends upwardly and a functioning squeegee that extends downwardly. The spare squeegee can be rotated to the downwardly oriented operative position between squeegee strokes. Referring to FIGS. **10** and **11**, each of the squeegees includes a flexible squeegee element and a support means therefor. That is, the operating squeegee includes a holder **320** and a flexible element **322** to pass along the surface of the screen. Likewise, the spare squeegee unit includes a holder **320'** and a flexible element **322'**. Both are mounted on a common support **328**, which is mounted to a carriage. Each has alignment stud members, **324** and **324'** respectively, which extend into passages **326** in fixed support member **328**. All of these members slidably interfit in slide tracks **330** in spaced members **232**. A pair pair of shoulder screws **340** extending into both ends of unit **328** through respective orifices **321** and **323** in plates **234** and element **232** to form pivot pins to enable element **328** and thus elements **232** to be rotated thereon. Control of this rotation is had by a pair of J-shaped detent members **350** and **350'**. These detent members also serve a secondary function of locking the lower squeegee means in its operative position to prevent it from falling out of the assembly and to release the spare, upper squeegee means for replacement thereof. These detents project through slots **325** and **325'** in members **232**. Each of these generally J-shaped hook members has an elongated leg which projects into corresponding passages **352'** and **352** in support **328**, with compression springs **354** and **354'** in these passages biasing the detents to an outward extended position. A recess **356** is formed in the inside face of member **234** and aligned with the J-shaped member which is associated with the upper squeegee unit to align the entire rotational mechanism into its intended operative vertical orientation. The detents also have short legs which can project into recesses **360** and **360'** in squeegee holders **320** and **320'**. Projection of detent into recess **356** retracts its short leg from holder **320'**, to release the upper squeegee element, enabling it to be removed and replaced. The combination detent hook element **350** for the lower squeegee assembly is held inwardly by the inside face of element **234** against its compression spring to a position where its second leg is inserted into recess **360**, to hold the lower squeegee in a locked position preventing it from falling out. An L-shaped latch **355** (FIG. **17**) is pivotally mounted in its center to member **234** and biased toward element **232** by a tension spring **357** between latch **355** and track **270** to lock the rotational squeegee assembly in aligned position. In order to shift squeegee **320** from its lowered position to an elevated position for replacement therefor, it is only necessary to release latch **355**, grasp the upper squeegee and forcibly

rotate it, causing the rounded outer end of hook **350'** to slide on the tapered surface of recess **356**, and thereby to retract it from recess **356** against its compression spring, so that the device can be rotated 180° in a fraction of a second. By so doing, the lower J-shaped member **350** snaps into the recess to automatically align the other lower squeegee in operative position, while enabling the upper squeegee to be removed and replaced, and the latch snaps back to lock position. Thus, there is no need to halt the entire web printing and drying process in order to replace squeegees, since the unit can be quickly revolved between print strokes.

As mentioned previously, a flow coater assembly is also employed as at **300** in FIG. **12**. This transverse flow coater blade is mounted to a support **400** which is free to float vertically in its slots **401** (FIGS. **6** and **13**), to ride under the bias of its own weight across the print screen **302**. It can be elevated by a T-shaped lifting link **404** which is pivotally mounted at **406**, and projects beneath an extending shoulder **400'** of support **400**. This link **404** can be shifted between stops **408** and **410** (FIG. **12**) by a linkage **414, 416**.

SUPPLEMENTAL EQUIPMENT

The slip coat applicator **30**, laminator **32**, cross slitter means **34**, longitudinal slitter means **36**, underside scoring means **38**, and cut off means **40**, may optionally be used.

The slip coater **30** is intended to apply a protective coating over the surface of the dry printed ink.

The laminator means **32** includes a main lamination roll support **500** (FIG. **1**) mounting a roll of an adhesively backed laminator material, normally transparent, which is also covered with a removable protective sheet. Unwinding of the laminator roll stock is controlled by a suitable brake **502**. The laminating material **504** is applied to the printed surface of web W by pressure roll means **506**, while the removable protective sheet **507** is wound up on a roll support **508**.

The cross slitter **34** is a transversely reciprocating mechanism with slitting devices **512** mounted thereon to slit the cover sheet or the cover sheet and web at spaced intervals.

The longitudinal slitting means **36** includes a plurality of transversely positioning slitting elements **520** for cutting the laminator sheet **504** at spaced intervals.

The underside scoring means **38** includes a plurality of slitters **522** for scoring the printed web.

If desired the printed stock can be rolled up at the end of the operation. Alternatively, it can be slit into separate printed sheets by cut off means **40** such as a vertically reciprocating blade unit.

OPERATION

Basically, the operation of the system and each of its cooperative components can be understood from the previous description given. In normal operation the web W extends the length of the system. Web W is pulled off the active roll **60** on roll support **12** by advancing vacuum tapes **63** and **65** until the slack web in chamber **16** shifts limit switch **67** to shut off the advancing tapes. The web extends around the curvilinear path of dryer **18**, where the air flow is constant, and through punch means **20** to the first printing unit. It is advanced through these components by reciprocating vacuum platen **170** in printer unit **22**. That is, with platen **170** in station **22*a***, index fingers rise on an arc into holes in web W to tighten the web and align it, while platen **170** is evacuated, and punch **20** then forms the next set of index holes. Platen **170** then advances with the web to the print station, as fingers **190** lower to miss the edge of stencil frame **172**. With the platen beneath the stencil frame in print station **22*b***, bed **169** is evacuated to help hold the web. The squeegee assembly is then lowered, and the squeegee is advanced transversely across the stencil screen to print one color in a pattern on the indexed web portion. The assembly then rises and returns to its initial position, pulling the flow coater **300** back across the screen. The vacuum in platen **170** then is released, while that in bed **169** is held, and platen **170** is shifted back to station **22*a***. The printed web is then progressively pulled to and through dryer **24** by the next printer **26**, as printer **22** advances more slack from chamber **16**. When the printed web is advanced to the next printer, it is accurately registered therewith by the index pins in this next printer. Then the vacuum bed is advances as with the first printer, so that when the web portion is printed with another color in a selected pattern, exact registry with the first ink pattern, now dried, occurs.

The web continues through the selected number of printers to the final dryer, after which the web is optionally worked on with the supplemental devices **30, 34, 36, 38** and **40**.

In actual practice, the system has worked extremely well, enabling very accurate, high quality, multicolor print patterns to be automatically reproduced hour on end, at a cost which is only a fraction of that normally encountered.

The unique printers are completely reliable and accurate. Replacement squeegees can be readily substituted between print strokes, so as to not require the system to be stopped.

The unique dryers are rapid, safe, reliable, and thorough, always giving complete web control, and completely cooperative with the printers for continuous operation.

It will be realized that the mechanical linkages and controls could be modified in many ways to suit a particular job, within the concepts taught herein. Hence, the invention is intended to be limited only by the scope of the appended claims and the reasonably equivalents thereto.

I claim:

1. A screen printing system capable of repeat printings of multiple color patterns in registry on portions of a continuous web comprising: means to support a continuous web on a flow path; web punching means in said flow path to punch holes in the web for creating index indicia at controlled intervals on the web; a plurality of screen printing units along said flow path, downstream of said web punching means; web advancing means associated with each of said screen printing units, said web advancing means including a web-supporting printing platen shiftable from a first position upstream of said printing unit to a second position aligned with said printing unit, said platen having pressure-differential web-attraction means at is surface to shift the web between said positions; web index register means at each of said screen printing units mounted for movement with said platen, said web index register means including shiftable projection means oriented and reciprocable toward the web holes to interengage the holes; and means to reciprocate said projection means to cause momentary registry of each web portion with each printing unit for accurate printing.

2. The system in claim **1** wherein said web index register means is mounted to said platen to move therewith, and said means to reciprocate said projections is operably associated with said bed in a manner to withdraw said projections from the holes in the web as the web is being advanced by said platen to said second position.

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