United States Patent [19]

Saueressig

[11] **3,783,780**

[45] **Jan. 8, 1974**

[54] **INTAGLIO PRINT MACHINE WITH NOVEL ROLL MOUNTING MANDREL AND BUSHING ASSEMBLY**

[76] Inventor: **Johann Heinrich Saueressig,** 19, Barlerstrasse, Wuellen, Ahaus, Germany

[22] Filed: **Mar. 8, 1973**

[21] Appl. No.: **339,075**

Related U.S. Application Data

[60] Division of Ser. No. 210,064, Dec. 20, 1971, which is a continuation-in-part of Ser. No. 23,564, March 30, 1970, abandoned.

[30] **Foreign Application Priority Data**

Mar. 29, 1969 Germany ..... P 19 16 359.8

[52] **U.S. Cl.** **101/153,** 101/216, 308/174

[51] **Int. Cl.** **B41f 13/20**

[58] **Field of Search** ..... 101/153, 212, 216, 101/219; 51/53, 259, 289 R, 290, 237 R; 142/56; 29/27–29; 308/20, 174

[56] **References Cited**

UNITED STATES PATENTS

1,737,378	11/1929	Littell	101/219 X
3,331,318	7/1967	Augustyn et al.	101/216
3,625,145	12/1971	Heatley et al.	101/212

FOREIGN PATENTS OR APPLICATIONS

1,048,872	12/1953	France	101/216

Primary Examiner—J. Reed Fisher
Attorney—Peter L. Costas

[57] **ABSTRACT**

An intaglio print machine for multicolor operation has a multiplicity of pairs of cooperating intaglio rolls and back up rolls rotatably supported on the machine frame and a vertical gate member pivotally mounted on the frame with a multplicity of inking units suppored thereon in vertical spaced alignment and cooperating with the intaglio rolls. The intaglio rolls are of cylindrical configuration and supported upon the frameby novel cone assemblies and novel expandable bushings which press fit in the ends of the cylindrical rolls and are engaged to prevent relative rotation.

8 Claims, 12 Drawing Figures

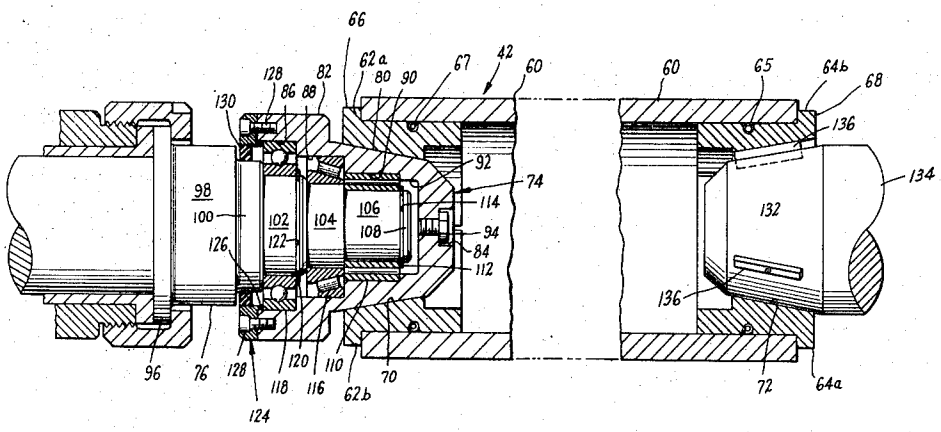
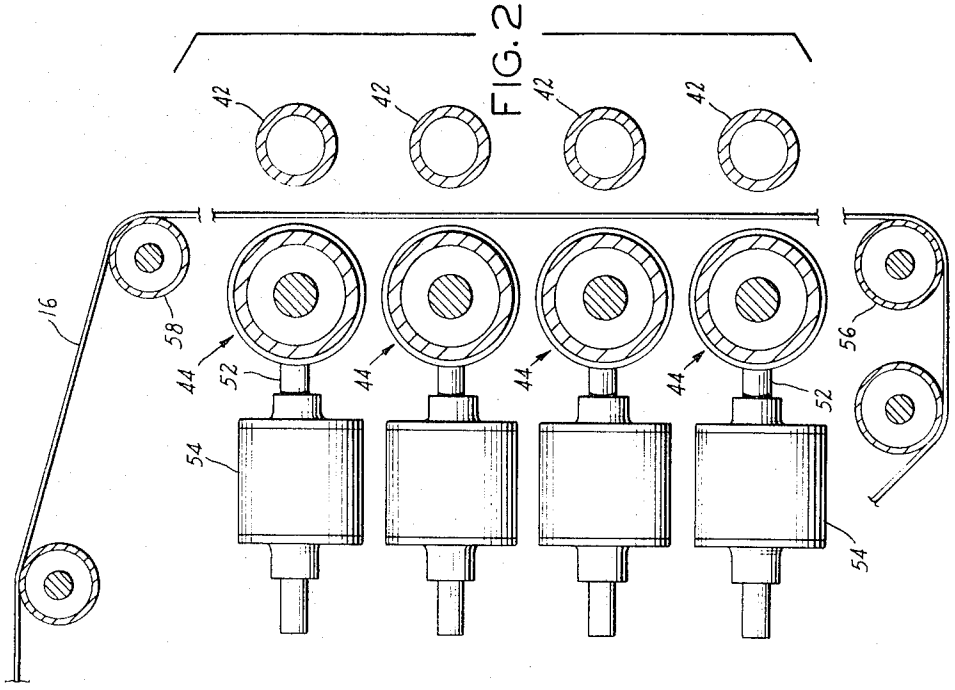


FIG. 2


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16
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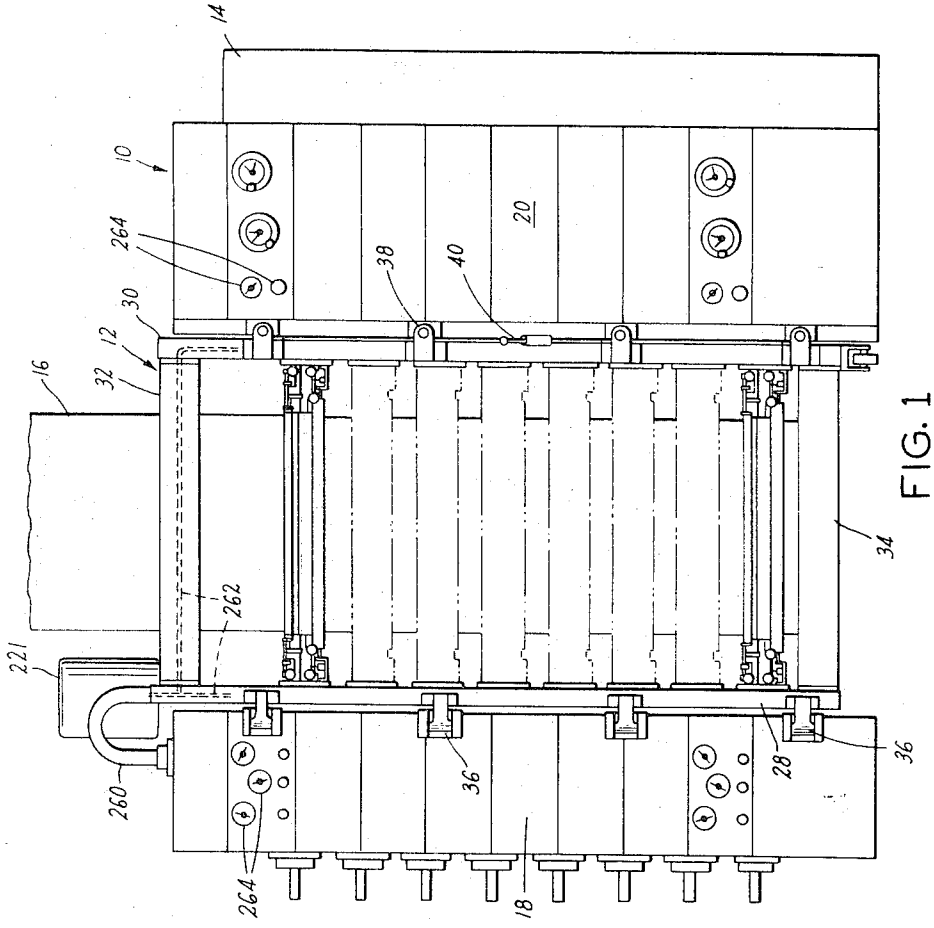

14
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264
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12
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18

FIG. 1

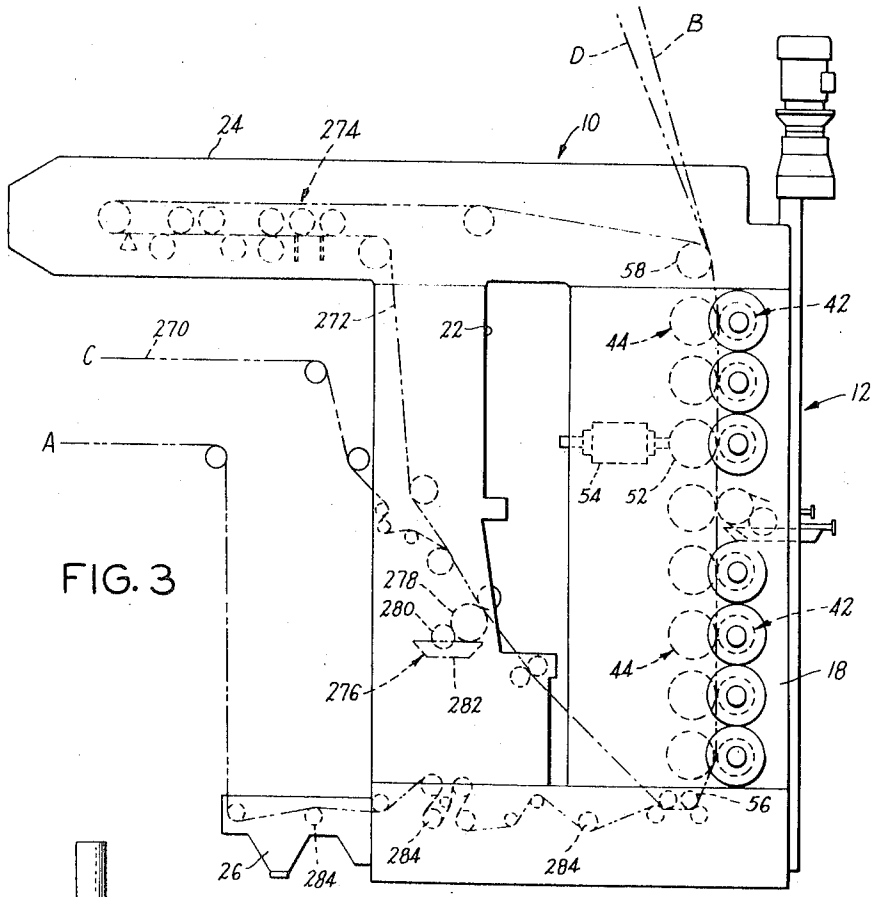

B
D
24
274
10
58
42
270
272
22
44
C
12
A
54
52
278
280
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44
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276
282
56
26
284
284
284

FIG. 3

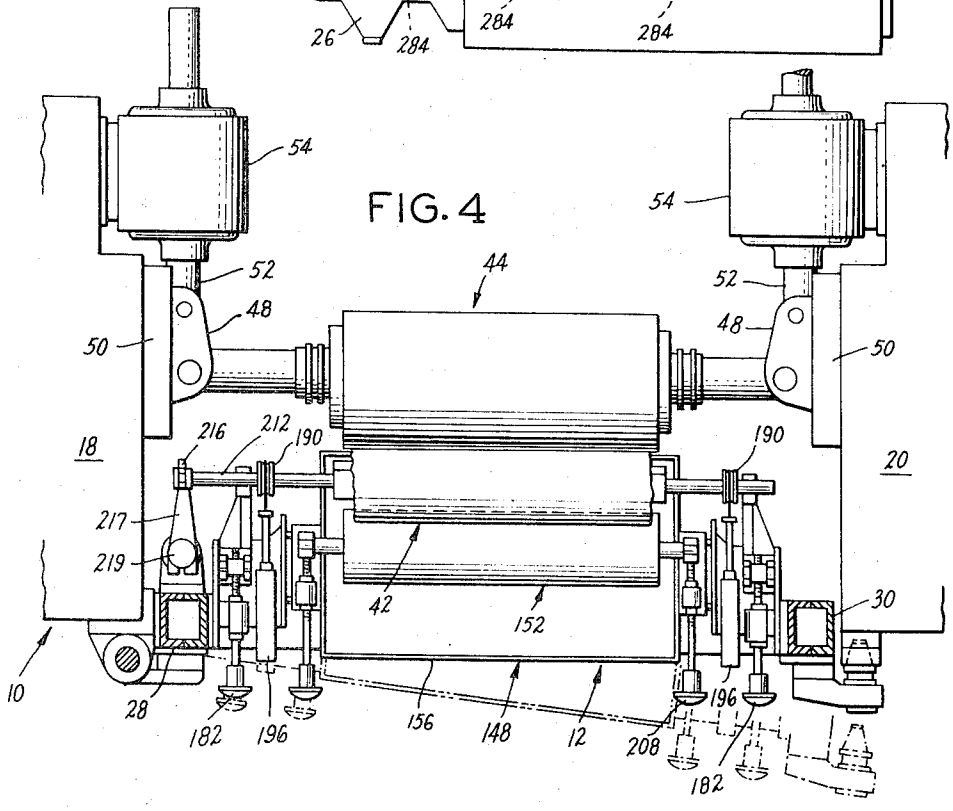

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216
212
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196
156
148
12
208
196
182

FIG. 4

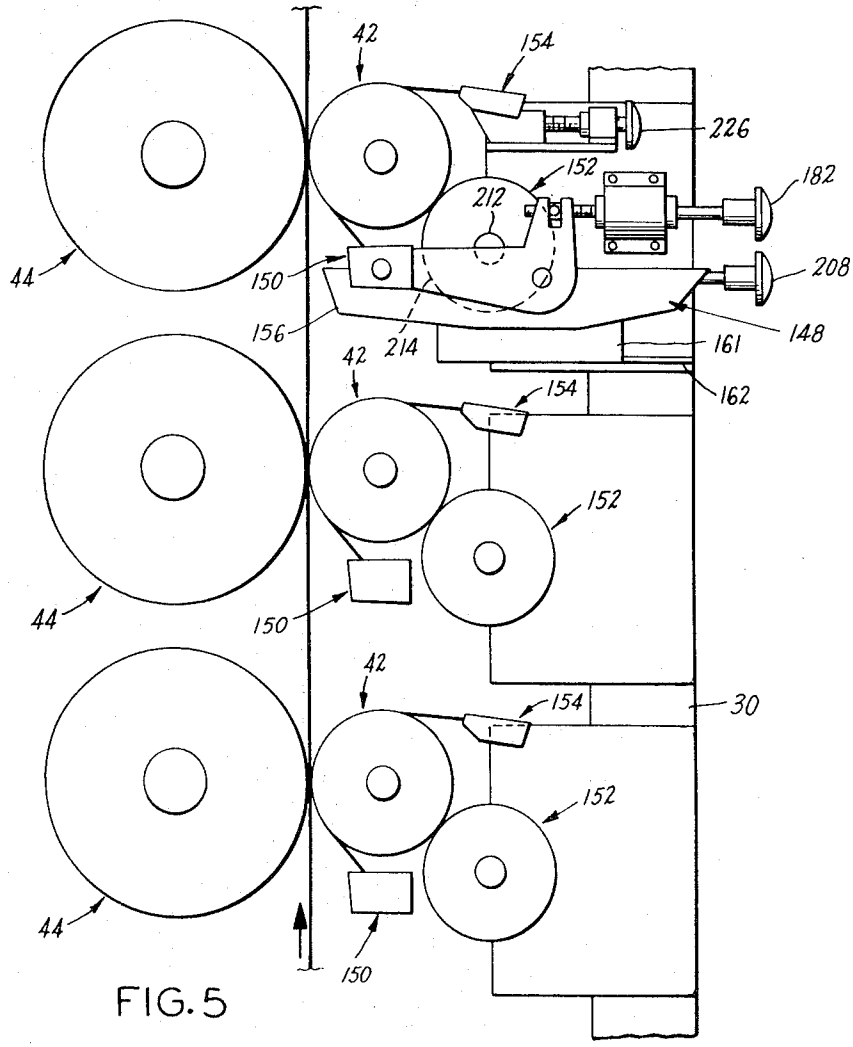

42
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226
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182
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154
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152
44
150

FIG. 5

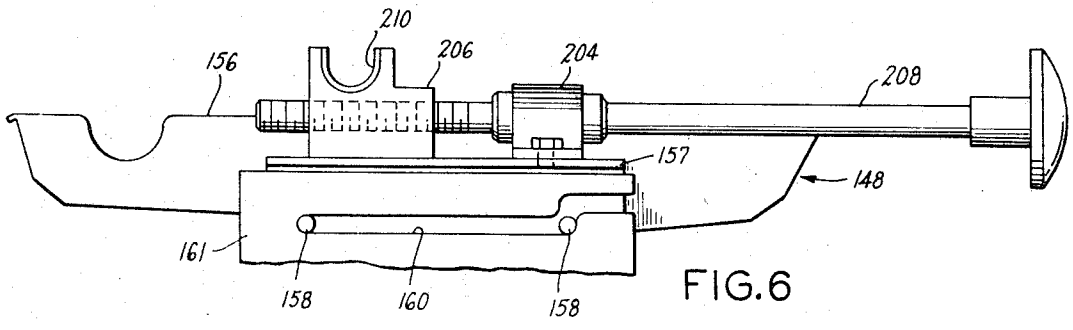

210
156
206
204
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157
148
161
158
160
158

FIG. 6

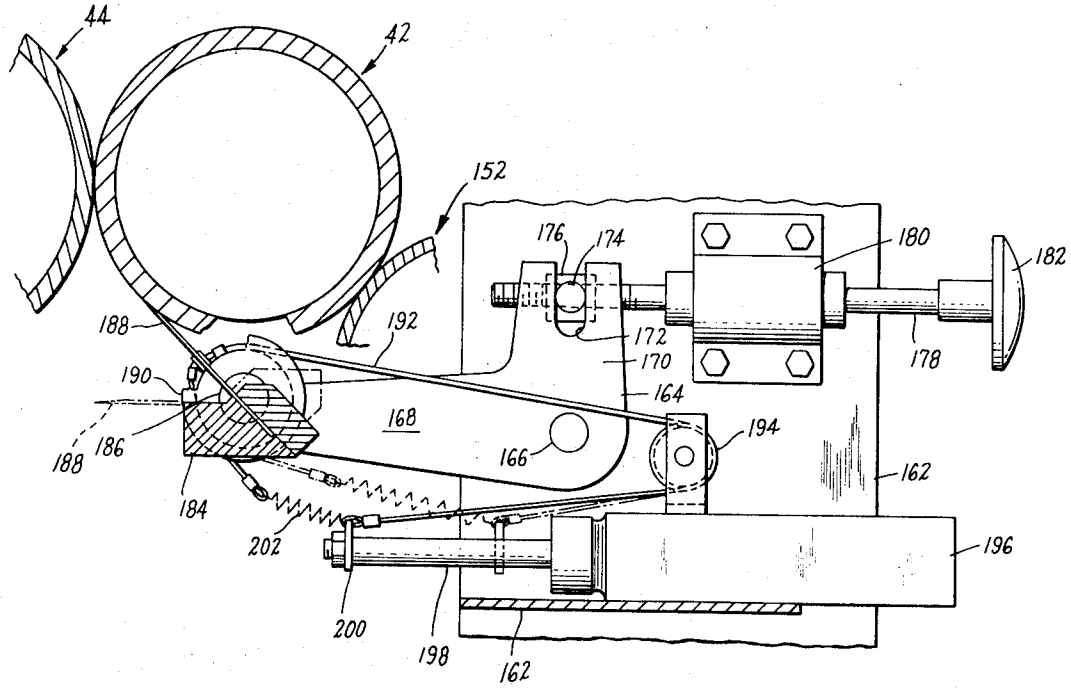

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42
152
176
174
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192
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202
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200
198
162

FIG. 7

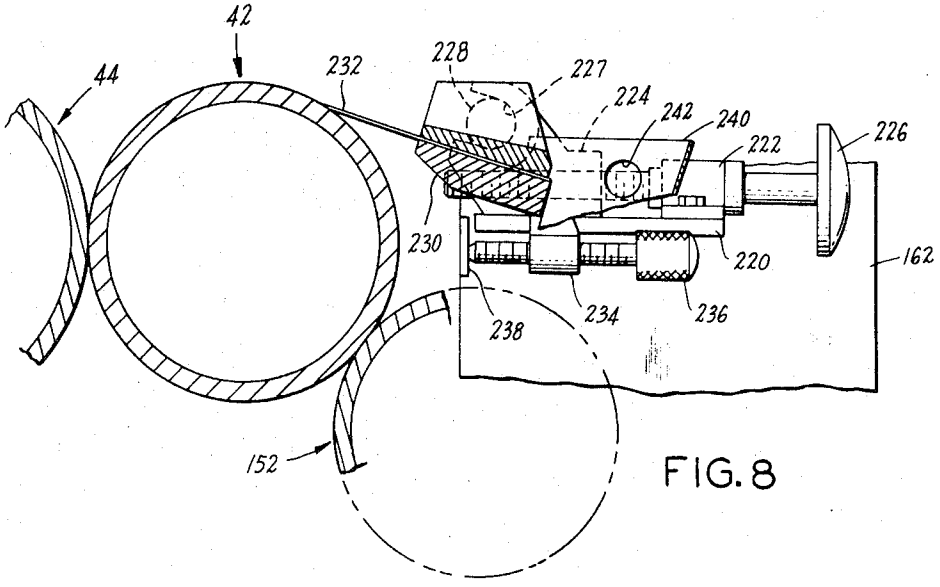

42
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232
228
227
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FIG. 8

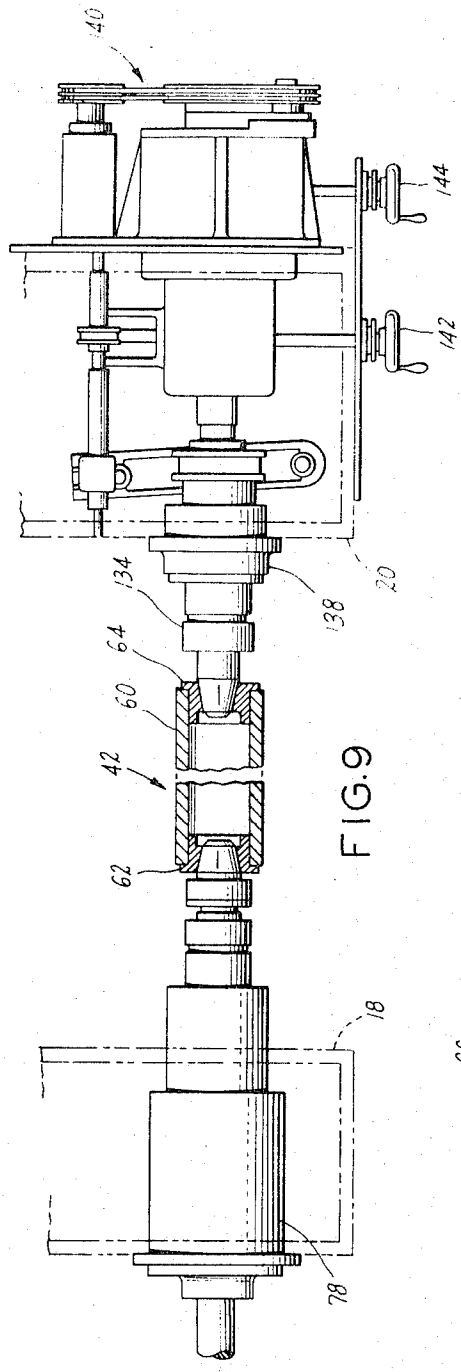

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144
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62
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78

FIG. 9

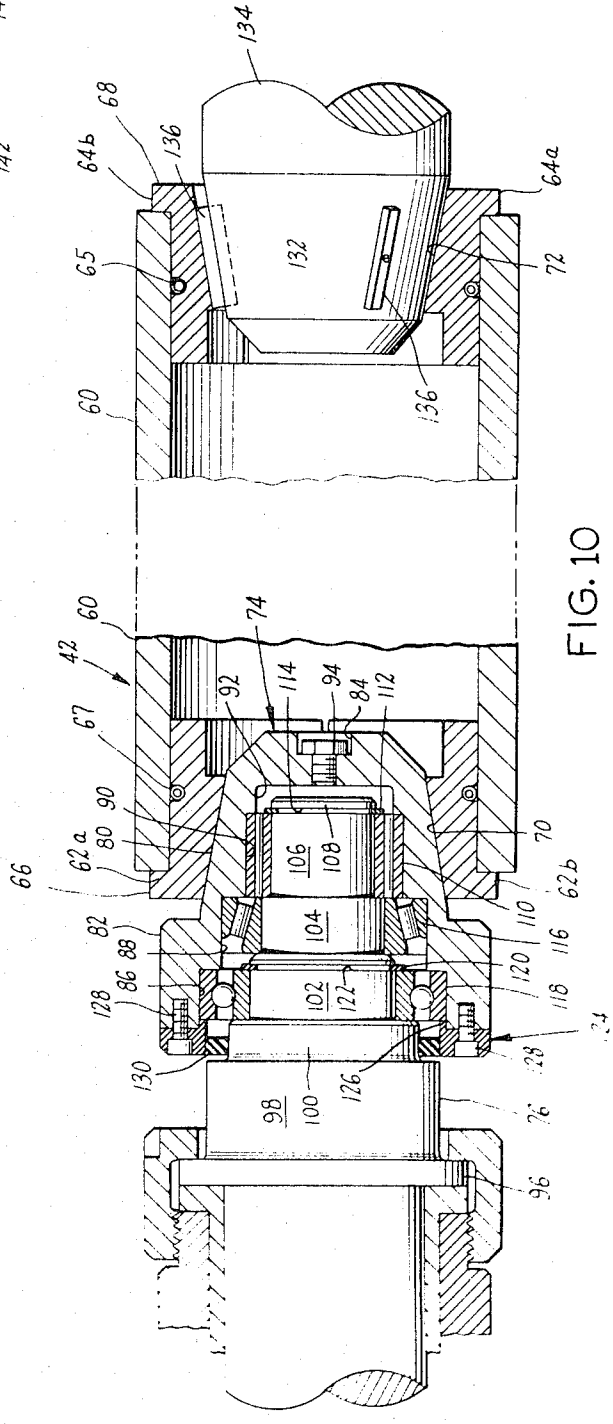

134
68
64b
136
64a
65
132
72
60
136
60
74
42
92
114
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84
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80
62a
66
70
62b
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FIG. 10

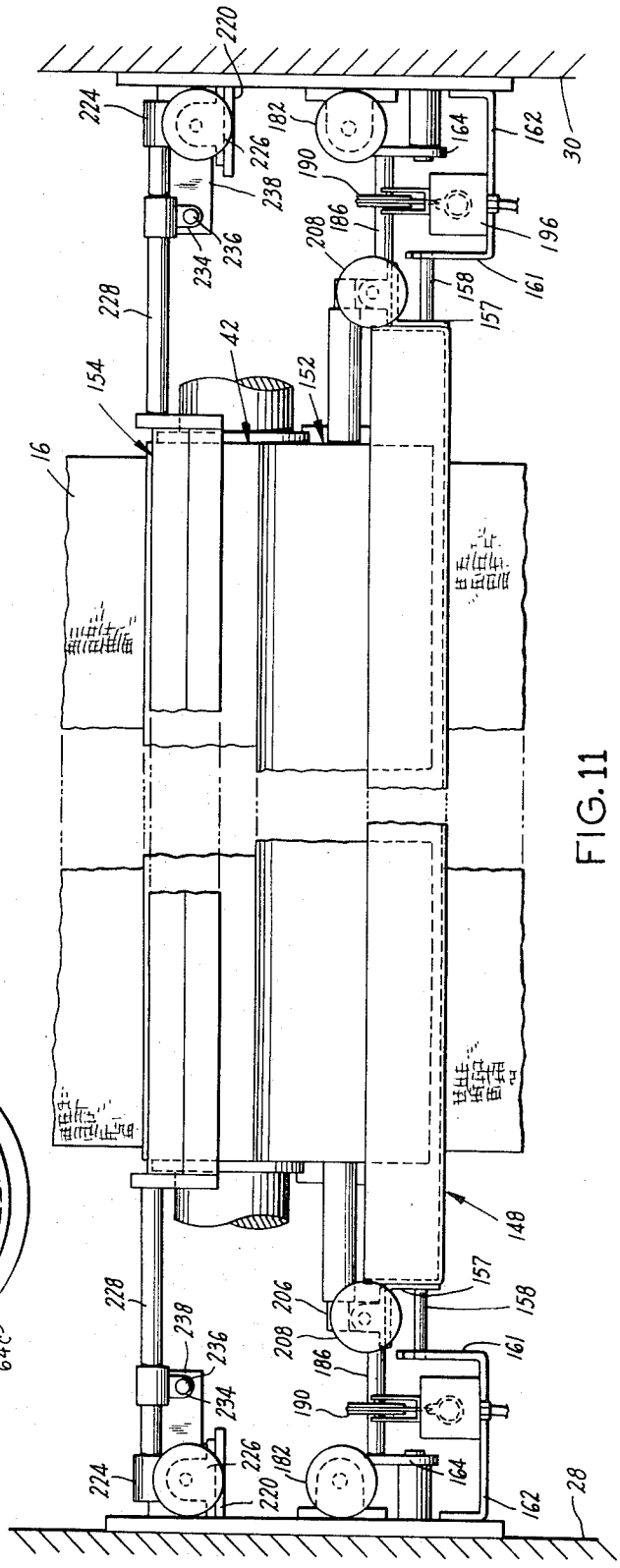
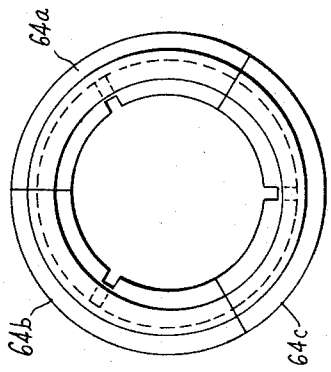

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FIG. 11

FIG. 12


64a
64b
64c

INTAGLIO PRINT MACHINE WITH NOVEL ROLL MOUNTING MANDREL AND BUSHING ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATION

The present application is a division of copending U.S. application Ser. No. 210,064, filed Dec. 20, 1971 entitled MULTICOLOR INTEGLIO PRINTING MACHINE WITH PIVOTABLE GATE SUPPORT FOR INKING UNITS which in turn was a continuation-in-part of U. S. application Ser. No. 23,564 filed Mar. 30, 1970 entitled COLOR INTAGLIO PRINTING MACHINE, MORE PARTICULARLY FOR PRINTING TEXTILES, now abandoned, based upon an application filed in the Federal Republic of Germany on Mar. 29, 1969, Ser. No. P 19 16 359.8.

BACKGROUND OF THE INVENTION

Various types of intaglio print machines have been designed and sold for many applications. The most commonly employed form of such machines utilizes a large backing cylinder about the circumference of which are disposed the engraved or intaglio rolls. However, it has also been proposed to utilize print machines employing pairs of intaglio and back up rolls disposed in horizontal or in vertical alignment, depending upon the desired path of the material being printed therethrough.

Most usually, the intaglio rolls are relatively massive structures in order to survive the stresses and pressures placed thereon. Consequently, they are generally expensive, difficult to handle, and require relatively massive drive units with attendant problems in torque, inertia and the like.

It is an object of the present invention to provide a novel intaglio print machine for multicolor printing of fabrics and the like in which the intaglio rolls may be readily assembled and disassembled.

A further object is to provide such a print machine in which relatively light weight intaglio rolls of substantially cylindrical config-uration are supported firmly and driven synchronously.

SUMMARY OF THE INVENTION

It has now been found that the foregoing and related objects can be readily attained in an intaglio print machine for multicolor printing which comprises a machine frame and a multiplicity of pairs of cooperating intaglio and back up rolls. The pairs of rolls are rotatably supported on the frame in vertically spaced alignment with the intaglio roll of each pair being disposed outwardly of the frame.

The intaglio rolls themselves are fabricated as relatively thin cylindrical shells. These cylindrical shells are supported by cone elements inserted into the opposite ends thereof and pneumatic means are included for effecting axial adjustment of the intaglio rolls relative to the machine frame. The cone elements are comprised of bushing members engaged in the openings at the ends of the rolls and providing a central cavity of generally frustoconical configuration of greatest diameter at the outer ends thereof, and mandrel members having generally frustoconical portions engaged within the frustoconical cavities of the bushing members. The bushing members and mandrel members have interengaging means to prevent relative rotation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of an intaglio print machine embodying the present invention with portions of the components of the individual inking units omitted for purposes of clarity of illustration;

FIG. 2 is a diagrammatic, fragmentary vertical sectional view through the machine showing the intaglio rolls and back up rolls spaced apart in the inoperative position thereof and to an enlarged scale from that of FIG. 1;

FIG. 3 is a fragmentary side elevational view of the print machine showing various internal components in phantom line and the back up rolls in operative engagement with the intaglio rolls;

FIG. 4 is a fragmentary top view of the print machine with portions of the components in section and broken away for clarity of illustration and with the gate partially illustrated in phantom line in a partially pivoted position;

FIG. 5 is a fragmentary sectional view to an enlarged scale of the machine at the gate assembly showing completely only one of the inking units;

FIG. 6 is a sectional view to an enlarged scale of the ink trough and its support and adjusting assembly;

FIG. 7 is a fragmentary sectional view to an enlarged scale of the machine showing the support and operating mechanism for the main doctor member and with the doctor member shown in its pivoted position in phantom line;

FIG. 8 is a similar view showing the support and adjusting mechanism for the top or second doctor member with the inkling roll shown in phantom line;

FIG. 9 is a fragmentary transverse sectional view of the machine to an enlarged scale showing the mounting and drive means for the intaglio roll and with the roll in section for clarity of illustration;

FIG. 10 is a greatly enlarged sectional view of the intaglio roll and mandrel member mounting means therefor;

FIG. 11 is a fragmentary front elevational view to an enlarged scale of the gate member with portions of the components broken away for clarity of illustration; and

FIG. 12 is an end view of a bushing assembly for mounting the intaglio rolls.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Turning now in detail to FIGS. 1 and 3 of the attached drawings, the intaglio print machine embodying the present invention and illustrated therein has a machine frame generally designated by the numeral 10 and a gate member pivotally mounted on one face thereof and generally designated by the numeral 12. A control panel console 14 is disposed to one side of the machine frame 10 and is separate therefrom. Fabric being printed by the machine is designated by the numeral 16 with the direction of movement being upwardly through the print rolls of the machine.

The machine frame 10 has side portions 18,20 which are provided with generally vertically extending apertures 22 therein, a top extension 24 extending from the face opposite that having the gate 12 mounted thereon and a bottom extension 26 extending from the same face. The gate 12 is generally comprised of the vertical side posts 28,30 top cross member 32 and the bottom cross member 34. As best seen in FIG. 1, the post 28

is pivotally mounted on the frame side position **18** by heavy duty hinges **36,** and the post **30** is held in position against the frame side portion **20** by the latches **38** which are mechanically operated by the latch control mechanism **40.**

As best seen in FIGS. **2–4,** the print machine includes a multiplicity of pairs of engraved or intaglio rolls generally designated by the numeral **42** and backup rolls generally designated by the numeral **44,** the rolls of each pair being disposed with their axes in a generally horizontal plane and the several pairs of rolls being disposed in a generally vertical stack. The backup rolls **44** are mounted for horizontal movement on the frame **10** relative to the intaglio rolls **42** by mounting the shaft supports **46** in slide blocks **48** which are seated slidably in slide supports **50** on the side portions **18,20** of the frame **10.** Connected to the slide blocks **48** are piston rods **52** which are reciprocable within the pneumatic cylinders **54** mounted on the side portions **18,20** to effect movement of the backup rolls **44** either toward or away from the intaglio rolls **42,** and these cylinders **54** may also be used to control the pressure at the nip between the rolls.

In FIG. **3,** the backup rolls **44** are shown in the operative position and, in FIG. **2,** they are shown in the retracted or inoperative position. When moved into the operative position shown in FIG. **3,** the fabric **16** is moved against the surface of the intaglio rolls **42** in the nip between the cooperating rolls so as to effect printing thereof. Conversely, when the backup rolls are moved into the inoperative position shown in FIG. **2,** the position of the vertically aligned idler rolls **56, 58** below and above the vertical stack of the pairs of cooperating rolls permits the fabric **12** to fall away from the surface of the intaglio rolls **42** into a position between the now spaced rolls **42,44** so as to effect substantially immediate discontinuance of printing with resultant avoidance of spoilage of material. The cylinders **54** are individually operable to permit testing of registry and color at each of the several pairs of cooperating rolls.

The mounting and drive arrangement for the intaglio rolls **42** is shown in FIGS. **9** and **10** with the shaft mounting mandrels only diagrammatically illustrated in FIG. **9.** The intaglio roll **42** is generally comprised of a relatively thin walled cylindrical shell **60** having press fit within its ends bushings **62, 64** having circumferential collars **66,68** which abut the end surfaces of the shell **60.** The bushings **62,64** have axially extending generally frustoconical recesses or bores **70,72** which are of greatest diameter at the outer ends thereof.

Seated in the bushing **62** is a rolling mandrel generally designated by the numeral **74** and carried by the shaft **76** which in turn is supported by the pneumatic cylinder **78** on the frame side portion **18** so that it may be moved inwardly and outwardly relative to the opposite side portion **20.** As seen in FIG. **10,** the mandrel **74** has a generally frustoconical inner end portion **80** and a circumferential collar **82** about its outer end; the angle of taper of the end portion **80** is substantially the same as that of the recess **70** in the bushing **62** so as to provide full circumferential press fit contact therebetween when the mandrel **74** is moved against the roll **44** by the pneumatic cylinder **78.**

The mandrel **74** has a stepped bore **84** providing a series of steps **86,88,90,** and **92** of decreasing diameter inwardly thereof; seated in and closing the inner end of the bore **84** is a lubrication nipple **94.** The end portion of the shaft **76** is provided with a circumferential collar **96** outwardly from the mandrel **74** and is configured to provide a series of steps **98, 100, 102, 104, 106** and **108** of decreasing diameter toward the end thereof seated in the mandrel **74.** A needle roller bearing **110** provides bearing surfaces between the shaft step **106** and mandrel step **90** and is held in position by the locking ring **112** seated in a circumferential groove **114** in the shaft step **108.** An annular contact roller bearing **116** provides bearing surfaces between the shaft step **104** and mandrel step **88** and is dimensioned so as to be wedged against the outer shoulder of the step **104** by the roller bearing **110.** A ball bearing assembly **118** provides bearing surfaces between the shaft step **102** and mandrel step **86** and is held against the outer shoulder of the step **102** by the locking ring **120** seated in the circumferential groove **122** at the inner end of the step **102.** A sealing cover generally designated by the numeral **124** is mounted on the outer end of the mandrel **74** and has an axially extending lip **126** extending inwardly of the bore **84** and bearing against the outer end of the ball bearing assembly **118.** The sealing cover is secured to the mandrel **74** by the fasteners **128** and an annular packing ring **130** is disposed between it and the step **100** of the mandrel.

Seated in the bushing **64** is a fixed mandrel **132** which is integrally formed on the end of the shaft **134** and which has a generally frustoconical configuration with an angle of taper substantially equal to that of the recess **72** in the bushing **64** so as to provide a firm press fit when it is forced thereinto by movement of the mandrel **74** into the opposite bushing **62** by the pneumatic cylinder **78.** To prevent any relative rotation therebetween, keyways are milled into the cooperating surfaces of the mandrel **132** and bushing **64** and a key **136** is firmly seated therein. The shaft **134** is seated in bearings **138** in the side portion **20** of the frame **10** and is driven synchronously with the shafts **134** of the other intaglio rolls **42** by conventional drive mechanism generally indicated by the numeral **140;** hand wheels **142,144** permit manual adjustment of the shaft **134** and thereby the intaglio roll **42** to effect axial and circumferential registry.

Cooperating with each intaglio roll **42** is an inking unit carried upon the side posts **28,30** of the gate **12** and comprised of a trough assembly generally designated by the numeral **148,** a main doctor member assembly generally disignated by the numeral **150,** an inking roll assembly generally designated by the numeral **152** and an upper doctor member assembly generally designated by the numeral **154.**

As best seen in FIGS. **4–6** and **11,** the trough assembly includes a pan-shaped member or trough **156** of generally rectangular configuration having angle brackets **157** at the sides thereof each of which has thereon a pair of horizontally outwardly projecting pins **158** seated in the horizontally extending generally S-shaped slots **160** in the inner legs **161** of the channel-shaped supports **162** mounted on the gate posts **28,30.** The sides of the trough **156** adjacent the inner end have generally circumferential recesses formed in the top surface thereof for a purpose to be explained hereinafter. As will be appreciated, the generally S-shaped configuration of the slots **160** and the cooperating dimensioning between the pins **158** and the base portion of the slots **160** ensure stable seating of the trough **156** within the supports **162.** However, the trough **156** may

be emptied while the gate 12 is in its closed position by lifting the outer end thereof so as to elevate the outer pins 158 to the level of the upper portion of the S-shaped slots 160, sliding the trough 156 outwardly until the inner pins 158 abut the generally vertical shoulders of the slots 160, and then pivoting the outer end of the trough downwardly to empty the contents thereof and effect cleaning. In this pivoted position, the inner pins 158 will retain the trough 156 within the supports 162.

Mounted on the horizontal portion of the angle brackets 157 of the trough 156 are fixed blocks 204 and slide blocks 206. Lead screws 208 have their shanks trapped in the fixed blocks 204 and threadably engaged in the slide blocks 206 so as to effect sliding movement of the slide blocks 206 along the upper surface of the brackets 157 inwardly and outwardly relative to the intaglio roll 42.

The slide blocks 206 have recesses in the upper surface thereof in which are mounted arcuate bearings 210. Rotatably seated within the bearings 210 is the shaft 212 of the inking roll 214 of the inking roll assembly 152. Thus it can be seen that movement of the lead screw 208 will move the axis of the inking roll 214 relative to the axis of the intaglio roll 42 to control the pressure at the nip therebetween. Moreover, the trough assembly 148 and inking roll assembly 152 thus comprise a unit for simple disassembly from the gate 12 for cleaning when required.

Turning now to FIG. 7, the mounting and operating elements for the main doctor member assembly 150 are therein illustrated. Bell crank or L-shaped members 164 are disposed at each side of the gate 12 and pivoted adjacent their apices upon the outer legs of the channel support 162 on the side posts 28,30 of the gate 12 by pivot pins 166, and the longer legs 168 extend inwardly of the machine below the intaglio roll 42. The shorter legs 170 extend upwardly and have a generally vertically extending slot 172 opening at the upper end thereof in which are captured the horizontally projecting studs 174 on slide blocks 176. Threadably engaged with the slide blocks are lead screws 178 which are rotatably seated in the mounting block 180 and rotatable by the hand wheel 182 so that the slide blocks 176 may be moved inwardly and outwardly relative to the intaglio roll 42, thereby pivoting the inner end of the longer legs 168 upwardly and downwardly relative to the intaglio roll 42 to effect manual adjustment thereof.

Mounted in arcuate slots in the upper surface of the inner or free ends of the longer legs 168 of the bell cranks 164 are stub shafts 186 on the doctor blade support bar 184. Removably engaged in the support bar 184 is a relatively thin doctor blade 188 with a substantially knife-like configuration at its free edge bearing against the inner circumferential surface of the intaglio roll 42.

As seen in FIG. 3, the stub shaft 186 has an extension 212 on the left side as viewed therein which has a collared coupling 216 thereon slidably engaged in a yoke on the pivot arm 217 mounted on and oscillated by the vertical shaft 219. The motor 221 on the top of the gate 12 oscillates the shaft 219 through a cam and crankshaft to oscillate the doctor blades 188 across the rolls 42 and minimize wear.

Mounted on the stub shafts 186 outwardly of the bell cranks 164 are pulleys 190 in which are seated one end of the endless wire cables 192. The other end of the endless cables extends about pulley elements 194 supported upon the pneumatic cylinders 196 mounted on the web portions of the channel supports 162. Reciprocably driven by the cylinders 196 are the piston rods 198 having collars 200 adjacent the free end thereof. As seen in FIG. 7, the endless wire cables 192 are secured to the collars 200 so that movement of the cables may be effected by reciprocation of the piston rods 198 within the cylinders 196. The endless wire cables 192 include tension spring portions 202 so that the piston rods 198 may effect pivoting of the doctor blade 188 from the position shown in full line in FIG. 7 to that shown in phantom line and then retract still further through expansion of the spring. Thus, when the piston rods 198 are moved to the left as shown in FIG. 7, they will act upon the endless cables 192 to pivot the doctor blade 188 into surface contact with the intaglio roll 42. Retraction of the piston rods 198 will act upon the endless cables 192 to pivot the doctor blade 188 downwardly from the intaglio roll 42 to the position shown in dotted line in FIG. 7 so that the blade 188 may be moved thereby upon pivoting of the gate 12 into its open position. It will be appreciated that the pressure exerted by the doctor blade 188 against the surface of the intaglio roll 42 may be adjusted through adjustment of the length of the stroke of the piston rod 198 and the pressure in the cylinder 196. This permits precision adjustment of the position of, and force exerted by, the doctor blade 188 against the intaglio roll 42 by a trained operator and subsequent repositioning of the elements will be effected automatically into the predetermined conditions, thus eliminating the need for highly trained operators after initial setup.

Turning now to FIG. 8, the upper doctor member assembly 154 is therein illustrated. Mounted on the outer legs of the channel supports 162 are horizontal blocks 220 upon which are fixedly mounted bearing blocks 222 and slide blocks 224. Lead screws 226 are trapped in the bearing blocks 222 and threadably engaged within the slide blocks 224 so as to effect sliding movement thereof along the surface of the horizontal blocks 220 upon rotation. Pivotably seated in upwardly and inwardly extending arcuate recesses 227 in the slide blocks 224 are stub shafts 228 at the ends of the doctor blade support bar 230 in which is removeably retained a thin doctor blade member 232 extending upwardly and inwardly into contact with the upper and outer circumferential surface of the intaglio roll 42. At both ends, the doctor blade support bar 230 has depending ears 234 in which are threadably engaged adjusting screws 236 which bear at their inner ends against the fixed plates 238 on the channel support members 162. Accordingly, rotation of the adjusting screws 236 will pivot the doctor blade support bar 230 and thereby the doctor blade member 232 in the slide blocks 224. Rotation of the lead screws 226 will move the slide blocks 224 and thereby the doctor blade member 232 relative to the intaglio roll 42 so as to effect variation in the contact pressure therebetween.

The doctor blade support bar 230 also carries a trough member 240 having a drain aperture 242 at one end thereof. In this manner, ink scraped from the intaglio roll 42 by the upper doctor blade member 232 will travel downwardly therealong and into the trough member 240 so as to avoid contamination of the ink in the trough 156 of the inking unit.

Compressed air for the operation of the cylinders of the gate 12 is supplied through the flexible conduit 260

to a fitting in the gate **12** and thence to the several cylinders through flexible conduits **262.** The air pressure in the cylinders and other pressure information may be readily ascertained for purpose of adjustment by suitable gauges and control instrumentation **264** (only partially shown) on the side portions of the frame **10** and on the control console **14.**

Turning now to FIG. **3,** the fabric **16** being printed is shown entering the machine at Point A and leaving at Point B. Backing grey **270** from a suitable source enters at Point C and leaves at Point D. The endless rubber blanket **272** passes through a cleaning station generally designated by the numeral **274** after it passes through the printing stations. In accordance with the preferred embodiment of the present invention, the backing grey **270** is coated with an adhesion promotor by the roller coating station generally designated by the numeral **276** and disposed at a location remote from the first printing station. The applicator roll **278** is coated by the feed roll **280** which rotates through a reservoir **282.** Various other idler rolls **284** are shown in phantom but the only driven rolls in the machine are the intaglio rolls **42** so that synchronizaton thereof will not be adversely affected and there will be no relative slippage.

Since the intaglio rolls **42** are relatively thin shelled cylindrical members with bushings **62,64** at the ends thereof, they are relatively lighweight and may be handled readily. As best seen in FIGS. **10** and **12,** the bushings **62** and **64** are fabricated from three or more arcuate segments defining a circular circumferential configuration and frustoconical interior cavity. The several segments **62** a,b,c and **64** a,b,c are held together by annular garter springs **65,67** which will normally hold their axial edges together and prevent inadvertent disassembly. When inserted into the ends of a roll **42** of slightly larger internal or nonuniform diameter, the circumferential surface will be expanded by the conical mandrels **74,132** to fit snugly against that surface. This affords significant advantages in accommodating minor deviations and ensures a firm fit.

As seen in FIG. **12,** the several segments **64** *a,b,c* mating with the fixed mandrel **132** each have keyways milled in their frustoconical surfaces which seat keys **136** seated in cooperating keyways in the mandrel portion **132** and held therein by the fasteners **69.** In this manner, the expanded segments will not slip relative to the mandrel or to each other. Similar key and keyway construction is employed with respect to the bushing **62.**

It is especially significant to note how readily colors may be changed at any of the several inking units without complete disassembly of the machine. If so desired, the gate **12** may be pivoted into its open position to permit cleaning of the intaglio rolls **42** where the color is being changed. Alternatively, where a similar color is being employed, the trough assembly **148** may be slid outwardly and pivoted downwardly to empty it and clean it and also to remove and clean the inking roll **214.**

When it is desired to clean the machine or to change the intaglio rolls **42,** the operator presses the control for the pneumatic cylinders **54** to withdraw the backup rolls **44** from contact with the rubber blanket **272,** backing grey **270** and fabric **16,** at the nip with the intaglio rolls **42.** He then presses the control for the pneumatic cylinders **196,** pivoting the doctor blade **188** downwardly to the dotted line position shown in FIG. **7.** He may then open the gate **12** by operating the latch control mechanism **40** to open the latches **38.** This permits the pivoting of the gate **12** on its hinges **36,** the free end thereof being supported upon a wheel **41** which preferably moves within a track (not shown) in the floor. As previously indicated, the trough assembly **148** and inking roll assembly **152** may be readily removed for cleaning and the doctor blade members **188** and **232** are also readily accessible for cleaning. With the gate **12** in the open position, the intaglio rolls are readily accessible for cleaning by the operator's assistant. When the necessary changes have been made, particularly if only cleaning and changing color are required, the trough assembly **148** and inking roll assembly **152** may be reintroduced into position and the gate **12** closed. Since the registry of the various members has not been affected, the printing operation may be begun almost immediately.

Color may be supplied to the various trough assemblies **148** by an air pumping system (not shown) which automatically controls the level within the troughs **156.** Whenever desired, one of the inking units may be taken out of operation while leaving the remaining units in operation simply by retracting the backup roll **44** for that particular inking unit.

Of particular significance is the doctor blade arrangement of the present invention. As a result of the disposition of the blades, and of their mounting, the doctor blades can be prepared on doctor grinding machines to a very high degree of accuracy since the pressure of the blade against the intaglio rolls **42** is controlled accurately by a piston operated by air pressure indicated upon a gauge. The friction of the doctor blades against the intaglio rolls may thereby be reduced to extend significantly the life of the engraving upon the intaglio rolls.

If so desired, the machine may be double sided to permit printing on either face, pivotable gates being employed in each instance in order to obtain the advantages of the present invention.

Conveniently, accessory mechanism includes a carrier for moving several intaglio rolls into position simultaneously to effect mounting thereof. Since the pressures at roll nip and at doctor blade nip are provided by the pneumatic cylinders, these may be controlled precisely and repeatably. The apparatus permits operation both with and without backing grey and is self-contained with respect to cleaning mechanism for the rubber blanket.

Thus it can be seen that the present invention provides a novel and highly effective print machine affording significant economies in operation and in downtime. It is highly versatile and permits rapid change of colors and removal from printing of one or more colors with resultant variation of pattern. The pressure at the roll nip and main doctor blade may be varied pneumatically and accurately. The inking unit may be cleaned and then replaced in operation in the previously established conditions. Lightweight rolls may be employed and held firmly. Its highly effective construction minimizes wear on operating components and facilitates operation by relatively untrained operators.

I claim:

1. In a print machine, the combination comprising:

a. a generally cylindrical roll shell;

b. split bushing members engaged in each end thereof, said split bushing members each being

comprised of at least three arcuate segments having circumferential surface portions cooperating to define a generally circular circumferential configuration and the inner surfaces of which are configured to define a generally frustoconical cavity, and resilient means holding said segments in generally circular circumferential disposition and permitting expansion thereof to increase the diameter of the circular cross section defined thereby;

c. mandrel members having generally frustoconical circumferential portions cooperatively configured and engaged within said generally frustoconical cavities of said bushing members, said mandrel members expanding the segments of said bushing members into firm press fitting engagement with the inner surface of said roll shell; and

d. means engaging said bushing and mandrel members to prevent relative rotation.

2. The print machine of claim **1** wherein said engaging means comprises keyways in the inner surface of each segment of said split bushing members and in the cooperating outer surfaces of said mandrel members; and keys seated therein.

3. In a print machine, the combination comprising:

a. a machine frame;

b. a multiplicity of rolls rotatably supported on said frame;

c. drive means for rotating said rolls, said rolls each being comprised of:

1. a generally cylindrical roll shell;

2. bushing members engaged in each end thereof having a cavity therein of generally frustoconical configuration of greatest diameter at the outer ends thereof;

3. mandrel members having generally frustoconical portions engaged within said frustoconical cavities of said bushing members, the bushing and mandrel members of said rolls having cooperating keyways in their opposing surfaces and keys seated therein to prevent relative rotations;

4. a pair of shaft elements mounted on said machine frame; one of said shaft elements being fixedly engaged with its associated mandrel member and the other of said shaft elements being seated within an elongated outwardly opening cavity in its associated mandrel member, said cavity having series of surface portions cooperating with surface portions on the end portion of said shaft element disposed therein to provide a plurality of seats; and

5. a plurality of bearing elements disposed on said seats between said shaft element and said mandrel member, said bearing elements including a bearing element providing for compensation of relative thrust between said shaft elements and said mandrel member;

d. bearing means on said frame for said one shaft element of each roll, said one shaft element being engaged with said drive means for rotation thereof and thereby said roll shell; and

e. support means on said frame for said other shaft element of each roll.

4. The print machine of claim **3** wherein said surface portions of said shaft element and said mandrel member are provided by a series of steps of decreasing diameter inwardly of said roll shell.

5. The print machine of claim **3** wherein said bearing elements include ball bearing means and angular contact roller bearing means.

6. The print machine of claim **5** wherein said bearing means also include needle roller bearing means.

7. The print machine of claim **3** wherein said bushing members are split bushing members each being comprised of at least three arcuate segments having circumferential surface portions cooperating to define a generally circular circumferential configuration and the inner surfaces of which are configured to define a generally frustoconical cavity, and resilient means holding said segments in generally circular circumferential disposition and permitting expansion to increase the diameter of the circular cross section defined thereby, said mandrel members expanding the segments of said bushing members into firm press fitting engagement with the inner surface of said roll shell, each of said bushing member segments having a keyway therein cooperating with a keyway on said mandrel; and keys seated in said keyways.

8. The print machine of claim **7** wherein said keys are removeably engaged in the keyways of said mandrel members by threaded fasteners.

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