A web printing press having apparatus for controlling movement of web stock along a path and at least one printing station for imprinting an image on the web stock as it moves therepast, the printing station including a plurality of rolls for printing the image on the web stock including an ink image carrying roll and an impression roll paired with the image roll, the web passing between the image and impression rolls for having an image printed thereon. The printing press further includes apparatus for moving the impression roll toward and away from the image roll, the impression roll being movable between a printing position in which the impression roll is in printing contact with the web stock between the image roll and the impression roll and a retracted position, and an ink fountain for inking the image roll. A drive assembly is provided for the press including a first drive for driving the image roll and the ink fountain and a second drive for driving the web control. Also provided is a coupler engageable and disengageable for coupling and uncoupling the second drive relative to the first drive, the coupler bringing the second drive up to speed and into register with the first drive to positively lock the first drive and the second drive together when these drives are in register with one another, whereby the second drive may be uncoupled from the first drive and the impression roll moved out of printing contact with the web stock so that the ink fountain and image roll may be operated independently of feeding web stock through the printing station.
BACKGROUND OF THE INVENTION

This invention relates to a web printing press and more particularly to a variable repeat-length web printing press. More specifically, this invention relates to such a web printing press especially adapted to print on a web and perform numerous in-line operations (e.g., die cutting, punching, sheeting, etc.) to form labels and cartons.

Web printing presses are conventionally used in high production printing runs for imprinting a series of impressions on web stock fed continuously through the press as opposed to imprinting images on separate sheets of paper fed intermittently through the press. Web printing pressing are conventionally used for high volume printing jobs and may be used for color process work by providing a series of printing stations along the path of the web for imprinting different color images in register with one another on the web as it passes thereby. Web printing presses may either employ the lithographic (offset) or letter press printing method, depending on the particular design of the press and the type of job to be printed.

A problem associated with known prior art web printing presses is the amount of time and labor required to begin printing a new job. In continuous web printing, it is necessary that the plate roll (and the blanket roll if the offset method of printing is used) be of such a diameter that a whole number (i.e., 1, 2, 3, ...) of images to be printed on the web can be equally spaced on the plate roll so that, as the plate roll is rotated, evenly spaced images are printed on the web. In label printing, it is desirable to have approximately one-eighth inch between images. If the repeat length of the image is such that with the desired spacing between images a whole number of images cannot be printed on each revolution of the plate roll, significant amounts of stock will be wasted. Most prior art web presses have a fixed repeat length (i.e., fixed plate roll diameter) and thus may only be used to print images of given repeat lengths or waste a good deal of stock when printing jobs having "nonstandard" repeat lengths. An intermittent paper feed for a web printing press is shown in U.S. Pat. No. 3,204,556 for conserving stock when images having a nonstandard repeat length are to be printed by feeding the web independently of movement of the plate roll.

Also in prior art web presses, printing plates were required to be applied to the plate rolls with the latter installed in the press. Thus, changing plates resulted in lengthy press downtime. Prior art web printing presses also present problems in insuring that the plate rolls at the various printing stations and the other operations carried by the press on the web (e.g., punching, perforating, die cutting, etc.) are driven at the same speed as the web.

Another problem with many conventional web printing presses is that, in order to operate the press so as to insure that the ink and water fountains are properly inking and wetting the plate roll, the web must be fed through the press. Because many web presses utilize five printing stations, and because it may take a few minutes for the ink and water fountains to stabilize at each station, large quantities of web stock are wasted while the press is being adjusted. On other prior art web presses, the inking means and plate roll may be operated independently of the web, but web tension is relaxed while the web is idling thus causing problems upon re-starting the press.

Also, with many prior art web printing presses (especially on small presses), it is difficult to adjust the transverse the longitudinal registration of the image imprinted at each printing station.

SUMMARY OF THE INVENTION

Among the several objects of this invention may be noted the provision of an in-line, variable repeat-length web printing press in which plate rolls of one diameter may be readily exchanged for plate rolls of a different diameter; the provision of such a press which requires that only two gears need be changed to maintain the surface speed of the inking means and the plate roll at the surface speed of the web fed through the press upon exchanging plate rolls of one diameter for plate rolls of another diameter to vary the repeat length; the provision of such a web printing press in which the plate roll and the inking means at each printing station may be operated independently of the web moving through the press, the provision of such a web printing press in which the plate rolls and the inking means at the various printing stations are independently of auxiliary in-line web operations (e.g., in-feed and out-feed pacing, die cutting, punching, etc.); the provision of such a web printing press in which both longitudinal and transverse or side register of the images printed at each printing station may readily be adjusted while the press is in operation; the provision of such a web printing press in which the ink fountain and the water fountain are adjustable relative to the plate roll and in which the impression roll (which forces the web into printing contact with the ink image carrying roll) is adjustable relative to the ink image carrying roll (e.g., the plate roll if the letter press or direct lithographic printing method is used, or a blanket roll if the offset printing method is used); the provision of such a web printing press in which the impression roll at each station may be remotely controlled to effect printing of the web; the provision of such a web printing press in which the image roll (i.e., the plate roll) and the inking means and the means for performing the above-mentioned auxiliary web operations are driven by a common drive in such manner that the means for effecting the auxiliary web operations may be coupled to and uncoupled from the image roll and inking-means drive means thereby to permit operation of the image roll and inking means independently of feeding the web through the printing press while maintaining tension on the web; the provision of such a web printing press in which various printing functions (inking, on and off impression, and register) at each printing station may be remotely controlled; the provision of such a web printing press in which the time required to set up the press for a new job is minimized; and the provision of such a web printing press which is reliable and economical in operation. Other objects and features of this invention will be in part apparent and in part pointed out hereinafter.

Briefly, a web printing press of this invention has means for controlling movement of web stock along a path and at least one printing station for printing an image on the web stock as it moves therepast. The printing station comprises a plurality of rolls for printing the image on the web stock and includes an ink
image carrying roll and an impression roll paired with the image roll, the web stock passing between the image and impression rolls for having the image imprinted thereon. Each printing station also includes means for moving the impression roll toward and away from the image roll between an imprinting position in which the impression roll is in printing contact with the web between the image roll and the impression roll and a retracted position. The press further comprises a drive including first means for driving the image roll and the inking means and second means for driving the web control means, and means engageable and disengageable for coupling and uncoupling the second drive means relative to the first drive means. This coupling means includes means for bringing the second drive means up to speed and into register with the first drive means and to positively lock the first drive means and the second drive means together when these drive means are in register with one another, whereby the second drive means may be uncoupled from the first drive means and the impression roll moved out of printing contact with the web stock so that the inking means and the image roll may be operated independently of feeding web stock through the printing station.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front side elevational view of a web printing press of this invention illustrating one path of web stock to be printed as it is fed through a plurality of printing stations for having impressions imprinted thereon, and as it is fed through optional in-line die cutting, punching and slitting apparatus;

FIG. 2 is a back side elevation view of the web printing press shown in FIG. 1 illustrating a first drive means including a pair of upper line shafts interconnecting gear boxes at each printing station and a second drive means including a lower line shaft for driving web control means and various auxiliary web operation means (e.g., die-cutters, punches and slitters), and means for coupling and uncoupling the first drive means relative to the second drive means;

FIG. 3 is an enlarged partial front elevation of one of the printing stations shown in FIG. 1;

FIG. 4 is an enlarged partial back view of the forward end of the press illustrating the above-mentioned drive and coupling means with some parts omitted for clarity;

FIG. 5 is an exploded perspective view of various parts constituting one of the printing stations;

FIG. 6 is a vertical section taken on line 6—6 of FIG. 3 illustrating a removable plate roll, means for driving the plate roll, and side and longitudinal register adjustment means for adjusting the position of the image printed on the web at each printing station;

FIG. 7 is an enlarged view of the right portion of FIG. 2 illustrating in detail the above-mentioned coupling means;

FIG. 8 is an enlarged plan view of means for sensing when the first and second drive means are in phase with one another for effecting engagement of a positive clutch constituting a portion of the above-mentioned coupling means;

FIG. 9 is an end elevation view of FIG. 8;

FIG. 10 is an enlarged view taken on line 10—10 of FIG. 4 illustrating a gear change box for connection of a pair of line shafts in the first drive means at a fixed speed relative to one another;

FIG. 11 is an enlarged vertical section taken on line 11—11 of FIG. 3 illustrating an ink fountain and an inking drive gear box;

FIG. 12 is an enlarged back side elevation view of the first printing station along the path of the web; and

FIGS. 13 and 14 illustrate a circuit diagram for controlling operation of the web printing press.

CORRESPONDING REFERENCE CHARACTERS INDICATE CORRESPONDING PARTS THROUGHOUT THE SEVERAL VIEWS OF THE DRAWINGS.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, an in-line, variable repeat-length web printing press, indicated in its entirety at 1, is shown (see FIG. 1) to comprise a station 3 for holding and supplying web stock W to be printed, an in-feed web pacing station 5, a plurality of printing stations 7A—7E for successively impressing ink images on the web stock as the web moves along a path (as indicated by the arrows in FIG. 1) from printing station to printing station, an out-feed web pacing station 9, a die cutting station 11, a punching station 13 and a rewinding station 15. Web paths other than that shown by the arrows may, of course, be used so that, for example, the web may be twisted by means of the inverting rollers thereby to enable printing on both sides of the web. The web supply station 3 and web pacing stations 5 and 9 constitute means for controlling movement of web W along the path as it moves through the press. Generally, the various stations comprising the press are mounted between a front side tooling plate 17A and a back side tooling plate 17B, these tooling plates being made of relatively thick aluminum plate, for example, of sufficient rigidity to support the various components of the press and thus constituting a frame for the press.

Each of the printing stations 7A—7E is essentially identical; consequently only printing station 7A is shown and described in detail. In FIGS. 1 and 3, printing station 7A is shown to comprise a plurality of rotary rolls R for printing an ink image on web W as the latter passes along its path through the printing station. An ultraviolet dryer H is provided downstream from each printing station to cure or dry the ink image imprinted on the web stock before it passes to the next succeeding operation (e.g., the next printing station or the die cutting station 11). At each printing station, an ink image carrying roll 19 and an impression roll 21 are provided, the impression roll being paired with the image roll. As shown in FIGS. 1 and 3, web stock W passes between the nip of the image and impression rolls for having an ink image imprinted thereon. Means, as indicated generally at 23, are provided for moving the impression roll toward and away from the image roll between an imprinting position (see FIG. 3) in which the impression roll is in printing contact with web W between the image roll and the impression roll and a retracted position (not shown) in which the web is not gripped between the impression and image rolls. Inking means, generally indicated at 25, are provided for applying ink to the image roll 19.

As best illustrated in FIG. 2, a drive, generally indicated at 27, for the press includes means, indicated at 29, for driving the image roll 19 and the inking means 25 at each of the various printing stations 7A—7E, this means 29 also being referred to as first drive means, and means 31 for driving the above-mentioned web
control means (e.g., web supply station 3, in-feed pacing station 5, and out-feed pacing station 9), this means 31 also being referred to as second drive means. Drive 27 further comprises coupling means, as generally indicated at 33, engageable and disengageable for coupling and uncoupling web control drive means 31 relative to image and ink-means or first drive means 29. This coupling means includes means 35 for bringing the second drive means up to speed and into register with the first drive means 29, and for positively locking the first drive means and the second drive means together when these drive means are in phase with one another, whereby the second drive means may be uncoupled from the first drive means and the impression roll moved to its retracted position out of printing contact with web stock W so that inking means 25 and image roll 19 may be operated independently of feeding web stock W through the press.

Printing press 1 is shown to have a plate roll 37 on which a printing plate P may be mounted (see FIG. 3). As illustrated, press 1 is designed to utilize either the letterpress or direct lithographic (offset) printing methods in which ink is applied to a plate P of the plate roll to form an ink image on the plate and the plate is then forced into printing contact with web W by impression roll 21 when the latter is in its imprinting position whereby to print an ink image directly on the web. It will be understood that the conventional offset printing method may be used in which an ink image from an offset plate is transferred to a blanket roll (not shown), this blanket roll being in printing contact with the impression roll and thus constituting an ink image carrying roll.

If the lithographic printing process is used, inking means 25, as illustrated, comprises an ink fountain 39 and a water fountain 41 positioned on opposite sides of plate roll 37 for applying both ink and water to a lithographic or offset plate P mounted on the plate roll. If, however, the letterpress printing method is employed, it will be understood that the water fountain may be used as a second ink fountain. As shown in FIG. 3, each ink fountain 39 and 41 includes a pair of mill rolls 43A, 43B in rolling contact with one another and one or more form rolls 45 to apply ink evenly to plate P mounted on plate roll 37. These rolls are journaled between a pair of side plates 47 (see FIG. 11) constituting a frame for the fountain. The side plates are slidable mounted relative to tooling plates 17A, 17B on bearing pads 49 of low friction material (e.g., a TFE material such as “Teflon”) so as to permit horizontal sliding movement of the fountain relative to plate roll 37 between an operating position in which form rolls 45 are in contact with the plate P on plate roll 37 for applying ink thereto (see FIG. 3) and a retracted position clear of the plate roll (this retracted position is not shown). The ink fountain includes a stirrup 51 which is rigidly mounted relative to the fountain frame and a rod 53 journaled between the side plates of the fountain frame, this rod fixedly mounting a pair of pinion gears 55. Rod 53 is journaled in stirrups 51 and these stirrups and pinion gears constitute means for moving the ink fountain between its operating and retracted positions. As illustrated in FIG. 3, impression roll 21 is positioned below plate roll 37 with the center line of the impression and plate rolls lying in the same vertical plane. The impression roll is movable up and down relative to the plate roll between its above-mentioned imprinting and retracted position by means 23.

More particularly, means 23 for controlling movement of impression roll 21 also controls movement of ink fountain 39 and water fountain 41, and includes three different control means for moving the fountains and impression roll. The first of these control means may be referred to as coarse adjustment means, indicated generally at 57, which simultaneously moves the ink and water fountains and the impression roll forward and away from the plate roll by means of a hand wheel 59 at each printing station. The second of the above-mentioned control means is indicated generally at 61, this second means being referred to as individual fine adjustment control means for making individual adjustments of the ink fountain, and the impression roll independently of another to insure that the form rolls 45 of each of the fountains and the impression roll are in proper contact with the plate roll. These fine adjustments may be effected by turning knobs 63A, 63B and 63C for controlling the ink fountain, water fountain and impression roll respectively.

The third of the above-mentioned means is a power-operated means, as indicated generally at 65 (see FIG. 5), operated by remote control comprising a pair of rotary cams 67A, 67B operable by means of fluid cylinder and piston units (e.g., air cylinders) 69A, 69B and 69C according to an operational sequence to first move water fountain 41 from its retracted to its operating position, thereby to wet plate P on plate roll 37, then to move ink fountain 39 from its retracted position to its operating position, thereby to ink the plate, and to move impression roll 21 from its retracted to its printing position (i.e., to bring the press “on impression”). These air cylinders are reversibly operable to move the impression roll from its printing position to its retracted position, then to move the ink fountain from its operating position to its retracted position and to move the water fountain from its operating position to its retracted position. It will be understood that during operation of this power-operated means, operation of the power-operated means may be stopped at any time so that, for example, only the impression roll need be moved from its printing to its retracted position while maintaining the ink and water fountains in their operating positions.

More particularly, the coarse or simultaneous adjustment means 57 includes two sets of bevel gears 71A, 71B interconnected to hand wheel 59 by means of a shaft 73. Bevel gear set 71A, which is adjacent the hand wheel, includes a pair of straight bevel gears facing one another with rotary cam 67A disposed between the bevel gears. Cams 67A and 67B are fixedly mounted on a shaft 75, this shaft being concentric with gear shaft 73 so that the bevel gears and the cams may be rotated independently of one another. As indicated generally at 77A, 77B and 77C, actuating assemblies operable either by bevel gear set 71A or by cam 67A are provided for effecting movement of water fountain 41 and ink fountain 39 between their retracted operating positions and for effecting movement of impression roll 21 and off impression. At the side of the printing station opposite hand wheel 57, only one bevel gear 71B and one actuating assembly 77C is provided for effecting movement of the outer end of the impression roll.

Fountain actuating assemblies 77A, 77B are essentially identical and, accordingly, only the water fountain actuating assembly 77A will be described in detail.
This assembly comprises a threaded rod 79 journalled relative to the press frame by means of bushings 81. A pinion gear 83 is fixed on the inner end of rod 79 and is in mesh with one of the bevel gears of gear set 71A. A cam follower 85 is carried by the inner end of the rod, this follower being rotatable with respect to the rod and being in camming relation with cam 67A. Rod 79 is axially movable relative to the press frame in bushings 81 and is in threaded engagement with a follower or nut 87 movable horizontally with respect to the press toward and away from cams 67A, 67B. This follower carries a stub 89 engageable with stirrup 51 for connecting the water fountain to the actuating assembly. A compression spring 91 (which may be a series of spring washers, for example) biases the rod toward bevel gears 71A and cam 67A, and thus maintains pinion gear 83 in mesh with the bevel gears and maintains cam follower 85 in camming relation with cams 67A, 67B. At each side of the press frame, gear racks 93 are provided. These gear racks are in mesh with pinion gears 55 (see Fig. 11) carried by the ink and water fountains whereby upon movement of the fountain either by means of gear sets 71A and 71B or by means of axial movement of rod 79 due to camming action of cam 67A, the racks 93 and pinions 55 maintain both sides of the fountain parallel and thus insure uniform movement of the fountain toward and away from the plate roll.

Impression roll actuating assemblies 71C are similar to the fountain actuating assemblies 71A and 71B, except for the differences as herein noted. The impression roll (not shown in Fig. 5) is journalled in bearing blocks 95. These bearing blocks are movable vertically in guides 97 which constitute a portion of the press frame to permit movement of the impression roll between its printing and retracted positions. A bearing cap 99 secures the impression roll in bearing block 95. An actuating nut 101 is held captive in block 95 and is in threadable engagement with rod 79 of the impression roll actuating assembly so that either rotation of the rod 79 in response to operation of bevel gear sets 71A, 71B or to axial movement of the rod in response to camming action of cams 67A, 67B effects an up and down movement of the impression roll.

Fine or individual adjustment control means 61, as heretofore referred to, are provided for individually adjusting water fountain 41, ink fountain 39 and impression roll 21 independently of one another so that the fountains and impression rolls as in proper engagement with plate P mounted on plate roll 37 when the fountains are in their respective operating positions and when the impression roll is in its imprinting position. The fine adjustment control means for the ink and water fountains are identical and thus only one will be described in detail. This fountain fine adjustment control means comprises a nut 103 threaded on rod 79 and held captive by follower 87. This nut has a worm gear on its periphery, and a worm 105 rotatable by means of a know causes rotation of the nut thereby to permit movement of follower 87 and the water fountain relative to rod 79. The fine adjustment control means for impression roll 21 includes two such worm actuated adjustment mechanisms, one for each end of the impression roll, so that the ends of the impression roll may be concurrently or independently adjusted relative to plate roll 37 thereby to insure that the impression roll properly engages the plate roll so as to uniformly press the web stock into the plate roll as the web stock is fed between the nip of the impression roll and the plate roll.

Power-operated means 65 is shown to comprise a series of air cylinders 69A, 69B and 60C rigidly mounted with respect to the frame of the press. The piston rods of each of these air cylinders is secured to a block 106 slideable relative to the press frame and carrying a gear rack 107. A gear sector 109 is in mesh with gear rack 107 (see Figs. 5 and 12) and this gear sector is fixed on one end of shaft 75. Cam 67A has cam lobes spaced on its periphery so that upon rotation of the cam through a series of equal predetermined angles (e.g., 25°), the cam first effects movement of the water fountain 41 from its retracted position to its operating position by permitting spring 91 via shaft 79 to move the water fountain as the cam follower 85 moves from the cam lobe to the dwell, then effects movement of ink fountain 39 from its retracted position to its operating position in a manner similar to the water fountain, and then effects movement of the impression roll from its retracted position to its imprinting position by forcing the impression roll into printing contact with the web thereby to form ink images on web stock W passing through the press. The stroke of the air cylinder 69A is such as to effect movement of rack 107 a distance sufficient to cause cam 67A to rotate through the above-mentioned predetermined angle (e.g., 25°) and the strokes of the piston rods of air cylinders 69A and 69B are also such as to cause the cams to rotate an additional predetermined angle when cylinder 69B is actuated and when cylinder 69C is actuated. The air supplied to these air cylinders is controlled by solenoid valves SV1A, SV2A and SV3A, etc., respectively, which are controlled by circuitry illustrated in Figs. 13 and 14. This circuitry fixes the above-mentioned sequence of operation of the air cylinders. Air cylinders 69A, 69B and 69C are double acting cylinders and thus, upon reverse energization, rotate cams 67A, 67B in the opposite direction, the water and ink fountains are returned to their respective retracted positions by cams 67A, 67B against the bias of springs 91, and the impression roll is allowed to move to its retracted position.

In accordance with the objects of this invention, printing press 1 includes means, as indicated generally at 111 (see Figs. 5 and 6), for removably mounting plate roll 37 thereby to permit ready installation and removal of the plate roll so as to permit a plate roll of one diameter readily to be exchanged for a plate roll of a different diameter thereby to permit the repeat length of the image to be printed to be varied. This ease of removal and installation of the plate roll also permits the plate to be mounted on extra sets of plate rolls remote from the press, to be ready by upon changing from one job to another the plate roll with the new plates previously mounted thereon may be quickly installed in the printing press thereby saving a considerable amount of press time upon changing from one job to another.

More particularly, plate roll 37 comprises a cylindrical body 113 on which a printing plate P may be mounted and a shaft 115 coaxial with the cylindrical axis of roll body 113. The shaft extends endwise from body 113 and is adapted to be journaled by means of centerless bearings 117 carried by guides 96. These centerless bearings rotatably support the plate roll and comprise a steady-rest journal for shaft 115. Means 111 also in-
cludes a pin connection, as indicated generally at 119, for quickly connecting and disconnecting shaft 115 to and from the image roll and inking-means drive means 29 (see FIG. 6).

As shown in FIGS. 3 and 5, centerless bearing means 117 comprises a first or lower roller 121 journaled by guide 97 and a pair of upper rollers 123A, 123B journaled in a hinged cap or clasp member 125 so that, with the plate roll in position and with the hinged cap closed, shaft 115 is supported on the outer periphery of rollers 121 and 123A, 123B. Cap 125 may be secured to its closed position by means of a clamping bolt (not shown). Upon shaft 115 being forced upwardly when the impression roll is moved to its printing position, rollers 123A, 123B form a self-centering journal for the shaft.

Connection means 119 comprises a block 127 (FIG. 6) keyed on and rotary with a plate roll drive shaft 129, this block having an enlarged axial bore 131 there-through for reception of one end of shaft 115 and a T-groove 133 for reception of a T-pin 135 extending radially through shaft 115, thereby to rotatably drive plate roll 37 and to permit longitudinal adjustment of the image printed on the webstock by the plate roll. Shaft 15 carries a rod end fitting 137 on its outer end, this end fitting having a spherical bearing (e.g., a monoball-type bearing) adapted to receive a pin 139 for holding shaft 115 in fixed axial relation to plate roll drive shaft 129 thereby to permit transverse adjustment of the image imprinted by the plate roll relative to the edge of the webstock as will appear. It will be particularly noted that the plate roll does not carry a gear which it has to be changed when plate rolls of various diameters are interchanged. This feature has many advantages, including low cost, elimination of gear pitch problems in which gears may bottom out depending upon the diameter of the plate roll, elimination of "gear streak" on the image due to improper mesh of the gears, increased operator safety, and allowance of the plate rolls to be removed without losing register. This last-mentioned feature permits plate changes to be made off the press. Thus a second set of plate rolls with plates already mounted thereon may be readily installed in the press, thus saving considerable press time.

Referring now to FIGS. 2, 4 and 12, image roll and inking-means drive means 29 is shown to comprise an ink and water fountain line shaft 141 extending from one end of the press to the other driving an ink fountain gear box, generally indicated at 143, and a water fountain gear box 145 (see FIG. 12), and a plate roll line shaft 147 interconnecting a plate roll gear box 149 with other plate roll gear boxes at each printing station 7A-7E. As is shown in FIG. 4, line shaft 141 is driven by hydraulic motor 151 via a toothed timing belt 153 and a toothed pulley 155 keyed on line shaft 141. Line shaft 147 is driven at a fixed-speed ratio relative to line shaft 141 by means of a quick-change gear box 157. As shown in FIG. 10, quick-change gear box 157 includes a drive gear 159 keyed on line shaft 141, an idler gear 161 journaled on an idler member 163, the idler member being pivotal relative to the center line of shaft 141 for swinging in an arcuate fashion relative to shaft 141, a toggle clamp 165 for locking member 163 positioned relative to gear box 157, and a quick-change gear 167 keyed on line shaft 147 by means of a quick-release nut 169, thereby to permit a quick change of gears of one pitch diameter to be exchanged with gears of a different pitch diameter. Upon exchange of a quick-change gear of one diameter for a quick-change gear of another diameter, toggle clamp 165 is loosened and member 163 swung within the gear box so that the idler gear is in mesh with both drive gear 159 and the new quick-change gear 167. Thus, the speed of each of the plate rolls 37 at each printing station 7A-7E may be readily changed upon the exchange of plate rolls of different diameters, so as to correspond to the surface speed of the rolls of the ink and water fountain merely by changing one gear in gear box 157.

As shown in FIG. 4, line shaft 150 (or second) drive means 31 is driven by means 33 for coupling and uncoupling the second drive means, a belt drive 171 and a second quick-change gear box 173. This second quick-change gear box is essentially identical to gear box 157 heretofore described, and upon changing plate roll sizes, the quick-change gear of gear box 173 must be exchanged with a quick-change gear of the same pitch diameter as the newly installed gear in gear box 157 so as to drive the in-feed and out-feed pacem stations 5 and 9, die cutting station 11, punching station 13 and rewound station 15 at a speed commensurate to the surface speed of the plate rolls 37 at the various printing stations 7A-7E. This second quick-change gear box 173, together with the various stations (list above) constituting the web control means are driven by a common line shaft 175 on which the quick-change gear in gear box 173 is removably secured.

The ink fountain and water fountain gear boxes 143 and 145, respectively (shown in FIG. 11), drive a shaft 181 which is in turn journaled within the gear box. The output end of shaft 181 is interconnected to mill rolls 43A, 43B of the ink fountain by means of a power transfer coupling 183 permitting back-and-forth horizontal movement of the ink fountain between its operating and retracted positions. For example, coupling 183 may be a Schmidt coupling manufactured by the Tool Steel Gear and Pinion Company of Cincinnati, Ohio. This coupling will permit approximately 2 inches of horizontal movement of the fountain relative to the press frame. Mill rolls 43A, 43B are interconnected by means of spur gears, 185A, 185B (only gear 185A is shown in FIG. 11) having equal pitch diameters so as to insure that the mill rolls are driven at the same surface speed. A reciprocating worm drive, indicated generally at 187, is provided to reciprocate form rolls 45.

Referring now to FIGS. 4, 7, 8 and 9, coupling means 33 will be described in detail. In accordance with the objects of this invention, it is desirable to be able to operate the ink and water fountains 39 and 41, respectively, and plate roll 37 independently of feeding web stock W through the press. This allows the ink fountains W and water fountains at each of the various printing stations 7A-7E to be operated so as to allow the press operator to adjust and to clean the fountains to properly wet and ink the printing plate P mounted on plate roll 37 without feeding web stock W through the press. Because web stock is fed through the press at high speed (e.g., 500 ft./min. or greater), substantial quantities of stock may be saved. Also, this coupling means allows the operator to stop the press while printing so that he can carefully examine the images being imprinted and then allows the press readily to be restarted. This web pause feature is particularly advantageous in assuring high quality control, especially in color process work, because it allows the registration of
the images to be inspected with the press stopped and then it permits the press readily to be restarted.

More particularly, clamping means 33 comprises a positive clutch (e.g., a drop pin clutch) generally indicated at 189 for positively locking the web control drive 31 to the plate (image) roll and inkinc-means drive means (the first drive means) 29 together, this positive clutch sometimes being referred to as a lock-on clutch. Clutch 189 comprises an input shaft 191 and an output shaft 193. The input shaft is driven by motor 151 by means of belt 194 and the output shaft is inter-connected to web control drive means (or second drive means) 31 by means of a belt 195 driving the drive gear of gear box 175. Positive clutch 189, when engaged, positively locks the input shaft to the output shaft. Positive clutch 189 is more particularly shown in FIG. 7 in which a drive disk 197 is keyed on and is rotary with input shaft 191, and driven disk 199 is keyed to and is rotary with output shaft 193, these two shafts being free to rotate relative to one another when clutch 189 is disengaged. Drive disk 197 has a bore 201 parallel to and spaced from its rotary axis and driven disk 199 has a corresponding bore 203. An actuating disk 205 is axially movable on input shaft 191. An index pin 207 is secured to and extends from actuating disk 205, this index pin being received by bore 201 in drive disk 197. The actuating disk has an external annular flange 209. A pair of air cylinders 211 (only one of these cylinders is shown) is secured to the press and each has a follower 213 on the outer end of its piston rod, this follower being held captive on flange 209 whereby actuation of the air cylinders effects axial movement of the actuating disk and pin 207 relative to input shaft 191 between a disengaged (or uncoupled) position (as shown in FIG. 7) in which the index pin is clear of driven disk 199 and an engaged (or coupled) position in which the outer end of the index pin is received by bore 203 in driven disk 199 thereby to positively lock the input shaft to the output shaft. Index pin 207 is provided with a bearing 215 on its outer end for rolling on the face of disk 199 when the pin is in its disengaged position. Operation of air cylinder 211 is controlled by a solenoid valve SV4 which is energized in response to an electrical signal in a manner as will appear. Air cylinders 211 and their associated electrical circuitry constitute means for engaging and disengaging positive clutch 189.

A soft starting clutch (e.g., a magnetic particle clutch) 217 is rigidly mounted on the press adjacent positive clutch 189. A pulley 219 is keyed on input shaft 191 and a pulley 221 is keyed on output shaft 193. A pulley 223 is fixed on the input shaft of starting clutch 217 and is driven by pulley 219 by means of a belt 225. A pulley 227 is fixed on the output shaft of clutch 217, this last-mentioned pulley driving output shaft 193 via pulley 221 and a belt 229 when positive clutch 189 is disengaged and starting clutch 217 is engaged. A belt tensioner 231 is provided for belt 225. It will be particularly noted that pulley 219 on input shaft 191 and pulley 221 on output shaft 193 are of different pitch diameters. For example, pulley 219 may have 26 teeth, while pulley 221 may have 28 teeth. This difference in pulley diameters causes the output shaft to rotate at a slightly slower speed than the input shaft. This difference in pulleys may be referred to as a differential drive.

In accordance with this invention, means, as indicated generally at 231 (see FIGS. 4, 8 and 9) is provided for sensing a desired rotational position or phase of the second drive 31 relative knob the first drive 29 so that upon starting of the second drive various auxiliary in-line operations performed on the web at die-cutting station 11 and punching station 13 are in phase with images printed on the web at each end stations 7A–7E. Sensing means 231 generates an electrical signal in response to sensing that the first and second drive means are in phase with one another, this signal energizing solenoid valve SV4 thereby to actuate air cylinders 211 so as to move actuating disk 205 and index pin 207 from their disengaged to their engaged position so as to positively lock output shaft 193 to input shaft 191 thereby insuring proper registration between the first drive means 29 and the second drive means 31. This sensing means is also referred to as a so-called pick-up and lock-on assembly. This pick-up and lock-on assembly is driven by a pulley 233 keyed on the outer end of output shaft 193 via belt 235. As best shown in FIG. 9, belt 235 drives a relatively large diameter pulley 237 keyed on a rotary shaft 239 and a smaller diameter pulley 241 keyed on a shaft 243. A tension adjusting idler assembly 245 is provided for belt 235. Due to the relative diameters of pulleys 237 and 241, shaft 243 is driven substantially faster (e.g., 3 times as fast as shaft 239). A disk 247 is secured to shaft 239 and rotates therewith, and a disk 249 is secured to and rotatable with shaft 243. Disks 247 and 249 are preferably of a nonmagnetic material (such as a thermoplastic) and carry a proximity switch, such as a magnetically actuated reed switch, these switches being indicated at 251 and 253, respectively. A magnet holder assembly 255 is rotatably journalled on shaft 239 and another magnet holder 257 is rotatably journalled on shaft 243. The holder assembly 255 includes a disk 259 in close proximity and in face-to-face relation with disk 247, this disk carrying a permanent magnet 261 having a field of sufficient strength to actuate switch 251 when the magnet and switch are substantially in line or in phase with one another. Holder assembly 255 also includes a relatively large diameter pulley 263. Holder assembly 257 includes a disk 265 in close proximity to and in face-to-face relation with disk 249, disk 265 carrying a magnet 267 having a field of sufficient strength to actuate switch 253 when the switch and the magnet are in close proximity to one another. Holder assembly 257 also includes a relatively small diameter pulley 269. As shown in FIG. 9, a belt 271 is trained around a pulley 273 keyed on plate roll line shaft 147 and around pulley 263 and 269 of holder assemblies 255 and 257, respectively. Thus, the holders 255 and 257 are continuously driven by the plate roll line shaft and the magnets 261 and 267 serve as an index for the plate rolls 37 at printing stations 7A–7E. Due to the difference in diameters of pulleys 263 and 269, holder 257 is driven at a rotational speed equal to the rotational speed of plate rolls 37 so that magnet 261 serves as an index for the plate rolls and holder 257 is driven at the rotational speed of line shaft 147 (which is equal to the speed of input shaft 191). Shafts 239 and 243 are driven by output shaft 193, and, due to the diameters of pulleys 237 and 241, disks 247 and 249 keyed on shafts 239 and 243, respectively, are driven in the same direction and at approximately the same speed as disks 259 and 265 driven by plate roll line shaft 147. However, due to the differen-
tial drive of pulleys 219 and 221, disks 247, 259 and 249, 265 rotate relative to one another so that magnets 261 and 267 move relative to their respective reed switches 251 and 253.

With positive clutch 189 disengaged, with the first drive means 29 and the second drive means 31 out of phase with one another, and with motor 151 energized, line shaft 175 is brought up to speed by starting clutch 217 to a speed slightly slower than the speed of the input shaft 191, this differential speed being due to the difference in size between pulleys 219 and 221, clutch 217 being energized by the closing of reed switch 251. Due to the fact that shaft 243 and holder 257 rotate three times faster than shaft 239 and holder 255, energization of switch 251 determines the in-phase relationship between the first and second drives to within 120°. Switch 251 provides a signal through a set of slip rings 271 to energize a relay coil 6CR (see FIG. 13). This relay is held closed by its own holding circuit and energizes clutch 217. It will be noted that switch 253 and magnet 267 are positioned ahead of switch 251 and magnet 261 so that switch 253 and magnet 267 are out of proximity relative to one another when switch 251 closes to energize clutch 217. This starting clutch provides for a soft start of drive means 31. Due to the difference in rotational speeds between magnet 267 and its respective switch 253, the magnet and the switch move relative to one another approximately one full revolution at a speed ratio of, for example, 1:1.034. Upon magnet 267 and switch 253 again coming into close proximity to one another, switch 253 is actuated by the field of magnet 267 and provides a signal via slip rings 274 to energize a relay coil 7CR which in turn energizes solenoid valve 4SO as so to effect operation of the air cylinders 211 to move index pin 207 from its disengaged to its engaged position. A limit switch LS1 is positioned adjacent the piston rod of air cylinders 211, this limit switch being actuated by the piston rod of the air cylinders as the index pin attains its fully engaged position. Actuation of limit switch LS1 deenergizes starting clutch 217 and thus the first and second drive means 29 and 31 are positively locked together in phase with one another thereby to insure precise registration between images printed on web stock W and the web control means (i.e., in-feed and out-feed pacing stations 5 and 9, die-cutting station 11, and punching station 13).

Referring now to FIG. 6, side register means, generally indicated at 275, are provided for adjusting the registration of the image printed on web stock W transversely with respect to the web stock. Also, means, as indicated at 277, are provided for adjusting the registration of the image longitudinally with respect to the web. More particularly, side register adjustment means 275 comprises a thrust bearing 279 with its inner race 281 secured to plate roll drive shaft 129. Shaft 129 is movable axially relative to gear box 149 so as to shift plate roll 37 (and hence the image printed thereby) relative to web W. A screw jack 283 is provided to apply axial thrust to the outer stationary race 285 of the thrust bearing and thus to shift shaft 129 axially. Screw jack 283 includes a sprocket 287 connected to a gear motor (not shown) at each printing station by means of an endless chain (not shown). Upon energization of the gear motor, sprocket 287 is rotated to effect axial movement of shaft 129 and plate roll 137 relative to the edges of the web stock. For example, side register of the plate roll relative to the web stock may be controlled to within approximately 0.005 inch or closer.

FIG. 6 also illustrates the particular details of plate roll gear box 149. Line shaft 147 turns a worm gear 289 by means of a worm 291 on the line shaft. The worm gear is fixed on a tubular shaft 293 which is rotatable in bearings 295. A spur gear 297 (also referred to as a first gear) is keyed to the outer end of tubular shaft 293. Shaft 129 is concentric within and rotatable relative to the tubular shaft. The outer end of shaft 129 extends beyond gear 297 and has a circular plate 299 fixed thereto. Plate 299 carries a bracket 301 which extends in beyond spur gear 297, this bracket and plate rotatably mounting a pinion gear (also referred to as a second gear) 303 which is in mesh with gear 297. A worm gear 305 is fixed to the outer end of the shaft of pinion 303, this worm gear being in mesh with worm 307 on the outer end of a d.c. gear-head motor 309. This gear-head motor rotates with shaft 129 and is provided with a slip ring 311 for supplying electrical power to the motor. It will be noted that with motor 309 deenergized, pinion 303 is held fixed with respect to plate 299 and thus spur gear 297 is fixed with respect to the plate. Upon energization of motor 309, pinion 303 is rotated by means of worm 307 and worm gear 305 to thus effect relative rotation between tubular shaft 293 and shaft 129. This relative rotation of the shaft provides registration control in the longitudinal direction of the web.

A control system generally indicated at 310 for printing press 1 is specifically diagrammed in the electrical schematic shown in FIGS. 13 and 14. From the electrical circuit schematic shown in FIGS. 13 and 14 and from the description contained in the specification, the operation of the press will be apparent to one skilled in the art. In FIGS. 13 and 14, S1, S2, etc. and S7A, S7B, etc. indicate manually operated switches, LSI indicates a limit switch tripped by air cylinders 211, relay coils are indicated by 1CR, 2CR, etc., relay contacts of these relay coils are indicated by 1C, 2C, etc., and solenoid valves are indicated by SV1, SV2, etc.

In FIG. 14, the circuitry for controlling movement of ink fountain 39, water fountain 41, and impression roll 21 for each printing station 7A-7E are shown in detail. The circuits for controlling the fountains and impression roll at each of the printing stations are essentially identical and accordingly only the circuits for printing stations 7A and 7B are shown, and only the circuitry for printing station 7A will be described in detail. The controls for each printing station 7A-7E are enclosed in a respective control panel 311A-311B at each printing station, respectively, and may be remotely controlled by a master control panel 313 (see FIG. 1). Control panel 311A includes a water fountain control switch S7A, an ink fountain control switch S8A and an impression roll control switch S9A. These control switches energize solenoid valves SV1A, SV2A and SV3A, respectively, at printing station 7A to actuate air cylinders 69A, 69B and 69C according to a predetermined operational sequence in which water fountain 41 is first moved from its retracted position to its operating position thereby to wet plate P on plate roll 7 prior to ink fountain 39 moving from its retracted to its operating position. This sequence of operation prevents ink from being applied to plate P before the plate is wetted with water or fountain solution. The impression roll switch S9A may then be actuated to move-
pression roll 21 from its retracted to its imprinting position, this operation being referred to as bringing the printing station "on imprinting".

More particularly, control panel circuitry for panel 311A, indicated within brackets in FIG. 14, is connected across power lines L1 and L2. To wet plate P on plate roll 37, switch S7A is first actuated, thereby to energize solenoid valve SV1A which in turn supplies compressed air to cylinder 69A and to energize relay coil 8CR which in turn closes contacts 8C. After the water fountain has been moved by cam 67A from its retracted to its operating position (in a manner as heretofore described), and has wetted plate P, switch S8A is actuated. Switch S8A supplies power to solenoid valve SV2B and to relay coil 9CR via contacts 8C, previously closed by energization of relay coil 8CR. Solenoid valve SV2B actuates air cylinder 69B and this air cylinder, via cam 67A, moves ink fountain 39 from its retracted to its operating position thereby to ink plate P. Relay coil 9CR has its own holding circuit and remains energized upon the release of switch S8A. Energization of relay coil 9CR closes relay contacts 9C thereby permitting energization of solenoid valve SV3A and relay coil 10CR upon actuation of switch 9A thereby to move impression roll 21 from its retracted to its printing position.

The circuitry within the master or remote control panel, as indicated within the dashed box 313 in FIG. 13, includes manual switches S1–S6 and S12 which remotely control movement of the water fountains 41, ink fountains 39 and impression rolls 21 at each printing station 7A–7E according to the above-described operational sequence. Upon selecting the remote control mode by proper selection of switch S1, and upon actuation of switch S5, solenoid valves SV1A, SV1B, etc. at printing stations 7A–7E and relay coils 8CR, 9CR, etc. are energized thereby to effect movement of the water fountains to their operating positions to wet plate P at each printing station and to close relay contacts 8C, 11C, etc. so as to permit subsequent movement of ink fountains 39 to their operating positions. Upon actuation of switch S6, the ink fountains are moved to their respective operating positions, and upon actuation of switch S12 impression rolls 21 aty each of the printing stations are simultaneously moved to their imprinting positions.

Upon depressing web stop switch S3, positive clutch 189 is disengaged and impression rolls 21 are simultaneously moved to their retracted positions thereby to stop movement of web W through the press. It will be noted then, when the web is paused, in-feed and outfend stations 5 and 9 maintain tension on the web so that upon restarting the web the web may quickly return to operating speed. Upon actuation of switch S3, solenoid valve SV4 is deenergized, thereby reversibly actuating air cylinders 211 to thus move index pin 207 to its disengaged position and thus disengage positive clutch 189. In this manner, line shafts 141 and 147 (i.e., drive means 29) may be driven independently of line shaft 175 (i.e., drive means 31) thus permitting the image or plate roll and the ink means to be operated independently of feeding web stock through the press. To restart the press, web start switch S2 is depressed, thereby to energize starting clutch 217 and to effect operation of the pick-up and lock-on assembly 231 so as to bring line shaft 175 up to speed and into phase with line shafts 141 and 147, and then to positively lock these line shafts together via positive clutch 189 in precise registration or phase with one another. With the web moving through the press and with the water and ink fountains in their operating positions, remote impression switch S12 may be actuated simultaneously to move impression rolls 21 at all printing stations on remote control into printing contact with web W. Thus, it can be seen that the web may be readily stopped and restarted. In operation, it has been found that with the web pause means of the invention only a small quantity of web stock (as compared to conventional web presses) is wasted during the period of time line shaft 175 is brought up to speed and into register with line shaft 141 and 147 while impression rolls 21 are moved to their printing positions. For example, it has been found that approximately one or two machine lengths of web stock are required to bring the web control means up to speed and into register with the plate rolls.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A web printing press having means for controlling movement of web stock along a path and at least one printing station for printing an image on said web stock as it moves along said path, said printing station comprising a plurality of rolls for printing said image on said web stock including an ink image carrying roll and an impression roll paired with said image roll, said web stock passing between said image and impression rolls for having an image imprinted thereon, means for moving said impression roll toward and away from said image roll between a printing position in which the impression roll is in printing contact with the web stock between the image roll and the impression roll and a retracted position, and means for applying ink to said image roll, a drive for said press including a first means for driving said image roll and said inking means and a second means for driving said web control means, and coupling means engageable and disengageable for coupling and uncoupling said second drive means relative to said first drive means, said coupling means including means for bringing said second drive means up to the speed of and into phase with said first drive means and to positively lock said first drive means and said second drive means together when these drive means are in phase with one another, whereby said second drive means may be uncoupled from said first drive means and said impression roll moved out of printing contact with said web stock so that said inking means and said image roll may be operated independently of feeding web stock through the printing station.

2. A web printing press as set forth in claim 1 further comprising a roll on which a printing plate may be applied for forming an ink image when ink is applied thereto.

3. A web printing press as set forth in claim 2 wherein said inking means is adapted to apply ink to said plate roll and is movable between an operating position in which it is in contact with said plate on said plate roll.
for applying ink thereto and a retracted position clear of the plate roll, and further comprises means for moving said inking means between its operating and retracted positions, and control means for selectively controlling movement of said impression roll and said inking means independently of one another.

4. A web printing press as set forth in claim 3 which uses the lithographic or offset method of printing, wherein said printing plate comprises a lithographic plate and said inking means comprising means for applying ink and water to said plate.

5. A web printing press as set forth in claim 4 wherein said means for applying water and ink comprises a water fountain and an ink fountain, said fountain each being located adjacent said plate roll and each being movable relative thereto between their respective operating positions, in which said water and ink fountains respectively apply water and ink to said plate, and a retracted position, in which the fountains are clear of the plate roll.

6. A web printing press as set forth in claim 5 wherein said ink and water fountains are positioned on opposite sides of said plate roll, and said impression roll is positioned below said image roll, said water and ink fountains being movable generally horizontally toward and away from said plate roll for movement between their said operating and retracted positions, and said impression roll being movable generally vertically toward and away from said image roll between its imprinting and retracted positions.

7. A web printing press as set forth in claim 6 wherein said impression roll and inking-means control means is operable to effect movement of said water fountain, ink fountain, said impression roll in sequence to first move said water fountain into its operating position with said plate roll, and then to move said inking means into its operating position relative to said plate roll, and then to move said impression roll into printing engagement with said image roll.

8. A web printing press as set forth in claim 7 wherein said image roll and inking-means control means further comprises power operated means for effecting movement of said water fountain, said ink fountain and said impression roll between their respective retracted positions and their said operating or imprinting positions.

9. A web printing press as set forth in claim 8 wherein said power operated means includes cam means for effecting movement of said water fountain, said ink fountain and said impression roll.

10. A web printing press as set forth in claim 9 wherein said cam means comprises a rotary cam, in camming relation with said water fountain, with ink fountain, and with said impression roll whereupon rotation of said cam in one direction effects movement of said water fountain from its retracted position to its operating position, and then effects movement of said ink fountain from its retracted to its operating position, and then effect movement of the ink fountain from its retracted position to its operating position, and then to effect movement of said impression roll from its retracted position to its imprinting position.

12. A web printing press as set forth in claim 11 wherein said power operated means further comprises a rack, and a gear in mesh with said rack, gear being interconnected with said cam for effecting rotation of said cam in response to rotation of said gear, said rack being translated by said fluid piston units to effect sequential movement of said water fountain, said ink fountain, and said impression roll.

13. A web printing press as set forth in claim 7 wherein said impression roll and inking-means control means includes means for simultaneously adjusting the position of the water fountain and the ink fountain relative to the plate roll and for simultaneously adjusting the position of the impression roll relative to the image roll.

14. A web printing press as set forth in claim 13 wherein said impression roll and inking-means control means further comprises means for adjusting the position of the water fountain, the ink fountain, and the impression roll independently of one another to insure that the water and ink fountains, when in their respective operating positions, are in proper engagement with the plate roll and to insure that when the impression roll is in its printing position, it is in proper printing contact with the web stock to print an image thereupon.

15. A web printing press as set forth in claim 14 wherein said plate roll constitutes said image roll and said impression roll is adapted to be in printing contact with the web stock between said impression roll and said plate roll when the impression roll is in its printing position.

16. A web printing press as set forth in claim 6 wherein said plate roll constitutes said image roll and said impression roll is adapted to be in printing contact with said web stock between said plate roll and said impression roll when the impression roll is in its printing position.

17. A web printing press as set forth in claim 2 further comprising means at said printing station for removably mounting said plate roll thereby to permit ready installation and removal of the plate roll.

18. A web printing press as set forth in claim 17 wherein said plate roll comprises a cylindric body on which a printing plate may be mounted and a shaft coaxial with the cylindric axis of said cylindric body, said shaft extending endwise from the cylindric body, and wherein said means for removably mounting the plate roll comprises centerless bearing means adapted to rotatably support said plate roll and means for quickly connecting said shaft to and for quickly disconnecting said shaft from said first drive means.

19. A web printing press as set forth in claim 18 wherein said centerless bearing means comprises a plurality of bearing members carried by the press, said bearing members being rotatable about an axis parallel to said cylindric axis of said cylindric body when the plate roll is installed in the press, the outer surfaces of said bearing members being in rolling contact with said shaft.

20. A web printing press as set forth in claim 19 wherein said means for removably mounting said plate roll further comprises a holding member movable between a locked position in which said plate roll is journalled by said centerless bearing means and an un-
19
locked position in which said plate roll shaft may be removed from said centerless bearing means.

20. A web printing press as set forth in claim 20 wherein said holding member carries at least one of said bearing members.

21. A web printing press as set forth in claim 18 wherein said first drive means comprises a plate roll drive, an inkling-means drive, and a gear train interconnected said plate roll drive and said inkling-means drive so that said plate roll is driven at a pre-selected speed relative to said inkling means for applying ink thereto.

22. A web printing press as set forth in claim 22 wherein said inkling means comprises an ink fountain having a plurality of rolls for applying ink to said plate roll, at least one of said inkling rolls being driven by said inkling-means drive, said plate roll being driven at a surface speed equal to the surface speed of said one inking roll.

23. A web printing press as set forth in claim 23 wherein said plate roll is interchangeable with plate rolls of different diameters thereby to vary the number of images arranged circumferentially around the plate roll which may be printed on said web stock upon each revolution of the plate roll, and wherein said gear train includes an interchangeable gear for effecting a change in speed between the plate roll drive and the inking means drive so as to maintain the surface speed of said one ink roll and the surface speed of said plate roll equal upon replacing a plate roll of one diameter with a plate roll of a different diameter.

24. A web printing press as set forth in claim 22 wherein said second drive means comprises a second gear train having an interchangeable gear for changing the speed at which said second drive means is driven when a plate roll of one diameter is replaced with a plate roll of a different diameter so as to feed the web through the press at a speed equal to the surface speed of the plate mounted on said plate roll.

25. A web printing press as set forth in claim 22 wherein said press includes a plurality of printing stations in line with one another for printing images on said web stock as the web stock moves from one printing station to another, and wherein said plate roll drive comprises a drive unit at each printing station, each plate roll being connected to a respective plate roll drive unit for being rotated thereby, and a plate roll line shaft driven by said first drive means interconnecting said plate roll drive units.

26. A web printing press as set forth in claim 26 wherein said inking means includes an ink fountain and a water fountain at each printing station, each of said fountains comprising a plurality of rolls for applying ink and water, respectively, to said plate mounted on said plate roll, said inking means drive comprising a drive unit at each printing station for driving said ink and water fountains and an inking means line shaft interconnecting said inking drive units.

27. A web printing press as set forth in claim 27 wherein said ink and water fountains are each movable toward and away from said plate roll, said inking means drive further including a coupling interconnecting each said fountain to said inking means drive unit thereby to permit movement of said fountain toward and away from said plate roll.

28. A web printing press as set forth in claim 22 further comprising means at said printing station for adjusting the image imprinted on said web stock transversely relative to the edges of the web stock and means for adjusting the position of the image imprinted on the web stock longitudinally therealong.

29. A web printing press as set forth in claim 29 wherein said printing station includes a plate roll drive unit comprising a drive shaft interconnected to said plate roll, a first gear driven by said first drive means, a second gear in mesh with said first gear, said second gear being carried by said shaft and being rotatably adjustable relative thereto, said image longitudinal adjustment means including power operated means rotary with said plate roll drive shaft for effecting relative rotation of said second gear relative to said first gear, thereby to vary the relative rotary positions between said first gear and said plate roll drive shaft so as to effect a change in relative rotation between the plate roll and the first drive means thereby to longitudinally vary the position of the image imprinted on said web stock.

30. A web printing press as set forth in claim 30 wherein said transverse position adjusting means comprises a plate roll drive shaft movable axially relative to said press, a thrust bearing having its inner race secured to said drive shaft and being rotary therewith, and power operated means in engagement with the outer race of said thrust bearing for applying an axial thrust load to said bearing thereby to effect transverse movement of said plate roll drive shaft and said plate roll relative to said web stock and to effect a change in transverse register of the image imprint relative to the edge of the web stock.

31. A web printing press as set forth in claim 31 wherein said plate roll includes a mounting shaft and said press includes means for quickly connecting said plate roll mounting shaft to and for quickly disconnecting said plate roll mounting shaft from said plate roll drive shaft comprising a member secured to said plate roll drive shaft including means for rotatably driving said plate roll and for enabling longitudinal adjustment of the image imprinted on the web, and means for transferring axial movement of said plate roll drive shaft to said mounting shaft thereby to permit transverse adjustment of the image printed on the web.

32. A web printing press as set forth in claim 32 wherein said mounting shaft has a pin extending radially outwardly therefrom and spherical bearing means, and wherein said member secured to said plate roll drive shaft has an enlarged bore for reception of one end of said mounting shaft, a slot for reception of said pin as said one end of the mounting shaft is inserted in said bore and a removable pin for reception in said spherical bearing means, said radial pin and said slot constituting said rotation transfer means and said spherical bearing means and said removable pin constituting said axial movement transfer means.

33. A web printing press as set forth in claim 33 wherein said coupling means for coupling and uncoupling said second drive means relative to said first drive means comprises an input shaft driven by said first drive means, an output shaft connected to said second drive means for driving the latter, a positive clutch engageable to lock said output shaft to said input shaft, means for engaging and disengaging said positive clutch, a starting clutch, means for coupling said starting clutch to said input shaft and to said output shaft so that with said positive clutch disengaged and with said starting clutch engaged said output shaft is driven at a speed different from the speed of the input shaft, and
means for sensing as desired rotational position of the input shaft relative to the output shaft, this rotational position corresponding to said in-phase relation between said first and second drive means, said position sensing means generating a signal in response to sensing that the input and output shafts are in their desired rotational positions relative to one another, said signal effecting operation of said positive clutch engaging means so as to engage said positive clutch.

35. A web printing press as set forth in claim 34 wherein said positive clutch comprises a first member rotary with said input shaft, a second member rotary with said output shaft, one of said members mounting an index pin for movement axially relative to said shafts, and the other of said members having an index hole therein for reception of said index pin when said index pin and said index hole are in line with one another and when said first and second drive means are in-phase with one another, said means for engaging and disengaging said positive clutch moving said index pin between a disengaged position in which said index pin is clear of said index hole and the other member thereby to uncouple the output shaft from the input shaft and an engaged position in which the index pin is received by said index hole whereby positively to lock said output to said input shaft.

36. A web printing press as set forth in claim 35 wherein said means for moving said index pin is responsive to said signal generated by said position sensing means.

37. A web printing press as set forth in claim 36 wherein said means for moving said index pin includes a solenoid operated air cylinder unit interconnected to said index pin, said air cylinder unit being operable in response to generation of said signal to move said index pin from its disengaged position to its engaged position.

38. A web printing press as set forth in claim 37 wherein said one member mounting said index pin is said first member, and wherein said means for moving said index pin further comprises a transfer member slidable along said input shaft, said index pin being secured thereto and being axially movable with said transfer member relative to said first and second members, said transfer member being connected to said air cylinder wherein actuation of the air cylinder unit causes axial movement of the index pin between its disengaged position and its engaged position.

39. A web printing press as set forth in claim 34 wherein said sensing means comprises one pair of rotary members in close proximity to one another, one of said rotary members being driven at a speed corresponding to the speed of the said input shaft and the other being at a speed corresponding to the speed of said output shaft, said rotary members carrying proximity sensing means which when in a predetermined position relative to one another corresponding to said predetermined rotational position between said input shaft and said output shaft generates said signal thereby to indicate that said first and second drive means are in phase with one another.

40. A web printing press as set forth in claim 39 wherein said proximity sensing means comprises a magnetically operated switch carried by one of the members and a magnet carried by the other of said rotary members, said magnet having field of sufficient strength to actuate said switch when said magnet and switch are in said predetermined position relative to one another.

41. A web printing press as set forth in claim 39 wherein said sensing means further comprises other proximity sensing means, operable for establishing said in-phase relation between said first and second drive means within less than one-half of a revolution of said input shaft relative to said output shaft and for effecting engagement of said starting clutch, and said first-mentioned proximity sensing means being operable to generate said signal upon sensing said desired rotational position thereby to effect actuation of said positive clutch.

42. A web printing press as set forth in claim 41 wherein said sensing means comprises a second pair of rotary members carrying said other proximity sensing means, said second pair of rotary members being driven at a rotational speed substantially lower than said first pair of rotary members, one member of each pair being driven by said first drive means and another member being driven by said output shaft whereby the rotary members of each said pair rotate relative to one another.

43. A web printing press as set forth in claim 1 further comprising a plurality of said printing stations in line with one another, and web pause means including said coupling means and means for automatically moving said impression roll between its printing position and its retracted position thereby to permit the web to pause and to permit the image roll and inking means to be operated for inspection of the images printed on the web or for cleaning or adjustment of the plate and the inking means and to again initiate movement of the web through the press for having images printed thereon, said web control means maintaining tension on the web when said web is paused thereby to rapidly bring the images being printed into register with said web control means.

44. A web printing press as set forth in claim 43 wherein said first drive means comprises a first drive shaft for driving said inking means and a second drive shaft for driving said plate roll, a gear train interconnecting said first drive shaft and said second drive shaft, said gear train including an interchangeable gear for varying the speed ratio between the first drive shaft and the second drive shaft when a plate roll of one diameter is exchanged for a plate roll of a different diameter thereby to insure that said inking means applies ink to said plate roll in a desired manner.

45. A web printing press as set forth in claim 1 having a plurality of said printing stations, wherein said web control means includes means for pacing the infeed of said web stock to the first of said printing stations and means for pacing the outfeed of web stock from the last of said printing stations, said infeed stock pacing means and said outfeed stock pacing means being driven by said second drive means.

46. A web printing press as set forth in claim 45 wherein said press further comprises means for performing auxiliary operations on the web, such as die cutting or punching, on said web stock after it has been imprinted, said auxiliary means being driven by said second drive means in phase with images imprinted on the web.

47. A web printing press as set forth in claim 45 wherein said printing press further comprises means for rewinding said web stock after it has been printed.
48. A web printing press as set forth in claim 1 further comprising a plurality of said printing stations in line with one another along said path, each printing station being adapted to imprint a different image on said web stock, and a dryer on the outfeed side of each printing station adapted to at least partially dry said image imprinted thereon at its respective printing station prior to the image being imprinted at the next successive station along said line.

49. A web printing press having means for feeding web stock to be printed, a plurality of printing stations arranged in a line for successively imprinting said web stock as it is moved along a path from one printing station to another, infeed pacing means for controlling the infeed of said web stock to the first of said printing stations and outfeed pacing means for the outfeed of said web stock from the last of said printing stations, means along said path for performing post-printing operations, such as die cutting or punching, on said web stock after it has been printed, and means for rewinding said web stock, each of said printing stations comprising a plurality of rolls for imprinting an image on said web stock, said rolls including an ink image-carrying roll and an impression roll paired with said image roll, said web stock passing between said image and said impression rolls for having an image printed thereon, means for moving said impression roll toward and away from said image roll between a printing position in which the impression roll is in printing contact with the web stock between the image roll and the impression roll and a retracted position, a gear box for driving said image roll, and a gear box for driving said inking means, said printing press further comprising a first line shaft interconnecting said plate roll gear boxes at each printing station and a second line shaft interconnecting said inking means gear boxes at each printing station wherein said plate roll gear boxes are simultaneously driven at the same speed and said inking means are driven at a corresponding speed, a third line shaft for driving said infeed and outfeed pacing means and said die cutting means, and coupling means engageable and disengageable for coupling and uncoupling said third line shaft from said first and second line shafts, said coupling means including means for bringing said third drive shaft up to speed and into phase with said first and second line shafts and to positively lock said third drive shaft relative to said first and second line shafts when the line shafts are in phase with one another so that post-printing operations may be performed on the web in register with the images imprinted thereon, and whereby said third drive shaft may be uncoupled from the first and second line shafts and said impression roll moved out of printing contact with said web stock so that said inking means and said image roll may be operated independently of feeding web stock through the printing station.