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Weidman

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[54] **MULTI-UNIT ROTARY PRESS**

[75] Inventor: **William H. Weidman,** Independence, Ohio

[73] Assignee: **Harris-Intertype Corporation,** Cleveland, Ohio

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[52] **U.S. Cl.** **101/183,** 101/232, 101/248

[51] **Int. Cl.** **B41f 7/06**

[58] **Field of Search** 101/136, 137, 177, 183, 101/184, 185, 232, 248

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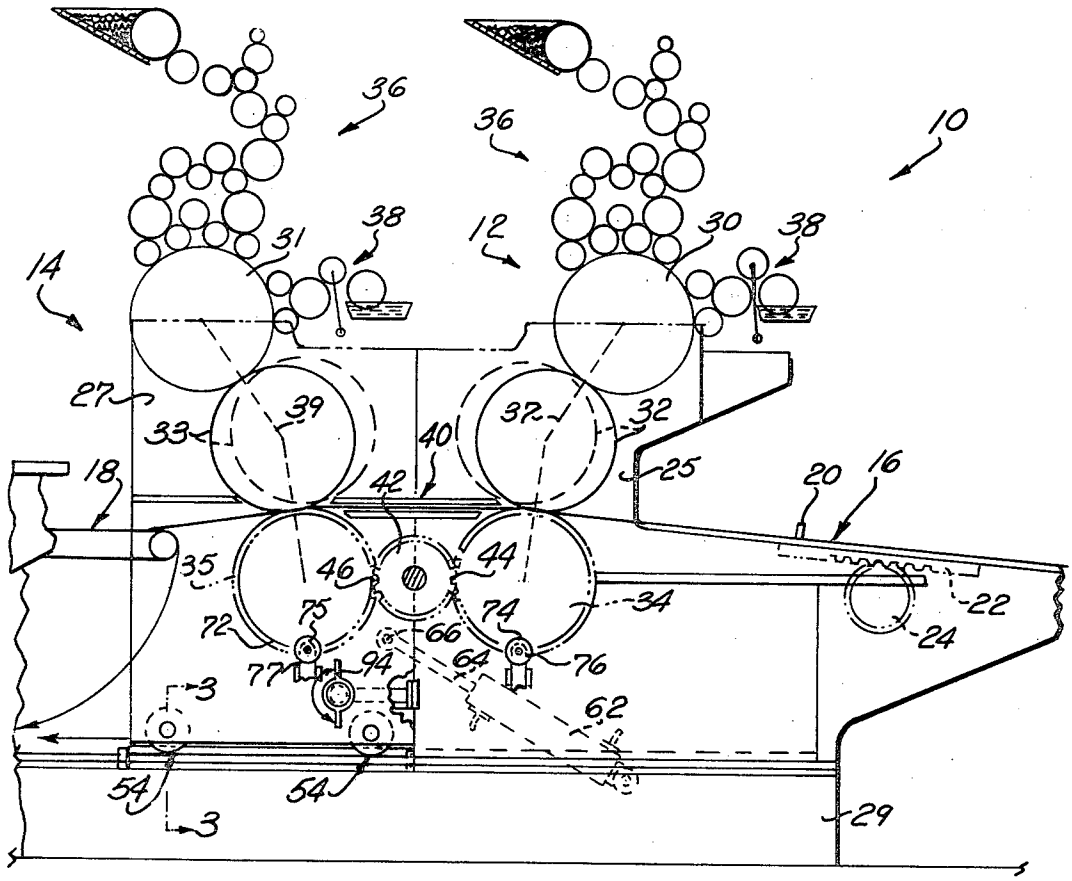
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Primary Examiner—J. Reed Fisher

[57] **ABSTRACT**

A sheet fed multi-unit metal decorating press in which a pair of printing units with diverging cylinder stacks are arranged back-to-back so that sheets pass directly from unit to unit with the forward edge of a sheet entering the nip of the second unit before the rear edge of the sheet passes from the nip of the first unit. The second unit is mounted for roll-back movement relative to the first unit to facilitate make-ready and clean-up operations on the first unit. A registration adjusting mechanism is provided to shift the entire second unit relative to the first for final precise adjustment of the second unit image to the first unit image. Registry of the sheets as they pass from the first unit to the second is maintained by a transfer guide unit positioned between the two units and which directs the sheets in a generally horizontal path from one unit to the next. The guide unit defines a controlled locus over which the sheets pass and is operative to confine the sheets to the desired locus by placing a controlled bend in the sheets.

24 Claims, 9 Drawing Figures



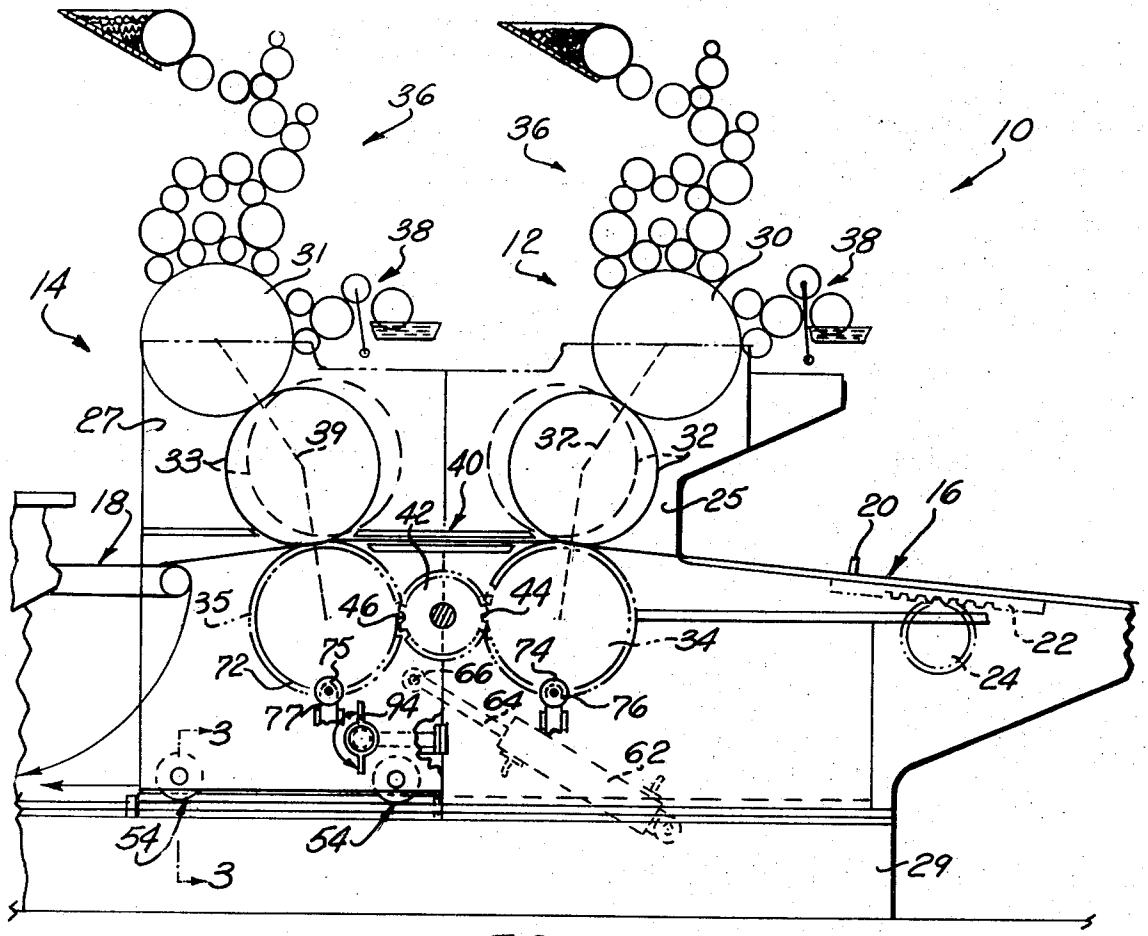


FIG. 1

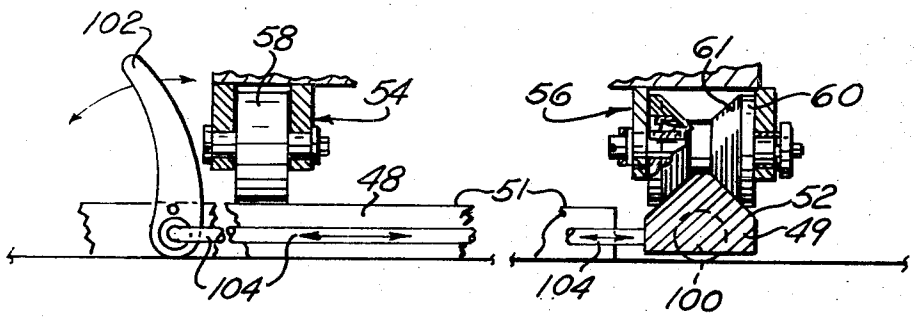


FIG. 3

INVENTOR
WILLIAM H. WEIDMAN

BY Young and Tarolli
ATTORNEYS

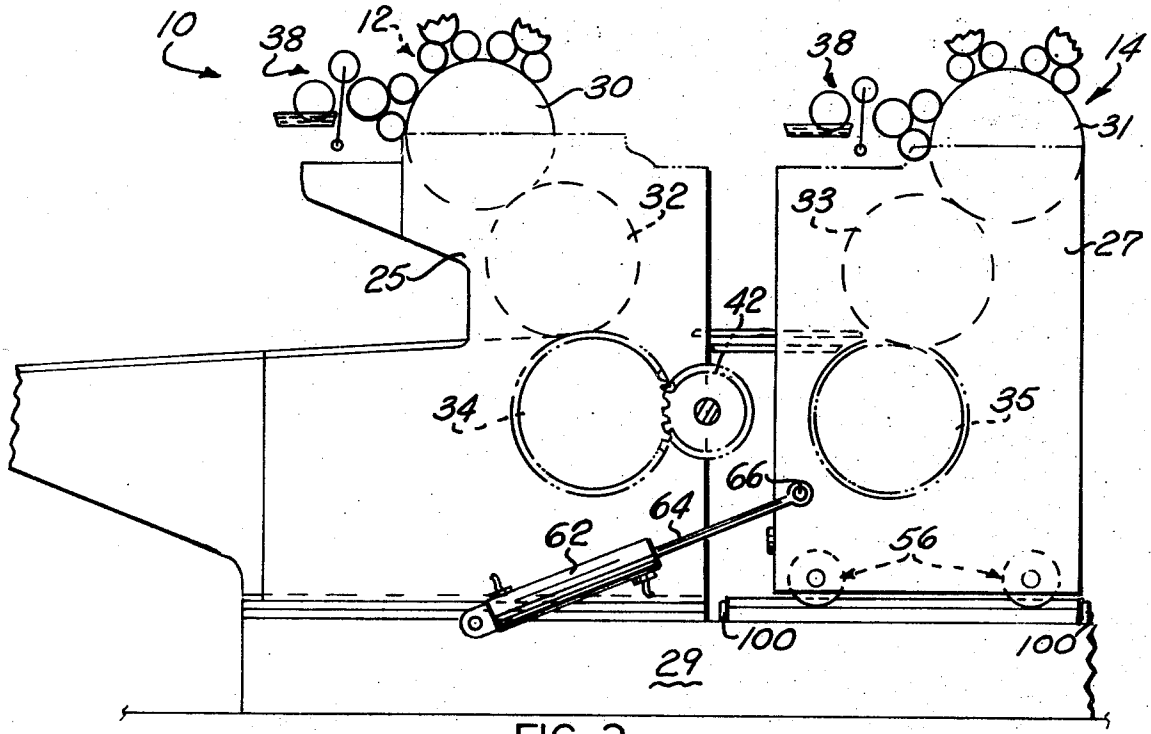


FIG. 2

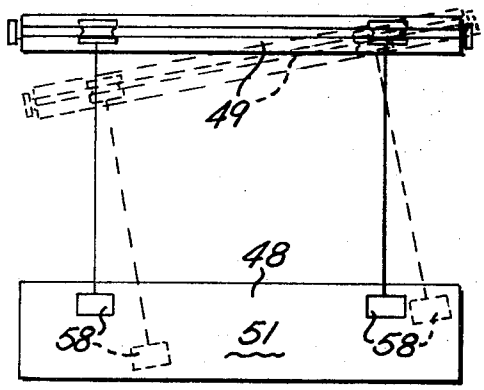


FIG. 5

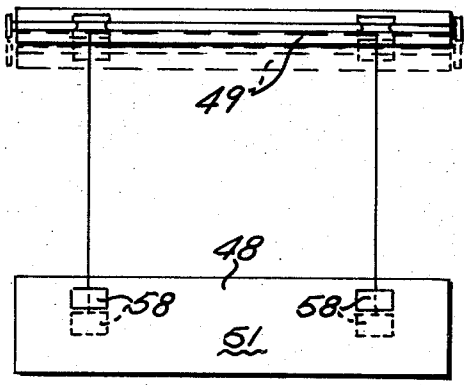


FIG. 4

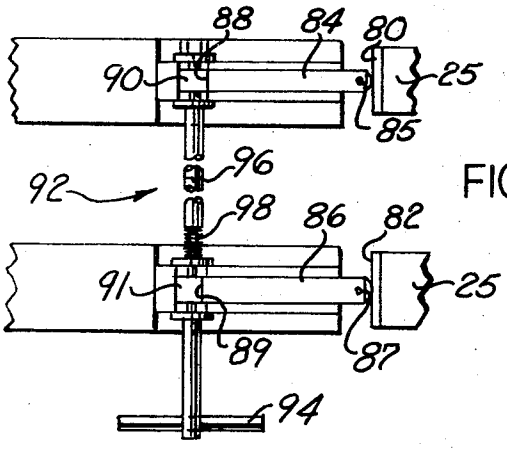


FIG. 6

INVENTOR
WILLIAM H. WEIDMAN
BY Yount and Tarolli
ATTORNEYS

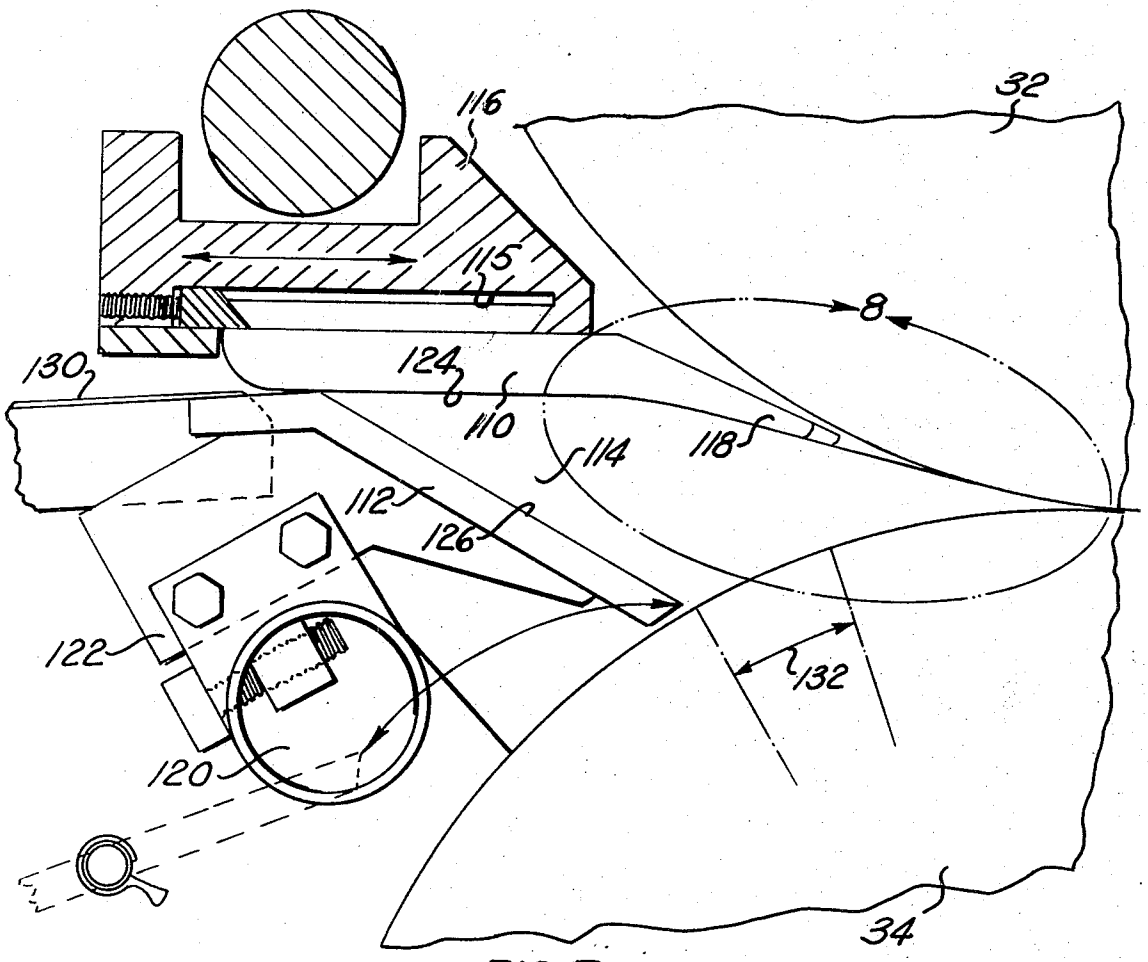


FIG. 7

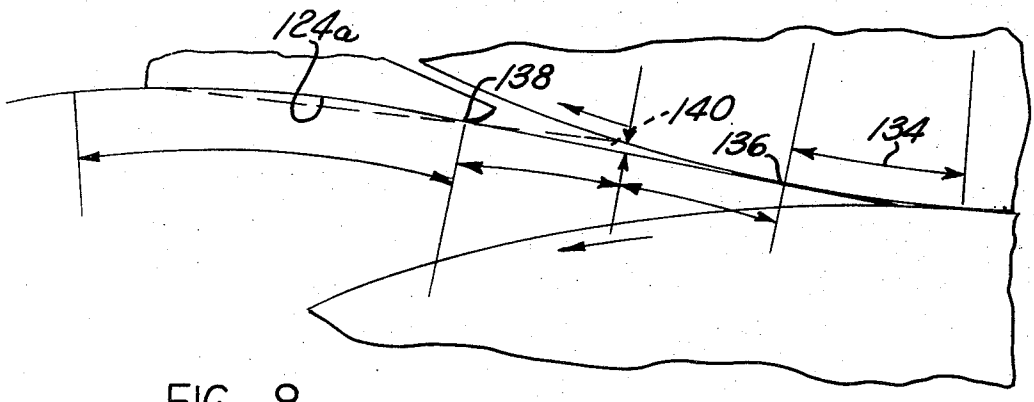


FIG. 8

INVENTOR
WILLIAM H. WEIDMAN
BY Yount and Tarolli
ATTORNEYS

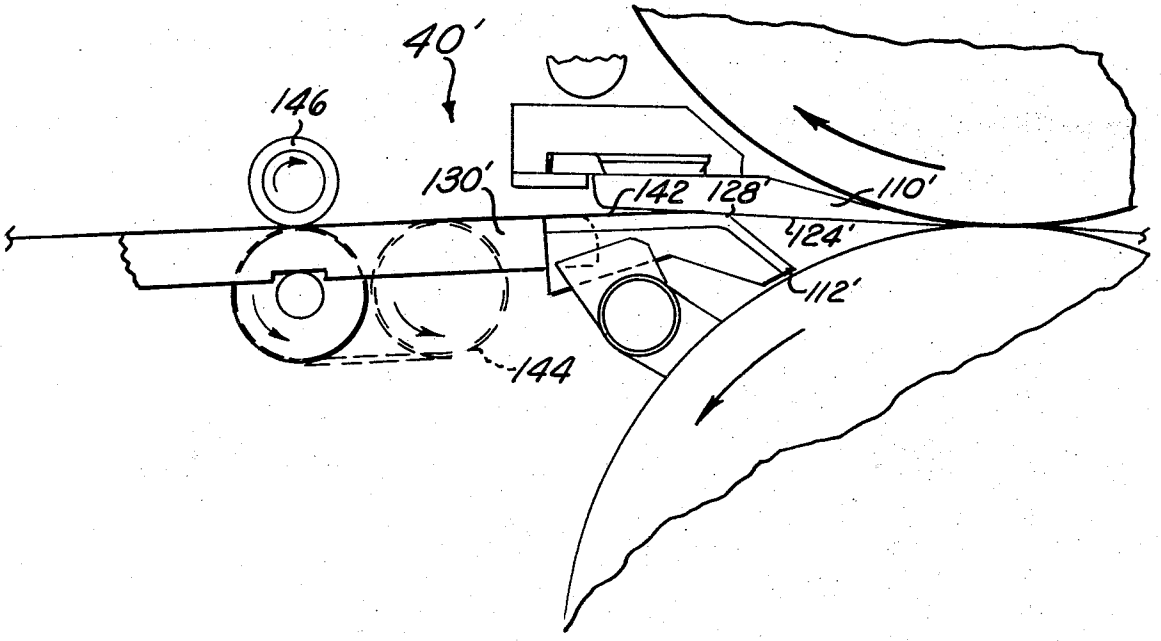


FIG. 9

INVENTOR
WILLIAM H. WEIDMAN

BY Yount and Tarolli
ATTORNEYS

MULTI-UNIT ROTARY PRESS

This invention relates to improvements in multi-unit rotary presses and, more particularly, to an improved multi-unit sheet fed metal decorating press.

One of the primary objects of this invention is to provide a sheet fed multi-unit rotary press in which relatively inflexible sheet stock may be advanced from one printing unit to the next printing unit without the need for a separate feeding and registering mechanism between the two units. To this end, this invention provides a multi-unit rotary press having first and second printing units with each of the units having generally vertically stacked printing and impression cylinders. Guide means interposed between the two units defines a generally horizontal path along which the sheets travel from the first unit to the second. The nips between the cylinders of the two units are spaced apart a distance less than the length of the sheets to be fed therethrough whereby a sheet being printed enters the nip of the second unit before it has completed passage through the nip of the first unit.

Another important object of this invention is to provide an on-the-fly registry adjustment for the second printing unit whereby registration adjustments can be made during press operation. More specifically, this invention contemplates supporting the second printing stand for movement relative to the first printing stand so that by shifting the entire stand, lateral, circumferential or skewed registration adjustments may be made.

Still another important object of this invention is to provide control over the sheet as it passes from the first unit to the second unit so that the sheet advances toward the second unit over a controlled locus thereby to assure correct registry as the sheet enters the nip of the second unit. Control over the sheet is obtained by the use of sheet transfer guides which define the desired locus and which impart a controlled bend to the sheet to assure that the sheet adheres to the controlled locus as it passes between units. In the preferred form of the invention, the controlled locus comprises a guide surface, either an overguide or an underguide, along which the sheet passes with the sheet being maintained in engagement with that guide surface either by a sheet tensioning device, in the case of underguiding, or a compression loading device in the case of overguiding.

Among other objects of this invention are the provision of an improved multi-unit metal decorating press which is economical to manufacture, requires less space than prior presses of this type and which is safe and reasonable to work on during make-ready and clean-up operations.

Other objects, features and aspects of the invention will become more apparent upon a complete reading of the following description which, together with the attached drawings, discloses but a preferred form of the invention.

Referring now to the drawings wherein like reference numerals indicate like parts in the various views:

FIG. 1 is a schematic elevational view from the feed side of a multi-unit metal decorating press embodying the present invention;

FIG. 2 is an elevation view from the gear side of the press of FIG. 1 and showing one unit rolled back from the other unit;

FIG. 3 is a sectional view along line 3—3 of FIG. 1 and showing the track support for the second unit;

FIGS. 4 and 5 schematically illustrate the various positions to which the second unit may be shifted to effect registration adjustments between the two units;

FIG. 6 is a sectional view along line 6—6 of FIG. 1;

FIG. 7 is an enlarged view of a portion of the transfer guide unit and illustrates the relationship between the guide and the cylinders;

FIG. 8 is an enlarged view of a portion of FIG. 7 and illustrates the relationship between the guides, the cylinders and the sheet as the sheet passes from the first unit;

FIG. 9 is a side elevation view of a modified form of the transfer guide unit.

Referring now more in detail to the drawings, the invention will be described with particular reference to a three cylinder offset sheet fed metal decorating press; however, it will be appreciated by those skilled in the art that certain aspects of the invention have broader application and may be employed with other types of presses. For example, the invention may be used to advantage with presses which are printing any relatively inflexible sheet stick and is not limited to metal decorating.

Referring now to FIG. 1, there is illustrated a multi-unit rotary press, indicating generally by the reference numeral 10, and which comprises a first press stand or unit 12 and a second press stand or unit 14. Associated with the multi-unit press 10 may be various types of equipment which, typically, would include a pile feeder (not shown) and a feeding and registering mechanism, indicated generally by the reference numeral 16. A suitable mechanism including a delivery conveyor 18 would be associated with the delivery end of the second printing unit 14.

The feeding and registering mechanism 16 is preferably of the back register type disclosed in U.S. Pat. No. 2,797,094, issued to Howard J. Seel on June 25, 1957, and to which reference may be had for a full disclosure of the details of that mechanism. In brief, the sheet feeding and registering mechanism comprises a conveyor carrying pushers which deliver the sheets to a table consisting of two or more longitudinal bars over which the sheets are adapted to slide. A pair of back gauges 20 disposed between the bars are mounted on a frame or carriage 22 which is reciprocated by a rack 24. The back gauges 20 project above the surface of the bars during forward movement of the carriage and retract below the surface during reverse movement. The carriage has a forward and rearward travel through a predetermined distance at a constant speed equal to the printing speed of the units 12 and 14. Appropriate side gauges are also associated with the registering and feeding mechanism.

A sheet delivered by the conveyor to the table is engaged at a rearward edge by the back gauges 20 and along its side edges by the side gauges thereby to align the sheet with the cylinders of the first printing unit. The forward travel of the rack 24 moves the sheet forward at a speed which coincides with the printing speed with the back and side gauges maintaining alignment of the sheet as it is being moved to the first unit. It is preferred, for sheet control purposes, that the feeding mechanism advance the sheet into the nip at a small up-

wardly inclined angle, as will be discussed hereinafter.

Although a back register mechanism is specifically disclosed and preferred, other types of registering mechanisms, such as a front register device, may be used.

THE PRINTING UNITS

The printing unit **12** includes side frames **25** which rotatably support a plate cylinder **30,** a blanket cylinder **32** and an impression cylinder **34** while unit **14** includes side frames **27** which rotatably support a plate cylinder **31,** a blanket cylinder **33** and impression cylinder **35.** The impression cylinders **34, 35** include conventional grippers which are operative to grip the forward edge of the sheets in conventional manner. Conventional inker mechanisms **36** and dampener mechanism **38** are associated with the plate cylinders **30** and **31.** Each of the units is supported on a base **29.**

Although the basic components of each printing unit **12** and **14** are conventional, the manner in which the units are arranged is important to this invention. Thus, it will be observed from FIG. **1** that the two printing units **12** and **14** are arranged back-to-back, that is, the blanket and impression cylinders of the two units are arranged adjacent each other but with the stack angles of the two sets of cylinders reversed. Thus, the line **37** interconnecting the centers of the cylinders **30, 32, 34** defines an angle which is equal to but the reverse of the angle formed by the line **39** interconnecting the centers of the cylinders **31, 33, 35** so that the two plate cylinders **30, 31** are offset in opposite directions from a vertical plane between the two units **12, 14.** In other words, the line of centers for the plate and blanket cylinders in the two units lie in outwardly and upwardly diverging planes.

In addition, the line of centers for the blanket and impression cylinders in the two units lie in downwardly and inwardly converging planes. In this manner, and as will be more apparent hereinafter, the sheets fed into both units enter the nips of the units in a direction essentially perpendicular to the line of centers.

The nips between the blanket and impression cylinders of the two units are spaced apart a distance, as measured along the path of travel of the sheets, which is less than the minimum length of the sheets to be fed through the press. A transfer guide unit, indicated generally by the reference numeral **40,** and which will be described in greater detail hereinafter, is positioned between the two units and defines a generally horizontal path over which the sheets travel in passing from unit to unit.

The two units are driven by a common drive pinion **42,** the axis of rotation of which is positioned essentially on the line of centers between the two impression cylinders **34, 35.** The drive pinion **42** meshes with gears **44, 46** on the cylinders **34, 35** respectively. The gears **44, 46,** in turn, mesh with gears on the other cylinders to drive the cylinders in conventional manner. To assure accurate registry between the units, each of the gears in the drive gear train is spring lashed. In addition, the ratio of the teeth on the drive gear to the impression cylinder gears is equal to the reciprocal of an integer equal to or greater than **1.** With this ratio of teeth, each tooth on the drive pinion engages the same tooth on the cylinder gears **44, 46** with each revolution of the cylinders thereby eliminating any variations in relative rotational positions of the two units at the time that the second unit nip takes the sheets, which variation could be caused by gear tooth lead variation if the identical teeth were not meshing each time.

Several advantages are obtained with the reverse stack angle, back-to-back arrangement of the two printing units. One important advantage is the elimination of the need for a separate feeding and registering mechanism between the two units. Thus, the relatively inflexible sheets fed into the first printing unit **12** are fed through the first unit by the cylinders **32, 34** and transferred in a generally horizontal path directly from the nip of the first unit into the nip of the second unit. In this manner, when a minimum length sheet is to be printed, the sheet is advanced by the cylinders of the first unit until the rear edge of the sheet is just passing from the nip of the first unit at which time the forward edge of the same sheet has at least entered the nip of the second unit. Since the sheet has been registered with the first unit by the feeding and registering mechanism **16,** and since the two units run at a constant and equal printing speed, it will be apparent that a sheet which is in the nips of the two printing units at the same time will be travelling at the same constant printing speed and should be in registry with the second printing unit.

Another advantage of the back-to-back arrangement of the two printing units is that the dampener mechanism **38** for the second unit may be positioned in conventional manner, that is, on the right-hand side of the plate cylinder **31,** as viewed from the feed side of the press, and between the two units. It will be appreciated that if the stack angles of the two units were the same, there would be no room for the dampener mechanism **38** of the second unit.

ROLL BACK ARRANGEMENT

The press **10** is designed so that the second printing unit **14** may be rolled back away from the first printing unit **12** for make-ready access, servicing and clean-up. This roll back arrangement includes a pair of tracks **48, 50** supported on the base **29.** The track **48** has an upper flat surface **51** while the track **50** has an inverted V-shaped surface **52.** Pairs of carriage wheels **54, 56** are carried by the frame **27** of the second unit **14.** One pair of carriage wheels on one side of unit **14** includes rollers **58** having a peripheral surface adapted to cooperate with the flat surface **51** on track **48.** The other pair comprises rollers **60** having a grooved configuration **61** adapted to cooperate with the V-shaped surface **52** on the track **49.** It will be appreciated that the carriage wheels **54, 56** cooperate with the tracks **48, 49** to permit the press unit **14** to by rolled toward and away from the press unit **12** with the grooved rollers **60** cooperating with the track **49** to maintain the press in alignment as the press is moved back and forth.

To roll back the unit **14,** there is provided a power cylinder **62** which comprises a double acting hydraulic cylinder having an extensible piston rod **64** connected at **66** to the frame **27.** Actuation of the hydraulic cylinder **62** by a source of hydraulic pressure, not shown, to extend the piston rod **64** moves the printing unit **14** out of mesh with pinion **42** and away from the printing unit (FIG. **2**) while actuation of the cylinder to retract the piston rod **64** will move the printing unit back toward the printing unit **12** and into mesh with pinion **42.** The power cylinder **62** serves to maintain unit **14** in drive

gear engagement during press operation. While a hydraulic cylinder is disclosed as the actuating means, it will be appreciated that any suitable mechanism might be employed for the purpose of displacing unit **14.**

It is, of course, important that the timed relationship of the two printing units be re-established when unit **14** is moved back into meshing engagement with drive gear **42.** To this end, the impression cylinders **34, 35** carry plates **70, 72,** respectively on one end thereof. The plate **70** has a notch **74** into which a detent **76** is receivable while the plate **72** has a notch **76** into which a detent **77** is received. The notches **74, 75** are angularly arranged such that the two cylinders **34, 35** are properly timed when the detents are aligned with the notches.

With this arrangement, and assuming unit **14** has been rolled back out of mesh with gear **42,** the press operator need only jog the two units until the detents **76, 77** have entered the notches **74, 75** thereby assuring the proper timed relationship of the cylinders. Thereafter, the power cylinder **62** may be actuated to move unit **14** back into mesh with the gear **42** and the press is ready for operation.

The control circuit for the units may be so designed that power cylinder **62** can not be actuated to move unit **14** back into drive gear engagement unless both detents **76, 77** have moved into their respective notches. Upon re-engagement of unit **14,** the detents **76, 77** would then automatically retract.

REGISTRATION ADJUSTMENT MECHANISM

To obtain precise registration of the second unit with the sheet being printed, there is provided an on-the-fly registration adjustment mechanism which is effective for circumferential, lateral and skewed adjustments. This adjustment mechanism contemplates shifting the entire second printing stand **14** relative to the first printing stand. Thus, circumferential adjustment is provided by moving the second unit **14** toward and away from the first unit while lateral adjustment is achieved by shifting the entire second stand laterally relative to the first stand. The laterally adjusted position of the unit is schematically illustrated in FIG. **4.** The skewed adjustment is made by "cooking" the second stand relative to the first as schematically illustrated in FIG. **5.**

The circumferential and skewed adjustments of unit **14** are accomplished by a manually operable register adjustment device illustrated in FIG. **6.** As shown in that Fig., a pair of stop surfaces **80, 82** are provided on the frame **25** and cooperate with a pair of adjustable stop members **84, 86** carried on the second unit **14.** The stop members **84, 86** comprise a pair of bars having rollers **85, 87,** respectively, adapted to engage the surfaces **80, 82.** The stop members **84, 86** also include aligned openings **88, 89** in which a pair of eccentrics **90, 91** are received. The eccentrics **90, 91** are secured for rotation to a shaft **92** which includes at its outer extremity a manually operable handle **94** whereby the shaft **92** and, hence, the eccentrics **90, 91** may be rotated in either a clockwise or a counter-clockwise direction. The angular relationship of the two eccentrics **90, 91,** as shown in FIG. **6,** is the same so that incremental rotation of the shaft **92** will impart the same degree of angular rotation to the eccentrics and an identical longitudinal displacement of the two stop members **84,86.** By rotating the shaft **92** in a counter-clockwise direction, the eccentrics **90, 91** cooperate with the stop members **84, 86** to extend the members and displace the unit **14** to the left along tracks **48, 49** as viewed in FIG. **1** while rotation of the shaft **92** in a clockwise direction retracts the members **84, 86** and permits the unit **14** to move along tracks **48, 49** to the right as viewed in FIG. **1.** Thus, circumferential registration adjustments may be made while the press is in operation simply by the operator rotating the handle **94** in the appropriate direction.

The same mechanism may also be used to effect a skewed or cocked adjustment. This is accomplished by a differential actuation of the two stop members **84, 86.** Thus, the shaft **92** includes appropriate means, schematically illustrated as a clutch or coupling **94,** whereby the eccentric **91** may be rotated independently of the eccentric **90.** Various mechanisms may, of course, be employed to accomplish this but, as shown, this is achieved by pulling the handle **94** outwardly against the bias of a spring **98** thereby disconnecting the clutch or coupling **96** and isolating eccentric **90.** Thereafter, the handle **94** may be rotated in either the clockwise or counter-clockwise direction to rotate only the eccentric **91.** The differential rotation of the eccentrics **90, 91** will clock the unit **14** as, for example, shown schematically in FIG. **5.** To accommodate this cocking movement, it is necessary that the rollers **58** slide laterally across the flat surface **51** on the track **48** and that a corresponding movement of the rollers **60** also be provided. However, since the rollers **60** can not slide laterally of the V-track **49,** it is contemplated that the entire track **49** will be shifted. Thus, as shown in FIG. **3,** the track **49** is supported by rollers **100** which enable the track **49** to shift relative to the base **29** as the unit **14** is cocked.

While a roller supported track **49** has been disclosed, it is to be understood that other means may be used to accommodate the shifting movement of the track. For example, the track might be supported on the base by hydrostatic bearings.

It should be noted that the meshing engagement of the drive gear **42** with the impression cylinder **46** is not affected by the shifting movement of the unit **14.** The magnitude of the required circumferential adjustment of the unit **14** is relatively small and is readily accommodated by the spur gear configuration of the meshing gears without separation of the teeth. For example, movements on the order of 0.010 to 0.015 inch in either direction would normally be all that would be required. The working depths of the teeth are such that movements of this magnitude can be made without separation of the teeth. Nor does the shifting of the unit to a cocked position affect the drive gear engagement of the second unit. The unit **14** pivots about the gear side and a relatively large cocking movement, as measured across the press, results in only a very small motion at the drive gear.

To laterally adjust the unit **14,** there is provided a pivotally supported actuator **102** (FIG. **3**) which is connected by a rod **104** to the track **49.** Actuation of the actuator **102** causes the rod **104** to shift the track **49** on the rollers **100** laterally of the press unit, as shown in FIG. **4.** Because of the grooved engagement of the rollers **60** with the track **49,** the shifting of the track will impart a similar shifting movement to the unit **14** with the rollers **58** simply sliding along the surface **51.**

While manually operable actuators **94** and **102** have been disclosed, it is to be understood that the shifting of the unit **14** may be controlled by suitable motor drive means, if desired.

TRANSFER GUIDE UNIT

As noted above, there is positioned between the nips of the two cooperating pairs of cylinders **32, 34** and **33, 35** a transfer guide unit **40** which defines a generally horizontal path over which the sheets travel in passing from one printing unit to the other. This guide unit defines a controlled locus which assists in maintaining the sheet in registry as it is advanced toward and enters the nip of the second unit. In particular, the guide unit is designed to impart a controlled bend to the sheet so that the sheet traverses the desired locus irrespective of varying conditions at the exit end of the nip in the first unit.

One embodiment of the transfer guide unit is illustrated in FIGS. **7** and **8** and comprises overguides **110** and underguides **112** which cooperate to define a throat area **114** at the exit of the nip in the first unit. The overguides **110** are supported in a dovetail groove **115** of a bracket **116** so that they may be shifted laterally of the press and positioned in the margins of the sheet. The overguides **110** includes a surface **124** and a nose portion **118** which projects toward the periphery of the blanket cylinder **32** and terminates at a point closely adjacent to that cylinder. The underguides **112** are pivotally supported at **120** on a bracket **122.** The underguide **112** comprises a plurality of fingers having surfaces **126** which slope downwardly toward the peripheral surface of the impression cylinder **34** and which are adapted to be positioned between the grippers on that cylinder. The surfaces **124, 126** converge axially to a point **128** which defines a small space or clearance through which the sheet passes.

A support surface in the form of rails **130** extend from the point **128** to a point closely adjacent the nip of the second unit. To maintain the sheet in engagement with the rails **130,** magnetic means may be used where metal sheets are being printed or, for example, a vacuum box might be employed where non-metallic sheets are being printed.

The transfer guide unit functions in the following manner. A sheet being printed in the first unit will be gripped at its forward edge in conventional manner by the grippers on the impression cylinder and carried through the nip and subsequently released. Normally, the grippers will release the forward edge of the sheet in the area indicated at **132** in FIG. **7.** It will be noted that the underguide **112** approaches the periphery of the impression cylinder **34** at a point beyond the point where the grippers will release the forward edge. Upon release of the forward edge of the sheets, and due to the relatively rigid nature of the sheet, the forward edge will spring away from the periphery of the impression cylinder **34.** As the sheet is advanced, the forward edge of the sheet will engage and travel up the inclined surface **126** and pass through the clearance at **128** onto the surfaces of the guide rails **130** where it is fed in a slightly angularly downward direction toward the nip of the second unit by the cylinders **32, 34.** Because of the upwardly inclined angle at which the sheet is fed into the first unit by the feeding mechanism **16,** coupled with the tendency of the sheet to adhere to the surface of the blanket **32** due to the tacky or pasty character of the ink, the main body of the sheet as it exits from the first nip will follow a path which will coincide with the surface **124** on the overguides **110.** Hence, the sheet will move up above the pass line through the nip of the first unit as it exits from the first unit, follow the guide surface **124** to the point **128** and, thereafter, move downward along the guide rails **130** toward the nip of the second unit. The downward angle at which the sheet enters the second unit is essentially the same as the upward angle at which the sheet was fed into the first unit.

The sheet is maintained in supported engagement against the guide surface **124** by the small compression loading imposed on the sheet by the frictional forces resulting from the sliding movement of the sheet across the surface of the rails **130.** These frictional forces impose a column loading on the sheet which is effective to confine the sheet to the overguide surface **124.**

The described overguiding arrangement results in the sheet being supported along substantially its entire length as it passes between the units. The only area in which the sheet remains unsupported is the small area between the forward end of the nose **118** on the overguide **110** and the periphery of the blanket cylinder **32.** Due to the pasty or tacky character of the ink transferred by the blanket cylinder there may be a tendency for the sheet unduly to adhere to the periphery of the blanket cylinder, in which case the sheet would tend to foreshorten and misregistry of the sheet as it enters the nip of the second unit may occur. However, provision is made in the overguide to compensate for such an "over wrap" condition.

Referring to FIG. **8,** it will be noted that the overguide surface **124** includes an arcuate portion **124a** in the nose region. Under normal operating conditions, a small amount of blanket wrap, indicated at **134,** normally will occur and the sheet will separate from the periphery of the blanket cylinder at the point **136,** follow a straight path until it engages the forward edge of the nose **118** at the point **138** and, thereafter, follow the arcuate contour of the surface **124*a*.** In the event the sheet tends to adhere to the blanket cylinder **32** beyond the point **136** and an overwrap condition results, the sheet will follow the arcuate path indicated by the dotted line **140.** The difference in the length between the points **136, 138** as measured along the dotted line **140** and a straight line connecting the same two points is the amount by which the sheet will tend to be foreshortened because of the overwrap. However, this foreshortening of the sheet is prevented with the described overguiding arrangement by the sheet moving away from the arcuate surface **124*a*** and moving closer to a straight line between the points **128** and **138.** In other words, when the length of the sheet between points **136** and **138** is longer than a straight line, the length of the sheet between points **138** and **128** gets shorter by more closely approximating a straight line.

In this manner, any tendency of the sheet to foreshorten due to variations in the angular wrap of the sheet on the blanket cylinder **32** is at least partially compensated for.

The foregoing arrangement of a transfer guide unit is based on a column loading concept which maintains the sheet against the overguides. However, other techniques might be used to maintain sheet control as the sheet passes from unit to unit. For example, and referring to FIG. **9,** there is illustrated a modified transfer

guide arrangement in which the overguides **110'** have a generally flat planar surface **124'**. The underguides **112'** are essentially as illustrated in the embodiment of FIG. **7**. Associated with the rails **130'** are appropriate sheet tensioning means which may comprise a vacuum or magnetic belt **144**. Upper feed rolls **146** may also be employed to run in the margins of the sheets.

With the arrangement illustrated in FIG. **9**, a sheet passing through the nip of the first unit would follow a path which would generally correspond to the planar surface **124'** on the overguide **110'** and through the clearance **128'** after which it would bend downwardly along the tail portion **142** of the underguide unit **112'** and onto the rails **130'**. The tensioning device **144** would produce a slight overfeed tension in the sheet which would prevent any undesired angular wrap of the sheet on the blanket cylinder **32** and would place a controlled bend in the sheet as it passes around the point **128'** to maintain the sheet in engagement with the underguide surface **142**.

Whether an overguiding or underguiding arrangement is employed, the important aspect is the maintenance of sheet control by a change of direction in the path of the sheet and the creation of a small controlled bend which assures adherence of the sheet to a controlled path or locus as it passes from nip to nip. In fact, it may be desirable to employ both the overguide construction of FIG. **7** and the sheet tensioning underguiding arrangement of FIG. **9** in the same press with the overguide control being used under some conditions and the sheet tensioning, underguide control being used at other times. In such a combined arrangement, when the overguide control is in operation, the sheet tensioning means **144** would be deactivated. When switching from an overguide sheet control to the underguide sheet control, it normally will be necessary to reregister the second unit to the first since the arcuate path defined by the surface **124, 124***a* on the overguide **110** is somewhat longer than the path followed by the sheet in the underguide arrangement. However, adjusting the registry of the second unit to the first may be accomplished very simply by operation of the actuator **94** to shift the second stand **14** in the manner described above.

While the invention has been described with reference to a preferred embodiment, neither the illustrated embodiment nor the terminology employed in describing it is intended to be limiting; rather, it is intended to be limited only by the scope of the appended claims.

Having thus described the invention, what is claimed is:

1. A sheet fed multi-unit printing press for printing images on relatively inflexible sheets fed to the printing press in succession, first and second printing units with each of said units having generally vertically stacked printing and impression cylinders and a frame supporting the respective cylinders of the unit, said second printing unit gripping a sheet fed thereto from said first printing unit to feed a sheet therethrough and said first unit maintaining a feeding engagement with said sheet at its printing nip until the sheet is gripped by said second printing unit, guide means interposed between said printing units for guiding the individual sheets along a generally horizontal path along which the sheets travel from said first unit to the second unit, the distance between said units being such that a sheet is gripped by said second unit while in the printing nip of said first unit, first means supporting said printing units during press operation for relative movement toward and away from each other and for relative lateral movement in the direction of the axes of said cylinders, second means for moving said first and second units relative to each other during press operation to adjust the distance between the said cylinders of said first unit with respect to the said cylinders of said second unit, and third means for relatively shifting said first and second units laterally with respect to each other during press operation, said first, second and third means comprising means for effecting registration of the second unit with the first unit while printing.

2. In a printing press as defined in claim **1** wherein said press includes gearing for driving said cylinders, said gearing comprising a first gear supported in a fixed location with respect to one of said units and a second gear supported in a fixed location with respect to the other of said units and said means for moving said units comprising means for relatively moving said units a distance great enough to separate said first and second gears to break the drive between said units.

3. In a printing press as defined in claim **1** wherein said means for effecting register of said second unit to said first unit comprises an adjustable stop means for limiting the movement of said units toward each other and determining the distance between said cylinders of said respective units during printing comprising an adjustable stop on one of said units and a stop surface abuttingly engaged by said stop to determine said distance.

4. In a printing press as defined in claim **3** wherein said press includes gearing for driving said cylinders, said gearing comprising a first gear supported in a fixed location with respect to one of said units and a second gear supported in a fixed location with respect to the other of said units and said means for moving said units comprises means for relatively moving said units a distance great enough to separate said first and second gears to break the drive between said units.

5. A printing press as defined in claim **1** wherein said guide means comprises a guide surface extending from immediately adjacent the said cylinders of said first unit to immediately adjacent the said cylinders of said second unit to guide the sheet therebetween.

6. A printing press as defined in claim **1** wherein said guide means comprises means for applying a force to said sheet along a line parallel to the direction of sheet travel and an arcuate surface for changing the direction of sheet movement against which said forces urge the sheet.

7. A printing press as defined in claim **6** in which said surface is an over-guide surface disposed adjacent the nip between said impression and printing cylinder of said first printing unit to receive sheets against the guide at an upwardly inclined angle for the sheet, the curved surface of said over-guide providing a protion of the guid away from which the sheet moves when the angle of the approach of the sheet to the guide changes toward the horizontal.

8. A printing press as defined in claim **1** wherein said guide means comprises stationary guide surfaces for supporting the lower side of the sheet and extending along said generally horizontal path and relative to which said sheet moves as it is fed from said first unit to said second unit.

9. In a printing press as defined in claim 1 wherein said guide means extends between said units and is inclined downwardly proceeding from said first unit to said second unit and the cylinders of said first unit have their axes in a plane diverging upwardly from said second unit to provide a sheet path from the unit which is in an upwardly inclined direction proceeding toward the second unit and said second unit has the axes of said cylinders of the unit in a plane which diverges upwardly away from the first unit to provide a downwardly inclined sheet path for the sheet moving through the printing nip, said guide means being inclined to guide said sheet along said downwardly inclined path as a sheet approaches said second unit.

10. In a printing press as defined in claim 1 wherein said cylinders of said second unit are disposed to receive the sheet proceeding along a downwardly inclined path and said guide means comprises guide surfaces extending along a downwardly inclined angle proceeding toward said second unit to guide the sheet along said downwardly inclined path.

11. A printing press as defined in claim 10 wherein said cylinders of said first unit are arranged to provide an upwardly inclined sheet path through the nip of said cylinders and said guide means includes a guide surface across which said sheet travels to change the direction of the sheet from an upwardly inclined sheet to a downwardly inclined sheet.

12. A sheet fed multi-unit printing press as defined in claim 1 wherein said first means comprises means for supporting said first and second units for angular movement relative to each other and said second means comprises means for relatively moving said first and second units with the axes of said cylinders in a fixed angular relationship and for selectively relatively moving said units to change the angular relationship of said cylinders.

13. A printing press as defined in claim 12 wherein said printing units each comprise frame members located at the opposite ends of said cylinders and said second means comprises means for relatively moving the frame members of said first and second unit at the corresponding ends of said cylinders toward or away from each other while said other frame members remain in the same relative positions to each other.

14. A multi-unit printing press for printing on sheet material fed therethrough, first and second printing units each comprising a printing cylinder and a second cylinder cooperating with the printing cylinder to define a printing nip, said printing cylinder being above said second cylinder in each unit, each of said units comprising frame members at the opposite ends of the said cylinders of the unit for supporting said cylinders, first means supporting said second unit for movement during press operation toward and away from, laterally of a direction generally parallel to the axes of the cylinders of said units, and angularly in a horizontal plane with respect to said first unit, second means for moving said second unit toward and away from said first unit during press operation including means for moving said second unit angularly with respect to said first unit, and third means for moving said second unit laterally of said first unit during press operation, said first, second and third means comprising means for adjusting the register of the second unit to said first unit during printing.

15. A multi-unit printing press for printing on sheet material fed therethrough, first and second printing units each comprising a printing cylinder and a second cylinder cooperating with the printing cylinder to define a printing nip, said printing cylinder being above said second cylinder in each unit, each of said units comprising frame members at the opposite ends of the said cylinders of the unit for supporting said cylinders, first means supporting said second unit for movement during press operation toward and away from, laterally of the first unit in a direction generally parallel to the axes of the cylinders of said units, and angularly in a horizontal plane with respect to said first unit, second means for moving said second unit toward and away from said first unit including means for moving said second unit angularly with respect to said first unit, third means for moving said second unit laterally of said first unit during press operation, said first, second and third means comprising means for adjusting the register of the second unit to said first unit during printing, fourth means for feeding successive sheets through said press comprising means constraining a sheet moving from said first unit to said second unit to move along a generally horizontal path between said units, said first and second units being spaced a distance apart such that the sheet is gripped and registered in said second unit while in the printing nip of said first unit, said fourth means being disposed to receive said sheet directly from the printing nip of said first printing unit.

16. A printing press as defined in claim 15 wherein said means constraining a sheet moving from said first unit to said second unit to move along a generally horizontal path comprises a revolvable vacuum member to apply tension in the direction of travel of sheet material moving between said first and second printing units.

17. A printing press as defined in claim 15 wherein means constraining a sheet moving from said first unit to said second unit to move along a generally horizontal path comprises means for applying force to said sheet along a line extending parallel to the travel of the sheet material.

18. A printing press as defined in claim 15 in which said means constraining a sheet moving from said first unit to said second unit to move along a generally horizontal path comprising means for tensioning a sheet traveling between the units in the direction of sheet movement.

19. A method of feeding a sheet through a multi-unit rotary press wherein each unit includes cooperating cylinders defining a printing nip therebetween, said method comprising steps of advancing the sheet into the nip of the first printing unit in register with the printing unit, gripping the lead edge of the sheet with grippers on one of the cooperating cylinders of the first unit, releasing the grip on the sheet on the exit side of the nip adjacent the nip, feeding the sheet from the first printing unit toward the second printing unit as it exits from the nip with a drive imparted to the sheet by the first printing unit, guiding the sheet from the first printing unit to the second printing unit along a generally horizontal path and directing the sheet into said second printing unit so as to be gripped thereby in registry with the unit prior to the sheet leaving the printing of the first printing unit, and applying a force along a line parallel to the direction of sheet movement as the sheet is being transferred to the second printing unit to maintain control of the sheet.

20. A method of feeding sheets as defined in claim 19 wherein said force is applied to tension the sheet as it moves between the first and second printing units.

21. A method as defined in claim 19 wherein said sheets are registered during printing to said second printing unit by moving the second printing unit relative to the first printing unit to adjust register in the direction of sheet movement and laterally of sheet movement.

22. A multi-unit sheet fed press for printing sheets fed in succession through the printing press comprising first and second printing units each comprising a printing cylinder and a second cylinder below said printing cylinder and cooperating with the printing cylinder to define a printing nip, said first and second printing units being spaced a distance apart such that a sheet being conveyed from said first printing unit to said second printing unit is gripped by said first printing unit before it leaves the printing nip of said first printing unit whereby the sheet is driven by the first printing unit as it travels to the second printing unit, guide means extending between said first and second printing unit comprising guide surfaces over which said sheet slides when moving between said first and second printing units, said guide means including a first guide surface inclined downwardly and toward and second cylinder of said first printing unit to guide a sheet from said second cylinder into said generally horizontal sheet path and a second guide surface disposed above the sheet and extending to a point adjacent said printing cylinder adjacent but above the path of sheet exiting from the printing nip to limit movement of the sheet upwardly with the printing cylinder and to guide the sheet into said generally horizontal path, said first and second surfaces forming a generally "V" shaped configuration immediately adjacent the exit side of the printing nip between the printing cylinder and the second cylinder of the first printing unit, said first printing unit having lead edge sheet grippers on said second cylinder which release said sheet as it approaches said first guide surface.

23. A printing press as defined in claim 22 wherein said guide means comprises means for tensioning the sheet in the direction of sheet movement as it moves along said guide means.

24. A printing press as defined in claim 23 wherein said tensioning means comprises a revolvable vacuum member engageable with the sheet.

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