United States Patent [19]

Black et al.

[11] **3,780,651**

[45] **Dec. 25, 1973**

[54] **SCREEN PRINTER INK SUPPLY WITH QUICK COUPLING AND LEVEL SENSING**

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[22] Filed: **Mar. 20, 1972**

[21] Appl. No.: **236,135**

Related U.S. Application Data

[62] Division of Ser. No. 51,852, July 2, 1970.

[52] **U.S. Cl.** **101/115,** 101/124, 101/364, 222/56, 222/64

[51] **Int. Cl.** **B41f 31/00**

[58] **Field of Search** 101/114, 123, 124, 101/364, 366, 335, 115, 119, 129; 222/64, 56; 116/118; 73/290; 137/386

[56] **References Cited**

UNITED STATES PATENTS

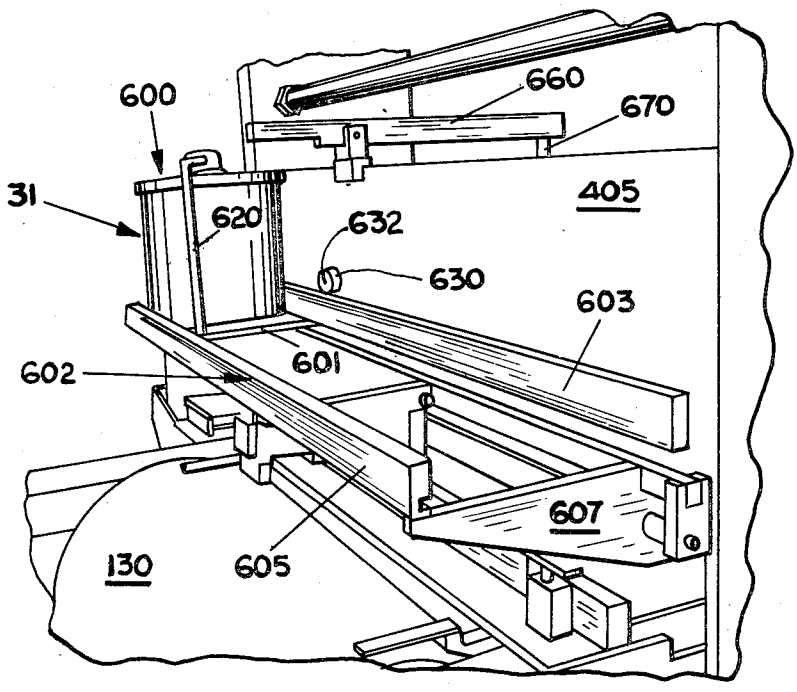
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Primary Examiner—Robert E. Pulfrey
Assistant Examiner—R. E. Suter
Attorney—Peter P. Price et al.

[57] **ABSTRACT**

A stencil screen printing press assembly including a pressurized ink supply means having a sensor and a control valve operably connected thereto. The sensor and control valve serve to cooperatively maintain a predetermined optimum ink level in the stencil screen.

7 Claims, 30 Drawing Figures



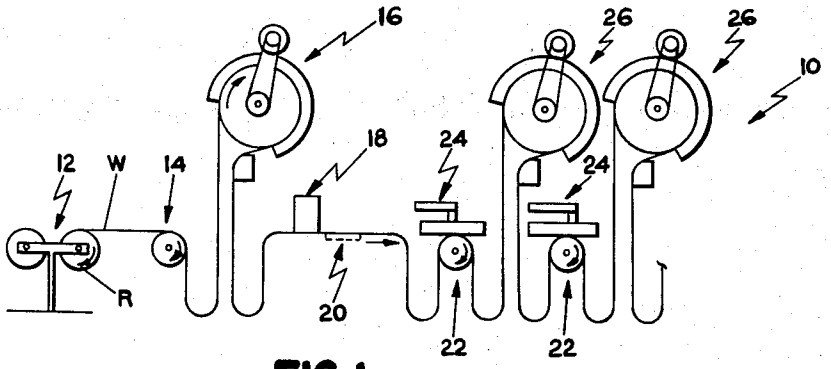


FIG. 1

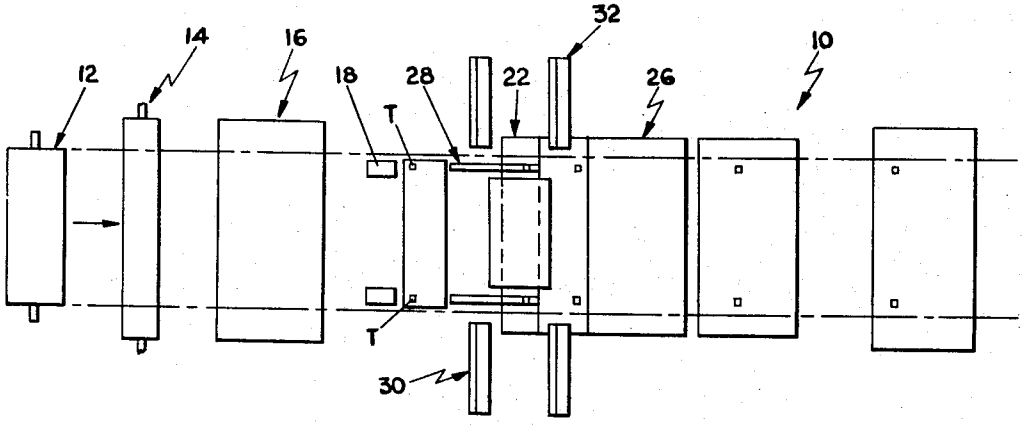


FIG. 2

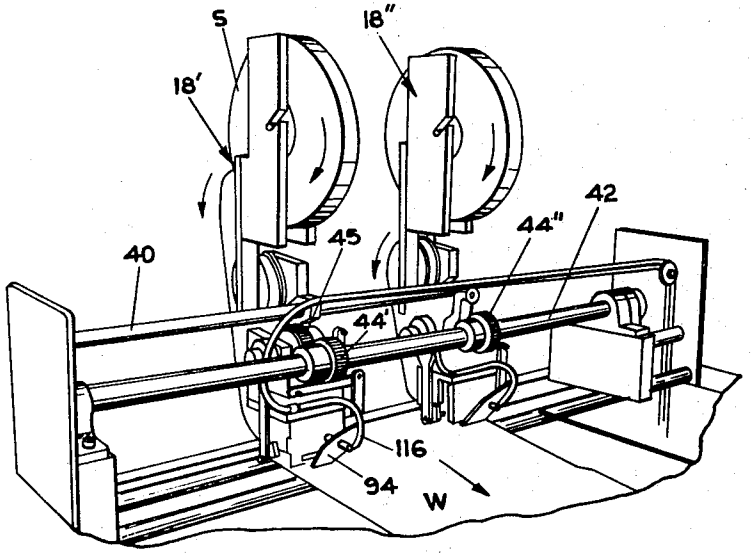


FIG. 3

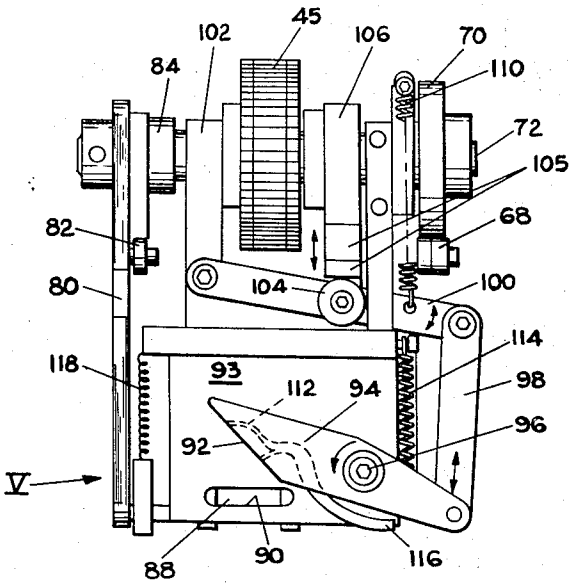


FIG. 4

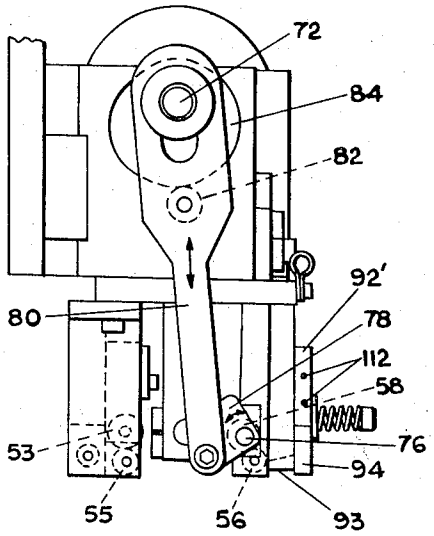


FIG. 5

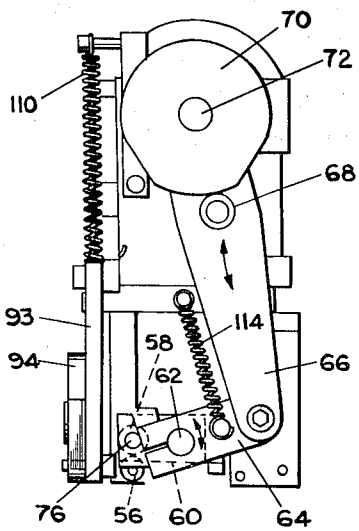


FIG. 6

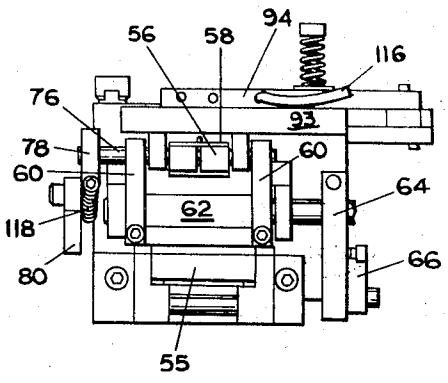


FIG. 7

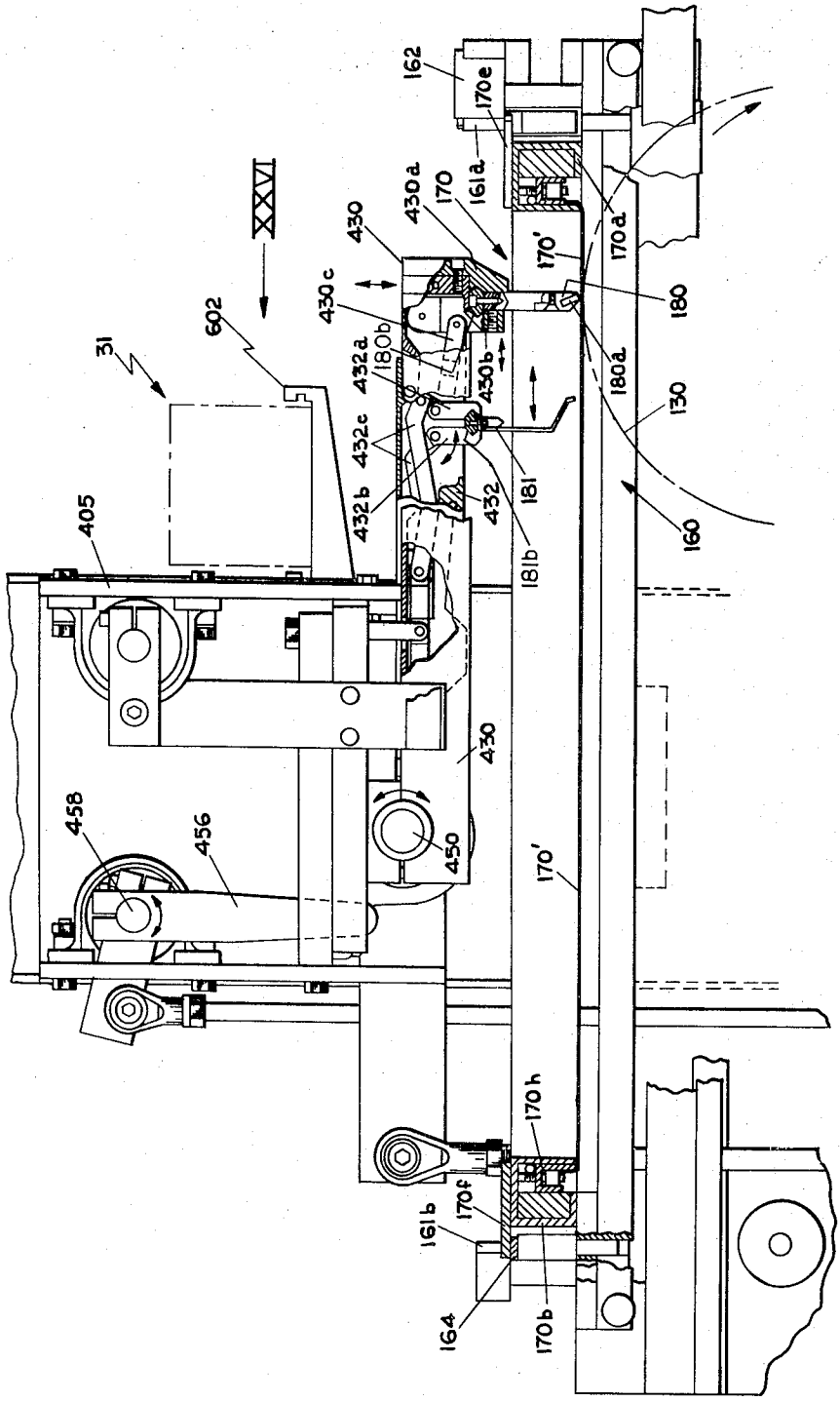

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161a
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XXVI
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170d
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430c
602
180b
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432a
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130
432c
181
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432b
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181b
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170'
170h
170f
161b
164
170b

FIG. 8

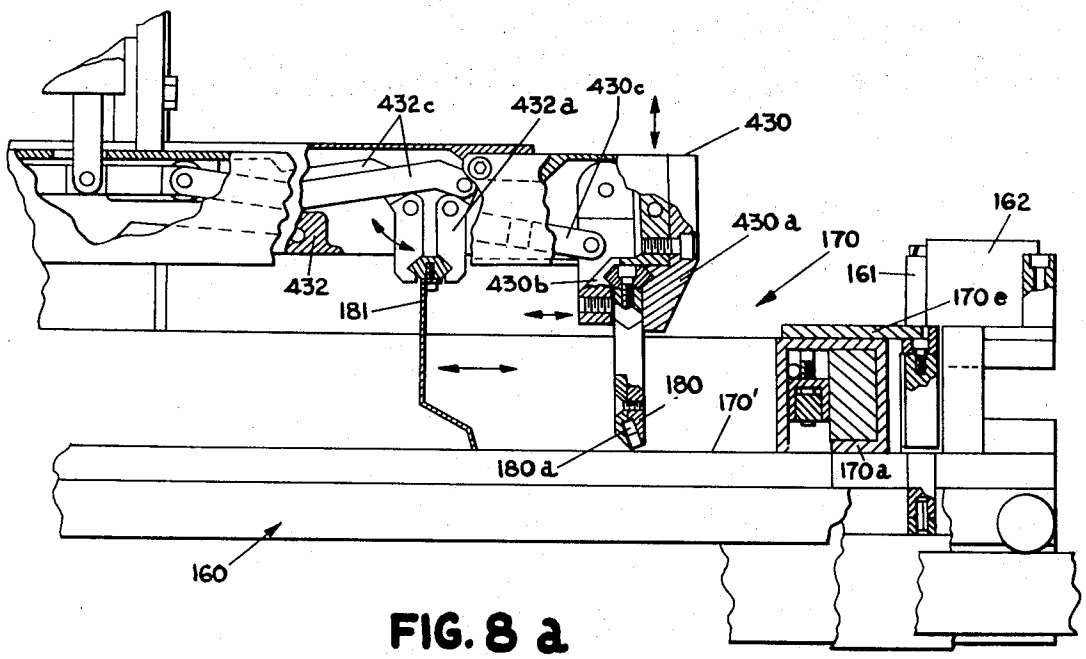


FIG. 8a

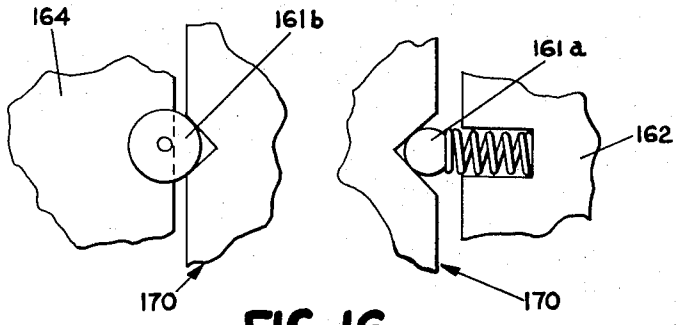


FIG. 16

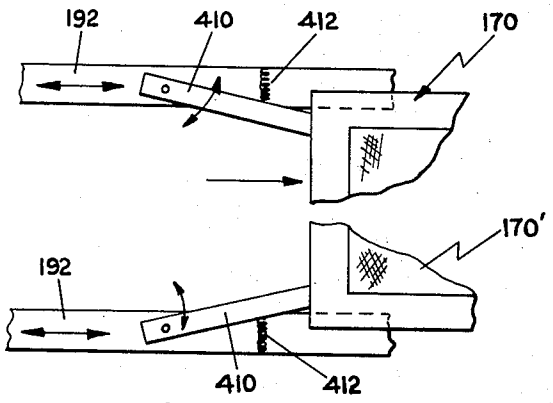


FIG. 17

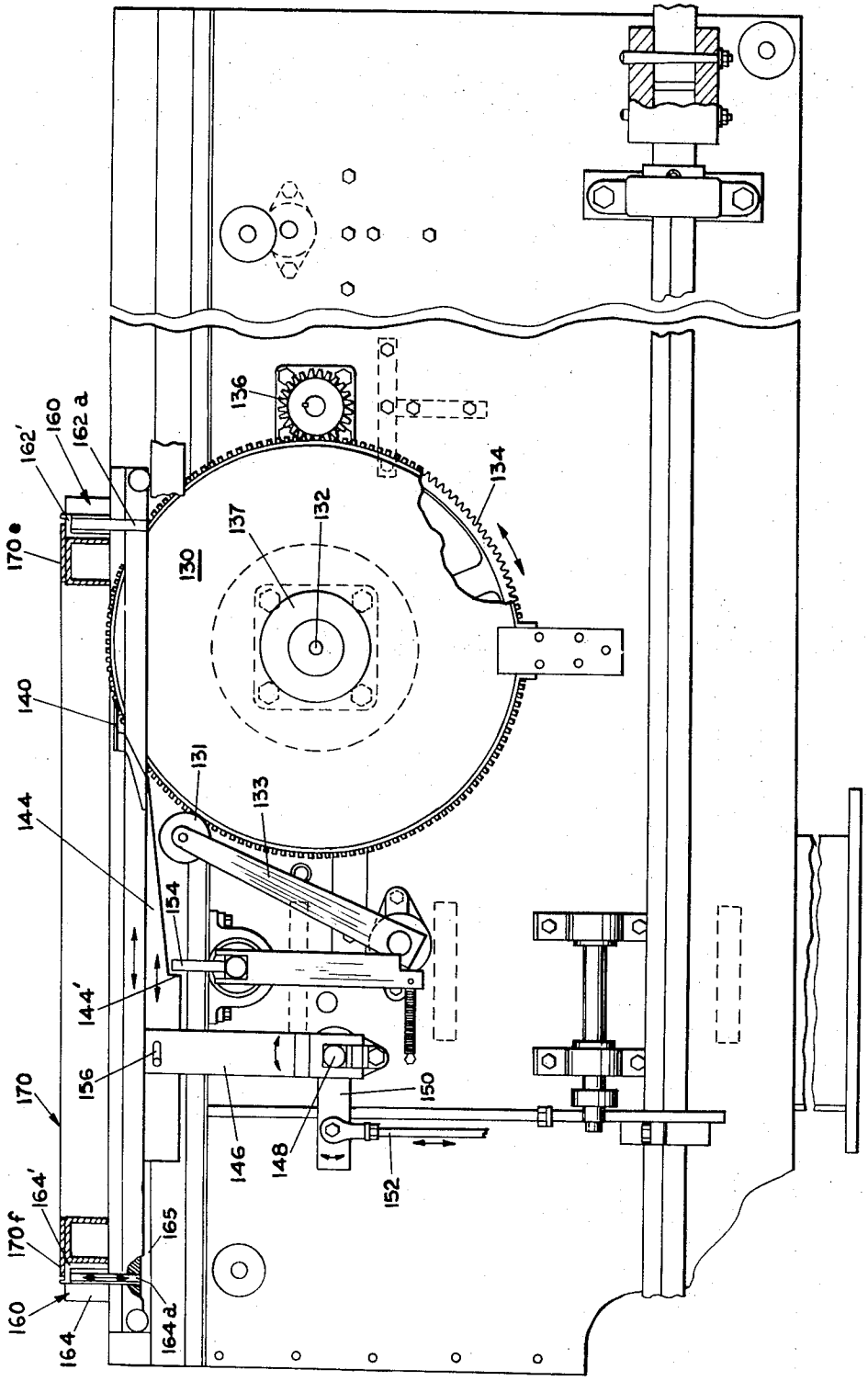

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FIG. 9

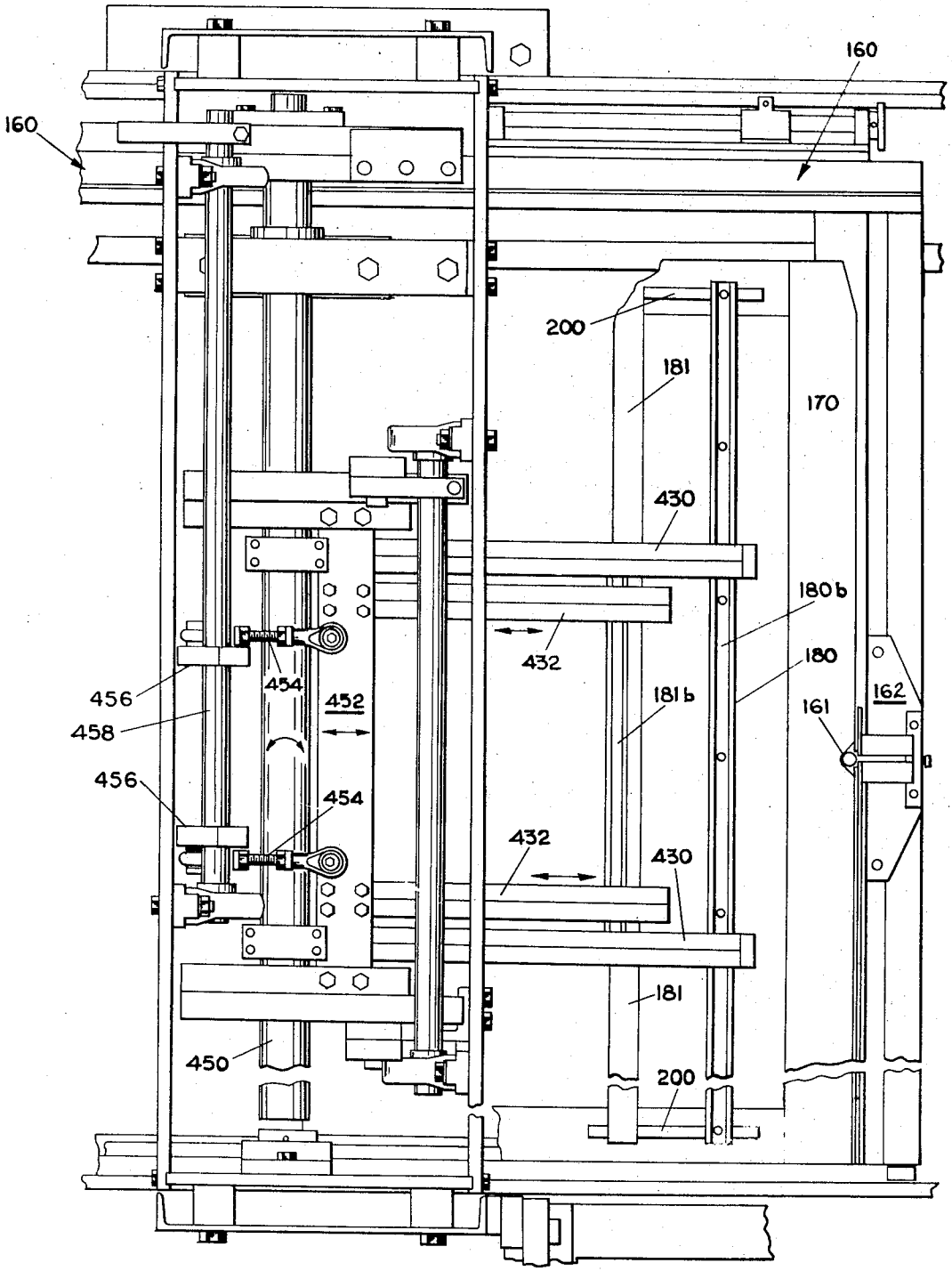

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FIG. 10

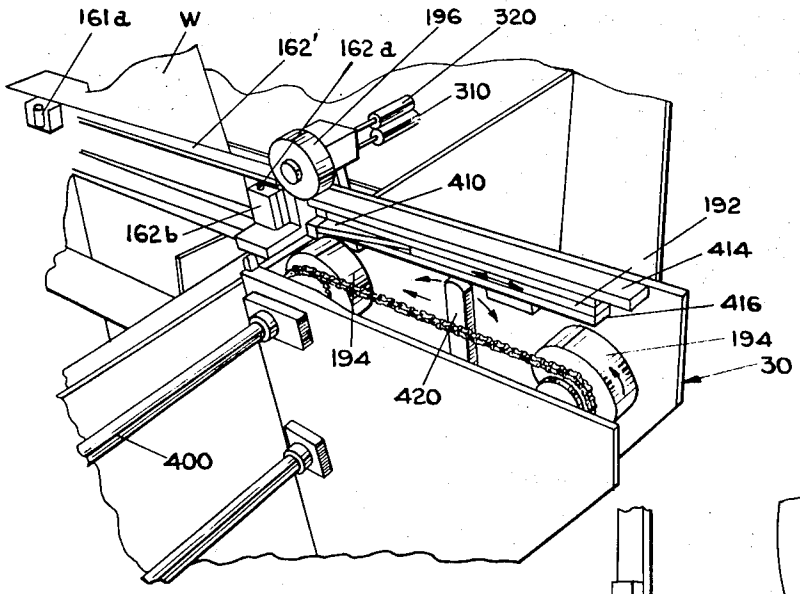


FIG. 15

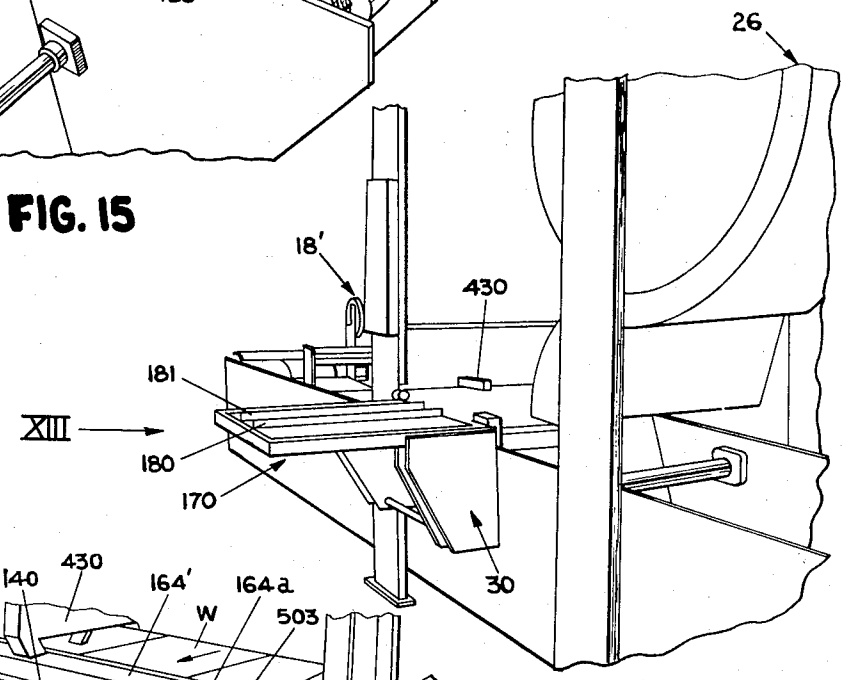


FIG. 11

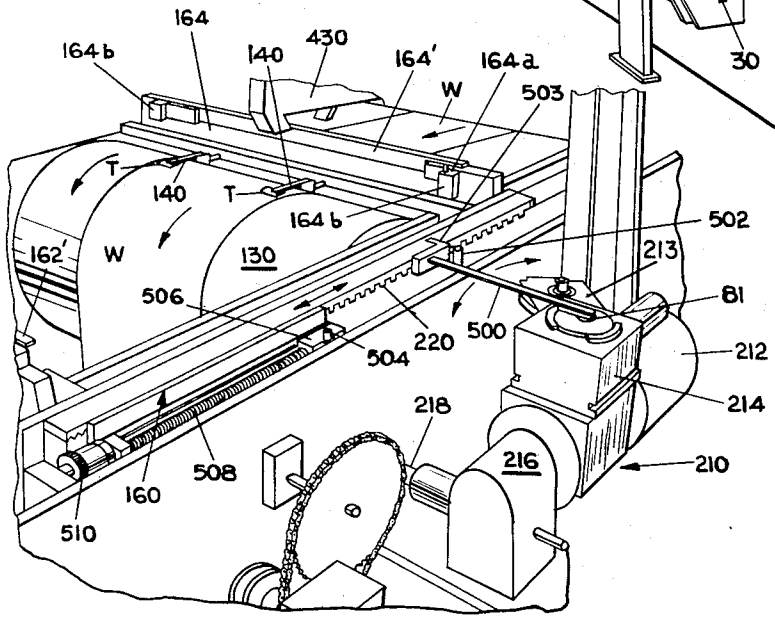


FIG. 12

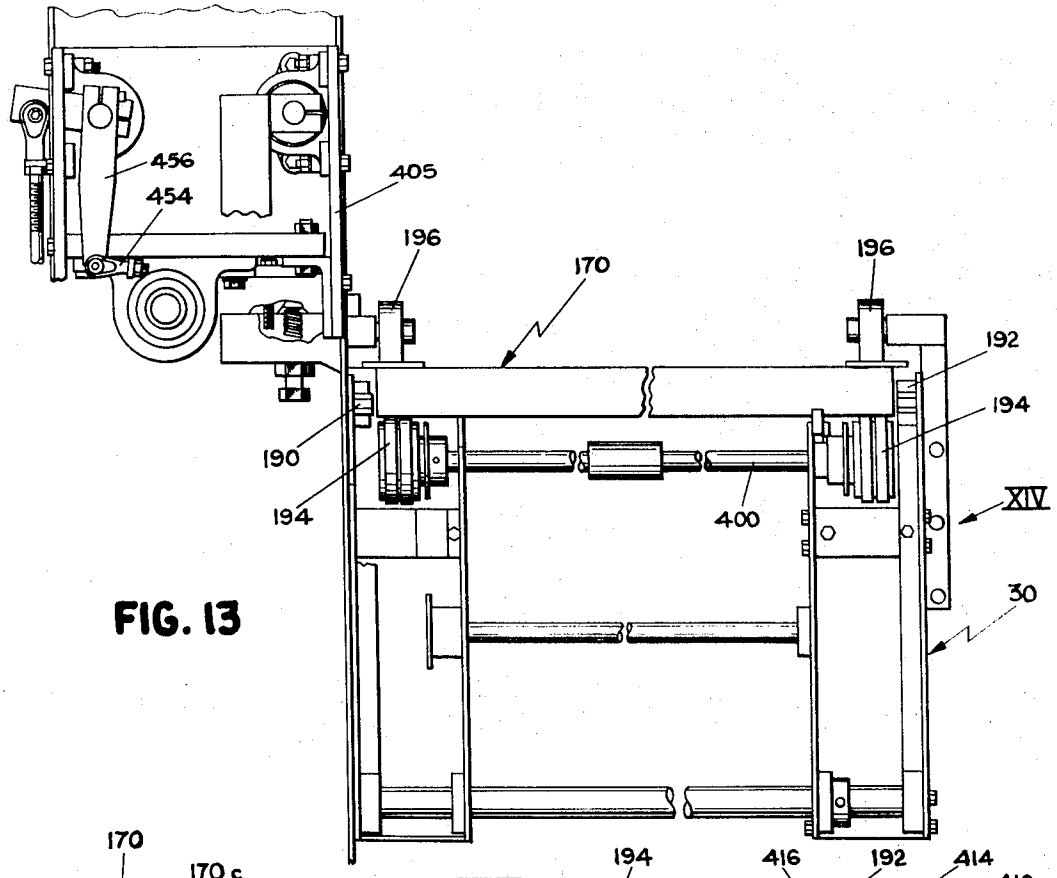


FIG. 13

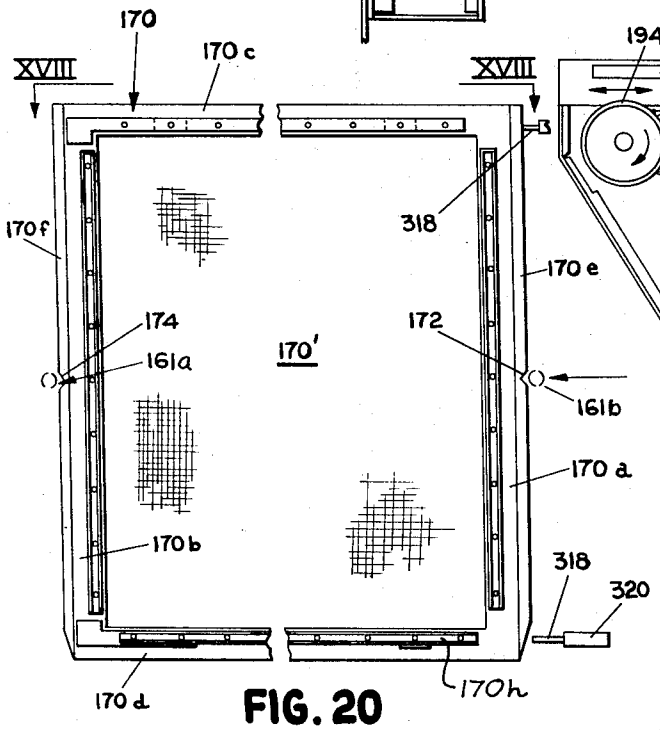


FIG. 20

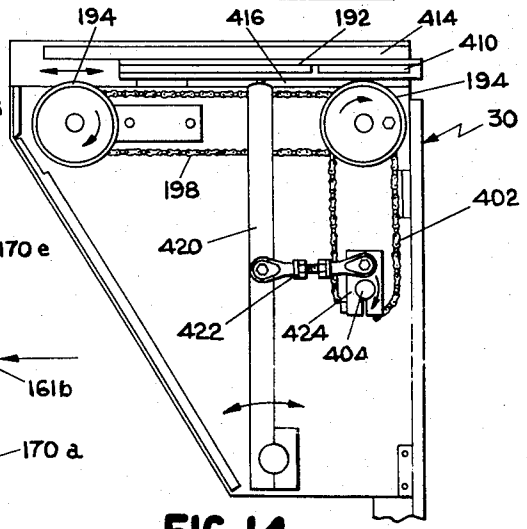


FIG. 14

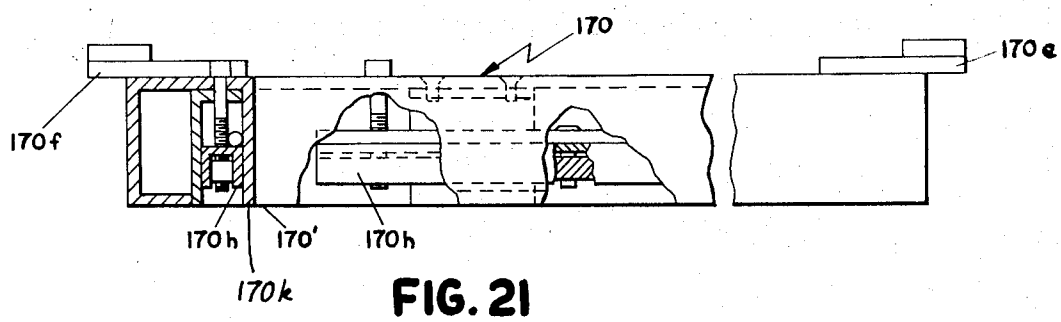


FIG. 21

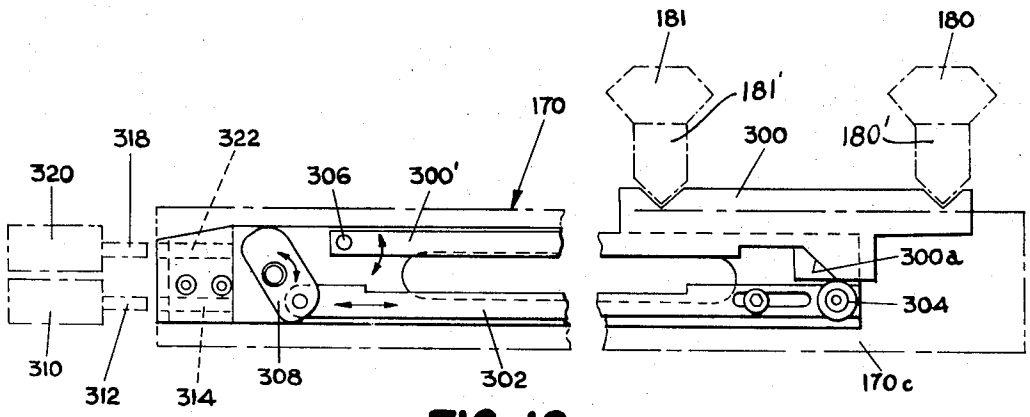


FIG. 18

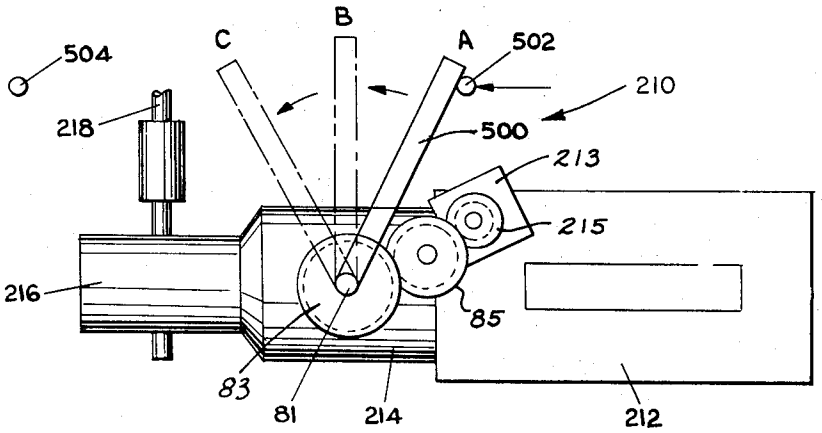


FIG. 23

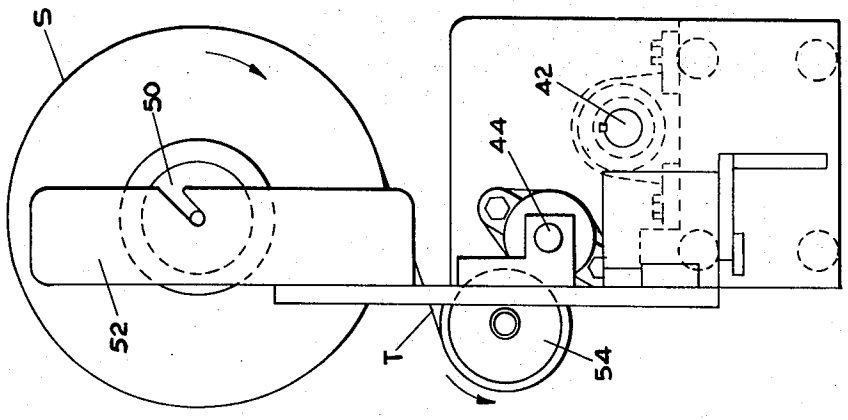


FIG. 22

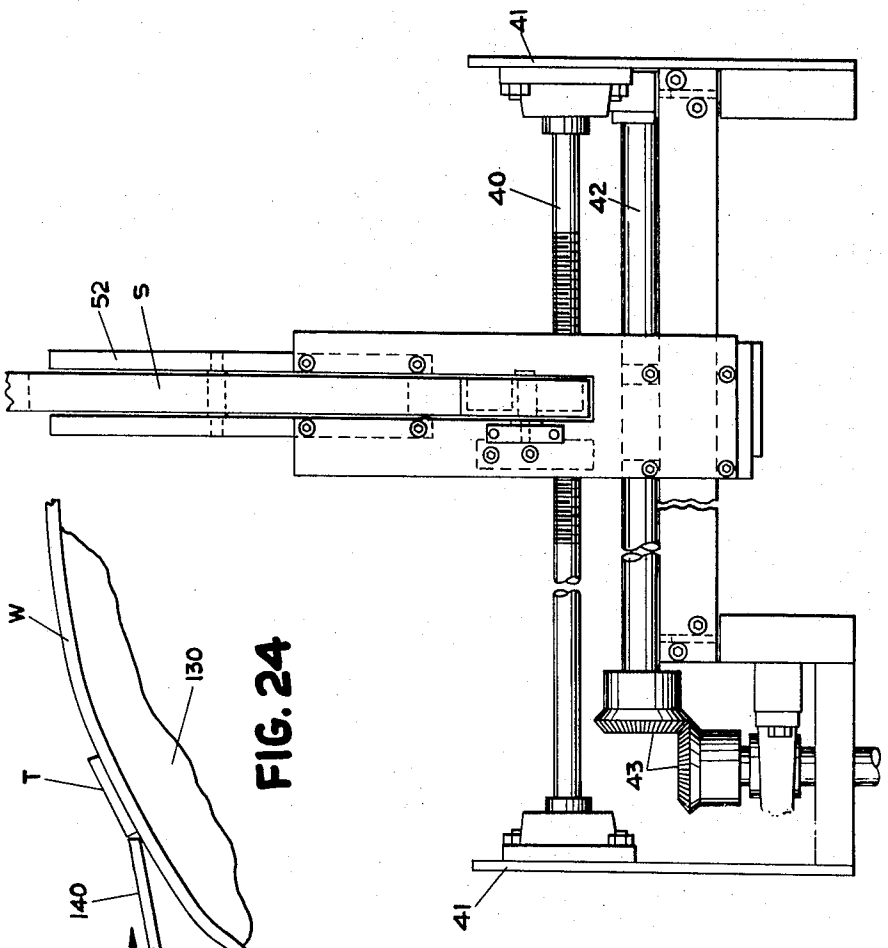


FIG. 19

FIG. 24

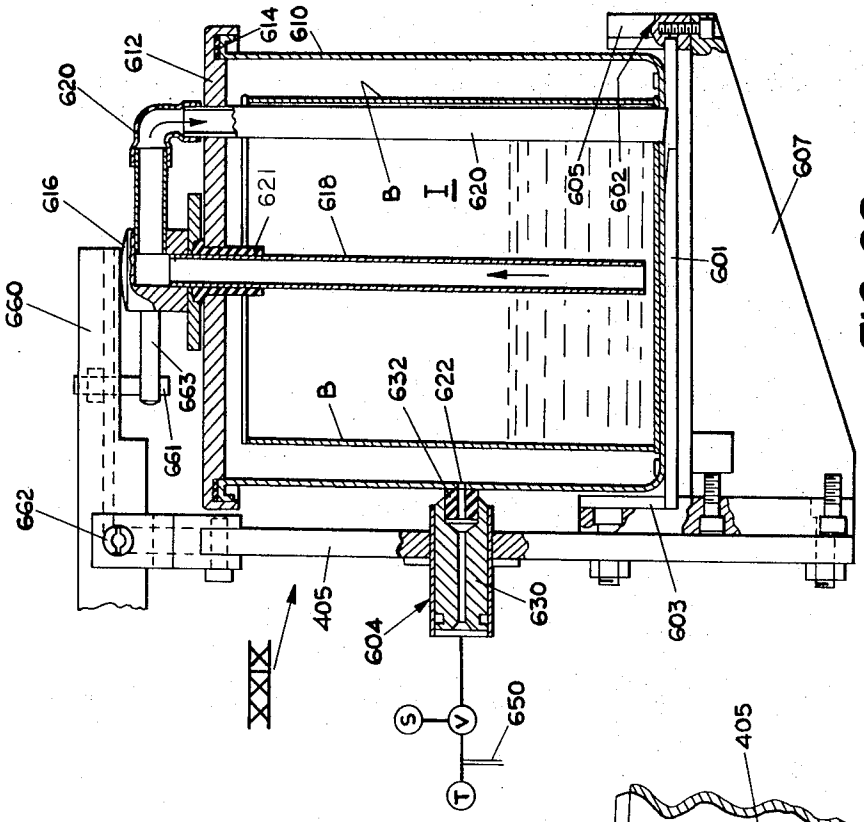


FIG. 28

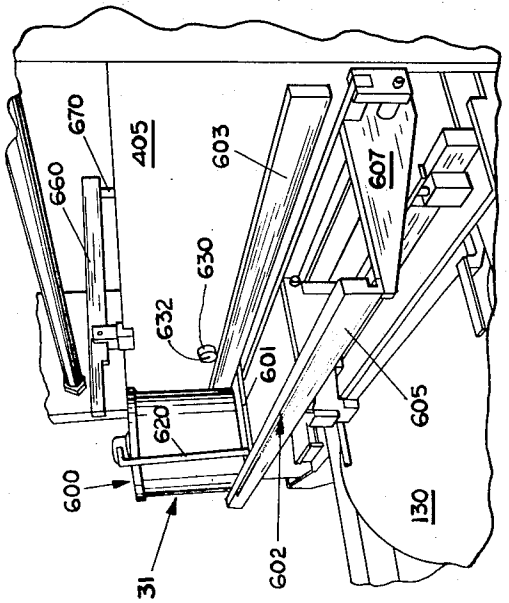


FIG. 25

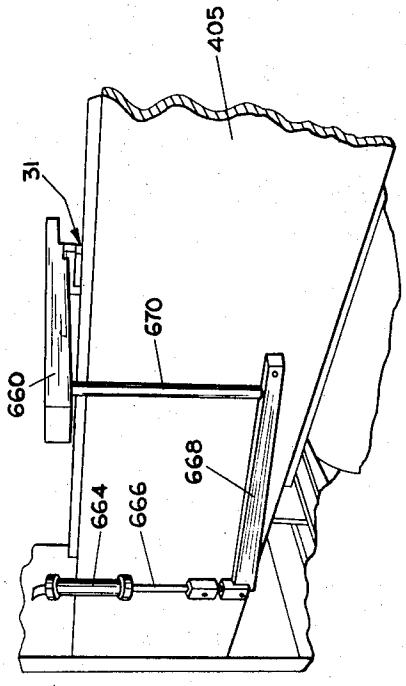


FIG. 29

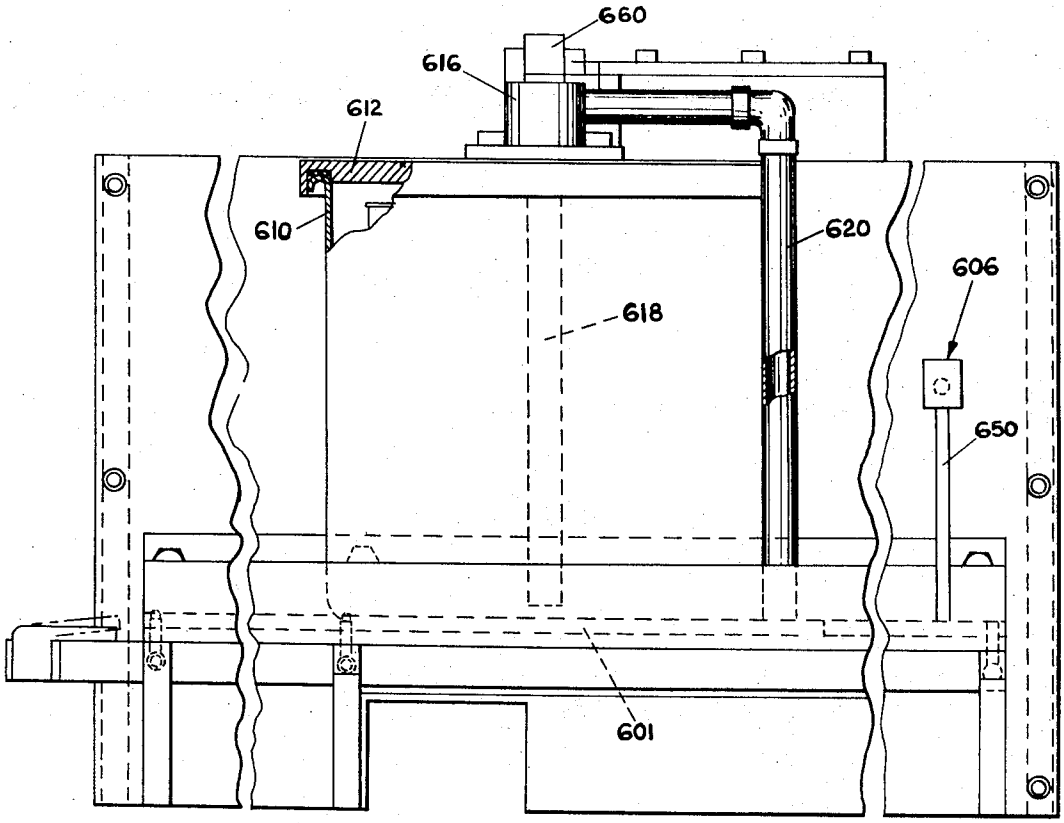

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FIG. 26

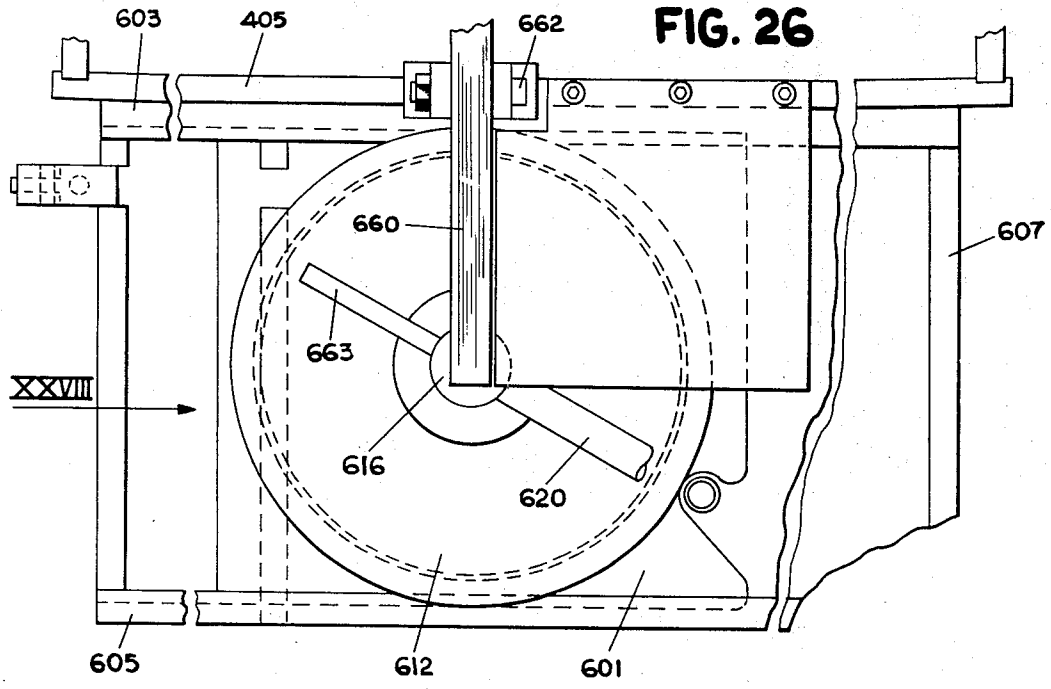

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FIG. 27

SCREEN PRINTER INK SUPPLY WITH QUICK COUPLING AND LEVEL SENSING

This is a division of application Ser. No. 51,852, filed July 2, 1970.

BACKGROUND OF THE INVENTION

This invention relates to web printing apparatus, and more particularly to screen stencil printing on web stock.

Stencil screen printing produces high quality products, as is well-known. Further, with careful control and handling of the stock and equipment, multiple colors can be printed on the sheets by stencil screen techniques. However, typical screen printing is slow, expensive, and demanding of highly skilled personnel. Further, stencil printing normally requires a large number of print cycles to render it worth setting up.

A possibility of overcoming difficulties normally involved in stencil screen printing on sheet stock was considered to exist in developing a special screen printer for web stock. However, although use of web presses for the flexigraphic and lithographic trades were known, the requirements of screen printing are very different and peculiar to it.

The inventor herein previously developed one type of stencil screen printer capable of printing on web stock, as set forth in application Ser. No. 617,885 now U.S. Pat. No. 3,499,233 issued Mar. 10, 1970. Although such apparatus was found useful in making this concept possible, another apparatus for stencil printing on web stock, set forth herein, was invented which rendered stencil screen printing not only possible but extremely advantageous.

SUMMARY OF THE INVENTION

It is a primary object of this invention to provide unique stencil screen printing on web stock in a fashion that effects highly versatile and efficient quality screen printing. Productivity values of almost 100% per print unit are achieved in comparison with approximately 60% experienced with present commercial screen printing on sheet stock. Scrap losses of only about 2–3% maximum are achieved in contrast to about 10–17% with present screen printing on sheet stock. Running of relatively small stencil print jobs can now be readily and economically accomplished. This not only renders an unprofitable area of business profitable for the printer, but also enables him to run samples of larger jobs, and fill partial orders at production speeds. The apparatus is even capable of screen printing color process work because of its associate registry. Registry is no longer a tremendous problem. Also, even a selected number of additional colors can be added to the web without significant added cost. Registration in this invention is positive and continuously reliable. It does not require stock orifices which disadvantageously tend to enlarge. It does not require a tension in the web between operation stations, thus eliminating web stretch. The registry is extremely accurate in contrast to the plus or minus 5–10 mils of web registry systems for (non-stencil) web printing on the market. The web is also laterally and longitudinally registered at each station in the operation. The invention employs unique tab or butt registry wherein applicators apply tabs to the web at intervals, such tabs cooperating with tab engagers to move the web into registry at each station of the operation. Even shrinkage of the web does not destroy registry, as with present web presses which in fact require tension in the web. The tab applicator applies the registry tab in a special fashion to the advanced web.

Another object of the invention is to provide a unique stencil frame, squeegee, and flow coater assembly. It can be inserted as a unit into a web press. Substitution of another such unit is readily accomplished in seconds when desirable, as for installing a new print pattern, a new color, or for other reasons, avoiding the normal extended shut down presently required. Moreover, the squeegee and flow coater cooperate uniquely with the remainder of the printer to be readily engaged thereby and released therefrom, as for substitution of another assembly unit, or the like. The novel stencil frame specially supports the detachable squeegee and flow coater, and cooperates with squeegee and flow coater elevating means for their positioning into mounting relation to the web printer apparatus. The web printer apparatus specially changes the squeegee and flow coater for operation, and for subsequent release when desired. The screen frame and screen are automatically registered in place on the press, in sharp contrast to the tedious registry problem with prior sheet screen printing. These features contribute to the tremendous versatility and to the accuracy of registry of the equipment.

Another object of this invention is to provide a unique screen frame, squeegee, and flow coater combination with a stencil press whereby the stencil screen need not be deformed a substantial fraction of an inch during printing as usually is necessary. Hence, stencils of highly flexible material need not be employed, allowing use of materials of greater stability and longer life. Further, the screen need not be extra large as usual to provide enough screen for flexing. Then too, no significant stress need be applied to the stencil fabric to weaken and fatigue it or to cause change of registry.

Another object of this invention is to provide a stencil printing press with special web advancement and control means. Intermittent advancement of the web is repeatedly accurately achieved without web tension.

Another object of this invention is to provide a stencil printing press with unique stencil frame loading and unloading, capable of rapid simple frame exchange.

Another object of this invention is to provide a novel ink supply system for printing apparatus, particularly suited to web printing equipment to enable complete automation thereof. The correct amount of ink is maintained on the stencil screen in the frame. No messy and time consuming transfer of ink from containers to the frame and screen are necessary. The ink level is constantly sensed, with controlled amounts being added to maintain optimum ink level from a pressurized container readily loaded into the press.

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

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view of the printing apparatus of this invention;

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

FIG. 3 is a fragmentary perspective view of the tab applicator portion of the novel apparatus;

FIG. 4 is an enlarged front elevational view of one of the two tab applicators illustrated in FIG. 3;

FIG. 5 is a side elevational view of the tab applicator in FIG. 4, taken from the direction illustrated at V in FIG. 4;

FIG. 6 is a side elevational view of the tab applicator in FIGS. 4 and 5, taken from the opposite side as FIG. 5;

FIG. 7 is a bottom view of the tab applicator in FIGS. 4–6;

FIG. 8 is a fragmentary side elevational, partially sectioned view of one of the printing stations of this apparatus, showing the apparatus above the printing cylinder;

FIG. 8*a* is an enlarged fragmentary view of a portion of FIG. 8;

FIG. 9 is a side elevational view of one of the printing stations of this apparatus, showing the structure adjacent the printing cylinder;

FIG. 10 is a top plan view of the apparatus illustrated in FIG. 8;

FIG. 11 is a fragmentary perspective view of one of the printing stations of this apparatus, as viewed toward the upstream end of the apparatus particularly illustrating the stencil screen frame insert means;

FIG. 12 is a fragmentary perspective view of one of the printing stations of this apparatus, showing the combination of the printing apparatus with the Floyd drive control;

FIG. 13 is a fragmentary end elevational view of the stencil screen frame insert means viewed in the direction XIII in FIG. 11;

FIG. 14 is an elevational view taken in direction XIV on FIG. 13;

FIG. 15 is a fragmentary perspective, somewhat enlarged view looking down upon the stencil screen frame insert means in FIGS. 13 and 14;

FIG. 16 is a fragmentary enlarged view of the interfitted alignment means between the stencil frame and the carriage;

FIG. 17 is a fragmentary plan view of part of the frame infeed pusher mechanism in FIGS. 13 and 14;

FIG. 18 is a side elevational view of one of the stencil and squeegee elevating devices of the novel stencil screen frame of this invention;

FIG. 19 is an elevational view of one of the tab applicator means;

FIG. 20 is a plan fragmentary view of the bottom of one of the novel stencil screen frame units;

FIG. 21 is an elevational partially sectional fragmentary view of the apparatus in FIG. 20;

FIG. 22 is a side elevational view of the tab applicator in FIG. 19;

FIG. 23 is a partial plan view of the Floyd drive unit in FIG. 12;

FIG. 24 is an enlarged fragmentary view of the tab pushing registry step.

FIG. 25 is a fragmentary perspective view of a printing station showing the novel ink supply container means being introduced;

FIG. 26 is a fragmentary elevational view of the apparatus in FIG. 25, viewed from the direction XXVI in FIG. 8;

FIG. 27 is a fragmentary top plan view of the apparatus in FIG. 26:

FIG. 28 is a side elevational, sectional view of the apparatus in FIG. 27, taken in the direction XXVIII; and

FIG. 29 is a fragmentary perspective view of the apparatus in FIG. 28 viewed generally from the direction XXIX.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The novel stencil screen printing press assembly for printing on generally continuous web stock employs a plurality of unique features in cooperation with each other for optimum results. For purposes of convenience, the successive stages in the printing operation will be discussed in sequence, along with the features involved with the respective successive stages.

Referring now specifically to FIGS. 1 and 2, the complete combination 10 there illustrated employs, in the normal usage of this invention, a roll stand subassembly 12, an unwinding wheel subassembly 14, a conditioning drier subassembly 16, a tab application subassembly 18, a web infeed subassembly 20 for the tab applicator, at least one and normally more printing stations including printing cylinder subassemblies 22 and stencil and squeegee subassemblies 24 as well as print drier subassemblies 26. Also, the apparatus employs web advancing subassembly 28 at each printing station, utilizing the tabs applied by tab applicators 18, stencil screen infeed subassembly 30 and outfeed subassembly 32 for each printing station and ink supply subassembly 31 (FIGS. 25–29) at each printing station.

The novel stencil screen printing apparatus prints one or more colors in accurate registry on a generally continuous web W which is normally unwound from a suitable roll R of web stock. Preferably, rolls are mounted on a flip-over roll stand subassembly 12. Such roll stands are conventional. The web stock is preferably unrolled by a rotating cylinder 14 which preferably uses vacuum gripping means or the like for pulling the web. The web stock slack created by roll 14 is advanced over the rotating conditioning drier 16, and then advanced past tab applicators 18 by a reciprocating table 20 or the like. This forwardly and rearwardly reciprocating table preferably employs vacuum gripping of the web during forward movement, to advance the web a definite increment, and then returns beneath the web, so that the web is advanced in intermittent fashion. Movement of the web through the elevated temperature drum drier subassembly 16 conditions it so that the shrinkage or other dimensional variations which might occur during application of heat and evaporation of moisture will occur prior to the registry tab applicators and prior to the first print station.

At subassembly 18, the web has registry tab means applied thereto. These tabs T (FIGS. 2 and 12) are preferably secured to the web by a pressure and/or heat activatable adhesive on the tabs. The individual tabs may be flat, configurated, and of varying dimensions to suit the particular type of web stock involved and provide the desired rear edge surface area. In some instances, it may be advisable that the tabs be an extended tape transversely across a significant portion of the web. However, normally it is necessary to only have a pair of relatively small tabs applied on opposite sides of the center line of the web stock, for accurate web advancement and registry purposes using these tabs, as will be explained more fully hereinafter. In the illustrated form of the invention, tab applicator subassembly 18 includes a pair of like applicators 18′ and 18″ (FIG. 3). These are laterally adjustably mounted to

threaded support bar 40 (FIG. 19) extending transverse to the direction of web movement and rotatably mounted on its ends to side support plates 41. The applicators are powered for tab application through a transverse rotational drive shaft 42 driven with bevel gears 43 by suitable power means (not shown). Shaft 42 has spur gears 44' thereon, engaging with spur gears 45 on the main shaft 72 of tab applicators 18' and 18'' (FIGS. 3 and 4). The applicators apply tabs at intervals, i.e. at controlled spaced longitudinal distances along web W. However, this spacing is not critical as will be understood more fully hereinafter.

Since applicators 18' and 18'' are alike, only one will be described in detail. The strip of material to be cut into tabs applied to the web stock by the applicator subassembly (FIGS. 1–7, 19 and 22) is wound on a spool S on a hub 50 rotatably supported on uprights 52. The tape T is pulled from this spool, guided around roller 54, passes between rolls 53 and 55 (FIG. 5) and then between rolls 56 and 58 to be fed intermittently to a position where it is cut off and applied to the web. More specifically, the tape is pulled intermittently between idler roller 56 (FIG. 6) and an intermittently powered roller 58 which is shifted into engagement with idler 56 during the tape advancement portion of the cycle, and out of engagement with idler 56 thereafter. This shift is possible by having power roll 58 mounted on a pair of spaced parallel pivot links 60 (FIGS. 6 and 7) which in turn are pivotally mounted on shaft 62. In this shifting movement, roll 58 is rotated through an arc, intermittently, as explained herinafter. Also mounted on the extended end of this shaft 62 is another link 64 which is also pivotally connected to link 66. Link 66 has a cam follower 68 in engagement with the periphery of a configurated cam 70 on power shaft 72. Rotation of shaft 72 and therefore cam 70 reciprocates link 66 linearly in one direction, while spring 114 returns it, causing arcuate oscillation of link 64 and link 60, to place power roller 58 into and out of engagement with idler roller 56. On the other end of power shaft 72 is mechanism for rotating power roller 58 through a controlled arc when it is in engagement with idler roller 56, so as to intermittently frictionally advance the tape therebetween. More specifically, power roller 58 is mounted on a driven shaft 76 to the extended end of which an oscillatory link 78 is affixed (FIG. 5), with crank 80 being pivotally connected to link 78. This crank is linearly oscillated in one direction by its cam follower 82 engaging an eccentric cam 84 mounted on shaft 72, and in the other direction by return spring 118. The tape is fed between rollers 56 and 58 to have its end portion projecting through the laterally elongated orifice 88 (FIG. 4) aligned with these rollers. This orifice has an outer edge 90 which constitutes a cutting anvil or edge. Edge 90 is cooperative with the lower cutting edge 92 on pivotal member 94. This member forms a cut off and applicator device as will be explained.

Member 94 is pivotally mounted intermediate its ends to fixed plate 93 on a pivot pin 96, with its other end pivotally connected to a link 98. Link 98 is in turn pivotally connected to link 100 which is pivotally mounted to a fixed support 102 on its opposite end, and includes a cam follower 104 intermediate its ends. Cam follower 104 is actuated by eccentric cam 106 rotating on shaft 72 through an intermediate, vertically shiftable member 105. Hence, rotation of cam 106 indirectly causes vertical reciprocation of link 98 and element 94 into the cocked position shown in FIG. 4, from which it can be released to allow tension spring 110 to rapidly shift the linkage and move element 94 past the projected tape end. This causes the free end of element 94 to sweep downwardly past cutting edge 90 of opening 88 to sever the portion of tape projecting therefrom. Vacuum passages 112 (FIGS. 4 and 5) in element 94, terminating adjacent its undersurface 92' alongside edge 92, causes the severed tape portion to be held against the under surface 92' until element 94 pivots far enough to smack the severed tape or tab against the surface of the web stock passing therebeneath. Suction is applied to passages 112 by connecting tube 116 to a vacuum unit (not shown). Actually, therefore, cam 106 cocks links 98 and 100 against the bias of tension spring 110, which causes element 94 to snap down sharply against the web stock with the severed tab for firm application thereof.

After the tabs are applied, the back edges thereof are employed for accurate registry of web sections at the succeeding plurality of printing stations.

At each printing station is a printing drum or cylinder subassembly 22, a stencil subassembly 24, and web advancing subassembly 28 that employs the tabs for advancement and registry. Since each web advancing subassembly 28 advances web stock from a slack condition into a registered position at its printing station, an infeed vacuum table 20 is provided immediately downstream of the tabbers to provide slack in the web just prior to the first printing station. This table 20 reciprocates from a web gripping position adjacent the tabbers to a web release position upstream of the first printer, and then returns.

The advancing subassembly 28 engages behind a pair of tabs on the slackened web and forces the web forwardly arcuately along the printing drum surface to the exact desired registry position. More specifically, in order to get the web in proper registry on the particular printing cylinder, at each print stroke, the back edges of the special tabs applied to the web are engaged and pushed by a pair of blade-like elements 140 (FIGS. 9 and 12) that follow the curvature of the drum. Pushing movement of the blades along the surface of the drum forces a portion of the web to be advanced therewith. Normally, the web is held against an arcuate portion of drum 130 by biasing rubber rolls 131 (FIG. 9) mounted on pivotal supports 133. These rolls are normally shifted away from the drum surface during web pushing by said blades, to allow uninhibited registry of the web. The primary purpose of the rolls is to assure web advancement on the rotating drum, when the particular station at the drum is not used for printing, by assuring good frictional engagement of the web on the drum. When printing is conducted at the station, pressure of the squeegee and the screen on the web against the drum assures sufficient frictional engagement for web advancement with the rotating drum. These blades 140 are mounted on supports 144, (FIG. 9) which in turn are mounted on upstanding legs 146 pivotally mounted at their lower ends to pivot shaft 148. Extending radially from shaft 148 is another link 150 connected to a tie rod 152 which, when linearly oscillated, causes arcuate oscillation of link 150 and leg 146, to cause oscillation of supports 144 and blades 140. Suitable power means (not shown) drives rod 152. In FIG. 9, the web would be advanced to the right over the crown of drum

130 (as the structure is viewed) until an abutment surface 144' on support 144 struck adjustable stop 154. Further attempted movement of legs 146 in their arcuate manner causes a lost motion to occur in the lost motion connection 156 between legs 146 and supports 144. Thus, the stopping point of the blades 140 can be very accurately controlled by adjustment of stop 154, to thereby accurately control the stopping position of the web during printing and this small registration advancement of the web occurs while drum 130 is stationary. The drum rotates forwardly during printing as will be described. Since the apparatus at each printing station is the same, only one will be described in detail.

Drum 130 at each printing station is rotationally mounted on a transverse axle 132. The drum is intermittently advanced through a controlled arc of rotation during the print stroke. This rotational movement is accompanied by linear advancement of the printing carriage that supports the stencil screen frame mechanism. The drive power for these components is obtained from the Floyd drive unit 210 (FIGS. 12 and 23) which includes an electrical motor 212, a position and direction control 214, a control motor 213, and a gear box output 216 with an output shaft 218 that has a gear 136 (FIG. 9) on its inner end to drive the larger gear 134 of the printing cylinder 130. Gear 134 actually drives cylinder 130 through a vacuum clutch 137 to cause the cylinder to rotate in only one (the forward) direction. Gear 134 engages an inverted gear rack 220 (FIG. 12) adjacent the printing cylinder, which rack is mounted to the printing carriage to reciprocate it back and forth above the cylinder. More specifically, immediately above the printing cylinder at each printing station is the reciprocable rectangular carriage 160 with front and rear brackets 162 and 164 for mounting a stencil screen frame subassembly 170 therebetween (FIG. 8 and 10). This carriage is adapted to reciprocate forwardly over and immediately adjacent the printing cylinder during the printing stroke, i.e. toward the downstream direction, and then to return to its starting position while in an elevated position spaced from the cylinder. The carriage registration means for registering the stencil frame and carriage which includes a pair of detents 161*a* and 161*b*, in the center of the rear (i.e. most downstream) and front (i.e. most upstream) portions 162 and 164, respectively, to fit into V-shaped notches in the center of the front and rear of each inverted stencil frame, for alignment. Detent 161*a* is movable and spring biased toward the frame to provide means for interlocking the frame and the carriage. Detent 161*b* is rotational on a vertical axis, but otherwise fixed to resist the pressure applied thereto by the frame during the printing stroke. The carriage has a special lifting action for the stencil frame for its return, nonprint stroke. This will be described after the stencil frame detail has been explained.

Each of the stencil screen frame subassemblies (FIG. 20) 170 comprises a basically rectangular frame structure formed of front leg 170*a*, rear leg 170*b*, and side legs 170*c* and 170*d*. It is capable of mounting a stencil screen 170' over the interior space defined by the peripheral frame. The frame has a forwardly extending flange 170*e* and rearwardly extending flange 170*f*, to enable the frame to rest upon support surfaces of carriage 160. In the center of these flanges are V-shaped vertically extending notches 172 and 174 into which alignment members 161*a* and 161*b* of carriage 160 engage when a frame is inserted into position. These stencil screen frame subassemblies are introduced from the side of the apparatus, and snap into aligned position as will be explained more fully hereinafter.

In the legs of the stencil screen frame are conventional screen stretching member 170*h* (FIG. 8) which grip the edges of the screen 170' and pull it tightly to form a stencil surface over which the squeegee 180 and flow coater 181 operate. The screen of course has a printing design preformed on it in conventional fashion.

In this invention, a significant feature is the use of a special assembly of stencil screen frame, squeegee, and flow coater, all insertable and removable as a unit into and out of the printing stations. The squeegee and flow coater are supported on the stencil frame when the latter is inserted into the printing station, and then are clamped by the printer mechanism. The stencil frame has unique means for supporting the squeegee and flow coater during this operation. That is, a pair of special supports shiftable between an elevated supporting position and a lowered inactive position are provided inside the frame. More specifically, referring to FIGS. 18 and 20, a support mechanism is included in each of frame legs 170*c* and 170*d*. Since they are identical, only one will be described by use of FIG. 18 taken from the direction XVIII–XVIII in FIG. 20. Support 300 is shiftable between the illustrated elevated support position where it engages one end of squeegee 180 and one end of flow coater 181, and a lowered inactive position inside the frame leg when the squeege and flow coater are clamped by the printer mechanism (in a manner to be hereinafter described relative to FIG. 8). The other ends are supported by such a support in the opposite frame leg. The upper edge of support 300 has a pair of V-shaped notches to receive the correspondingly shaped ends of these elements (FIG. 18). When so supported, the squeegee and flow coater hang suspended in the frame above the screen 170'. The hexagonal upper ends of the elements protrude so as to be readily clamped as in FIG. 8. Support 300 is elevated as in FIG. 18 by longitudinal shifting of bar 302 and its roller cam 304. The tapered edge 300*a* under support 300 follows roller 304 to cause bar 300' on the end of which is support 300 to pivot vertially about pin 306. Bar 302 is shifted for its elevating function by rotating link 308 to which bar 302 is pivotally attached, counterclockwise as it is viewed in FIG. 18. This is done by actuating a motor such as fluid cylinder 310 whose pin 312 is inserted through frame opening 314 into engagement with link 308. Retraction of the support 300 is achieved by shifting rod 302 in the reverse direction. Pin 318 of cylinder 320 does this by extending through frame opening 322 into engagement with link 308 to rotate it clockwise (as viewed in FIG. 18).

Cylinders 310 and 320 are mounted on the printing press at each printing station to act upon the frame mechanism when the frame has been inserted in carriage 160 in a fashion that the V notches 172 and 174 (FIG. 20) are engaged with corresponding alignment elements 161*a* and 161*b*. The frame, squeegee, and flow coater assembly is inserted laterally in a fashion to be described.

When so inserted, the frame can be advanced with carriage 160, forwardly in a print stroke, and rearwardly in a return stroke. When in the return stroke the frame is elevated a fraction of an inch to move its sten-

cil screen clearly out of engagement with the web stock resting on the printing cylinder. The frame is elevated by elevating a pair of front and rear elongated transverse plates **162'** and **164'** (FIGS. **9, 12 & 15**) upon which the stencil frame rests. Specifically, each of these plates **162'** and **164'** is raised by a pair of vertical pins, **162*a*** and **164*a*** respectively, which shift vertically in guide blocks **162*b*** and **164*b*** (FIGS. **9, 12 & 15**). These pins are raised by a pair of longitudinally shiftable camming bars **165** (FIG. **9**) therebeneath. When this frame is so elevated, the squeegee is elevated even more by its mechanism (to be described) to lift it out of engagement with the stencil screen on the return stroke. However, the flow coater is not vertically moved, as will be explained so that it engages the screen on the return stroke but not on the print stroke.

As previously mentioned, the stencil frame, squeegee, and flow coater are insertable laterally into each printing station as a unit when desired. This unit insertion and removal is very advantageous, since the squeegee and flow coater need not stay in the printing station, and therefore, the machine need not be shut down for a long clean up period. Rather one set is rapidly substituted for another, enabling the printing station to proceed almost immediately with a new print design and/or color.

However, prior to insertion of these three units together into the press (as will be described), they are first placed in cooperative relation to each other. Further, prior to this being done, the stencil, stencil fabric, and stencil frame are assembled. First, the stencil fabric **170'** (FIG. **21**) is stretched onto the frame by extending it under the lower peripheral edge **170*k*** and clamping its four edges within the two part clamps **170*h*** (FIG. **20 & 21**) along the four frame edges, in conventional fashion. The stencil is then attached to the stencil screen fabric, also in conventional fashion. This process is repeated on each stencil frame assembly to be used, all prior to printing. Also, all the stencil screens are checked for register. When these preliminary steps are complete, the squeegee and the flow coater can be mounted on the frame assembly.

These three units are inserted using the mechanism best shown in FIGS. **2, 11, 13** through **15**. Specifically, a squeegee **180** and a flow coater **181** are rested on supports **300** (FIG. **18**) which are elevated (manually if necessary by pushing a pin in hole **314**). Elements **180** and **181** are retained in a parallel relationship by the tapered lower surfaces on the ends **180'** and **181'** thereof interfitting with correspondingly configurated grooves in the upper surfaces of each of the supports **300** (FIG. **18**) receiving these ends of the elements or components.

The three components, as one unit, are then manually positioned on the laterally extending frame infeed subassembly **30** (FIGS. **2** and **11**) so that the squeegee **180** and flow coater **181** extend transversely of the web travel direction, their inner ends being oriented toward the printing station. The parallel front and rear legs (relative to the direction of web movement) **170*a*** and **170*b*** of the stencil frame each rest on pairs of rotatable friction wheels **194** (FIGS. **13** through **15**). These wheels are drivingly interconnected. That is, the two rolls closest the printer are on a common shaft **400**, with the pairs on either side being connected by chains **198**. Shaft **400** is rotated by chain **402** driven by power shaft **404**. These friction rollers advance the frame in most of the way, at which time additional positively acting reciprocating pushers take over the frame infeed function. The pusher mechanism uses a pair of pivotal pusher bars **410** which engage the opposite rear edges of frame **170** (FIG. **17**). These pushers are reciprocated toward and away from the printing station as part of a pair of opposite slides **192** each guided between upper and lower retention elements **414** and **416** which form guide tracks. Pushers **410** are pivotally attached to slides **192** and are biased to a protruding pusher position by springs **412**. Their tapered or sloped back surfaces enable a frame to be advanced past them by the friction rolls by shifting them outwardly against the bias of these springs. Hence, the friction wheels advance the frame to a position where the reciprocating pushers engage the rear edge and push it in the remainder of the way until the pins **161** snap into notches **172** and **174** of the frame. The frame is held in position during entry by top rollers **196** (FIG. **13**) which engage the upper surfaces of the frame to prevent its tilting. Reciprocation of slides **192** is achieved by rocking of a pair of like vertical arms **420**, the upper ends of which engage slides **192** and the lower ends of which are pivotally mounted to the frame of subassembly **30** (FIG. **14**). These are rocked by connecting rods **422** attached to cranks **424** on power shaft **404**.

When the frame, squeegee, and flow coater are aligned in the printing station and above the drum, the frame infeed drive is stopped. (If another stencil frame were in the station, it would have been pushed out the opposite side by the entering frame.) The elongated hexagonal upper end **180*b*** of the squeegee **180** is then clamped at its ends of a pair of longitudinally extending squeegee support arms **430** (FIGS. **8** and **10**) while the hexagonal upper end **181*b*** of flow coater **181** is clamped by a pair of longitudinally extending flow coater support arms **432**. Specifically, each arm **430** has a fixed clamp jaw **430*a*** and a pivotal shiftable jaw **430*b*** operated by a power linkage **430*c***, while each arm **432** has shiftable clamp jaws **432*a*** and **432*b*** operated by a power linkage **432*c***.

The squeegee arms shift the squeegee vertically. The squeegee blade **180*a*** is aligned with the crown of the printing cylinder in its lowered position, closely adjacent the cylinder, with only screen **170'** and web stock W separating it from the cylinder. This lifting and lowering action is achieved by having arms **430** mounted on pivot shaft **450** which is rotated on a controlled basis by suitable power means (not shown). The squeegee is lowered during the print stroke. It is elevated even more than the stencil frame during the return stroke of carriage **160** and frame **170**.

The flow coater arms are mounted to shift a controlled distance longitudinally toward and away from the squeegee, during the return stroke of the stencil frame, to move the flow coater which scrapes ink on the screen into a more concentrated zone adjacent the squeegee. The flow coater support arms **432** are mounted on a transverse support **452** which is shiftable longitudinally of the press by a pair of rods **454** attached to a pair of vertical pivot members **456** suspended from rocking shaft **458**. It will be obvious that these linkages can be varied several ways to achieve these movements. The significant factors are that the squeegee supports shift vertically to put the squeegee in a lowered print position or an elevated non-print return position, and that the flow coater move horizon-

tally, longitudinally, to move the ink at the end of the return stroke. The flow coater is up out of contact with the stencil screen during the print stroke when the screen is lowered into engagement with the cylinder, and is in contact with the screen when the latter is raised during the return stroke.

During the printing operation, the stencil frame on the carriage reciprocates forwardly and backwardly over the crown of the cylinder for the print stroke and the return stroke. Simultaneously with the forward print stroke, the printing cylinder rotates through a controlled arc to advance the web stock held between the cylinder and the stencil screen, causing the stationary squeegee to force ink through the screen onto the web. The amount of forward movement of the carriage and frame, and the amount of simultaneous rotation of the drum are controlled by the Floyd drive unit in FIG. **12.** This drive unit is basically a two-way universal clutch and is described in detail in U.S. Pat. No. 3,071,018. The directional control pivot pin **80–81** of the unit in the above patent is provided here with a radial extension **500** (FIG. **12** & **23**) which can be engaged from either of two directions by abutments **502** and **504** mounted on carriage **160.** Also, a gear **83** is keyed to pin **80–81.** Meshed with gear **83** is an idler gear **85.** Meshed with idler **85** is a drive gear **215** of reversible control motor **213.** Gear **215** is driven by motor **213** through a slip clutch (not shown). The function of control motor **213** and gears **215, 85,** and **83,** is to shift the Floyd drive **214** to a carriage driving condition after the carriage has come to a halt from one direction and is to be moved back in the opposite direction. This also causes arm **500** to be shifted from the "B" (neutral or non-drive) position (FIG. **23**) to either the "A" or "C" (forward or reverse drive) position. Abutments **502** and **504** on the carriage function with sensor **500** to shift the Floyd drive to a carriage non-drive (halt) condition (B) at the end of a drive stroke. In FIG. **12,** abutment **502** on support **503** is shown having come into engagement with arm **500** and having shifted it through a small arc from the "A" drive position. When sensor arm **500** is directly transverse to the carriage direction of movement, (i.e. in "B" position) the Floyd unit stops the output drive in the forward direction of the carriage. In the other direction of the carriage movement, abutment **504** on the carriage will strike sensor arm **500** and move it from the "C" drive position to the "B" neutral position. This abutment is mounted on a nut **506** on threaded shaft **508** to enable it to be adjustably positioned longitudinally of the carriage for varying the length of the carriage stroke and amount of drum rotation. Shaft **508** can be rotated with gear **510.** Like adjustment units at each printing station can all be simultaneously adjusted by rotating all the gears **510** at all the carriages at once with a common shaft, if desired. This adjustment provides a highly variable stroke length range.

As to the operation of the Floyd drive unit, reference is made to FIG. **23** as well as to FIG. **12** and to the cited patent. Basically, the output of the Floyd drive unit is controllably operated in forward, reverse, and neutral by shifting arm **500** to the "A", "C", and "B" positions. Specifically, the unit is such that when sensor **500** is in position A shown in FIG. **23,** the unit will drive the carriage **160** and its abutment **502** in the forward direction illustrated by the arrow in FIG. **23.** When abutment **502** strikes sensor **500** to pivot it to a transverse condition B, and thereby pivots shaft **81,** the clutch drive unit is in neutral so the carriage stops. When lever **500** is in the "C" position, the Floyd drive unit will drive the carriage in reverse until lever **500** is moved back to the "B" neutral position. This then is how lever **500** is moved from either drive position to neutral position to stop the carriage when moving in either direction. To cause the carriage to move when at rest, i.e. to shift the Floyd drive unit from neutral condition to either forward or reverse drive condition, control motor **213** is actuated in forward or reverse direction, preferably through a conventional electrical timer to provide a controlled time delay for the carriage to be at rest after it has been halted. Control motor normally operates constantly in forward or reverse direction, with its output shaft and gear **215** being driven by a slip clutch. Hence, after the Floyd drive has been shifted into neutral condition for a controlled time delay, motor **213** through gears **215, 85,** and **83** rotates pin **81** (and lever **500**) to a forward or reverse carriage drive condition as necessary.

Obviously, suitable electrical control circuitry of a variety of types can be employed as will be readily apparent to those in the art.

Each of the printing stations employs this same apparatus just described. The actual number of printing stations used can vary from one to several. Normally, it is advantageous to use at least two or more to obtain multicolor patterns in registry with each other. If the apparatus has several stations, only the desired number of those need be used for any one job. The web is merely advanced through the remainder without printing by removal of the stencil frame, squeegee, and flow coater. The unique tab registry system allows the slack web to be accurately and rapidly brought into registry at each printing cylinder. Actual operation of the equipment described has proven registry to be dependable, rapid, and very accurate.

The ink to be employed with the stencil screen at each station intended to print is provided by an ink supply subassembly **31** at each such station. Each subassembly **31** discharges ink in controlled fashion on the stencil screen in the frame by applying discharge pressure to a container of ink when the level of ink in the stencil frame decreases below an established optimum level, as detected by a sensor.

More specifically, a pressurizable container means **600** is placed on a platform **601** (FIGS. **25** and **28**) which slides along an elongated track means **602** generally above the drum **130** at a printing station and extending transverse to the web advancement direction (FIGS. **8** and **25**). Track means **602** has one rail **603** attached to fixed plate **405** and a second rail **605** spaced from rail **603** and mounted on brackets **607.** This container means **600** receives ink and cooperates with a controlled pressure supply means **604** for ink discharge. Sensor means **606** (FIG. **26**) controls the pressure supply means **604,** as explained more fully hereinafter.

Container means **600** includes an open top vessel **610,** a cover **612,** and seal means **614** therebetween. In usage of the apparatus, a bucket B of ink I is placed in vessel **610.** On cover **612** is a hollow hub or boss **616** with a bottom opening and a side opening. A discharge tube **618** is mounted in said bottom opening, extends down through an opening in cover **612** to a position with its lower open end adjacent the bottom of vessel

610 and bucket B. Tube 618 is sealed to cover 612 by annular seal 621. A second tube 620 projects out the side opening of boss 616, is in communication with tube 618, and extends radially outwardly beyond the edge of vessel 610 and then downwardly, with its open lower end above the stencil area for discharge of ink thereon. In the side wall of vessel 610 is a pressure inlet opening 622 (FIG. 28) for cooperation with pressure supply means 604.

Means 604 includes a pressure conduit 630 having an outlet 632 cooperatively related to orifice 622 to supply pressurized gas, e.g. air, to vessel 610. Outlet 632 may be a resilient, e.g. rubber, hollow hose capable of forming a releasable sealed connection between vessel 610 and supply means 604 which is a sealed coupling when the vessel is slid into engagement therewith and which is easily disconnected by sliding the vessel away from the operative ink supplying position along the tracks. Pressurized gas is supplied from any suitable conventional source S, through an on-off control valve V (FIG. 28) (shown in schematic form) which is controlled by sensor means 606.

Sensor means 606 has a probe 650 which extends downwardly to a position a fraction of an inch above the stencil screen to a point of optimum ink level in the stencil frame. A slight stream of gas, e.g. air, is constantly supplied to this probe from any suitable source such as tank T; to flow out the lower end of the probe. When the ink on the stencil is up to the level of the bottom end of probe 650, air flow through the probe is resisted by the ink, creating a back pressure in the probe conduit which retains the valve V in closed condition whereby gas from source S is closed off. When the ink level in the stencil frame is below the lower outlet end of the probe, so that gas can flow freely out of the probe the pressure responsive diaphragm valve V opens to allow pressurized gas from source S to flow to means 604 for creating pressure in vessel 610 and thereby forcing ink I out tubes 618 and 620 onto the stencil until the ink level on the stencil rises to the level of the probe tube 650. At this point the valve V closes to stop the gas to vessel 610. Valve V may be a conventional diaphragm actuator valve which has a diaphragm that shifts in one direction to open the valve when the pressure differential is in one direction, and shifts in the opposite direction to close the valve when the pressure differential is in the other direction.

Since pressure is to be internally applied to vessel 610, cover 612 must be held down into sealed engagement thereon. This is done by a lever 660 pivotally mounted intermediate its ends by pin 662 to rigid transverse press panel 405, one end of lever 660 engaging the top of boss 616 and the other end being shifted by cylinder actuator 664 (FIG. 29) as follows. The piston rod 666 of cylinder 664 is pivotally connected to one end of link 668, the opposite end of which is pivotally attached to plate 405. A push rod 670 has its upper end attached to the end of lever 660 opposite the end engaging cover 612, and has its lower end resting on link 668. Hence retraction of cylinder 664 elevates link 668 and push rod 670 to pivot lever 660 which holds cover 612 down on vessel 610.

A stop member 661 on lever 660 may be used to engage an abutment 663 extending radially from boss 616 for rotating boss 616 and tube 620 to the proper position over the stencil frame as container 600 is slid into position on the tracks.

Immediately downstream of but closely adjacent each printing station is a heated elevated, rotational drying drum subassembly 26 to dry the ink just applied in preparation for the next printing station. The drum may be a conventional vacuum grip type, functioning to advance and dry the web stock without putting it in tension.

The operation of the apparatus is apparent from the above detailed description. However, for added clarity, it will be briefly reviewed. The web stock W is unwound from roll R by vacuum cylinder 14 and advanced around conditioning drier drum 16 to the tabbers. At the tabbers, the registry tabs are applied while the web is stationary, such web being advanced intermittently by reciprocating vacuum platform 20 to a slack condition upstream of the first printing station. The web is advanced into registered position by the blades pushing the tabs at the printing cylinder. At each printing station a combined stencil screen frame, squeegee, and flow coater are inserted laterally to a position above the printing cylinder, by the friction rolls and the positive pushers. The squeegee and flow coater, elevated, are gripped by the jaws of their support arms. The carriage and stencil frame are reciprocated forwardly in a print stroke and rearwardly, elevated, in a return stroke. The printing cylinder is rotated forwardly during the print stroke, advancing the web past the squeegee, but is stationary during the return stroke. On the return stroke, the elevated stencil screen cooperates with the flow coater to push the ink adjacent the squeegee, the flow coater also moving a short distance toward the squeegee to further concentrate the ink.

The printed web is advanced around drum drier 26 for drying, after which it is advanced successively through the remaining printing stations in similar fashion.

It is realized that various details of the specific embodiment set forth herein as illustrative of the invention may be made without departing from the inventive concept. Hence, the invention is not intended to be limited thereby but only by the scope of the appended claims and the reasonable equivalents thereof.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A printing press assembly comprising: stencil support carriage means; ink vessel support means; ink vessel means positionable on said ink vessel support means, and including a gas inlet formed through a side wall of the vessel, said vessel support means providing support for transporting said ink vessel between an operative position and a non-operative position thereon, said vessel including an ink outlet extending from said vessel toward said stencil support carriage means to discharge ink onto a stencil supported thereon; gas supply means for supplying pressurized gas to said ink vessel means, said supply means including coupling means having a sealing member positioned for releasably engaging a portion of said side wall surrounding said gas inlet of said vessel when said vessel is in said operative position on said support means for coupling said supply means to said vessel, and control valve means for regulating the supply of gas to said ink vessel means.

2. The assembly in claim 1 including ink level sensor means positioned relative to said stencil support carriage means to sense the ink level on said stencil and

coupled to said control valve means for actuating said valve means as a function of the ink level sensed.

3. The assembly in claim **2** wherein said control valve means is pressure actuated and said sensor means includes a gas conducting tubular probe with a lower outlet extending toward said screen, said probe coupled to said gas supply means for causing a flow of gas through said probe, whereby back pressure created in said probe by the presence of ink at said lower outlet of said probe actuates said control valve means.

4. For use in screen printing apparatus, an ink supply system comprising:

stencil support carriage means;

a printing station including an elongated track for receiving an ink supplying vessel and transporting said ink supplying vessel between non-operating and operating positions;

an ink supplying vessel including a removable cover providing access to the interior of said vessel and a side wall including an orifice formed therethrough;

an ink discharge tube extending through said cover to be submerged in a supply of ink in said vessel and extending to a stencil screen supported on said stencil support carriage means and to which ink is to be supplied;

a fixed plate positioned adjacent said track and including resilient coupling means coupled to a source of pressurized gas and positioned on said plate to sealably contact a portion of said side wall surrounding said orifice of said vessel for coupling said source of gas to said vessel when said vessel is at said operating position on said track to supply the interior of said vessel with pressurized gas for forcing ink from said vessel through said discharge tube; and

means for controlling the gas pressure applied to said vessel to control the flow of ink through said discharge tube.

5. The system as defined in claim **4** wherein said ink supplying vessel is shaped to receive and support an open container of ink such that said discharge tube extends into said ink container when said cover is in position, and means for sealing said cover on said ink supplying vessel such that gas entering said ink supplying vessel through said orifice exerts pressure directly on the surface of ink in said ink container to force ink from said discharge tube.

6. The system as defined in claim **5** wherein said sealing means includes a seal interpositioned between said vessel and said cover therefor, and a pivot lever positioned adjacent said cover and movable toward said cover to clamp said cover tightly against said seal.

7. The system as defined in claim **6** wherein said cover includes an outwardly projecting abutment and said lever includes a stop member for engaging said abutment to position said ink supplying vessel as it is moved along said track into engagement with said resilient coupling means.

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