

Aug. 1, 1939.

C. J. MacARTHUR

2,168,229

WEB-FED PRINTING PRESS

Filed Dec. 17, 1937

4 Sheets-Sheet 1

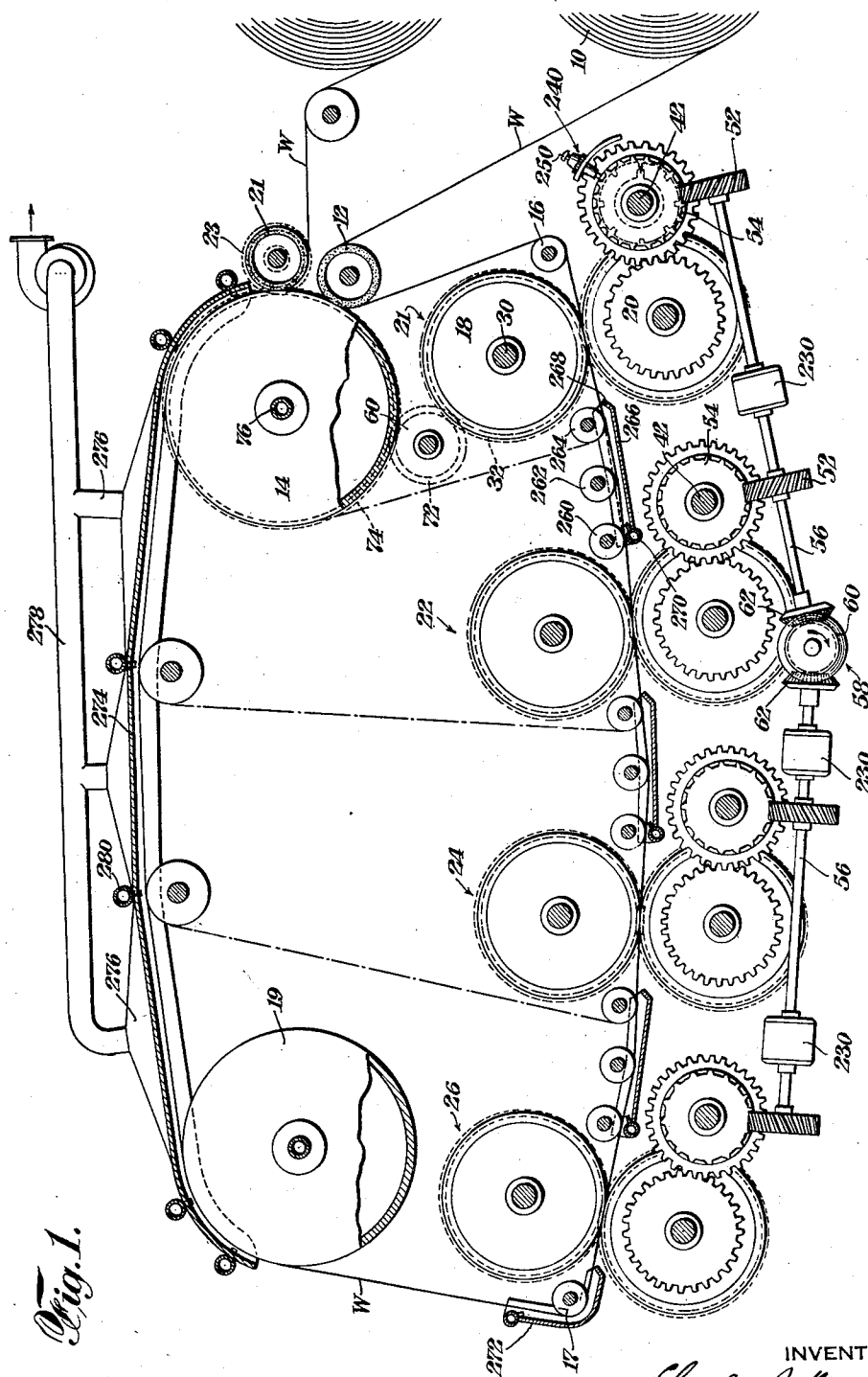


Fig. 1.

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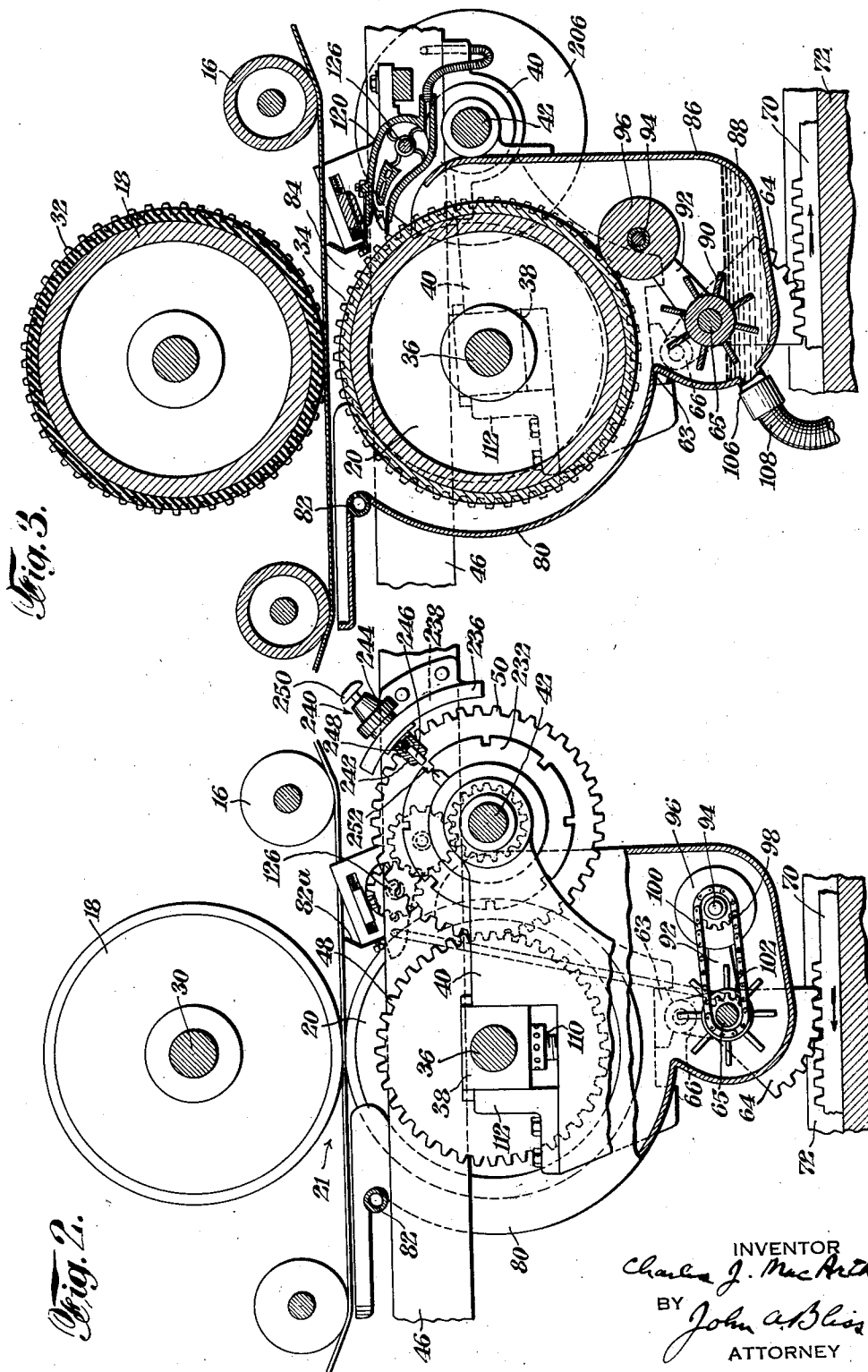
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4 Sheets-Sheet 2



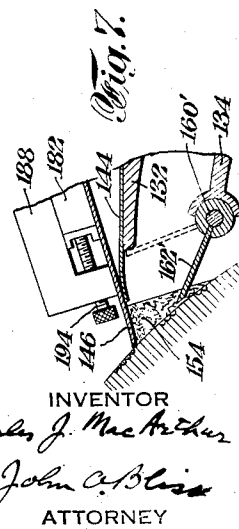
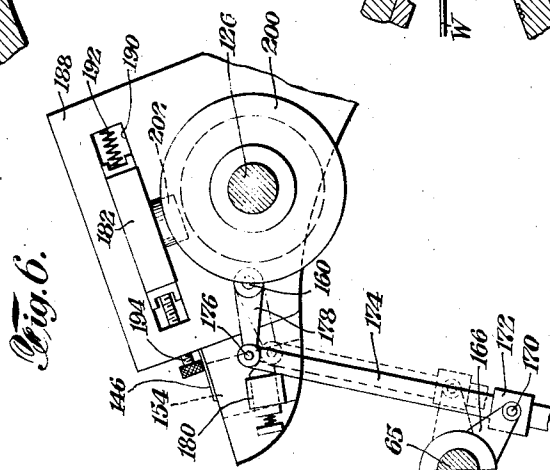
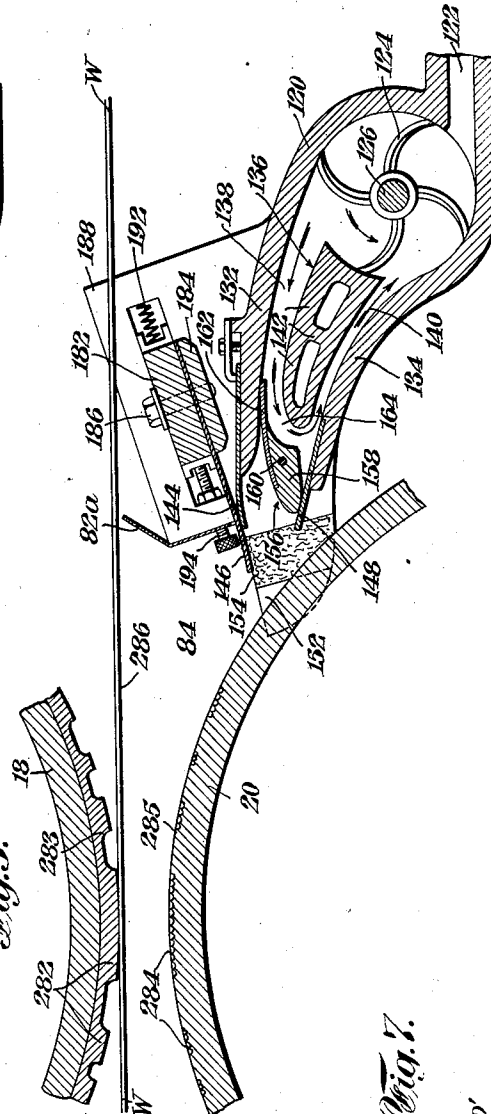
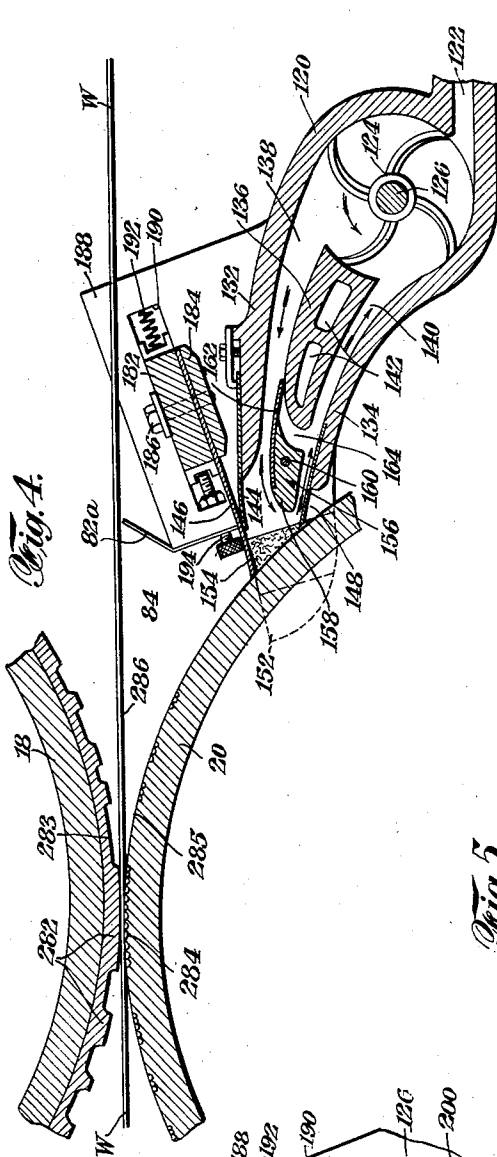
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4 Sheets-Sheet 3



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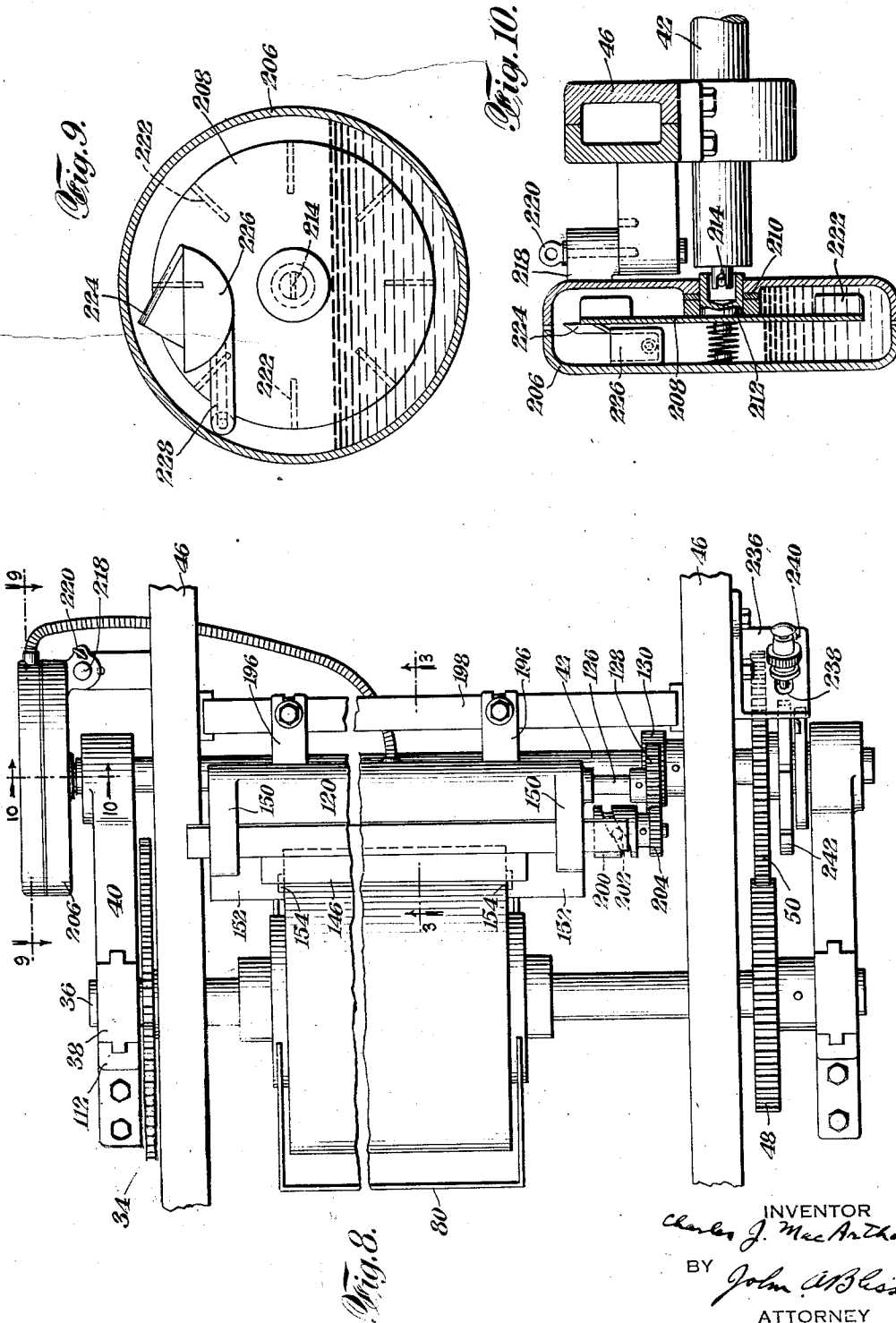
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UNITED STATES PATENT OFFICE

2,168,229

WEB-FED PRINTING PRESS

Charles J. MacArthur, Glen Ridge, N. J.

Application December 17, 1937, Serial No. 180,285

47 Claims. (Cl. 101—181)

This invention generally relates to new and improved methods in web-fed printing presses and more particularly to multicolor presses wherein fluid inks, lacquers, dyes and coatings are applied to printable web materials by the intaglio, or so-called gravure, printing principle.

Heretofore, web-fed gravure presses generally have employed substantially the same methods to produce multicolor gravure printing as those employed in the original monicolor gravure presses. The difficulties encountered in striving to maintain uniformity in web tension and the desired degree of accuracy in printing register are traceable to certain deficient methods employed therein and which are the cause of variant printing register, and also excessive wastage of web material.

A brief analysis of these methods and their consequent handicaps may serve to explain the objectives of the present invention. In this connection it will be observed that the principal printing factors are so closely interrelated that to obtain full advantage from improvements in one of these features necessitates improvements in the other contributing factors.

In presses of the kind referred to, resilient impression rollers of indefinite peripheral sizes are employed to impress the web material to the printing cylinder and thereby effect transfer of ink from the intaglio engravings of the printing cylinders to the web material. The movement of the web material through successive printing operations depends upon the traction between these deformable web-carrying pressure rollers and the rotating printing cylinders, and commonly referred to as the "nip pull". In endeavors to prevent slippage between the driving printing cylinders and the web-carrying impression rollers while printing on relatively hard or smooth web materials such as aluminum foil, Cellophane, board stocks or hard-finish papers, excessive printing pressures are invariably applied to the web. These excessive and unnecessary pressures are not only detrimental to printing performance but cause extreme deformations in the resilient pressure rollers and injurious distortion of web material. Should there be only slight circumferential differences in the multiple printing cylinders, the resulting lags and tugs on web during successive printings, cause continual changes in web tension, variation in printing register, slippings at web splicings and frequent web breaks.

Stoppage of the press to perform any of the several necessary presswork operations, necessitates separation of the printing couples, other-

wise, should the web remain in pressing contact with the stationary inked cylinders, for more than a brief period, the web would adhere thereto. Also, to prevent the ink in the engravings from drying and solidifying therein, the cylinders are rotated and continually charged with fresh ink. In the former types of presses, the web-carrying pressure rollers are raised from the printing cylinders. Consequently web tension is relaxed or disturbed, printing register lost, and entire length of web material within the press a total loss as printed material. Again, in resuming printing operation, additional web spoilage invariably occurs in restoring former web tension and printing register. The lengths of web threadings in such presses range from 100 to 250 feet. It is a common occurrence to waste from 200 to 500 feet of web in recovering former printings conditions.

The necessity for these relatively abnormal lengths of web material in gravure presses compared with web-fed multicolor relief printing presses is primarily due to employing web impressing members which bring the web material into all-over impression contact with the printing members. In this connection a similar handicap prevails in web-fed presses employing the planographic printing principle and which tends to retard the development of multicolor web-fed planographic printing.

Expressed in simple terms, the principal components of multicolor gravure inks comprise: a solid, synthetic resin (or nitrocellulose) dissolved into a resinous fluid by a volatile liquid solvent. The resin acts as the binding agent for the coloring matter and both of which represent the dried film of printed ink. A freshly printed ink film contains approximately 70% solvent, and the ink-resin is restored to its former solid, or so-called "dry" state by the evaporation of its solvent content. However, when the ink is printed on highly absorbent web materials, such as newsprints or machine-finish papers, solvent escape or removal is aided to a great extent by its penetration into the web materials, but in this respect, scant aid is received from hard-finish stocks and none from non-absorbent web material such as aluminum foil, vegetable parchment, etc. During its transitional stages from a fluid to a solid, the ink-resin develops ascending degrees of tack until it re-hardens. Should undried printed ink be brought into impression contact with un-inked or non-printing areas of the succeeding printing cylinder some of this extremely tacky ink would adhere thereto. To accelerate the natural volatilizing

action of the solvents, heating and vapor exhaust appliances are employed between printings. The appliances, according to speed of press, character of web material being printed, volatility of solvent used and solvent retentive properties of the resin, require sufficient length of web travel to insure that ink is dry or tack-free before it is pressed into contact with the solid surface sections of the succeeding printing cylinder.

Under the foregoing condition including resulting shrinkages of web due to repeated heat-treatments between printings the handicaps which hamper press operators in trying to control web tension and printing register on long webs, are obvious.

In efforts to reduce the distance of web travel and effect suitable ink drying with lower temperature heat treatments, highly volatile ink solvents are used. Owing to fire hazard, their toxicity and their extremely volatile nature, unused inks formulated with these solvents must be well protected from atmospheric exposure. To afford some measure of protection, the printing cylinders including the ink supply are sometimes enclosed in housings insofar as it is possible and practicable to do so. When printing "long run" editions the handicaps imposed by these housings in performing presswork operations are less apparent than when printing comparatively "short run" editions. In the latter case, cylinder replacements, proofing engraving to determine tonal translations, and printing register, color-matching, wash-up etc. are frequent. However, despite the inconvenience tolerated, the interior of these housings and their ink contents are exposed to the atmosphere to gain access to the printing cylinder or remove ink doctor therefrom.

Therefore it is an object of this invention to provide in a web-fed gravure printing press of the kind described, printing couple units wherein each unit comprises a printing member, an impression member and inking appliance means whereby the printing couple is separated without disturbing the existing printing position of the web material, or changing the web-impressing position of the impression member, or altering the inking position of the inking appliance, by employing suitable mechanism to remove the printing member from its printing position to an operable, temporary, non-printing position.

It is a further object of this invention to provide means to detect and indicate the exact printing register existing between the web material and printing member when press is brought to rest and printing couple separated, whereby the former existing printing register can be accurately restored after the printing member has been rotated in its non-printing position, thereby preventing wastage of web material when printing operations are resumed.

It is a further object of this invention to provide impression members having high and low circumferential areas, the high or relief areas having substantially the same circumferences as the printing members and composed of resilient, or semi-resilient or non-resilient materials and which are arranged in relative positions corresponding with the engraved or inked sections of the printing members, whereby the web material may be brought into impressional contact with only the engraved or inked sections of the printing members, thereby the preceding printed ink is not brought into impressional contact with the un-inked or non-printing areas of the succeeding printing member and which contributes to a

great extent in making it practicable to shorten the distance of web travel between successive printings. This web impressional method takes advantage of the natural and rapid tack-acquiring property of a drying gravure ink, and since the wet ink in the inked engravings of the succeeding printing member has a greater affinity for tacky ink than it has for hard-dry ink, transfer of the entire contents of the engravings of the succeeding printing member is thereby effected with less pressure than if the preceding printed ink on the web were hard-dry.

It is a further object of this invention to provide a compact ink applier, cooperating with an ink doctor, and having its ink-discharge and unused-ink-return channels closed by a gate, preferably with means adapted to open the gate when the printing member is in printing operation, and close the gate when the printing member is in its non-printing position, although the gate may be arranged for manual opening and closing independent of the printing position of the printing member, whereby said ink applier substantially protects its unused fluid ink contents or the like from exposure to the atmosphere while engaged with or disengaged from the printing member or its cooperating ink doctor, including the provision of an auxiliary ink reservoir which feeds a controlled supply of ink or the like to the ink applier, whenever necessary, whereby ink applier and ink supply reservoir cooperatively maintain fluid inks, lacquers or the like in a uniform state of distribution and at desired temperatures, and substantially protect their fluid contents from exposure to the atmosphere, thereby rendering aid in shortening distance of web travel between printings.

It is a further object of this invention to provide a cleansing fluid bath containing high boiling or relatively slowly evaporating solvents such as butyl carbitol, varnol or xylol or a combination thereof for dissolving nitrocellulose or synthetic resin inks or lacquers, whereby the printing member rotating in its temporary non-printing position is automatically de-inked, also cleansed free from foreign accumulations during a few rotations, thereby cylinder rotations may be stopped and unnecessary wear on both cylinder and ink doctor avoided.

It is a further object of this invention to provide preferably a uniform tension on web material while web is in motion or at rest. While any suitable means may be employed as an in-feed, I prefer to use means which may take the form of a single web control element to feed and pull web material into, through and out of printing and ink drying operations in unison with, but substantially independent of, the aid or influence of, the printing couples, including means provided to guide and adjust the web material traversing convex polygonal paths through printing operations.

Other objects of this invention includes a vapor exhaust chamber to draw heavier-than-air ink or lacquer solvent vapors downwardly from the freshly printed side on the traveling web so that these vapors may be reclaimed in their most concentrated vaporous form, and also to arrange an air baffle adjacent to the traveling web and ink doctor to prevent the oncoming air induced by the traveling web from impinging upon the freshly inked engraving of the rotating printing member, and whereby a pocket of almost stagnant air is formed wherein volatile solvents are slug-

gish and wherein molten ink waxes or resins are unaffected.

The above and various other objects and advantages will be readily understood from the following description taken in connection with the accompanying drawings of preferred embodiments of the invention, in which modifications may be made without departing from the scope of the appended claims.

10 In the drawings—

Fig. 1 is a semi-diagrammatic view in side elevation, partly in section, of a web-fed multi-color press embodying my invention, illustrating the driving mechanism for a series of printing couple units in their printing positions, the single web control element, and the mechanism for detecting and indicating printing register between web and printing cylinder;

Fig. 2 is a fragmentary view of a printing couple unit of the type shown in Fig. 1, mechanism for obtaining registration between the web and the printing cylinders in operating printing position, the appliance with gate open, not visible, and ink doctor, not visible, and the cleansing mechanism for the printing cylinder idle;

Fig. 3 is a detailed cross section of a printing couple unit of the type illustrated in Fig. 2 with printing cylinder in lowered position, the inking mechanism used in conjunction therewith with its gate in closed position, ink doctor disengaged, and the cleansing mechanism for the said cylinder in operative position;

Fig. 4 is an enlarged fragmentary sectional view of the ink applying mechanism in operative position, a printing cylinder and an impression member having high and low circumferential areas adapted to impress the web only at engraved portions of the printing cylinder;

Fig. 5 is a similar view to that shown in Fig. 4 except that the inking mechanism is shown with its gate closed and the printing cylinder is shown in associated lowered position;

Fig. 6 is an end view of the doctor blade mechanism showing means for reciprocation of the same and also showing associated gate operating means for operating the gate to open and close ink-discharge and surplus-ink-return channels;

Fig. 7 is a fragmentary sectional detail of a modified ink gate mechanism;

Fig. 8 is a plan view of an individual printing unit of the type shown in Fig. 2;

Fig. 9 is a sectional view taken substantially on the line 9—9 of Fig. 8 of the ink reservoir; and

Fig. 10 is a fragmentary sectional view taken substantially on the line 10—10 of the ink reservoir.

Referring to Figs. 1 to 3, the web W is supplied from a web supply roll 10 and passes over a driven roller 12 in frictional contact with a web driving drum 14. The web continues around a free roller 16 disposed substantially in a plane normal to a pair of cylinders 18 and 20 comprising a printing couple 21. The cylinders 18 and 20 are preferably of the same circumferential size, the cylinder 20 representing the printing member and the cylinder 18 cooperating as the impression member. The web is adapted to pass between the printing couple 21 and similarly is adapted to pass between the successive printing couples generally designated as 22, 24 and 26. The construction of each of these printing couples, including the first, is substantially similar, the first having certain registry means to be more fully described later.

Referring to Fig. 2, the printing couple here shown comprises the initial unit shown in Fig. 1 and comprises an impression cylinder shaft 30 suitably mounted for rotation in the frame of the machine, not shown. Secured to this shaft 30 is a gear 32 adapted for engagement with a gear 34 fixed to the printing cylinder shaft 36, rotatably mounted in bearing blocks 38 carried by a cantilever bracket means 40 pivotable about a drive shaft 42 rotatably supported in bearings 44 secured to longitudinal rails of the frame, indicated as 46, of the machine.

Also secured to the shaft 36 on one side the printing cylinder and preferably outside the frame 46 is a gear 48 adapted for engagement with a gear 50 fixed to the drive shaft 42. Referring to Fig. 1 the drive shaft 42 and the gears associated therewith are driven by a worm 52 and worm wheel 54 on a line shaft 56 and the drive shaft 42. The line shaft 56 is in sections for the purpose of simplifying the driving arrangement in the instance shown in Fig. 1. The line shafts 56 are driven by a level gear arrangement 58 or the like which comprises an input bevel gear 60 and a take-off bevel gear 62 on each of the inner ends of the line shafts 56.

With this arrangement it is observed that each of the printing couples rotate in equal phase relation and the printing and impression cylinders of each couple maintain equal surface speeds. Referring to Figs. 2 and 3, and in view of the cantilever supporting arrangement for the printing cylinder 20, the cylinder may be lowered for the purpose of disengaging the printing cylinder from contact with the web. This lowering of the printing cylinder is accomplished by the following means: the bracket 40 is provided with a slide-groove in which a sliding block is adapted to move. Pivotaly secured to this block is a gear segment 64, pivoted as at 65, and having an arm 66 articulatively connected to the sliding block 63. The gear segment 64 is adapted for engagement with a slidable rack 70 suitably supported in the frame, a portion of which is indicated at 72. In Fig. 2 this rack is shown in its extreme left position and upon movement of the rack in the opposite direction as indicated in Fig. 3, the gear segment 64, as well as the arm 66 and block 63, move leftward to the position indicated in Fig. 3. The arcuate movement of the block as aforesaid includes a downward component in that its pivot is confined to an arcuate movement prescribed around the shaft 65. As will be seen in Figs. 2 and 3 the bracket 40 rests upon the slide-block 63 and upon movement of the block to the left and downward the bracket 40 is permitted to assume a lowered position as indicated in Fig. 3, thereby disengaging the gears 32 and 34. Referring to Fig. 1 the web-driving drum 14 is rotated by a gear train which includes the gear 32 of the first printing unit, an idler gear 72 in mesh with a gear 74 fixed to the web-driving drum 14 on the shaft 76 thereof.

It is preferable that the racks of each of the printing units operate together and that the racks raise and lower the cylinders simultaneously, which can be accomplished by their intercommunication, not shown. It will therefore be seen that in the lowered position of the printing cylinders they may be rotated without affecting the web. It is also necessary during non-printing operations to keep the cylinder wet or de-inked. The printing cylinder is supplied with ink by an ink applying mechanism cooperating with an ink doctor to be described later. For the purpose of

protecting the printing cylinder from the surrounding air a casing 80 is provided which has a blower tube 82 associated therewith for resisting solvent vapor escape from the casing and in the vicinity of the web, thereby giving conditions which tend to maintain the solvent vapors in concentrated form. A baffle 82a is provided at the inlet side of the printing unit to block air currents which follow the traveling web, thereby providing an air pocket of more or less still air, indicated as 84. This air pocket 84 becomes more or less saturated with the solvent vapors. Such an air pocket tends to prevent the ink in the engravings of the rotating cylinder from drying therein. The casing 80 is provided with a well 86 containing relatively slow evaporating cleansing fluid 88 such as butyl carbitol, varnol, xylol or a combination thereof, at a suitable level. Rotatably mounted on the shaft 65 is a paddle mechanism 90 partly immersed in a bath of said cleansing fluid and adapted to splash the cleaning fluid against the inking surface of the printing cylinder when it is rotating in a non-printing position. Fixed to the shaft 65 and rotatable therewith during rotation of the segment 64 in the lowering of the printing cylinder, is an arm 92 adapted to support a shaft 94 and to move the same arcuately when the cylinder is lowered. This arm 92 is adapted to support a frictional resilient roller 96, which may be covered with glue and glycerin composition, which engages the printing cylinder in its lowered position thereof. Adapted to rotate with the friction roller 96 is a sprocket wheel 98 connected as by a chain 100 to a sprocket wheel 102 rotatable on the shaft 65 but fixed to the paddle mechanism 90.

By the above described arrangement of the cleaning mechanism, the ink on the rotating non-printing cylinder may be effectively removed by the washing and squeegeed virtually dry by roller 96. A suitable inlet and outlet opening 108 is provided in well 86 for supplying and removing the cleaning fluid 88. As indicated, the usual contact adjusting means 110 is provided and retaining means 112 may be applied to the printing cylinder boxes to permit ready removal of the printing cylinder. Transverse register adjustment on web is made by moving the printing couple unit laterally on a slidable support frame, not shown.

Referring to Figs. 4 to 8 inclusive the inking appliance comprises a housing 120 adapted to receive additional ink or the like through a passage 122 from a suitable reservoir to be described later. The housing is adapted to receive and permit the effective operation of a rotary impeller means 124 or the like and which is mounted upon a rotatable shaft 126 extending out of the housing 120 at one end thereof and having affixed thereto an impeller gear 128 adapted for operative engagement with an intermediate gear 130 fixed to the drive shaft 42 aforementioned. If desired, the impeller means 124 can be independently driven. The ink-discharge and ink-return channels for the impeller mechanism are provided with elongated nozzle walls 132 and 134 which, together with an intermediate section 136, provide outgoing and incoming passages 138 and 140 respectively adjacent the walls 132 and 134. This intermediate section may be provided with wall portions 142 which may be adapted for receiving a heating or cooling medium in the form of fluid, such as hot oil or chilled water, or electrical heating means may be inserted in these wall portions 142. It will therefore be seen that the

temperature of the ink may be maintained to a suitable degree and in a uniform state of distribution in the ink applicer housing. The nozzle walls extend substantially close to the printing cylinder, the wall 132 at its forward end being provided with a flexible sealing plate 144 adapted to yieldingly contact a doctor blade 146 arranged for suitable operative engagement with the printing cylinder. The lower nozzle wall at its forward end thereof is provided with a flexible ink-trap blade 148 adapted to be adjusted adjacent to the printing cylinder surface and the surface tension of the ink or the like prevents leakage thereof while the cylinder is in motion or at rest. The housing 120 is also provided with end walls 150 forming an enclosure at the ends of the ink applicer housing, which walls are provided with extensions 152 adapted to embrace the end walls of the printing cylinder. A felt pad 154 in each of the end walls is adapted to maintain a substantial seal between the cylinder and the extensions 152, particularly the space between the blades 144 and 148. The doctor blade is adapted to engage the upper edge of the felt pads to provide a seal at this point and also to provide a wiper means for the doctor blade extensions in its transverse reciprocatory movements. A gate mechanism 156 comprising a member 158 fixed to a pivotable shaft 160 and provided with a yieldable blade 162. In the position of the gate mechanism shown in Fig. 4 an ink circuit is established up to and including the surface of the printing cylinder between the doctor blade and the ink-trap blade 148. In this position the yieldable member 162 is in engagement with the upper surface of the intermediate section 136, thereby closing off a channel 164 between the forward tip of the intermediate section 136 and the member 158. In the position shown in Fig. 5 the gate mechanism has been rotated counter-clockwise to a position where the yieldable member 162 engages the ink-trap blade 148 to shorten the ink circuit and to by-pass the inking fluid issuing from the impeller around the intermediate section 136 and back, thereby preventing the deposition of ink upon the printing cylinder. The channel 164 is open in this gate position.

Mechanism is preferably provided for opening and closing the gate mechanism 156 in accordance with the raised or lowered position of the printing cylinder, the gate naturally being closed during the lowered position of the cylinder and opened upon the cylinder's return to printing position. This mechanism comprises an arm 166 fixed to the shaft 65 (see Fig. 6) and pivotally connected as at 170 to a frictional block 172 slidably engaging the gate operating rod 174. The upper end of the rod 174 is pivotally connected as at 176 to the gate operating arm 178 fixed to the shaft 160. With this arrangement of mechanism the gate is closed upon actuation of the cylinder lowering mechanism and, conversely, opened when the cylinder is raised to printing position.

A detent mechanism 180 operatively engages the gate arm 178 to urge the gate definitely open or closed.

The doctor blade 146 is adapted to be clamped to a holder bar 182 by suitable means including a clamping blade 184 cooperating with clamp screws 186. The holder bar 182 is adapted to extend transversely through projections 188 of the inking housing at the ends thereof; the holder bar passing through suitable openings 190 in these projections. Suitable means 192 are provided and

adapted to urge the doctor blade into operative engagement with the printing surface. Stop means 194 are also provided and adapted to co-operatively engage the holder bar against undue displacement during the lowered or disengaged position of the printing surface from the doctor blade.

The ink appliance housing 120 is provided with suitable ears or extensions 196 adapted to be secured to a cross-bar 198 suitably supported by the frame members 46.

The doctor blade is reciprocated by a barrel cam 200 cooperating with a follower 202 fixed to the holder bar 182. The barrel cam is rotated by engagement with a gear 204 associated therewith and the impeller gear 128.

Referring to Figs. 9 and 10 the auxiliary ink supply mechanism comprises a reservoir 206 adapted to rotatably support a disc 208 in a liquid sealed opening 210 in one wall of the reservoir. A shaft 212 in said bearing and attached to said disc is adapted to project through said supporting wall and is provided with a key 214 adapted for engagement with the driving shaft 42. The driving engagement is preferably of a separable nature whereby the ink supply reservoir may be quickly disengaged to facilitate ink changes. A supporting projection 216 extends from the frame member 46 and is adapted to swingably support, as at 218, the reservoir 206, whereby the driving connection between the shaft 42 and the shaft 212 may be quickly engaged or disengaged. A locking pin 220 is employed for maintaining the reservoir 206 in engaged or disengaged position. The disc 208 is provided with agitating fins 222 in one side thereof, the other side of the disc presenting a smooth surface adapted to be engaged by a scraper 224 at a relatively high level. The scraper is associated with a receiving cup 226 having an outlet 228 for gravitationally feeding the ink into the passage 122 of the fountain impeller mechanism. By this means ink in the impeller chamber is maintained substantially at a predetermined level.

Referring to Fig. 1 the printing units are preferably arranged in an arc with the printing cylinders on the convex side and the impression cylinders on the concave side, thus providing substantially polygonal paths for the web. The printing surface of the web is therefore convex and after passing the last printing unit, is projected upwardly around a free roller 17 to an idler drum 19 and thence over the web control drum 14. A frictional or other suitable roll 21 geared to the web control drum 14 as by means of engagement of the gear 23 with the gear 74, maintains a non-slipping, constant lineal pull at this point which is equal to the lineal feed at the web intake and through the printing couple units. With this means, once the tension on the web through the printing couples is established, equal linear feed and pull under constant tension are obtained, and in the event the machine is stopped, the tension on the web is maintained. It will be observed that the web by this means is not employed as a power supply or transmittal means for imparting any driving motion to the printing or the impression cylinders and it will also be observed that the rotation of the printing and impression cylinder is not employed for transmitting motion to the web. Excessive or undue retardation or advance of the web, particularly at the printing lines, is thereby eliminated. In view of the fact that the web feeding and pulling and the printing mechanism are adapted to operate

on said web at equal linear speeds and are indirectly connected with the same propulsive power, changes in impression pressure will not vary the tension of the web and registry between successive printing units, thereby web tension is uniformly maintained.

In order to obtain initial registry of the multiple printing units, differential means 230, well known in the art, are preferably provided between the printing units and associated with the common drive shafts 56 therefor. Such differential means are usually provided with micrometer adjusting means for compensating any variations tending to alter the desired registry. In the course of the printing it becomes necessary to separate the printing cylinders from the impression cylinders and this separation is done after the web and the cylinders are brought to rest. In order that the printing may be resumed without web wastage usually accompanying a press stop, means are provided to re-engage the printing cylinders with the web in the precise printing registry prior to the separation. During the separated condition, however, and by means of the arrangement aforementioned, the printing cylinders may be rotated out of registry with the stationary web, the detector and indicating means now to be described affording means to obtain desired re-registry. Referring to Figs. 1, 2 and 8, the drive shaft 42 of the first unit is provided with a notched disc 232 preferably secured to the gear 50. Engaging the notched disc 232 is an indicator disc 234 adapted to rotate with the notched disc and adapted for manual adjustment with respect to the notched disc when the machine is at rest. This means comprises a bracket 236, suitably secured to the frame 46, provided with an elongated arcuate slot 238 of a size greater than the distance between two adjacent notches. Cooperating with said bracket 236 and adjustable within the range of the slot 238 there is preferably provided a sensing or detector means 240 comprising a barrel 242 adapted to be secured in fixed position on the bracket 236 by means of a thumb screw 244 or the like. Slidably retained within this barrel 242 is a sensing pin 246 normally pressed outwardly by a spring 248. A button 250 is provided to permit the manual inward movement of the pin 246 against the action of the spring. In operation of this device the machine is brought to rest and in any stationary position one of the notches 252 will come to rest within the range of the limit of movement of the pin mechanism, whereupon the pin barrel is moved so that the pin therein may be depressed into the said notch 252. The particular notch 252 engaged by the pin is designated by moving the indicator with respect to the notched disc so that the pointer thereof is in associated position shown in Fig. 2, thereby designating the particular notch. In this position the pin barrel is locked to the bracket.

It will be observed that in the lowered position of the first printing cylinder the separation between the gears 32 and 34 thereof disconnects the driving train to the web control drum 14.

During rotation of the printing cylinders in their lowered position, the particular notch rotates with the pointer of the indicator and when the cleaning operations are completed and the rotation of the cylinder is stopped, the particular notch, whenever it comes to rest, is still designated. Before raising the printing cylinders it is advanced to the position so that the designated notch is engageable by the sensing pin 246. In so doing the printing cylinder is in re-

registerable position with the last impression made prior to the separation and upon re-engagement of the web, by raising the printing cylinder into printing contact with the web, the re-registration is effectively established without 5
spoilage of web material when printing operations are resumed.

This re-registry mechanism is employable preferably on the most convenient unit associated 10
with a series of printing units cooperating under a common drive.

If desired, local tension adjusting means such as the three rollers 260, 262 and 264 are provided, the middle roller 262 being vertically adjustable. 15
The end rollers 260 and 264 are positioned to provide a normal path of the web in its passage through a printing unit. Also provided, if desired, is a solvent reclaiming means comprising an inverted hood 266 disposed substantially close 20
to the printed side of the web and having a baffle 268 to prevent an excess of air between the printed side of the web and the hood. Suction means 270 are provided at the opposite end of the hood through which the volatile medium is con- 25
ducted to suitable reclaiming apparatus, not shown. Where heavier-than-air ink solvent vapors are vaporized, arranging the web to travel face downwardly between printing couples, allows the very advantageous recovery of such heavier- 30
than-air solvents by drawing them downwardly by suction; while they are in concentrated condition. A similar hood 272 may be provided at the zone surrounding the free roller 17. Disposed over the series of printing units is a large hood 35
274 extending substantially over the idler drum 19 and the web control drum 14. As indicated, this large hood 274 has connected to it a number of suction ducts 276 which lead to the trunk suction duct 278.

Idler drum 19 may have heating or cooling means disposed within the same as is well known in the art, as also may web control drum 14.

As indicated at 280 a plurality of air injectors may also be provided to assist in the ink drying 45
operation.

As previously noted, reduction in web travel between successive printings while employing all-over pressure rollers in subsequent printing units has definite limitations even under the most 50
favorable circumstances, such as printing on highly absorbent web material and using extremely volatile and low viscosity inks. Therefore referring to Fig. 4, a rigid impression cylinder 282a is provided with circumferential areas 55
in relief 282 and having areal depressions 283. The relief areas may be appropriate layers of rubber or its synthetic substitutes such as thiokol, etc. or rubber impregnated fabrics, or tough papers or textiles etc., secured to the surface of 60
the impression cylinder with their suitable adhesives and in relative positions corresponding to the engraved or inked areas 284 of the co-acting printing cylinder, whereby the web material 286 may be brought into impressional con- 65
tacts with only the engraved or inked areas 284 of the printing cylinder, and thereby web impressional contacts with the non-inked or non-printing areas 285 are avoided, thereby making it practicable to considerably shorten the distance 70
of web travel between successive printings regardless of whether the web material being printed is absorbent or non-absorbent and regardless of whether the ink is wet or dry. This method of impressing the web to printing con- 75
tacts takes advantage of the natural and rapid

tack-acquiring properties of resinous gravure inks and nitrocellulose printing lacquers and also in two other important respects.

The wet ink on the engraved cells of the succeeding printing cylinder has a greater affinity 5
for a printed un-dry, tacky ink than for a printed hard-dry ink. Hence this tacky ink will "take" or "trap" substantially all of the wet ink out of the engravings of the succeeding printing cylinder with less pressure than if it were hard-dry 10
resulting in truer translational of the tonal value of the engravings, because a hard-dry printed ink invariably leaves behind an ink residue of one-third to one-quarter of the wet ink in the cells resulting in the reproduction of faulty or 15
untrue tonal values. Again this ink residuum dries rapidly because it is chiefly solid matter and if not protected from atmospheric exposure will solidify almost immediately in the ink cells. Hence the reason for housing the printing cylinder 20
when employing an all-over impression roller. However with the new and improved ink applier, in cooperation with the new and improved method of applying pressure to web, and in co- 25
operation with a new and improved method of separating the printing couples in cooperation with new and improved methods of web tension control, better quality of multicolor gravure printing can be produced with a substantial saving in web wastage. 30

It will be obvious to those skilled in the art that various other changes and modifications of the invention may be employed but it is to be understood that the invention is not to be limited to what is described in the specification and shown 35
in the drawings but only as indicated in the appended claims.

I claim—

1. In a multi-color press comprising a plurality of printing couples for printing on web material 40
in motion, rotatable means adapted to move and to stop web material in unison with the web printing cylinders without reliance upon the printing couples, and to maintain the same tension on web material during printing and non- 45
printing operations substantially independent of the web impressing members.

2. In a web printing rotary gravure press comprising, an impression member rotatable in an adjustably fixed position, for impressing web 50
material, conducted in a fixed path, upon a gravure printing cylinder adapted for rotation in and out of web printing position, means for moving said cylinder into and out of web printing position in motion or at rest, means for main- 55
taining the web under tension in motion or at rest, and locator means adapted for locating the printing relation between the web printing cylinder and the web impressing member when both are brought to rest, and to re-locate the same 60
relation after said cylinder is rotated out of printing position with the said web impressing member.

3. In a rotary press, a plurality of co-operating printing units adapted to produce multi-color 65
printings on web material in motion, each unit including a web impressing member rotatable on an adjustably fixed axis and a gravure printing cylinder rotatable on an axis movable to and from web printing position, means for moving said 70
cylinder into and out of web printing position, means for maintaining web material under the same tension and in the same path during printing and non-printing rotation of said cylinder, and register locator means in one of said units for 75

locating and re-locating the printing relations between all printing units and the partly printed web when brought to rest, whereby the same printing relations can be restored after printing cylinders are rotated out of their printing positions with said web.

4. A press as defined in claim 3 wherein the register locator means include a notched disc rotating and resting in unison with the printing cylinders and having a notch indicator slidably attached thereto, a fixed support having a shiftable notch fitting pin spring influenced to normally remain free of said disc and adapted to engage any convenient notch therein, means for locking said pin against shifting when notch is located, whereby after cylinders are rotated out of their printing positions, and indicated notch re-located, said printing relations between stationary web and printing cylinders can be conveniently restored.

5. In a web printing multi-color rotary press, in combination, a plurality of printing units each comprising a web impressing member in geared relation with a cooperating printing cylinder, the circumferential surfaces of said printing cylinders normally having certain un-inked non-printing areas thereon and the circumferential surfaces of succeeding web impressing members having areal depressions arranged therein which correspond approximately with the non-printing areas of their respective printing cylinders, independent means adapted to advance web material through printing operations under constant tension along fixed paths without reliance upon the printing units, in unison with the peripheral movement of the printing units substantially unaided thereby, and means adapted to disengage and to re-engage the printing cylinder and web impressing members without disturbing the tension on, and the path of web material in motion or at rest.

6. A press as specified in claim 5, wherein said printing units are adjacently spaced in arcuate formation whereby a moving web is brought into contact with a printing unit only at their lateral printing lines and whereby the printing side of said web contacts only the inked printing or desired printing areas of succeeding printing cylinders during and between successive web printing operations.

7. A press of the character described in claim 5, wherein said web advancing means includes a rotatable web control means adapted to simultaneously feed and pull the web material into and out of printing operations in unison with the web impressing members without reliance upon the printing units, and maintain uniform tension on said web retained in fixed paths, whereby the web impressing members and the printing cylinders, or both, may be moved out of contact with said web without disturbing the tension of the latter.

8. In a web printing rotary press, the combination of a printing means including a printing cylinder normally having certain printing and non-printing areas and a cooperating impression member with a substantially equal circumference, means independent of said printing means for moving and stopping the web and maintaining the same under tension without reliance upon the printing means, means for rotating the printing cylinder out of printing position while maintaining the web in fixed position, suitable web impressing substance mounted on said impression member having predetermined peripheral depressions corresponding approximately with the

non-printing areas of said printing cylinder to avoid bringing web material into impression contact with the non-printing areas of said printing cylinder, consisting in effect a reverse of the relief wet multi-color printing method, and register locating means adapted to locate and relocate the mutual printing position of said printing means and web material at rest, whereby the printing position of the printing means and its printing relation with the web material may be restored after the printing cylinder has been rotated out of its printing position.

9. A method of reverse relief printing for producing wet multi-color intaglio or planographic printing in which a plurality of closely successive printing means are used and in which a web is moved by means spaced apart from the printing means without reliance upon the printing means, and maintained under constant tension, and in which printing inks are super-imposed or juxtaposed in continue sequence on rapidly moving web material which includes providing relief areas of appropriate web impressing substances on succeeding impression members and impressing the web into suitable contact with only the desired printing areas of the printing cylinders co-operating with said impression members, whereby the freshly printed ink on web material traveling a short distance from the preceding printing means is not brought into impression contact with the non-printing areas of succeeding printing cylinders.

10. In a web printing machine which includes a web impressing member adapted to rotate and rest in a fixed position and a printing member adapted to rotate in and out of contact therewith, means to move said printing member into and out of web printing positions, means to maintain the web in a fixed path during printing and non-printing rotations of said printing member, means cooperating with the printing means to pull the web through said printing means and ink drying means, said ink drying means positioned between the printing means and the cooperating web pulling means whereby the freshly printed web contacts the said cooperating pulling means only after the printed material on the web is substantially dry.

11. A combination as defined in claim 10 wherein the web is maintained in the same path during printing and non-printing rotations of the printing member and which further includes means to locate and relocate register relation between the printing member and the web when printing operations are temporarily stopped and the printing member rotated out of printing position whereby the same register relation can be conveniently restored before resuming printing operations.

12. In a web printing machine a plurality of synchronized printing units, each unit including a web impressing member adapted to rotate and rest in a fixed position and a printing member adapted to rotate in and out of web printing positions, means to move said printing member into and out of web printing positions, means to maintain the web in the same path during printing and non-printing rotations of said printing members, pulling means cooperating with the printing units to pull the web through the printing operations and ink dry means, said ink drying means placed between the final printing means and said web pulling means whereby the freshly printed web contacts the pulling

means only after the printed material is substantially dry.

13. A combination as defined in claim 12 wherein the web is maintained in a fixed path during printing and non-printing operations, which further includes means associated with one of said printing units to locate and relocate register relations between all printing units and the partly printed web when printing operations are temporarily suspended and the printing members rotated out of their web printing positions, whereby the same register relations can be rapidly restored before printing operations are continued.

14. A combination as defined in claim 12 which further includes adjacently spaced printing units to multiprint on a web traveling comparatively short distances between successive printings, by virtue of providing, when necessary, areal depressions in the circumferential surface of the web impressing members, said depressions corresponding to the non-printing areas of their respective printing members, whereby the preceding printed ink is not brought into impression contact with the non-printing areas of the succeeding printing members, which in effect is a modified reversal of relief printing to obtain the wet multi-color printing advantages thereof.

15. In a rotary web printing press, a printing unit which includes an impression member rotatable in a fixed position and a printing member rotatable in and out of printing position, means for maintaining the web in the same path during printing and non-printing rotations of the printing member, including a web pulling means which contacts the freshly printed side of the web only after the freshly printed ink is substantially dried.

16. A press as defined in claim 15 which further includes register locator means to restore the former printing register existing between the web and printing member after the printing member has been rotated out of its web printing position.

17. A press as defined in claim 15 wherein the web contacts the impression member and printing member only at the printing line.

18. In a rotary web printing press adapted for printing a plurality of colors, a plurality of printing units each including an impression member rotatable in an adjustably fixed position and printing member rotatable in and out of printing position, means for maintaining the web in the same path under tension during printing and non-printing rotations of the printing members including a web pulling means which contacts the web only after the freshly printed ink is substantially dried.

19. A press as defined in claim 18 which further includes register locator means to restore the former printing register existing between the web and the printing members after the printing members have been rotated out of web printing position.

20. A press as defined in claim 18 wherein the web is substantially under the same tension during printing and non-printing operations.

21. A press as defined in claim 18 wherein the web contacts only the printing members upon its printing side during its traverse through the printing units.

22. A press as defined in claim 18 wherein the web contacts the printing members only at the printing lines during its traverse through the printing units.

23. A press as defined in claim 18 wherein the printing units are closely grouped with the web passing directly from one unit to another, and wherein the impression members have areas in relief whereby colors printed in one unit may pass through successive units without impression-al contact.

24. A press as defined in claim 18 wherein the printing units are closely grouped with the web passing directly from one unit to another and under substantially the same tension during printing and non-printing operations and wherein the impression members have areas in relief whereby colors printed in one unit may pass through successive units without impression-al contact.

25. In a rotary multi-color printing press adapted to print upon a web, a plurality of printing couples each comprised of an impression cylinder and a printing cylinder adapted for separate or contactual rotation, said printing couples being arranged in close association and adapted to contact web material only at the printing lines of the printing couples, and a single web pulling means positioned after the last printing couple adapted to pull the web material through the couples without reliance on the web impressing members.

26. A printing press as defined in claim 25 wherein the web travels directly from one couple to another without reversing the direction of web travel, wherein the impression members are in fixed axial position, and wherein web tension means are provided to maintain tension upon the web whether or not printing couples are separated or in printing engagement.

27. In a rotary web multi-color printing machine, a plurality of closely spaced printing units, each including a printing member and an impression member, means for imposing and maintaining a substantially uniform tension on the web during printing and non-printing operations including means positioned after said units for pulling the web through all the units without reliance upon said units for feeding the web.

28. In a rotary web multi-color printing machine, a plurality of closely spaced printing units, each including a printing member and an impression member, means for imposing and maintaining a substantially uniform tension upon the web during printing and non-printing rotations of the printing members including means positioned after said units for pulling the web through all the units without reliance upon said units for feeding the web, and means at the in-feed portion of the units to aid in maintaining the tension.

29. A combination as defined in claim 28 which further includes means for disengaging the printing units without disturbing printing the position of the web.

30. A combination as defined in claim 28 which further includes means for disengaging the printing units without disturbing the printing position of the web and register means allowing reestablishment of the register between web and printing units upon the reengagement of the units.

31. In a rotary web multi-color printing press a plurality of closely spaced printing units each including a printing cylinder and an impression cylinder, means for imposing and maintaining a substantially uniform tension upon the web during printing and non-printing operations, including means positioned after the last couple

for pulling the web through the couples without reliance upon the couples for feeding the web, means for lowering and rotating the printing cylinders, and means for maintaining the web in a fixed path during printing and non-printing operations.

32. A combination as defined in claim 31 which further includes means for reestablishing register between the printing cylinders and the web, after the printing cylinders have been lowered and rotated.

33. In a multi-color gravure printing press, a plurality of closely associated printing couples each including an impression member and a printing member, means for imposing and maintaining tension upon the web during printing and non-printing operations including pulling means after the last couple for pulling the web through the couples without reliance upon the couples for feeding the web, the said couples being so associated that the web may be passed directly from couple to couple substantially in a straight line with the web contacting its printing side only with the printing cylinders during its traverse through the press.

34. In a multi-color gravure printing press, a plurality of closely associated printing couples each including an impression member and a printing member, means for imposing and maintaining tension upon the web during printing and non-printing operations including pulling means after the last couple for pulling the web through the couples without reliance upon the couples for feeding the web, the said couples being so associated that the web may be passed directly from couple to couple substantially in a straight line with the web contacting its printing side only with the printing cylinders at their printing lines during its traverse through the press.

35. In a web printing gravure press a plurality of printing couples each couple including an impression member rotatable on an adjustably fixed axis and a printing member rotatable during printing and non-printing operations in an axis movable to and away from said impression member, means for maintaining the web in a fixed path and under tension during printing and non-printing rotations of the printing member, and means for locating and relocating relative printing position between the web and printing couples.

36. In a rotary web printing machine, a plurality of printing units, each including a printing member and an impression member for printing on web material and being arranged so that the printing members may be rotated without printing, means for guiding said web through all printing operations without reliance on the web impressing members including means for maintaining said web in the same path during printing and non-printing rotations of the printing members.

37. In a rotary printing machine, a plurality of printing units, each including a printing member and an impression member for printing on web material, means for guiding said web through printing operations without reliance on the web impression members, including means for maintaining said web in the same path whether or not there is pressure between the printing members and the impression members.

38. A combination as defined in claim 37 which further includes means for engaging and disengaging the printing members and impres-

sion members without disturbing the position of, and tension on, the web material.

39. A combination as defined in claim 37 which further includes means for removing and replacing printing members without disturbing the printing position of the web, and register locator means for restoring former register between the web materials and printing members after the printing members have been removed from printing units.

40. In a web printing press a plurality of closely associated printing couples each couple including a printing member and an impression member, means for guiding and maintaining the web in the same path during printing and non-printing rotations of the printing members, including means positioned after said couples for pulling the web through all of said couples without reliance upon either member of the said printing couples, including means whereby the web is brought into contact with said pulling means only after all printing operations are completed and ink drying treatments substantially accomplished.

41. In a multi-color rotary printing press comprised of a plurality of printing units each including an impression member and a printing member for printing on web material, means for engaging or disengaging the printing members into and out of printing position, means for pulling and maintaining a web in a fixed path whether the printing units are in or out of printing position, and impression members having portions in relief.

42. A press as defined in claim 41 wherein the path of the web between the first and last printing units is arcuate.

43. A press as defined in claim 41 wherein the printing members may be disengaged and rotated and which further includes register means for relocating the original printing register between the printing members and the web before the disengagement of the printing members.

44. A press as defined in claim 41 wherein the printing units are positioned relatively close one to another and the path of the web is short between the first and last printing units, the web touching only the printing cylinders on the printing side of the web between the entry of the web into the first printing unit and the exit of the web from the last printing unit.

45. A press as defined in claim 41 wherein the printing units are positioned relatively close one to another and wherein the web proceeds directly from one unit to another without reversals, the web being contacted by the printing cylinders only on the printing side of the web during its traverse through the printing units.

46. In a rotary printing machine a plurality of printing units each unit including a printing member and an impression member for printing on web material, means for maintaining the web in the same path during printing and non-printing rotations of the printing members including a web pulling means which contacts the freshly printed side of web only after all printing operations are completed and ink-drying treatments are substantially consummated.

47. A machine as defined in claim 46 wherein the web travels in a substantially closed path.

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