United States Patent

[11] 3,625,145

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[54] **CYLINDER CART FOR EXCHANGING CYLINDERS ON THE FLY**
33 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **101/152,** 101/150, 101/212, 101/216, 101/366
[51] **Int. Cl.** **B41f 9/18**
[50] **Field of Search** 101/152, 153, 157, 181, 219, 216, 150, 151, 171, 173, 174, 178, 183, 248, 366, 364, 212

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ABSTRACT: A rotogravure printing press has a printing station frame defining a hollow space, and a detachable gravure carriage is movable into and out of the hollow space in the frame. The detachable printing carriage is an integral unit and carries a number of components which are employed in the printing operation. The carriage is provided with lower wheels for movement of the carriage along the ground when it is outside of the station. In addition, rollers are provided on the side of the carriage frame for carrying the carriage into the printing station to a position where the printing cylinder on the carriage engages the main drive mechanism in the printing station through coupling means. This can be accomplished "on the fly" with adjacent printing stations in operation. Means are also provided to engage the printing cylinder "in register." Additional features include an idling drive mechanism mounted on the gravure carriage for rotating the printing cylinder outside of the printing station and a complete inking system for off-press make-ready. With this mechanism the doctor blade which is also positioned on the carriage can be "run in" outside of the station. A unique connecting assembly partly positioned on the carriage and partly positioned in the printing station is provided for enabling the doctor blade to be joined with an oscillatory drive mechanism in the printing station.

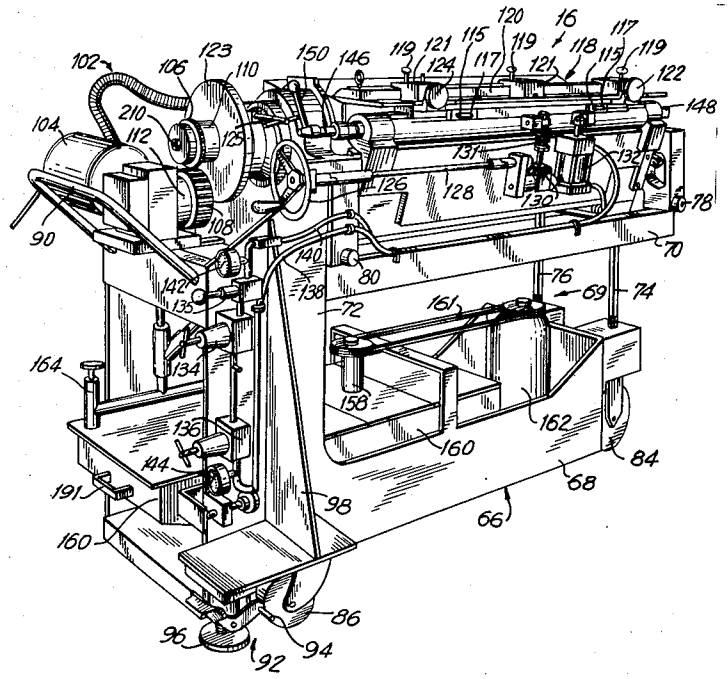

FIG. 1

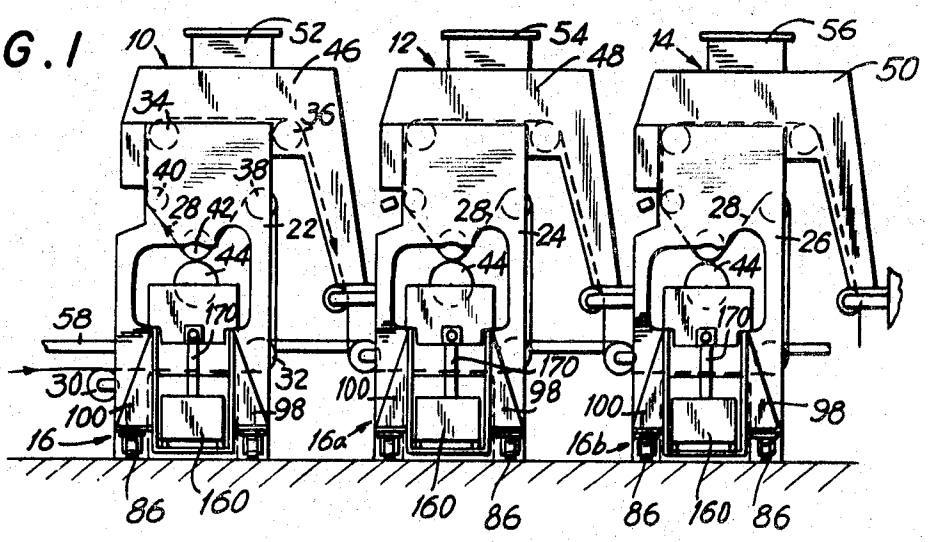

FIG. 2

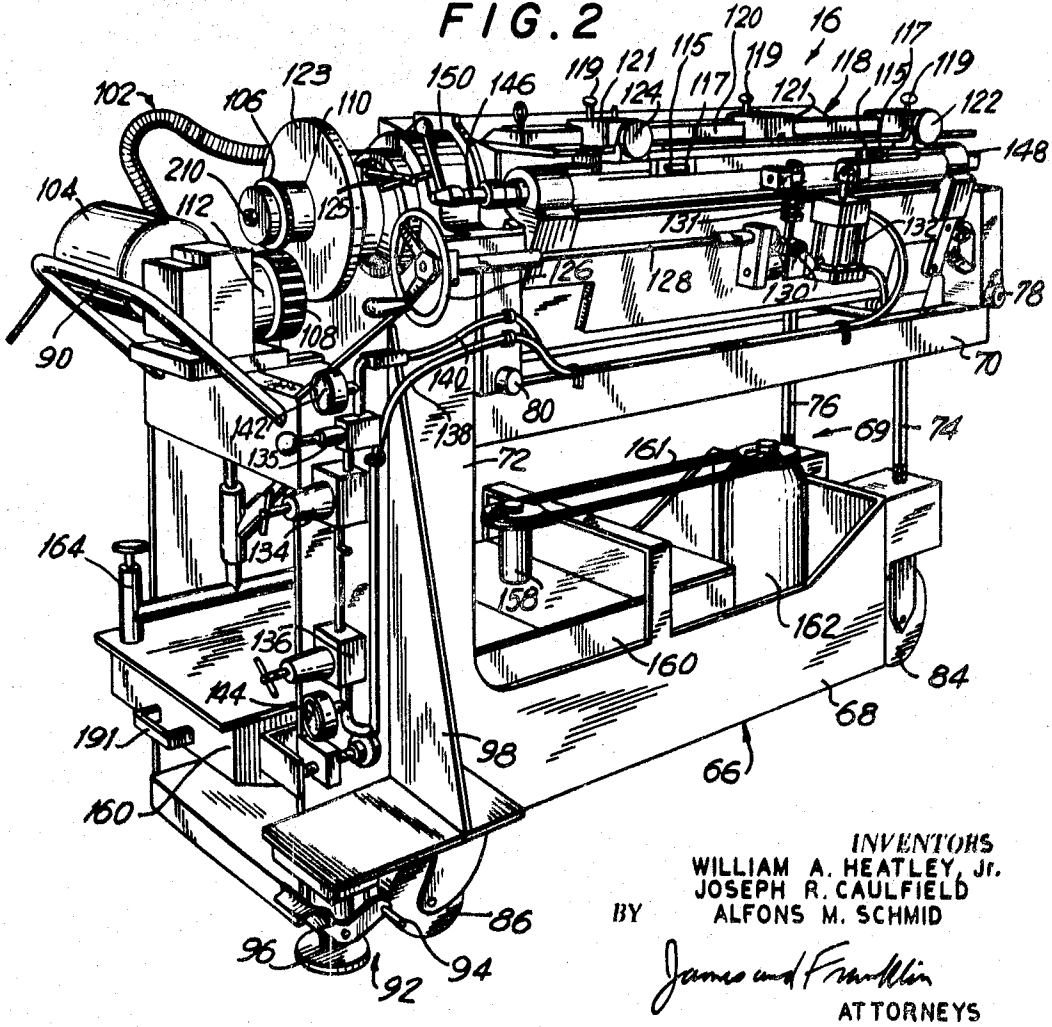

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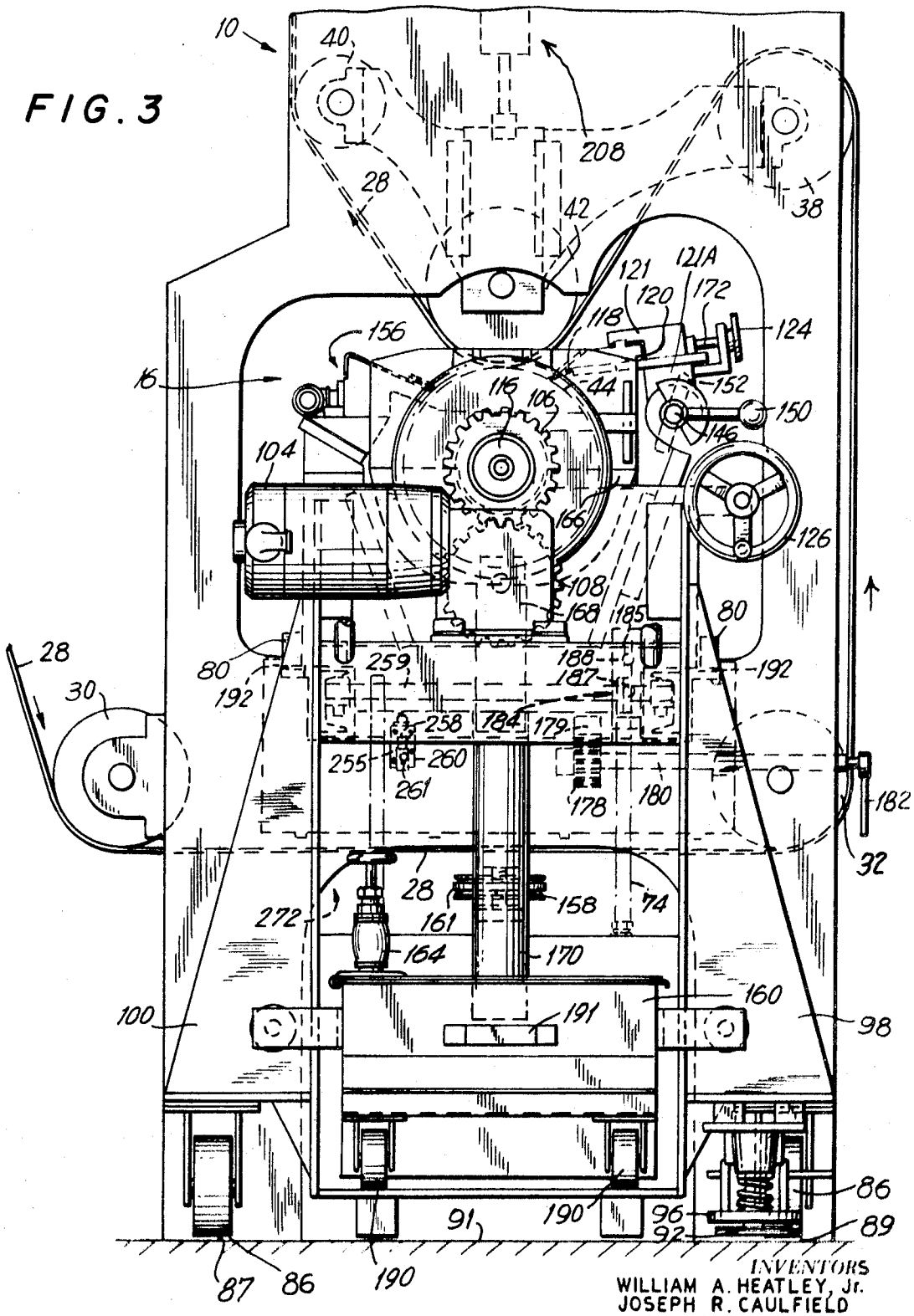
FIG. 3



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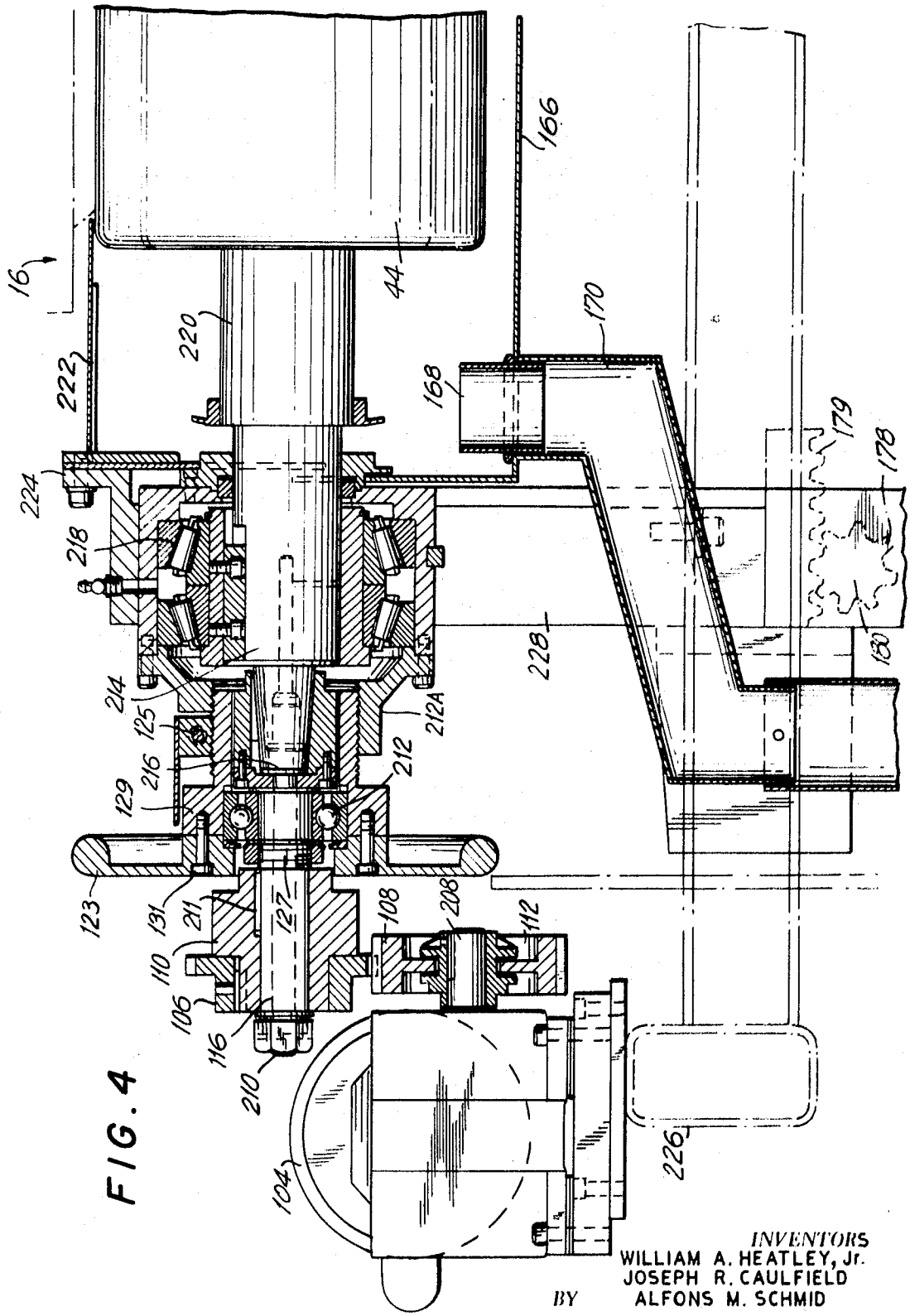

FIG. 4

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FIG. 6

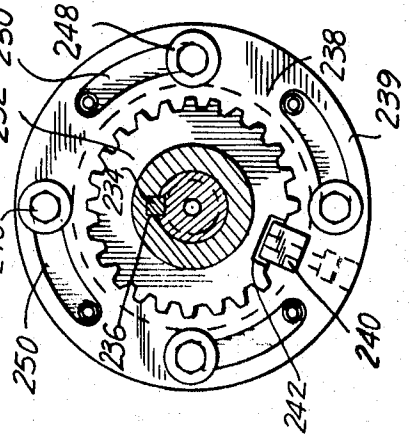

FIG. 7

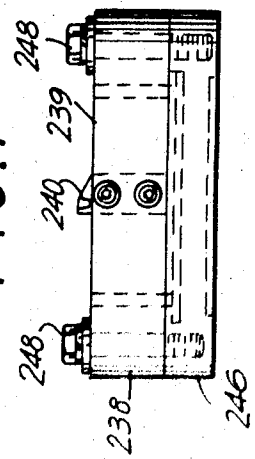

FIG. 5

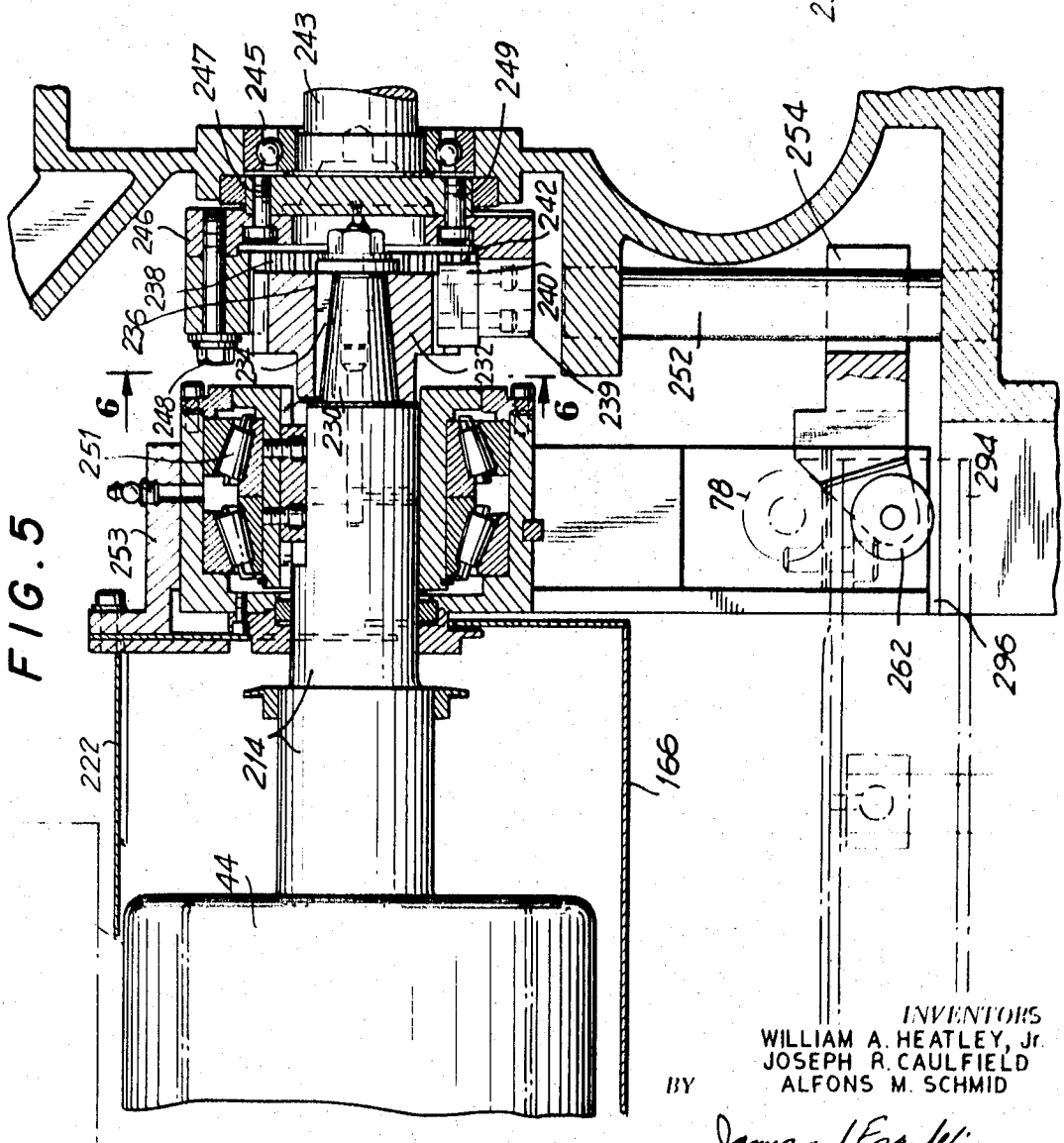

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FIG. 8

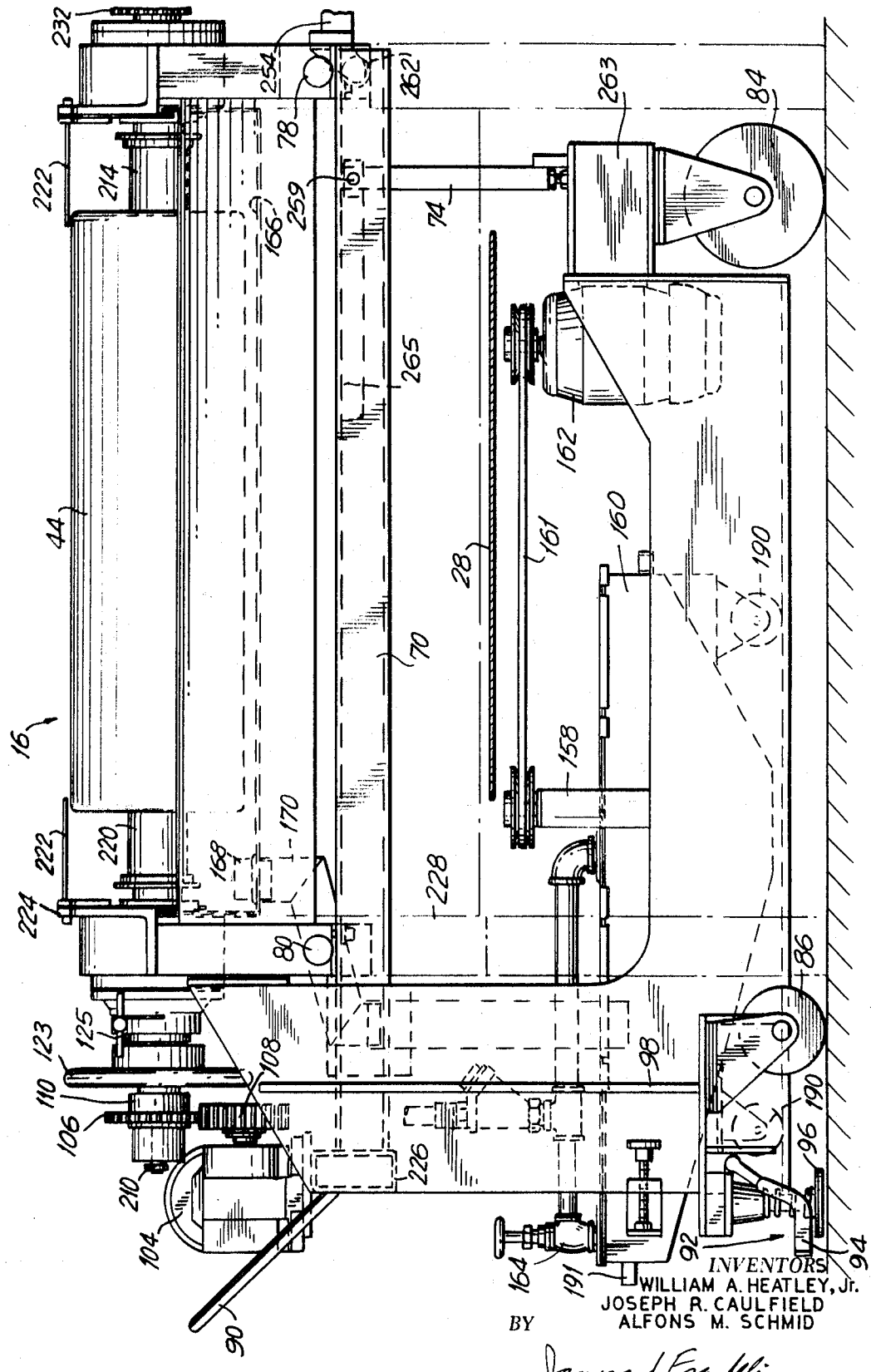

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FIG. 9

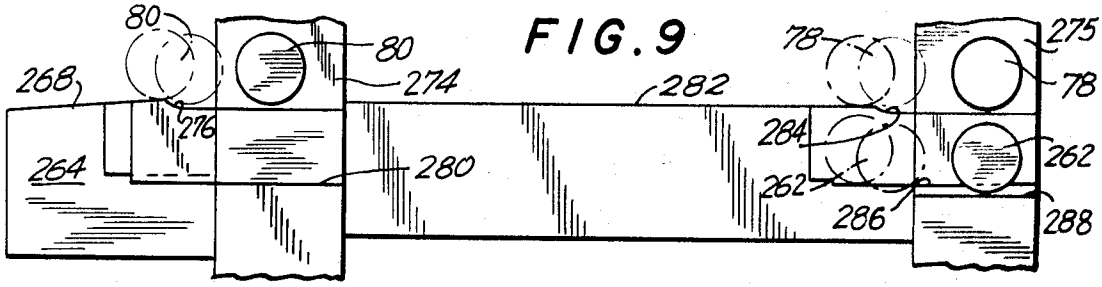

FIG. 10

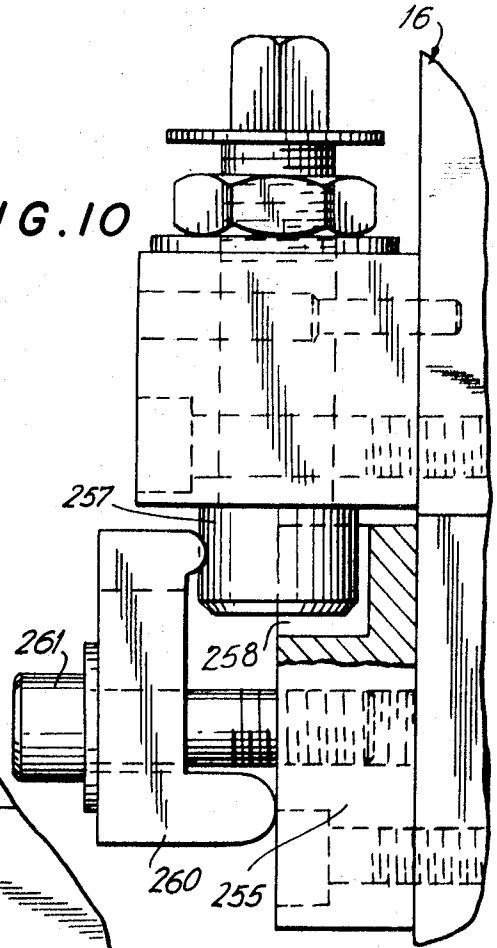

FIG. 11

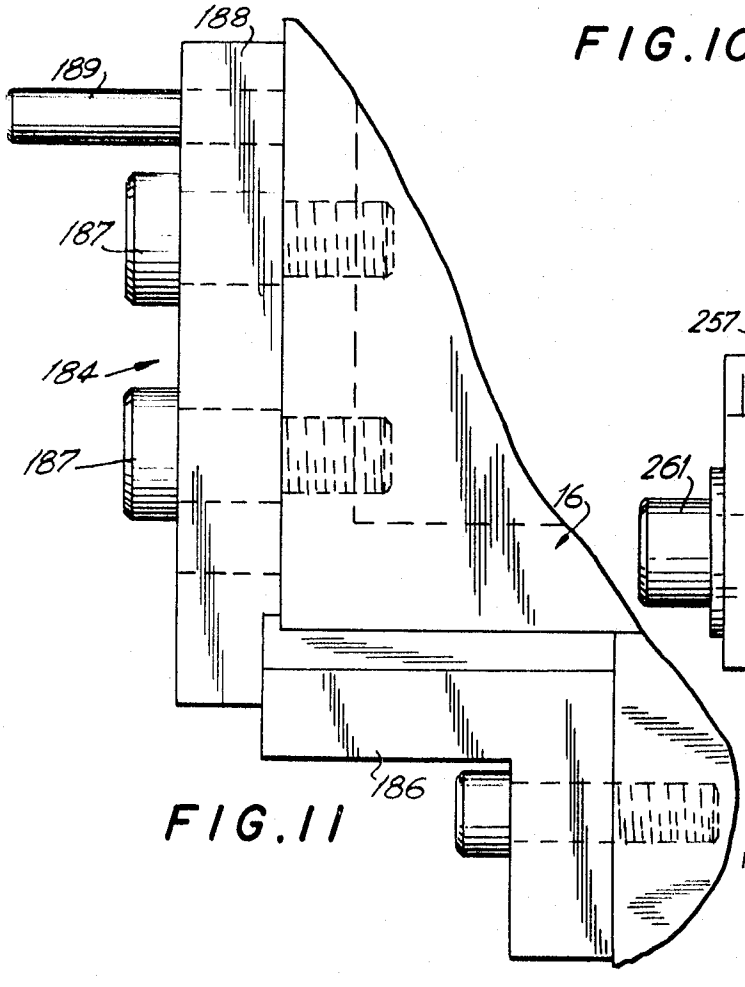

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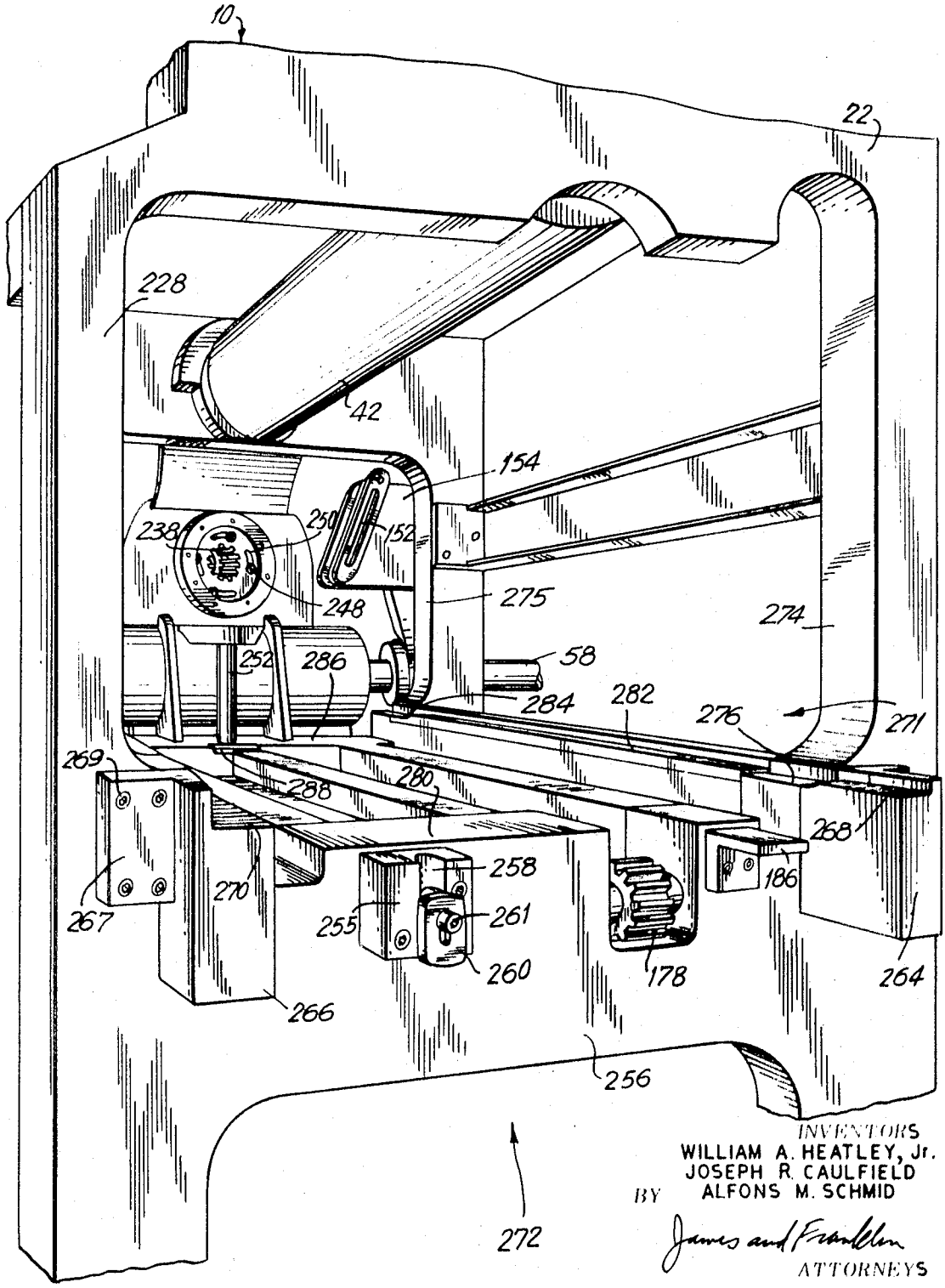
FIG. 12



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CYLINDER CART FOR EXCHANGING CYLINDERS ON THE FLY

This invention relates to printing presses, and more particularly to rotogravure printing presses.

Gravure printing presses are usually constructed with a plurality of adjacent printing stations through which the printed web is passed. Each printing station is designed to print a specific color or indicia on the web. For this purpose each printing station is provided with components which are normally found in a gravure press, e.g. printing cylinder, impression roller, ink fountain, doctor blade and ink applicator mechanism. The several stations are generally interconnected by means of a common drive mechanism. Each such station is quite complex in terms of the number and variety of components which are required to properly print the selected color or indicia on the passing web. One important difficulty in a press of this type is the inaccessibility of the various components in a station, and the inability to change printing cylinders. Normally if a critical component breaks down or is worn beyond repair and must be replaced, the entire series of stations are shut down, and the press becomes inoperative. Attempts are made to construct the press so that free access to the parts can be achieved without difficulty during this period. However, accessibility of the parts is still a major problem and down time of the press for repair or replacement continues to be unavoidable.

This invention provides a printing press of the type above discussed which is characterized by a structure which permits ready access to the various components for repair and replacement without necessitating press shutdown. Any station of the several which are operating can selectively be disconnected from the remaining stations, and the components in the disconnected station can be readily and quickly repaired or replaced. Not only does this provide the desired attribute of not having to shut down the press, but it provides the additional advantage of variety and flexibility in the overall printing operation. For example, if it desired to change part of a print format by simply changing a label or a name in the label, one disconnected station may have the printing cylinder engraved to include the new information while the press is operating with the original information in an adjacent station. The new cylinder can then be inserted and the adjacent station disconnected, so that the press then includes the required new information.

It is the primary object of this invention therefore, to provide a printing press of the type above discussed which is characterized by a structure which permits the insertion of the printing carriage in the printing station frame in register while the press is in operation, or conversely the printing carriage can be removed from the printing station frame while the press is in operation. The advantages of this feature are recognized by authorities in the graphic arts since it reduces misregister printing waste associated with the stopping of a rotogravure printing press. For example, in the printing of a particular format many times the basic configuration or format is retained, with only the name of the supplier changed, such as occurs in the printing of paperboard milk cartons or similar cartons or labels. With the proposed invention, the printing carriages with printing cylinder can be completely prepared for printing "off-press" and inserted in the disconnected printing station while adjacent color stations are operative. The printing station is made operative by lowering the impression cylinder onto the gravure cylinder and confining the web between the two members. The adjacent printing station which it replaces is made inoperative by raising the impression cylinder and the subsequent removal of the printing carriage. Thus, it can be seen that since printing tension is maintained throughout the press, color registration will be maintained and only a few cartons are wasted as compared to several hundred feet of web if the press were stopped to engage the new printing carriage.

Broadly, the objects of the invention are accomplished by a gravure printing press comprising a printing station frame

defining a hollow space and a detachable carriage movable into and out of the hollow space of the frame. The detachable carriage carries a plurality of components many of which are basic to the operation of the press. Such components include the printing cylinder, ink tank, ink pump, doctor blade mechanism and doctor blade holder, ink applicator mechanism and other associated equipment. The carriage and components form an integral unit which is readily inserted into and detached from the printing station frame which houses the remainder of components employed in the printing operation. The carriage rests on wheels when it is outside of the printing station and is carried on rollers positioned at the front and rear side sections of the carriage frame as it is being inserted into the station.

The carriage also may include a separate idling motor and several clutches. The motor is used to rotate the printing cylinder so that the doctor blade may be adjusted properly against the cylinder surface and then run in outside of the printing station, so that it is ready for instant use when the carriage is operatively positioned. In addition, the motor may be used to rotate the printing cylinder at a desired speed so that it may be inserted into the printing station for direct connection with the rotating drive mechanism therein. For the purposes of this connection a splined male member is accurately positioned at the rear of the carriage and when the carriage is inserted into the printing station this member engages a splined female member which is operatively connected to the main drive mechanism in the printing station. Slip and one way clutches are included as a safety device and declutching means to detach the idling motor on the carriage from the printing cylinder once the connection with the main drive mechanism in the printing station is achieved. The proper orientation of the printing cylinder is obtained by a proper registration of these splined members. This may be accomplished by employing a projecting key on one member which joins with a similarly shaped receptacle in the other member. By engraving the art work on the printing cylinder relative to the projecting key, all printing carriages will be in register upon their insertion in this printing station frame.

Additional features of the apparatus of the invention include doctor blade connect and disconnect mechanism which permits the doctor blade on the carriage to be easily joined to and disconnected from the printing station frame. When the carriage is positioned within the printing station, the doctor blade is connected to a mechanism which imparts an oscillatory motion to the doctor blade in the conventional manner while the blade wipes the ink from the unetched surface of the printing cylinder. This connection is effected by the engagement of a projecting finger on the doctor blade holder and a slotted yoke which is a part of the oscillatory drive mechanism. The carriage also includes a plurality of components which are used to adjust the doctor blade to a proper wiping angle position on the periphery of the printing cylinder prior to the connection of the doctor blade with the oscillatory drive mechanism.

Still other features of the apparatus include a stop assembly which is arranged to prevent the engagement of the male and female splined members with excessive inertia. For this purpose the carriage is provided with a slidable member which contacts and interferes with a projecting block on the printing station frame as the carriage moves to within a few inches of the engagement position. After the stop assembly stops the carriage, the slidable member is lifted out of engagement with the projecting block so that the carriage can proceed the remaining few inches into spline-produced engagement with the station main drive mechanism. To ensure proper engagement of these members a rack and pinion is included, the pinion being positioned on the frame of the printing station at the front part thereof, and the rack being positioned on the front part of the carriage. When the stop assembly stops the carriage, the rack engages the pinion. At this position, the carriage frame is resting upon the station frame and not on the carriage rollers, and thus a high frictional resistance to further

movement results. The rack and pinion is operated to over come this frictional resistance, and in this manner the carriage is brought to the final position slowly and with care.

In one embodiment several struts are positioned at the rear of the carriage and are employed to provide additional vertical support to the upper portion of the carriage when the carriage is not in the printing station. These struts are pivotally mounted on the carriage so that when the carriage is inserted into the printing station, they are automatically moved into a horizontal position which does not interfere with the travel of the carriage along the station frame and does not strike or destroy the web as it passes through the station.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to construction of a printing press apparatus as defined in the appended claims, and as described in this specification, taken together with the accompanying drawings in which:

FIG. 1 is a front elevational view of several printing stations in the printing apparatus of the invention;

FIG. 2 is a perspective view of a carriage which is used in all of the printing stations illustrated in FIG. 1;

FIG. 3 is a front elevational view of the carriage illustrated in FIG. 2 after it is inserted into a printing station;

FIG. 4 is a side elevational view partly in section of the front portion of the carriage illustrated in FIG. 2;

FIG. 5 is a side elevational view partly in section of the rear portion of the carriage illustrated in FIG. 2 after it had engaged the printing station drive mechanism;

FIG. 6 is a transverse view taken along the lines 6—6 of FIG. 5;

FIG. 7 is a plan view of the apparatus illustrated in FIG. 6;

FIG. 8 is a side elevational view of the carriage illustrated in FIG. 2;

FIG. 9 is a schematic illustration of the path of travel of the carriage as it approaches and reaches a final position in the printing station frame;

FIG. 10 is an enlarged side elevational view of a locking mechanism employed to lock the carriage of FIG. 2 to the printing station frame;

FIG. 11 is an enlarged fragmentary side elevational view of a stop assembly for stopping the carriage of FIG. 2 as it is inserted into the printing station; and

FIG. 12 is a perspective view of the interior of a printing station frame into which the carriage is inserted.

Referring to the drawings in detail, FIG. 1 illustrates several printing stations with the detachable carriages positioned within the printing station frames. The detachable carriage **16** is most clearly shown in FIG. 2, while the printing station **10** without the carriage is best illustrated in FIG. 12. Referring to FIG. 1, each printing station **10, 12, 14** is illustrated as including carriages **16, 16*a*** and **16*b*** positioned within the printing station frames **22, 24** and **26**. A web **28** passes over a plurality of lightweight metal alloy rollers which in printing station **10** are designated by the numerals **30, 32, 34** and **36**. As the web passes over these rollers it is also passed over two support rollers **38** and **40** and impression cylinder **42**. The web is shown to pass between the impression cylinder **42** and printing cylinder **44** and it is at this area that pressure is applied to the web and printing from the printing cylinder is effected thereon. The support rollers **38** and **40** move with the impression cylinder **42** by means of a mechanism such as a hydraulic cylinder (**208** in FIG. 3). Such a mechanism is provided for lowering or raising the impression cylinder **42** together with the rollers **38** and **40**. This movement is employed when a carriage is inserted into a printing station. The other printing stations **12** and **14** are provided with similar rollers as shown.

Each station is also provided with a dryer such as at **46, 48** and **50** and each dryer is provided with an exhaust pipe **52, 54, 56** which is connected to an exhaust fan known to the arts. Each of these dryers is designed to provide approximately 7 feet of drying length and is suitable to dry normal gravure ink at speeds up to one thousand feet per minute. An after-dryer, now shown, having approximately 20 feet of drying length may be provided at the last rotogravure color station for further drying of the ink and for positive removal of any residual odor remaining in the material being processed.

A common drive shaft is schematically illustrated at **58** in FIG. 1 and is connected to each printing station by means not shown, but well known, such as a sliding worm and worm wheel drive, a planetary drive gear arrangement, or a worm gear or bevel gear drive. The two former drives permit a space or cylinder correction to effect printing register and are applicable to the printing units in question. The two latter drives are used in conjunction with compensators whereby the web length between stations is varied to obtain color registration. The drive shaft imparts rotation to the printing cylinders at a desired speed when they are inserted into the printing station, so that the information engraved on the cylinders can be properly imprinted on the passing web.

FIG. 2 clearly illustrates a detachable carriage generally designated **16** which is inserted into a printing station. The carriage **16** includes a carriage frame **66** which is generally "C" shaped. The frame **66** includes a horizontally extending lower frame portion **68** and a horizontally extending upper frame portion **70** which are rigidly connected by the vertical frame portion **72**, and are also further supported by struts **74, 76**. The struts **74** and **76** are pivotally mounted on the inside portion of the carriage frame by shaft **259** (see FIGS. 3 and 8) and are adapted to swing freely therefrom. These struts are moved to a horizontal position after they contact the cross bar **256** of the printing station frame **22** (FIG. 12). Thus the struts are moved out of the way so that they do not interfere with the web which passes between the lower portion **68** and upper portion **70** of the frame **66** once the carriage is positioned in the printing station.

The particular embodiment of the carriage frame **66** illustrated in FIG. 2 may be employed when the printing station has a cross bar or brace which is identified in FIG. 12 by the numeral **256**. The opening **69** in the "C" frame carriage shown in FIG. 2 passes over the cross bar **256** of the station frame **22** and provides a path for the web **28** in FIGS. 1 and 3 as it passes over the various supporting rollers. Of course, other suitable carriage configurations may be employed, and the embodiment shown in FIG. 2 is not intended to be limiting.

With reference to FIG. 2 the carriage there specifically disclosed also includes rollers **78** and **80** which are affixed to both sides of the carriage for the purposes of rolling the carriage along the printing station frame as the carriage is being pushed into the frame. The carriage is carried along the ground by front and rear wheels **84** and **86** (FIGS. 1, 3) when it is outside of a printing station. A handle **90** is positioned at the top front of the carriage and facilitates the movement of the carriage both into the printing station and along the ground after it is removed from the station. A brake mechanism is generally designated by the numeral **92** and is shown to include a foot rod **94** and brake disc **96**. The brake **92** is employed after the carriage has been removed from the printing station to stop the carriage from rolling along the surface. The carriage also includes winged frame portions **98** and **100** for structural strength and rigidity.

The carriage holds a plurality of auxiliary components not used during the actual printing but used for off-press makeready. These include the idling mechanism shown generally at **102**. The idling mechanism includes an idler motor **104**, idler gears **106** and **108**, and clutches **110** and **112**. The idling mechanism is connected to printing cylinder **44** (FIG. 4) through the shafts **116** and **220**. This idling mechanism serves two functions. It enables the printing cylinder **44** to be rotated prior to the engaging of the printing cylinder drive coupling **232** and **238** (FIG. 5) so that it can obtain the proper rotational speed for insertion into the printing station on the fly. In this manner the shock load introduced because of the mismatch is speed between the printing cylinder and the press drive is greatly reduced. In addition, the ability to rotate and ink up the printing cylinder off-press enables the doctor blade to be run in with the printing cylinder in

order to obtain a clean wipe prior to the insertion of the carriage into the printing station. Thus, the need for adjusting the doctor blade after the printing cylinder engages the main drive mechanism in the printing station is avoided.

For the purposes of adjusting the doctor blade outside of the printing station, a plurality of adjusting mechanisms are included as components on the carriage **16** (see FIGS. **2** and **3**). The doctor blade itself is designated generally by the numeral **118**, and is positioned in the doctor blade holder **120**. Two rotatable knobs **122** and **124** perform the function of orienting the doctor blade holder **120** so that the doctor blade itself can be moved toward or away from the printing cylinder to obtain a uniform contact area. Tilting the doctor blade holder **120** upwardly or downwardly relative to the print cylinder is achieved by turning the hand wheel **126**. This motion is translated through the shaft **128** to the bevel gear mechanism **130** and spring **131** which causes the doctor blade holder mechanism to pivot. The spring force is resisted by the doctor blade **118** when it contacts the printing cylinder. Pressure for the doctor blade loading against the printing cylinder **44** is provided through the air cylinder **132** which is superimposed on the bias pressure of spring **131**. The cylinder **132** is controlled through the pressure regulators **134** and **136**. These regulators are connected to the air cylinder **132** through air hoses **138** and **140**, and the pressure is indicated by pressure gauges **142** and **144**. Lever operated four-way valve **135** is used to engage or disengage the doctor blade **118** from the gravure cylinder **44**.

As is normally the case, once the doctor blade **118** is positioned within a printing station, it is horizontally oscillated across the surface of the printing cylinder **44** so that its wiping action can be effectively achieved. The drive mechanism for providing this oscillation is positioned within the printing station itself but the means through which the oscillation is imparted to the doctor blade is mounted on carriage **16** and is shown in FIGS. **2** and **3**. A rod **146** and the radially protruding finger **148** are integrally connected together, and are rotated by means of the crank arm **150**. The finger **148** is adapted to be positioned within the slotted yoke **152** (shown best in FIG. **12**) when the carriage **16** is in its inserted operative position and once positioned therein is locked in place on the yoke by turning the crank arm **150** a quarter turn. The oscillation drive mechanism is located within the housing **154** also shown in FIG. **12** and oscillates the doctor blade **118** through the yoke **152**, rod **146** and holder **120**. When the carriage **16** is to be withdrawn from a printing station the crank arm **150** is given a reverse twist, thus aligning the finger **148** with the slot **152**, and the carriage **16** may then be withdrawn without resistance by using the rack and pinion mechanism for this purpose.

The oscillation of the doctor blade is in a direction parallel to the longitudinal axis of the printing cylinder, that is, from the front to the rear of the carriage and back. The oscillation occurs very slowly as is normally the case. During the oscillation, the doctor blade holder support **121***a* is carried on the rollers **115** (FIG. **2**) which are moved along the grooves **117**.

Removal or positioning of the doctor blade holder **120** is achieved by loosening the thumb screws **119**, which are fastened to the blocks **121**. When these screws **119** are loosened, the doctor blade holder **120** is permitted to slide between the blocks **121** and the doctor blade holder support **121A**, FIG. **3**. The screws **119** are tightened and the doctor blade holder **120** and the support **121A** oscillate together.

The relative position of the printing cylinder **44** within the printing carriage is effected by means of the handwheel **123** and the lock handle **125** to obtain lateral printing register. This particular motion of the printing cylinder can best be explained by referring to FIG. **4**. As there illustrated, the handwheel **123** is rotatable over the ball bearing **212** and the shaft **116**. Handwheel **123** is securely fastened to the threaded flanged tube **129** by means of the bolts **131**. The front extension **216** of the printing cylinder shaft **220** is carried within the tube **129** and thus is actually displaced when the tube **129** is actually displaced. This lateral displacement occurs when the handwheel **123** is rotated in either direction through the ball bearing **212** which is fastened to shaft **116** by locknut **127**. The outer bearing race is confined between handwheel **123** and the threaded flanged tube **129**. After the repositioning of the printing cylinder **44** is completed the lock handle **125** is tightened, which locks the threaded tube **129** in the front bearing housing **212A**. Lateral movement of the printing cylinder can be obtained while the station is in the printing mode.

The carriage **16** also includes the ink applicator mechanism **156** shown most clearly in FIG. **3**. Also included on the carriage **16** (FIG. **8**) is a self-contained system to supply ink to the applicator. This includes the ink pump **158**, ink tank **160** in which the ink is stored, drive motor **162** which is drivingly connected to the pump **158** by means of belt **161**, and a valve **164** for controlling the flow of the ink to the ink applicator. An ink pan **166** shown best in FIG. **4** contains a reservoir of the ink through which the ink printing cylinder **44** passes. An opening **168** feeding the ink return pipe **170** provides an overflow exit when the ink level in pan **166** rises above the opening. The ink then flows back into ink tank **160** to be again pumped up to the applicator **156**.

FIG. **3** illustrates in a front elevational view the carriage **16** positioned within the printing station **10**. As illustrated in FIG. **3** the doctor blade **118** is positioned against the printing cylinder **44**, and is held in doctor blade holder **120**. The manually operated knob **124** is shown to be operatively connected to the holder **120** through the shaft **172**. In addition, the slotted yoke **152** is illustrated with the rod **146** positioned therein.

Additional features of the carriage and printing station assembly are shown in FIG. **3**, and include a pinion **178** and a rack **179**, a rod **180** and a rack handle **182**. The pinion **178** is positioned on the front of the printing station frame as illustrated most clearly in FIG. **12**, and is there drivingly connected to handle **182** by rod **180**. The rack **179** is positioned on the carriage frame, and when the carriage is positioned approximately three to four inches from its fully inserted operative position in which position the carriage engages the drive mechanism in the printing station, the rack **179** meshes with the pinion **178**. Handle **182** may then be manually rotated, and the entire carriage is positively moved the remaining three or four inches to its fully inserted operative position. In this manner the engagement of the carriage mechanism and the printing station mechanism is carefully effected, and damage is avoided.

Another safety feature which is designed to overcome the inertia of the carriage when it is pushed into the printing station frame is the stop assembly designated generally in FIG. **3** by the numeral **184**. This stop assembly on the carriage cooperates with a protruding block **186** (illustrated in FIGS. **11** and **12**) which is mounted on and projects from the printing station cross bar **256** adjacent the pinion **178**. This block **186** engages the slidable member **188** (FIG. **11**) which is positioned near the front of the carriage. When these two parts are connected the carriage cannot move until the slidable member **188** is lifted out of engagement with the block **186**. This can be readily done by simply lifting the member **188** by means of handle **189** to a position where it no longer interferes with the block **186**. The member **188** is provided with a slot **185** so that it readily slides under bolt head **187**. With this construction, the prevention of improper engagement of the various mechanisms is ensured.

FIGS. **3** and **8** also illustrate that the ink tank **160** is itself positioned on wheels **190**. This permits the easy removal of the tank such as by means of handle **191** for the purposes of changing the ink or cleaning out the tank. This can be done without disassembling the frame in any manner. It will also be noted in FIG. **3** that when the carriage is in position in the printing station the wheels **86** are spaced (**87**,**89**) from the ground **91** and the rollers **80** are also positioned off the printing station frame as shown at **192**. The carriage at this position is maintained on the station frame by virtue of a metal-to-

metal contact therewith, that is, the rear part of frame section **70** in the upper portion of the carriage frame **16** rests on the section **286** (FIG. **12**) of the station frame as is hereinafter further explained.

FIG. **3** further illustrates the auxiliary equipment which is employed to pass the web **28** through the printing station and on to the next station. For example, guide rollers **30** and **32** are positioned at either side of the carriage, and pass the web to the impression cylinder **42** over guide roller **38** and guide roller **40**. A hydraulic piston assembly **208** is positioned above the impression cylinder **42** by means (not shown) to raise or lower the impression cylinder as desired. As before mentioned the guide rollers **38** and **40** are simultaneously lifted and lowered with the impression roller **42**. These three rollers are raised a slight amount when the carriage is to be inserted into the printing station so that they do not interfere with the printing cylinder **44** and the impression roller **42**. Raising of the impression roller **42** and the two web guide rollers **38** and **40** does not change the web length between printing stations because of the parallel webbing.

FIG. **4** illustrates in greater detail the idling mechanism which is used to rotate the printing cylinder **44** when the carriage is outside of the printing station. As there shown the idling motor **104** is connected through shaft **208** to a torque limiting clutch **112** upon which is mounted the gear **108**. This gear meshes with gear **106** which in turn is mounted on the overrunning clutch **110**. The clutch **110** is positioned on a shaft **116** and locked to the shaft by means of the bolt **210** and key **211**. The shaft **116** extends through bearing **212** to connect with the printing cylinder shaft **214** at the joint **216**. The printing cylinder shaft **214** is mounted within the bearing **218** and connects to the printing cylinder **44** through its flanged extension **220**. An outer cover **222** is bolted to the frame **224** and encloses the upper portion of the shaft **220** and the end of the printing cylinder. The ink pan **166** is positioned below the printing cylinder **44** and houses the ink (not shown) through which the cylinder is passes as it rotates. The idling motor **104** is mounted on a brace **226** which is integrally secured to the carriage by any suitable means, not shown. The illustration in FIG. **4** depicts the carriage **16** joined to the printing station **10** as indicated by the station frame member **228** which forms a part of the printing station.

As before indicated the idling motor may be employed to rotate the printing cylinder with the inking system operating in order to run in the doctor blade, that is to enable the doctor blade to wear against the printing cylinder before the carriage is operatively inserted into the press. This action can occur only after the doctor blade **118** is adjusted to the proper wiping angle and with desired degree of pressure on the cylinder, and the cylinder is rotated for an appreciable period of time. Only after this has been done is the printing cylinder ready for use. For this purpose the printing cylinder **44** may be rotated at a suitable speed by the idling motor **104** while the carriage is removed from the printing station frame.

When it is desired to engage the drive mechanism in the printing station on the fly, the printing cylinder is rotated at a speed approximately 50 to 75 r.p.m. slower than the drive mechanism in the printing station. When the printing cylinder engages the drive mechanism the rotational speed of the printing cylinder increases to that of the station drive speed and clutch **110** disengages the idling motor **104** from the printing cylinder shaft **214**. If for any reason the idling speed for the printing cylinder is greater than the speed of the drive mechanism within the printing station, then the idling motor **104** is disengaged by means of the torque limiting clutch **112**.

The engagement of the printing cylinder and the main drive mechanism in the printing station is best explained with reference to FIGS. **5** through **7**. FIG. **5** illustrates the connection at the rear of the printing cylinder shaft **214**. As there illustrated, the end **230** of the shaft **214** is affixed to a male splined member **232** by means of the key **234** which is wedged in the keyway **236**. The male splined member **232** fits within the female splined ember **238** and is oriented by means of the key **240** which fits into a keyway **242** in the male member **232**. The key **240** is for coarse registration of these members while fine registration is affected by the use of chamfered edges on the splines of member **238**. As illustrated in FIGS. **6** and **7**, the female member **238** is fastened to plate **246**. Female member **238** is movable relative to plate **246** and is adjusted by means of the bolts **248** positioned within the slots **250**. As illustrated in FIG. **6** there are a plurality of such slots about the front surface **239** of the female member **238**. By adjusting member **238**, the key **240** is preset so that the engraved information on the cylinder surface is correctly oriented after engagement of the two members **232** and **238**. This information is therefore transferred to the web in the proper area on the web relative to information transferred from the printing cylinder in the other stations. This adjustment is made once for a given cylinder size.

The female splined member **238** rotates together with the plate **246**. The rotation thereof is effected through the drive shaft **243** which is carried in bearing **245**. The shaft **243** is secured to the plate **246** by the bolts **247** and **249**. This rotation is transmitted through the male splined member **232** to the printing cylinder shaft **214** which is rotated in the bearing **251**. The shaft **214** and bearing **251** are enclosed in the carriage frame **253** as illustrated.

A locating post **252** is vertically positioned within the printing station frame directly below the female splined member **238**. The post **252** is also illustrated in FIG. **12**. This post **252** is employed to align the printing cylinder **44** as it is inserted into the printing station. For this purpose a yoke **254** is mounted at the rear of the carriage and fits tightly about the post **252** when the carriage is inserted into the station.

In addition to the yoke **254** and post **252**, a separate mechanism is also provided for alignment purposes at the front of the carriage and at the front of the printing station frame. Referring to FIG. **12** there is illustrated at the crossbar **256** on the printing station frame **22** a block **255** having a groove **258** therein and a bracket **260** slidably positioned over bolt **261** just below the groove **258**. A stud **257** best shown in FIG. **10** projects from the rear of the carriage and is dimensioned so that it tightly fits within the groove **258** when the carriage is inserted into the printing station. The stud **257** is arranged so that it is eccentrically positioned within the groove **258**. Thus if the stud **257** is rotated within the groove **258** a force is generated due to the eccentric arrangement sufficient to laterally move the carriage and printing cylinder **44** as much as one-sixteenth of a inch. The post **252** and yoke **254** act as a pivot point during this movement. After the stud **257** is rotated the plate **260** is raised and bolted directly over the stud as shown in FIG. **10**. In this manner the carriage is locked in place after it is positioned within the station.

FIG. **8** is a side elevation view of the carriage and illustrates the relative positions of the various components before described For example, the yoke **254** is shown positioned at the rear of the carriage, that is the portion of the carriage which first enters the printing station frame. A segment of the web **28** is illustrated as being positioned within the carriage frame only after the carriage is inserted into the printing station. As illustrated in FIGS. **1** and **3**, the web **28** actually passes through the carriage if a carriage configuration such as that illustrated in FIG. **2**, that is a "C" type frame, is employed. Strut **74** is shown in FIG. **8** in solid lines in its vertical position supporting the carriage frame and resting upon the member **263** which is positioned just above the wheel **84**. The dotted illustration **265** indicates the position of the strut **74** after it is raised about pivot point **259**. The pivot action occurs when the strut strikes the crossbar **256** of the printing station frame (illustrated in FIG. **12**).

FIG. **8** also illustrates a wheel **262** which is positioned directly below and behind the yoke **254**. The wheel **262** is shown by means of the dotted illustration to indicate that it is positioned behind the frame segment **70** and toward the center of the carriage. This wheel **262** performs the function of temporarily supporting the carriage near the front of the printing station frame as it is being pushed therein.

The supporting functions of the several carriage components and the printing station frame may be readily understood by referring to FIGS. 9 and 12. In FIG. 12, two projecting blocks 264 and 266 extend outwardly from the crossbar 256 of the printing station frame and are secured thereto by supporting means such as member 267 and bolts 269. These blocks are slightly inclined downwardly at their upper surfaces 268 and 270 so that the carriage can be received at each of these surfaces as it is being pushed into the hollow space 271 in the station frame. FIG. 9 illustrates the block 264 and the inclined surface 268 in schematic profile. The vertical supports 274 and 275 of the printing station frame are partially illustrated in FIG. 9 and shown in perspective in FIG. 12. As indicated in the schematic illustration there is a slight recessed area 276 at the edge of the inclined block 264 which is also shown clearly in FIG. 12. The corresponding block 266 on the opposite side of the station frame is also provided with a recessed area (not shown). Also shown in FIG. 12 is an extended platform 280 which is positioned at the front central portion of the station frame and extends inwardly from the crossbar 256. At each side of the printing station frame there is a track 282 which is employed to support the rollers 78 as the carriage is pushed into the frame. The tracks 282 are positioned immediately adjacent the recessed areas 276. At the rear end of the tracks 282 there are also recessed printing station frame substantially directly opposite the platform 280. The rear platform 286 is provided with a recessed area 288 in the central portion thereof.

As the carriage is initially inserted into the upper and lower hollow spaces 271 and 272 in the station frame, the rear rollers 78 on the carriage 16 engage the blocks 264 and 266 at the inclined surfaces 268 and 270. As the carriage is further pushed into the station frame the carriage wheel 262 (FIG. 9) contacts platform 280 and provides support for the carriage is further pushed At the point of contact between the wheel 262 and the platform 280 the rear rollers 78 are positioned above the recessed areas 276 and provide no support for the carriage. During further travel of the carriage into the station the wheel 262 reaches the edge of the platform 280 at the same time that the rollers 78 reach the front edge of the tracks 282. Thus the rollers engage the tracks 282 and provide support to the carriage at the same time that the wheel 262 is disengaged from the platform 280, and at this point the rear of the carriage is supported solely by the rollers 78. During this period of travel the front portion of the carriage is supported on the ground by the front wheels 86 (FIG. 2). As the carriage is further moved into the station frame these front wheels 86 are eventually lifted off the ground and this occurs simultaneously with the engagement of the front rollers 80 with the inclined surfaces 268 and 270. While the front rollers 80 are traversing the inclined surfaces 268 and 270, the rear rollers travel along tracks 282. At the precise point that the rear rollers arrive at the recessed areas 284 at the rear of the tracks 282, the front rollers 80 reach the recessed areas 276 and the wheel 262 is positioned above recess 288. Thus at this point none of these members support the carriage. Rather, the carriage is supported by the engagement of the rear portion of carriage frame 70 with the platform 286 in the rear of the station frame. The front of the carriage is locked in position by means of the stud 257, groove 258 and locking plate 260, as explained with reference to FIG. 10. Of course, prior to this locked position the carriage is gradually moved toward its final engagement with the printing station drive mechanism by means of the rack 179 and pinion 178 and associated equipment as before explained. The positions of rollers 78 and 80 and wheel 262 during this latter phase of carriage movement is shown by the dotted illustrations in FIG. 9. Once the carriage is in its final position the printing cylinder is rotated by its direct coupling through splined member 238 to the drive shaft 243. The manipulative steps which are carried out when the carriage is inserted into the printing station frame are simply reversed when the carriage is detached from the printing station.

From the foregoing detailed description it will be appreciated that the detachable carriage structure which is disclosed provides important advantages in the operation of a printing press of the type described. When the carriage is detached from a station the auxiliary idling mechanism may be used to rotate the printing cylinder and run in the doctor blade outside of the press. In addition, the printing cylinder can continue to be rotated after doctor blade adjustment is accomplished for the purposes of maintaining the ink in the system in a web and flowable condition. This latter capability is quite advantageous for achieving immediate operation of the cylinder after insertion into the printing station.

Another important feature of the printing press as described is the fact that the carriage frame is integral with the printing cylinder and other components, and this feature permits ready removal of all of the carriage components without the necessity of providing a separate removal carriage. With this construction, accessibility of the carriage components is readily achieved.

We claim:

1. In a rotogravure printing press having a printing station frame defining a hollow space therein, a driving mechanism and an impression roller mounted on said station frame, a detachable carriage movable into and out of said hollow space of said frame, said printing station frame having support means adapted to receive and support said carriage, a coupling member operatively connected to said driving mechanism, said carriage comprising a carriage frame, means operatively connected to said carriage frame for engaging said support means on said printing station frame when said carriage is moved into and out of the hollow space of said printing station frame, a printing cylinder having means on a surface thereof adapted when engaged with web material to apply printed matter thereto, said printing cylinder being rotatably mounted on said carriage frame, means to operatively connect said driving mechanism in operative driving relationship with said printing cylinder during rotation of said driving mechanism, including a coupling member operatively connected to said printing cylinder and adapted to operatively engage said driving mechanism coupling member while said driving mechanism coupling member is rotation to thereby drivingly join said printing cylinder to said driving mechanism on said printing station frame when said carriage is inserted into said printing station frame during rotation of said driving mechanism, keying means operatively connected to said coupling members for joining said coupling members in a predetermined relative position with respect to one another, said keying means being selectively positioned relative to the printed matter applying means on the surface of said printing cylinder thereby to align said printing cylinder in a given position relative to said driving mechanism when said coupling members are operatively joined.

2. The rotogravure printing press of claim 1, in which said coupling members comprise a splined male member positioned at the rear of said carriage and a splined female member positioned at the rear section of said printing station frame, said members being adapted to be joined together upon the insertion of said carriage substantially completely into said printing station frame.

3. The rotogravure printing press of claim 2, in which said keying means comprises a projecting part operatively connected to one of said splined members and a receptacle adapted to receive said projecting part operatively connected to the other of said splined members.

4. The rotogravure printing press of claim 3, in which said splined members are provided with chamfered edges to effect a fine registration of said members when said members are joined.

5. In the detachable carriage of claim 1, an idling mechanism on said carriage operatively connected to said printing cylinder to drive the printing cylinder when the carriage is out of the printing station frame, whereby said doctor blade may be dynamically fitted to said printing cylinder outside of said printing station frame.

6. The rotogravure printing press of claim 5, in which said printing cylinder coupling member is disposed at one end of said printing cylinder and said idling mechanism comprises a motor, gearing means operatively connecting said motor and to said other side of said printing cylinder, and clutch means for detaching said motor from said printing cylinder when said printing station driving mechanism is coupled to and drives said printing cylinder.

7. In the detachable carriage of claim 1, a self-contained ink providing system on said carriage, said system comprising an ink reservoir containing a supply of ink, pump means for circulating the ink between said reservoir and said ink applicating means, and conduit means for carrying the ink while it is so circulated.

8. The rotogravure printing press of claim 1, in which said printing station frame support means comprises a pair of substantially horizontal tracks, one track of said pair being positioned on each side of said hollow space, a platform at the rear section of said printing station frame and extending between said tracks to receive and support the rear part of said carriage, and in which said carriage support engaging means comprises a pair of rollers on each side of the carriage frame, one roller of one pair being positioned at each front side section of said carriage frame and one roller of the other pair being positioned at each rear side section of said carriage frame, said rollers being effective to cause said carriage to slide along said tracks when said carriage is inserted inserted into the printing station frame.

9. The rotogravure printing press of claim 8, in which a pair of blocks are positioned at the front section of said printing station frame and project outwardly therefrom, each block of said pair being positioned in substantial alignment with one of said tracks, each of said blocks having a downwardly inclined surface at the upper portion thereof to receive said rollers on said carriage frame and thereby to assist in the insertion of said carriage into the printing station frame.

10. In the rotogravure printing press of claim 1, a stud mounted on said carriage and projecting therefore, and a groove provided on said printing station frame in the crossbar at the front portion thereof, said groove being adapted to receive said stud on said carriage when said carriage is inserted into said printing station frame, and locking means at the lower portion of said groove, said locking means securing said stud in said groove thereby locking said carriage to said printing station frame.

11. The rotogravure printing press of claim 10, in which said stud is eccentrically positioned relative to the axis of said groove and is rotatable within said groove, the rotational change of position of said stud causing said carriage to be laterally repositioned within said printing station frame, whereby the position of said printing cylinder in said printing station may be adjusted.

12. In the rotogravure printing press of claim 11, a vertical post mounted at the rear central portion of said printing station frame, and a yoke mounted at the rear central portion of said carriage and projecting outwardly therefrom, said yoke being adapted to tightly fit about said post thereby providing a pivot point about which said carriage is laterally moved by the rotation of said stud.

13. In the rotogravure printing press of claim 1, a stop assembly comprising a slidable mounted bar projecting from said carriage frame at the front portion thereof, and a block projecting from the front section of said printing station frame, said block being positioned so as to interfere with said bar on said carriage when said carriage is inserted into said printing station frame, thereby to prevent said carriage from being joined to the drive mechanism in the printing station frame with excessive inertia.

14. In the rotogravure press of claim 1, a doctor blade operatively connected to said carriage frame and adapted to cooperate with said cylinder.

15. In the rotogravure printing press of claim 14, an oscillating yoke positioned in the rear portion of said printing station frame, and an elongated rod having a projecting finger at one end thereof, said rod being operatively connected to said doctor blade, said projecting finger being positioned at the rear portion of said carriage, said yoke being adapted to receive and hold said projecting finger when said carriage is inserted into said printing station frame thereby to transmit the oscillatory motion thereof to said doctor blade.

16. A rotogravure printing press having a printing station frame defining a hollow space therein and a detachable carriage movable into and out of the hollow space of said frame said printing station frame comprising support means to receive and support said carriage, a driving mechanism, coupling means operatively connected to said driving mechanism, an impression roller, and means to raise and lower the impression roller, said carriage comprising a carriage frame, means operatively connected to said carriage frame for engaging said support means while said carriage is moved into and out of the hollow space of said frame, a printing cylinder rotatably mounted on said carriage frame, a doctor blade operatively connected to said carriage frame and adapted to cooperate with said cylinder, means on said carriage frame for adjusting the position of said doctor blade relative to said cylinder, means for joining said printing cylinder to said coupling means on the printing station frame where the carriage is inserted into said printing station frame, and while said driving mechanism coupling means on said printing station frame is rotating, means on said carriage frame for providing application of ink to the printing cylinder, and an idling mechanism on said carriage frame operatively connected to said printing cylinder to drive the printing cylinder when the carriage is out of the printing station frame, whereby said printing cylinder may be inked and said doctor blade may be dynamically fitted to said printing cylinder outside of said printing station frame.

17. The rotogravure printing press of claim 16, in which said printing cylinder coupling member is disposed at one end of said printing cylinder and said idling mechanism comprises a motor, gearing means operatively connecting said motor and to said other side of said printing cylinder, and clutch means for detaching said motor from said printing cylinder when said printing station driving mechanism is coupled to and drives said printing cylinder.

18. A rotogravure printing press having a printing station frame defining a hollow space therein and a detachable carriage movable into and out of the hollow space of said frame, said printing station frame comprising support means to receive and support said carriage, a driving mechanism, a coupling member operatively connected to said drive mechanism, an impression roller, and means to raise and lower the impression roller, said carriage comprising a carriage frame having an integral upper support frame portion and a lower support frame portion, lower wheels positioned beneath said lower support frame portion of said carriage frame for movement of the carriage along the ground when it is outside of the printing station frame and for partial support of the carriage while said carriage is moved into and out of the hollow space of said frame, a printing cylinder rotatably mounted on said upper support frame portion, a doctor blade operatively connected to said carriage frame and adapted to cooperate with said printing cylinder, means on said carriage frame for adjusting the position of said doctor blade relative to said printing cylinder, coupling member operatively connected to said printing cylinder for joining said printing cylinder to said driving mechanism through said coupling member on said printing station frame when the carriage is inserted into said printing station frame, and while said driving mechanism coupling member on said printing station frame is rotating, and means on said carriage frame for providing application of ink to the printing cylinder.

19. A rotogravure printing press having a printing station frame defining a hollow space therein a detachable carriage movable into and out of the hollow space of said frame, said printing station frame having a crossbar extending across said hollow space at the front of said frame to aid in the support of

said frame and comprising support means to receive and support said carriage, a driving mechanism, a coupling member operatively connected to said driving mechanism, an impression roller, and means to raise and lower the impression roller, said carriage comprising a carriage frame having an upper support frame portion, a lower support frame portion spaced from said upper support frame portion and a vertically extending frame position connecting the upper frame portion and the lower frame portion, said vertically extending frame portion being positioned proximate the front segment of said carriage, lower wheels positioned beneath said carriage frame for movement of the carriage along the ground when it is outside of the printing station frame and for partial support of the carriage while said carriage is moved into and out of the hollow space of said frame, a printing cylinder rotatably mounted on said carriage, a doctor blade operatively connected to said carriage frame and adapted to cooperate with said printing cylinder, means on said carriage frame for adjusting the position of said doctor blade relative to said printing cylinder, a coupling member operatively connected to said printing cylinder for joining said printing cylinder to said driving mechanism through said coupling member on said printing station frame when the carriage is inserted into said printing station frame, and while said driving mechanism coupling member on said printing station frame is rotating, and means on said carriage frame for providing application of ink to the printing cylinder.

20. The rotogravure printing press of claim **19**, in which at least one upright strut is positioned at the rear of said carriage frame, and extends between said upper support frame portion and said lower support frame portion to provide additional support thereto, said upright strut being pivotally mounted on one of said frame portions, whereupon when said carriage is inserted into said printing station frame it is pivoted to assume a horizontal position by engagement with the crossbar of said printing station frame.

21. The rotogravure printing press of claim **19**, in which said printing station frame support means comprises a pair of substantially horizontal tracks, one track of said pair being positioned on each side of said hollow space, a platform at the rear section of said printing station frame and extending between said tracks to receive and support the rear part of said carriage, and in which said carriage support engaging means comprises a pair of rollers on each side of the carriage frame, one roller of one pair being positioned at each front side section of said carriage frame and one roller of the other pair being positioned at each rear side section of said carriage frame, said rollers being effective to cause said carriage to slide along said tracks when said carriage is inserted into the printing station frame.

22. The rotogravure printing press of claim **21**, in which a pair of blocks are positioned at the front section of said printing station frame and project outwardly therefrom, each block of said pair being positioned in substantial alignment with one of said tracks, each of said blocks having a downwardly inclined surface at the upper portion thereof to receive said rollers on said carriage frame and thereby to assist in the insertion of said carriage into the printing station frame.

23. In the rotogravure printing press of claim **19**, a stud mounted on said carriage and projecting therefrom, and a groove provided on said printing station frame in the crossbar at the front portion thereof, said groove being adapted to receive said stud on said carriage when said carriage is inserted into said printing station frame, and locking means at the lower portion of said groove, said locking means securing said stud in said groove thereby locking said carriage to said printing station frame.

24. The rotogravure printing press of claim **23**, in which said stud is eccentricaLly positioned relative to the axis of said groove and is rotatable within said groove, the rotational change of position of said stud causing said carriage to be laterally repositioned within said printing station frame, whereby the position of said printing cylinder in said printing station may be adjusted.

25. In the rotogravure printing press of claim **24**, a vertical post mounted at the rear central portion of said printing station frame, and a yoke mounted at the rear central portion of said carriage and projecting outwardly therefrom, said yoke being adapted to tightly fit about said post thereby providing a pivot point about which said carriage is laterally moved by the rotation of said stud.

26. In the rotogravure printing press of claim **19**, a stop assembly comprising a slidably mounted bar projecting from said carriage frame at the front portion thereof, and a block projecting from the front section of said printing station frame, said block being positioned so as to interfere with said bar on said carriage when said carriage is inserted into said printing station frame, thereby to prevent said carriage from being joined to the drive mechanism in the printing station frame with excessive inertia.

27. In the rotogravure printing press of claim **19**, an oscillating yoke positioned in the rear portion of said printing station frame, and an elongated rod having a projecting finger at one end thereof, said rod being operatively connected to said doctor blade, said projecting finger being positioned at the rear portion of said carriage, said yoke being adapted to receive and hold said projecting finger when said carriage is inserted into said printing station frame thereby to transmit the oscillatory motion thereof to said doctor blade.

28. In the rotogravure printing press of claim **19**, a self-contained ink providing system on said carriage, said system comprising an ink reservoir containing a supply of ink, pump means for circulating the ink between said reservoir and said ink application means, and conduit means for carrying the ink while it is so circulated.

29. For use in a gravure printing press having a printing said carriage frame and a driving mechanism in said station frame, a detachable carriage comprising a substantially C-shaped carriage frame having a substantially horizontally extending upper frame portion, a substantially horizontally extending lower frame portion spaced from said upper frame portion and a substantially vertically extending frame portion connecting said upper frame portion and said lower frame portion and positioned at the front segment of said carriage, lower wheels positioned beneath said carriage frame for movement said carriage along the ground, means operatively connected to said carriage frame for supporting said carriage while said carriage is moved into and out of said printing station frame, a printing cylinder rotatably mounted on said carriage frame, a doctor blade operatively connected to said carriage frame and adapted to cooperate with said cylinder, means on said carriage frame for adjusting the position of said doctor blade relative to said printing cylinder, means for joining said printing cylinder to said driving mechanism in the printing station frame when the carriage is inserted into said printing station frame, and when said driving mechanism on said printing station frame is rotating, and means on said carriage frame for providing application of ink to said printing cylinder.

30. In the detachable carriage of claim **29**, an idling mechanism on said carriage operatively connected to said printing cylinder to drive the printing cylinder when the carriage is out of the printing station frame, whereby said doctor blade may be dynamically fitted to said printing cylinder outside of said printing station frame.

31. The rotogravure printing press of claim **30**, in which said printing cylinder coupling member is disposed at one end of said printing cylinder and said idling mechanism comprises a motor, gearing means operatively connecting said motor and to said other side of said printing cylinder, and clutch means for detaching said, motor from said printing cylinder when said printing station driving mechanism is coupled to and drives said printing cylinder.

32. The detachable carriage of claim **29**, in which at least one upright strut is positioned at the rear of said C-shaped carriage frame, and extends between said upper support frame portion and said lower support frame portion to provide additional support thereto, said upright strut being pivotally mounted on one of said frame portions, whereupon when said

carriage is inserted into said printing station frame said strut is pivoted to assume a horizontal position.

33. In the detachable carriage of claim **29**, a self-contained ink providing system on said carriage, said system comprising an ink reservoir containing a supply of ink, pump means for circulating the ink between said reservoir and said ink applicating means, and conduit means for carrying the ink while it is so circulated.

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