

Aug. 12, 1947.

C. R. KADDELAND

2,425,680

PRINTING PRESS

Filed Sept. 4, 1941

10 Sheets-Sheet 1

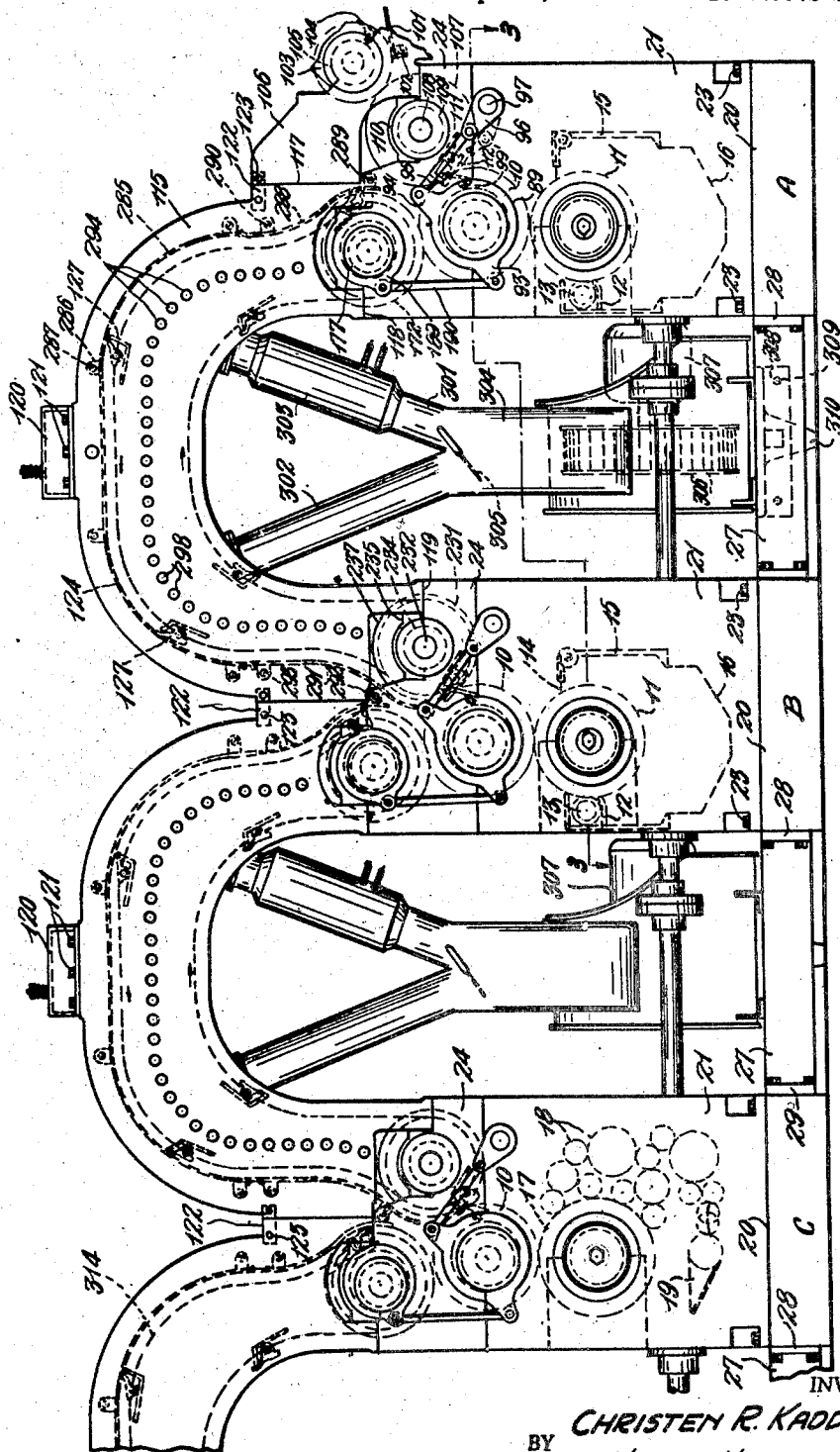


FIG. 1

INVENTOR.
CHRISTEN R. KADDELAND
BY *Kwis Hudson & Kent*
ATTORNEYS

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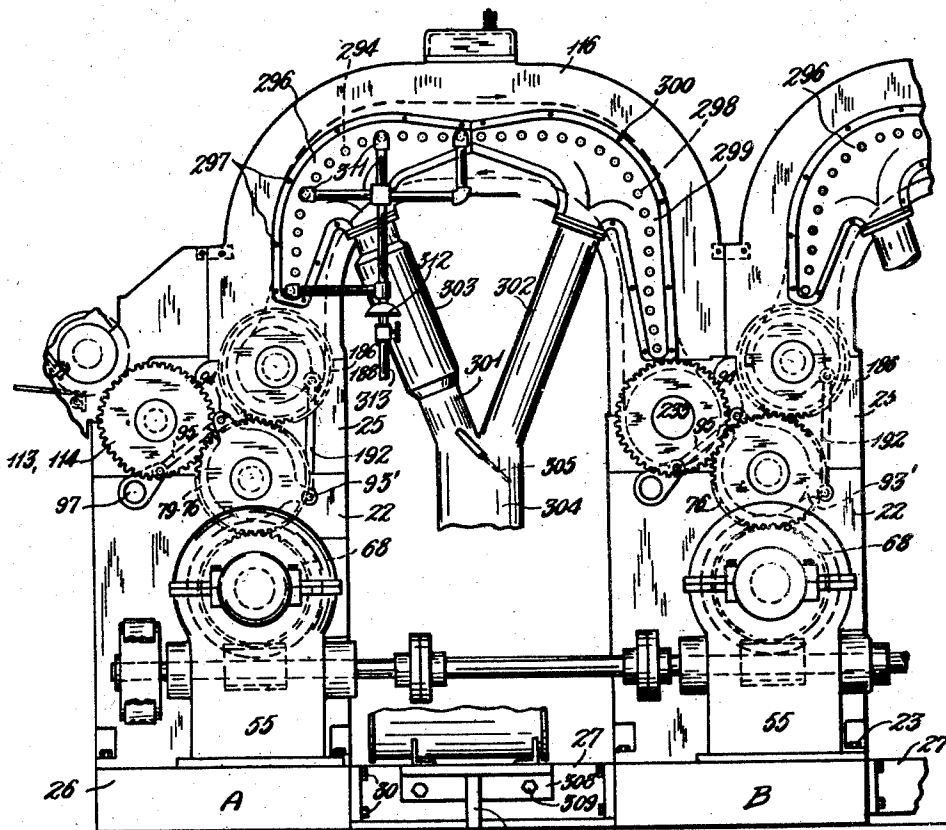
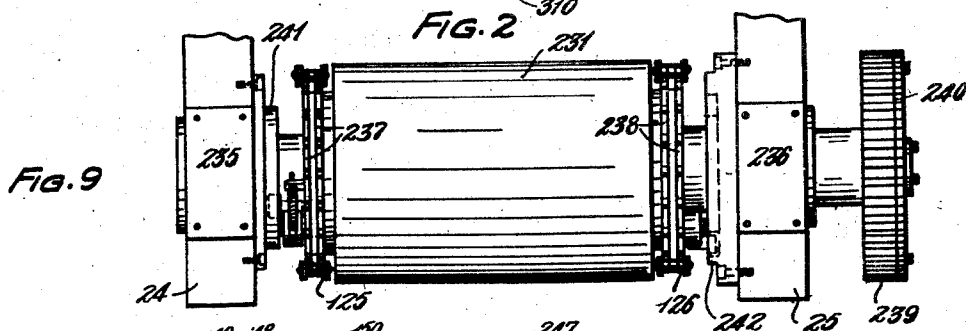
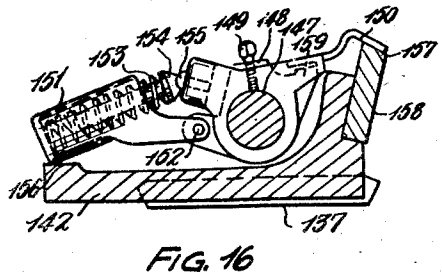
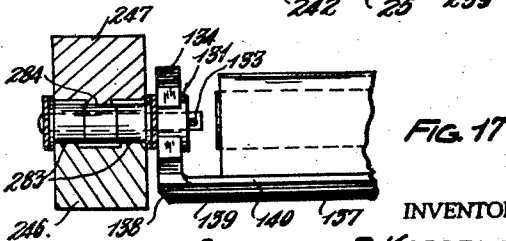
C. R. KADDELAND

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10 Sheets-Sheet 2



INVENTOR.
CHRISTEN R. KADDELAND
BY *Kewis Hudson & Kent*
ATTORNEYS

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C. R. KADDELAND

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10 Sheets-Sheet 3

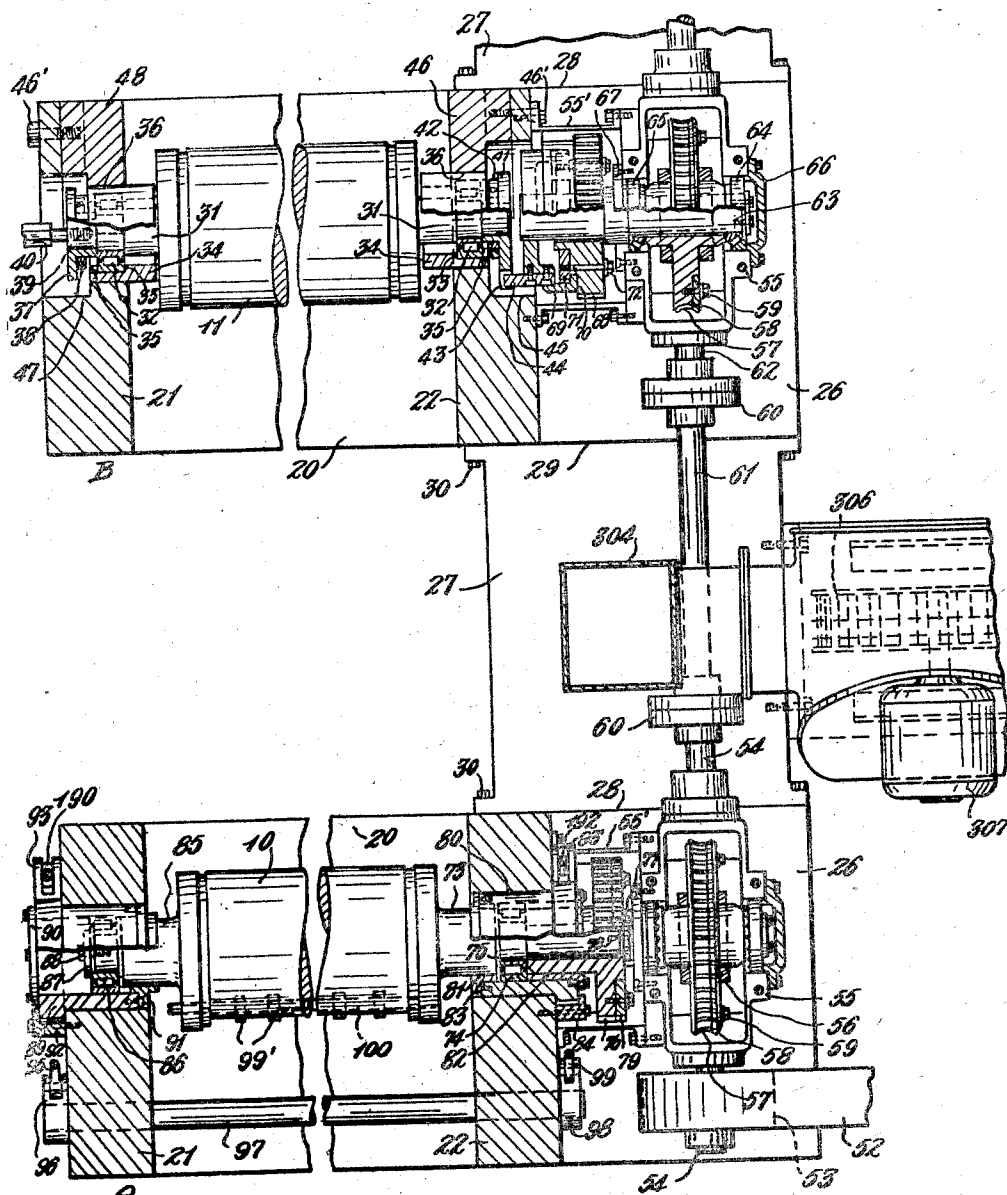


FIG 3

INVENTOR.
 BY *CHRISTEN R. KADDELAND*
Revis Hudson & Kent
 ATTORNEYS

Aug. 12, 1947.

C. R. KADDELAND

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10 Sheets-Sheet 4

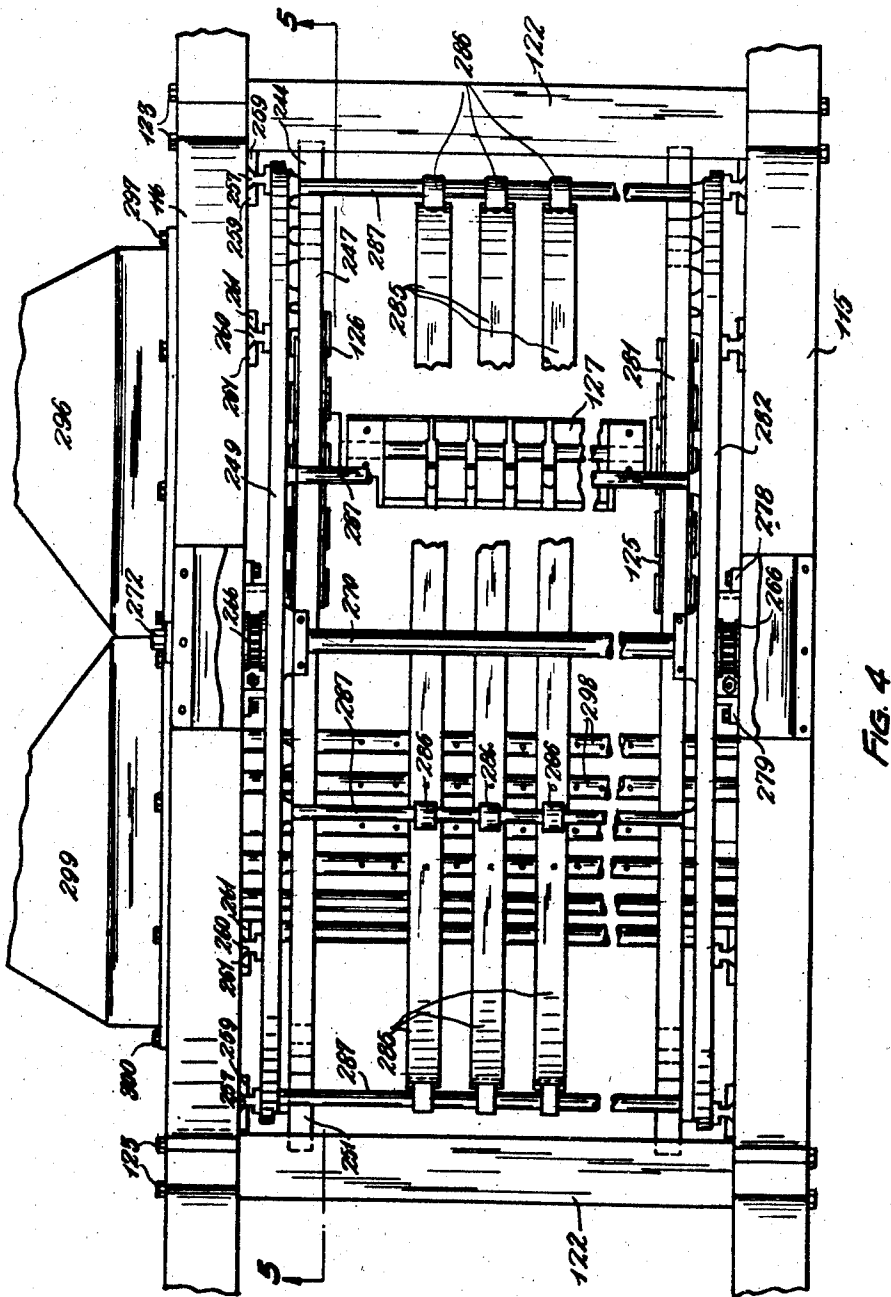


FIG. 4

INVENTOR

CHRISTEN R. KADDELAND

BY

Kuris Hudson & Kent

ATTORNEYS

Aug. 12, 1947.

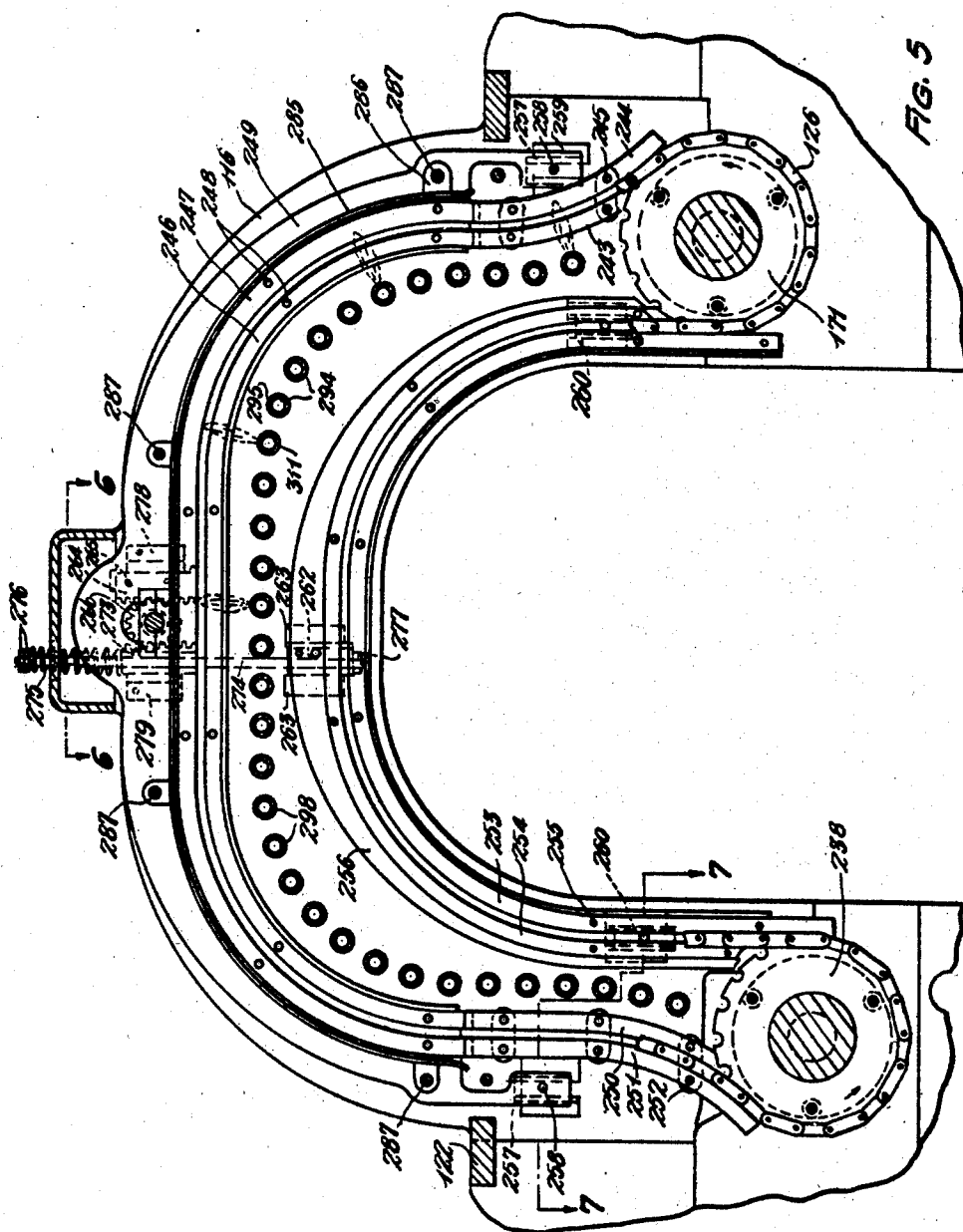
C. R. KADDELAND

2,425,680

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Filed Sept. 4, 1941

10 Sheets-Sheet 5



INVENTOR.

BY CHRISTEN R. KADDELAND

Kenn Hudson & Kent
ATTORNEYS

Aug. 12, 1947.

C. R. KADDELAND

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10 Sheets—Sheet 6

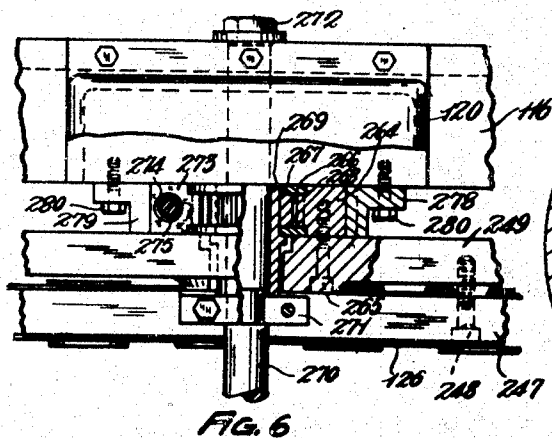


FIG. 6

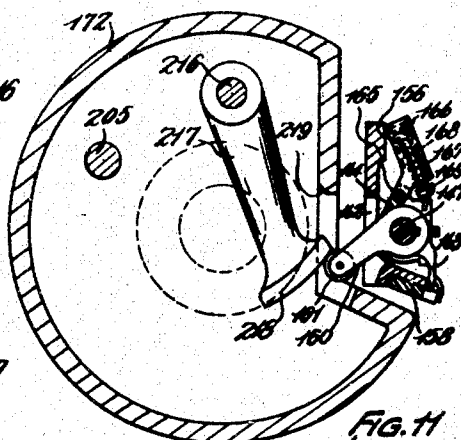


FIG. 11

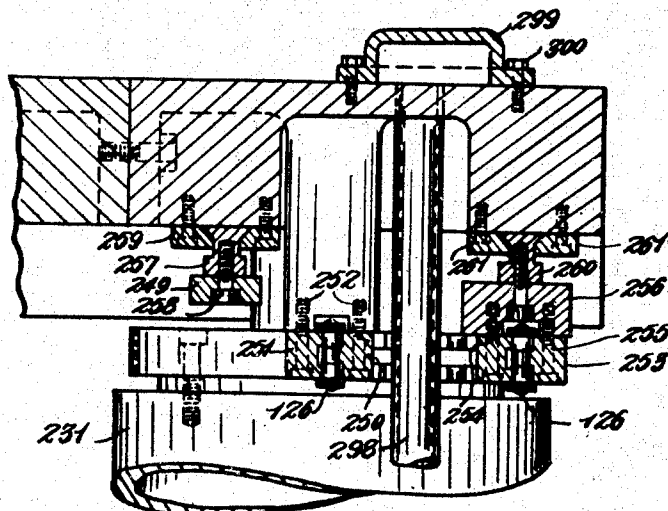


FIG. 7

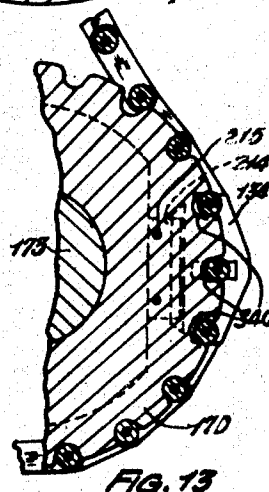


FIG. 13

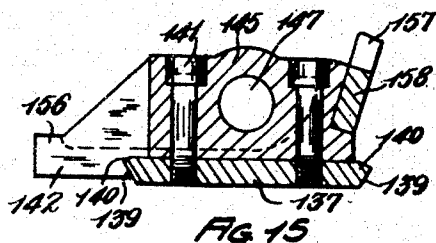


FIG. 15

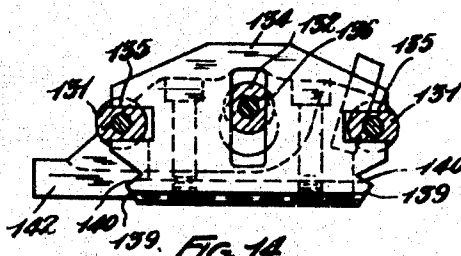


FIG. 14

INVENTOR.
CHRISTEN R. KADDELAND
BY *Kwis Hudson & Kent*
ATTORNEYS

Aug. 12, 1947.

C. R. KADDELAND

2,425,680

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10 Sheets-Sheet 7

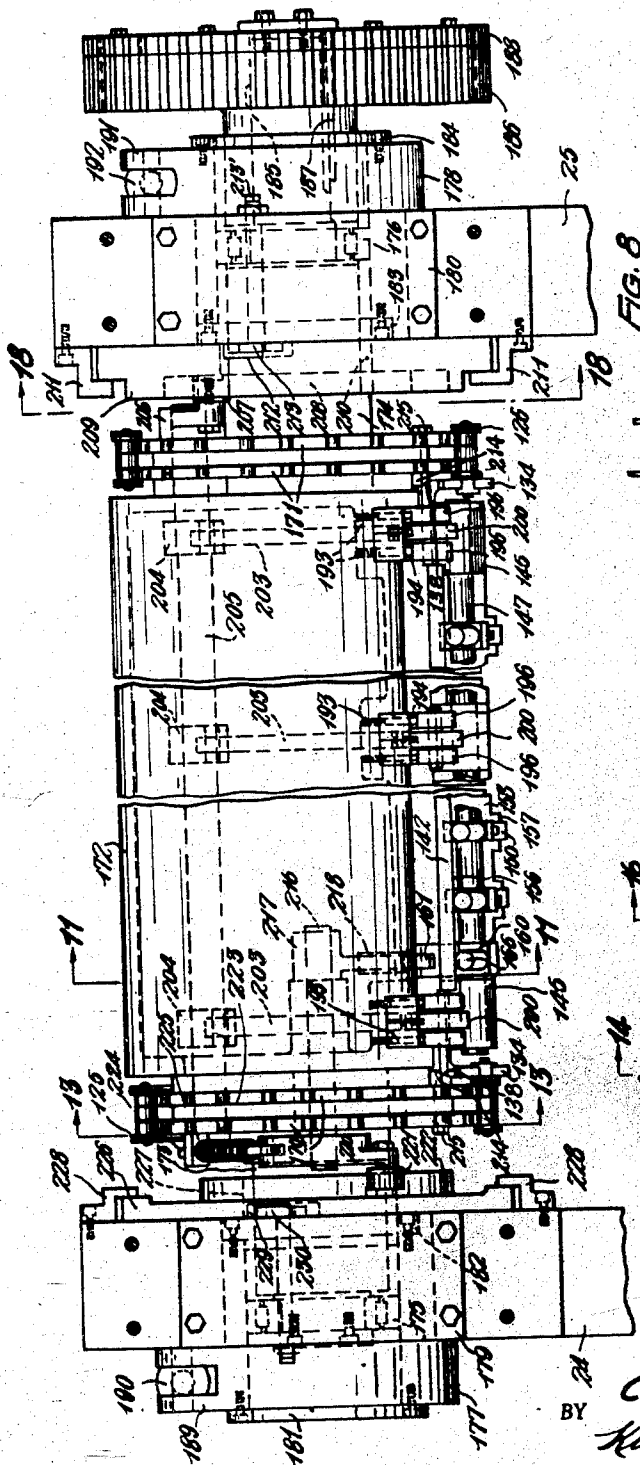


FIG. 8

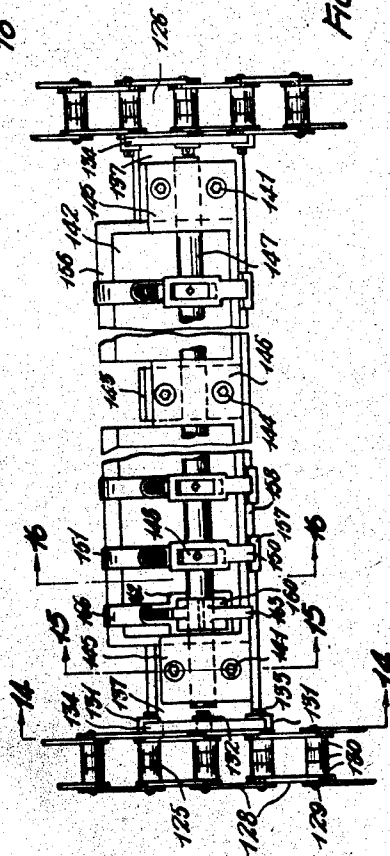


FIG. 12

INVENTOR.

CHRISTEN R. KADDELAND

BY *Kiris Hudson & Kent*
ATTORNEYS

Aug. 12, 1947.

C. R. KADDELAND

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10 Sheets-Sheet 8

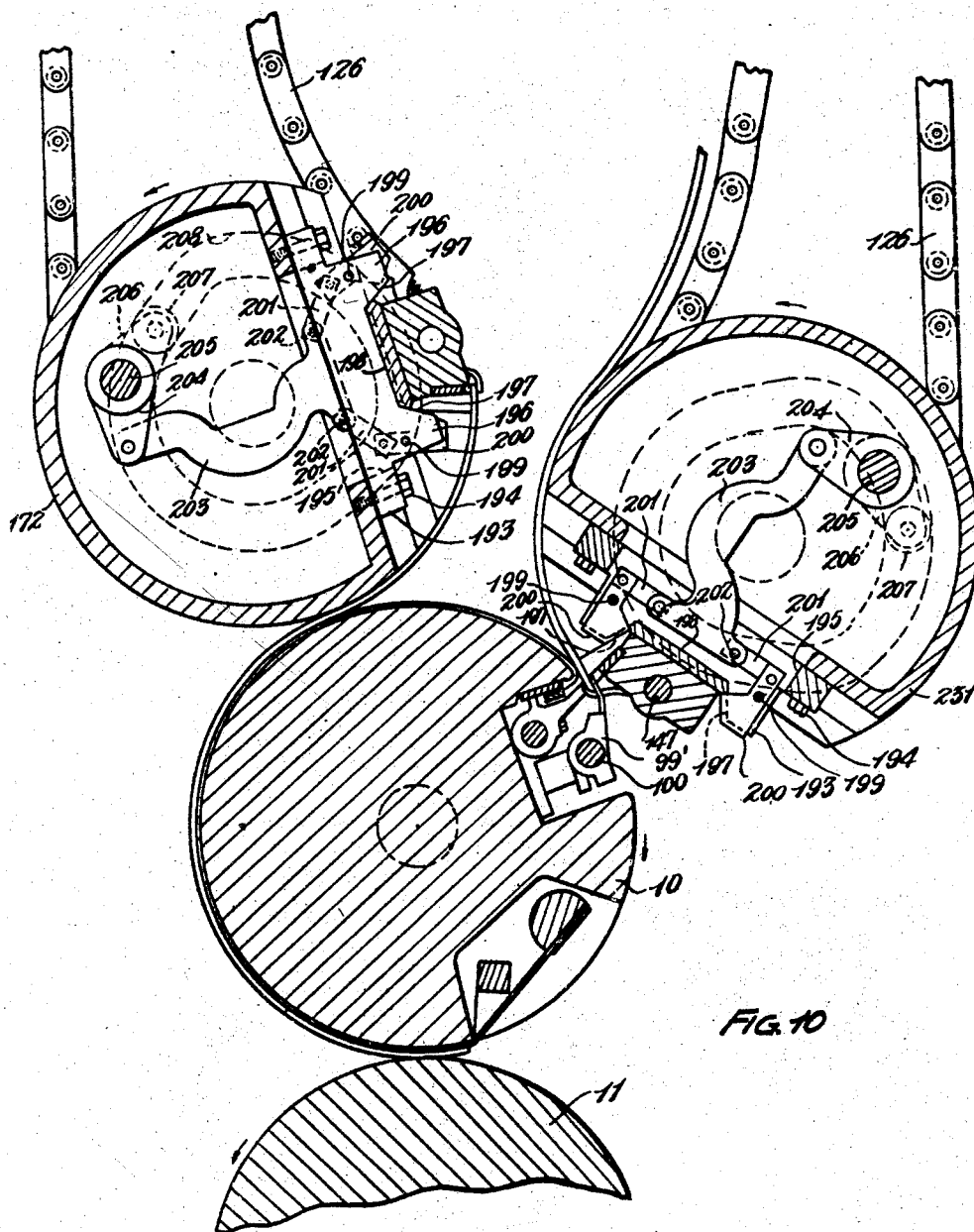


FIG. 10

INVENTOR.
CHRISTEN R. KADDELAND
BY *Kuris Hudson & Kent*
ATTORNEYS

Aug. 12, 1947.

C. R. KADDELAND

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10 Sheets-Sheet 9

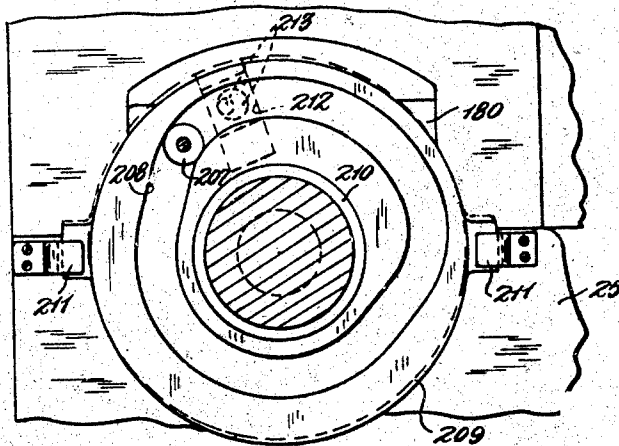


FIG. 18

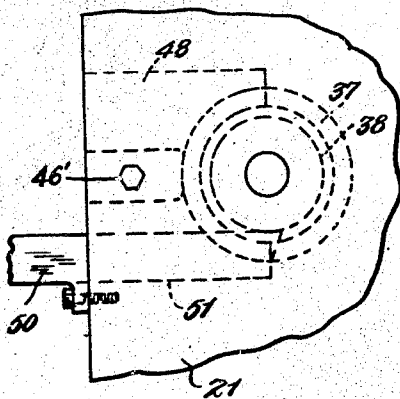


FIG. 19

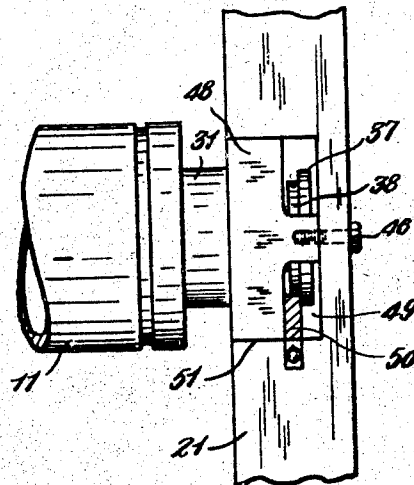


FIG. 20

INVENTOR.
CHRISTEN R. KADDELAND
BY *Kewis Hudson & Kent*
ATTORNEYS

Aug. 12, 1947.

C. R. KADDELAND

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10 Sheets-Sheet 10

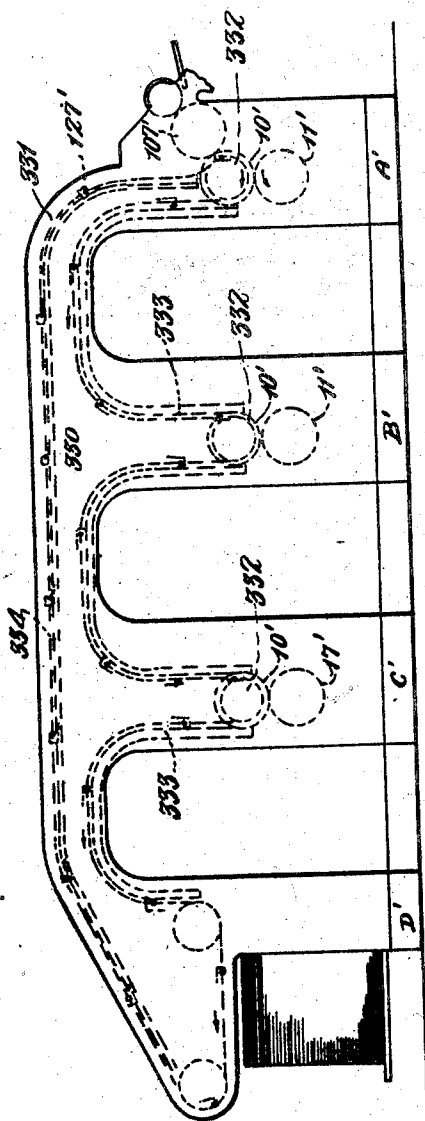


FIG. 22

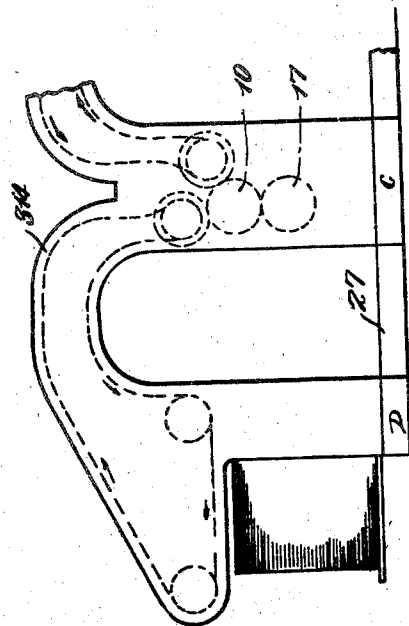


FIG. 21

INVENTOR.
BY **CHRISTEN R. KADDELAND**
Kewis Hudson & Kent
ATTORNEYS

UNITED STATES PATENT OFFICE

2,425,680

PRINTING PRESS

Christen R. Kaddeland, Shelton, Conn., assignor
to Harris-Seybold Company, a corporation of
Delaware

Application September 4, 1941, Serial No. 409,547

33 Claims. (Cl. 101—184)

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This invention relates to printing presses and like machines adapted to perform operations associated with printing, such as delivering, slitting, perforating, etc., and more especially to rotary multicolor printing presses adapted to print on sheets of paper, cardboard and the like.

One of the objects of the invention is the provision of a printing press so constructed and arranged as to be especially suited to the production of multicolor printing either intaglio or typographical, or a combination of the two, or a combination of either with other kinds of printing.

Another object is the provision of a press having improved accessibility for removal and replacement of the form cylinders and for operations which must be performed by the press operator.

Another object is the provision of a press or similar machine having spaced operating units with head-high floor-level working space between them which is accessible from at least one side of the machine and over which sheets are carried in accurate register from one unit to the next.

Another object is the provision of a multi-unit press having novel means for transferring sheets from one unit to another and including air devices for supporting the sheets and simultaneously drying the ink thereon.

A further object is the provision in a multi-unit machine of novel supporting means for a flexible endless sheet conveyor whereby the conveyor is yieldably maintained taut under varying conditions.

Another object is to provide a unit type of multicolor press having means forming a part of the framing of the press for holding the units in rigid and accurate alignment.

Other objects reside in the various combinations of features and details of construction and operation which are disclosed in the following specification and pointed out in the claims.

A preferred form of the invention is described herein, reference being made to the accompanying drawings, in which:

Fig. 1 is a side elevational view, partly diagrammatic, of the operator's side of that portion of a printing press required to illustrate the invention;

Fig. 2 is a side elevational view of a part of the drive side of the press;

Fig. 3 is a plan view, partly in section, along the line 3—3 of Fig. 1 with the inking devices omitted;

Fig. 4 is a partial plan view showing the arrangement of the conveyor mechanism;

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Fig. 5 is a vertical sectional view of the conveyor mechanism, the view being taken substantially along the line 5—5 of Fig. 4;

Fig. 6 is an enlarged fragmental plan view of that portion of Fig. 4 showing the resilient support for the chain tracks;

Fig. 7 is a fragmental sectional view taken on a larger scale, the view being taken substantially along the line 7—7 of Fig. 5;

Fig. 8 is a plan view on a larger scale of one of the conveyor take-off drums;

Fig. 9 is a plan view of one of the feeding drums;

Fig. 10 is a vertical sectional view taken through one of the printing units and its associated take-off and feeding drums on a plane perpendicular to the impression cylinder axis;

Fig. 11 is a vertical sectional view of one of the take-off drums substantially along the line 11—11 of Fig. 8;

Fig. 12 is a plan view of one of the gripper units of the endless conveyor;

Fig. 13 is a fragmental sectional view taken substantially along the line 13—13 of Fig. 8;

Fig. 14 is a view of the gripper unit mounting, partly in section, along the line 14—14 of Fig. 12;

Fig. 15 is a detailed sectional view taken substantially along the line 15—15 of Fig. 12;

Fig. 16 is a detailed sectional view taken substantially along the line 16—16 of Fig. 12;

Fig. 17 is a partial view of an end of one of the gripper units of the endless conveyor showing the chain tracks in section.

Fig. 18 is an elevational view, partly in section, taken along the line 18—18 of Fig. 8, illustrating a movable cam employed for actuating the gripper bar-holding means on a sheet take-off cylinder, regardless of whether or not that cylinder is moved by the throw-off mechanism;

Figs. 19 and 20 are side and end views, respectively, of a fragment of a form cylinder together with apparatus used in removing the cylinder;

Fig. 21 is a diagrammatic side elevational view of the delivery end of the press illustrated in Fig. 1; and

Fig. 22 is a diagrammatic side elevational view of a press constructed according to a modification of the invention.

In referring to the drawings, and particularly to Fig. 1, the letters A, B, and C designate generally three printing units of a multicolor press constructed according to the invention. As illustrated, units A and B are arranged for intaglio or gravure printing and comprise a printing couple including an impression cylinder 10, a form cylinder 11 cooperating therewith, and inking mechanism for inking the design on the latter

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cylinder. The form cylinder may be either a solid cylinder or one to which a thin metal plate is attached, and the inking mechanism may be of any preferred or known construction. As diagrammatically illustrated, the inking mechanism comprises a trough 12 to which gravure ink is supplied from a source, not shown, a brush 13 partially submerged in the ink and rotating counter-clockwise, as seen in Fig. 1, to apply ink to the form cylinder 11, a doctor blade 14 pivotally carried by a frame 15, and a pan 16 into which excess ink drains and from which it is returned by a circulating system, not shown, to trough 12.

Any desired number of similar units such as the gravure units A and B may be employed to print successively on each sheet passing through the press, and all the units may be of one kind. Preferably, however, at least one of the units is of a different kind than the gravure units described for the reason that certain kinds of printed matter, for example, type matter, may be reproduced to better advantage by other than the gravure process. Such a different unit may be an offset lithographic unit, a typographic unit, or a unit employing any other suitable printing process. In the illustration such different unit is a typographical printing unit C comprising a printing couple including an impression cylinder 10, a typographical form cylinder 17, and inking mechanism for the latter having inking rollers, generally indicated at 18, which distribute ink supplied by a fountain 19 and apply it to the form. Each printing couple is supported by framing comprising a base 20 adapted to rest upon the floor, lower side frames 21, 22 secured to base 20 by bolts 23, and upper side frames 24, 25 secured to frames 21, 22 by bolts, not shown.

The bases 20 are somewhat wider than the distance between side frames 21, 22, as shown best in Fig. 3, being provided with integral lateral extensions 26 at the drive side of the press which serve to support the driving mechanism and co-operate with spacer blocks, as later described.

The bases 20 are spaced apart accurately and rigidly by blocks 27 which are machined parallel on two faces 28, 29 which are fastened by bolts 30 against similar faces on the base extensions 26, the latter machined accurately parallel to the axes of the cylinders of the printing couples. The arrangement of bases 20 and blocks 27 is seen to provide an open floor area between adjacent bases, which areas are unobstructedly connected to the floor area at one side of the press. The purpose of this arrangement will be more evident as the description of the machine proceeds.

Form cylinder mounting

The form cylinders 11 and 17 are mounted in side frames 21, 22 in such a way as to be readily removable from the frames into the spaces between units. Referring especially to Fig. 3, the form cylinder 11 is provided with integral shanks 31 which have mounted thereon roller bearings 32 whose outer races are clamped against shoulders 33 of sleeves 34 by threaded clamp rings 35. Sleeves 34 rest in openings 36 in frames 21 and 22, the arrangement being such as to permit lengthwise sliding movement of the sleeves while preventing rotation thereof in the frame.

At one end of cylinder 11 the inner race of roller bearing 32 is clamped to shank 31 by a flanged collar 37 which is keyed to the shank. On this collar there is mounted a ball bearing 38 for a

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purpose presently to be referred to. Journal 31 is also provided with a threaded hole into which is removably inserted a stud 40. In practice, certain mechanism, not shown, is provided which is mounted on frame 21 and arranged to engage stud 40 to adjust cylinder 11 and its mounting, including sleeves 34, endwise to a slight extent to bring the same into proper registration with the other cylinders of the press.

At the end of cylinder 11 opposite that just referred to, the inner race of roller bearing 32 is clamped on shank 31 by flanged collar 41, the latter being keyed to the journal. On this collar is mounted a ball bearing 42 similar to bearing 38 and for a similar purpose. Collar 41 is formed with a slot 43 whose outer end is open and into which a driving lug 44, which is rotated by drive mechanism described below, projects with a snug sliding fit. It is by means of this lug 44 that cylinder 11 is rotated during operation of the machine, this driving connection being such as to readily permit removal of the cylinder.

Frame 22 is formed with the recess 45 to accommodate the rotating lug 44 and driven collar 41, this recess extending from the outer face of the frame inwardly to the wall which supports sleeve 34. This frame is also provided with a removable block or cap 46 which is secured in place during operation of the machine by a bolt 46' and other suitable fastenings not shown, and which may be removed at other times to allow sleeve 34 to be moved perpendicularly to its axis for removing or replacing cylinder 11. Frame 21 is similarly arranged with a recess 47 and cap 48.

Each of the caps 46 and 48 is shaped to provide an opening 49 into which a bar 50 may be inserted when it is desired to remove or replace the cylinder. Bar 50 rests on the ledge 51 of the frame and is of such height that it engages ball bearing 38 or 42, as the case may be, to support the latter. When it is desired to remove cylinder 11 from its frame, stud 40 is removed from shaft 31, bars 50 are inserted under ball bearings 38, 42, caps 46 and 48 are removed, and cylinder 11 is rolled out on the bars 50 onto a suitable truck or other support positioned in the spaces between bases 20. The cylinder does not revolve. The outer races of ball bearings 38 and 42 do, however, revolve. Thus when the cylinder is in the position shown in Fig. 3, collar 41 is easily disengaged from drive lug 44 without disturbing the drive mechanism. The level of the space between adjacent bases being the same as the level surrounding the press, namely, floor level, a truck or other cylinder carriage is easily and quickly moved into and out of position.

Drive to form cylinders

The form cylinders 11 and 17 are driven by drive mechanism, viewed best in Fig. 3. Power from a motor, not shown, is supplied to belt 52 which runs upon pulley 53 keyed to shaft 54. The latter shaft extends through housing 55 which is bolted to extension 26 of base 20 of unit A and attached to frame 22 by spacer block 55'. Inside the housing, shaft 54 carries a worm gear 56 which meshes with the worm wheel 57 having a backlash ring 58 adjustably clamped to wheel 57 by bolts 59, permitting slightly angular displacement of ring 58 with respect to wheel 57.

Shaft 54 is connected by angularly adjustable couplings 60 and connecting shaft 61 to another shaft 62 for driving unit B. The details of the

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connections from shafts 62 and 64 to their respective form cylinders are the same. As best shown with reference to unit B, the worm wheel 57 is keyed to a shaft 63 which is supported in housing 55 on tapered roller bearings 64, 65 retained by plates 66, 67. Shaft 63 extends through plate 67, and keyed to this extension is a gear 68 which meshes with a gear on the impression cylinder shaft, as later described. Associated with gear 68 is a carrier ring 69 which carries driving lug 44. The ring 69 is arranged to loosely fit on the end of shaft 63 and to be adjustably clamped against face 70 of gear 68 by clamp ring 71 and bolts 72. The arrangement is such that carrier ring 69 may be adjusted to any desired angular relation with gear 68 by simply loosening bolts 72 and moving the ring and gear relatively to each other.

The driving arrangements for additional printing units are preferably the same as those already described. It is to be noted that, in effect, a single main driving shaft is provided from which all printing units are driven by gearing from which backlash may be removed; that arrangements are provided for adjusting different segments of the main driving shaft to bring each unit into desired angular relation with the others; that the form cylinder of each unit is angularly and longitudinally adjustable independently of the position of the driving shaft, drive gears, or other printing cylinders; and that the form cylinders may be quickly and easily disconnected from their drive mechanism and accurately returned to their previous positions.

Impression cylinder mounting

All the impression cylinders 10 are similarly mounted in the following manner, see particularly Fig. 1 and unit A of Fig. 3. Cylinder 10 is provided at one end with an integral shank 73 which, on a reduced portion, carries roller bearing 74. The inner race of the latter is clamped against shoulder 75 by the hub of a gear 76 which is keyed to a further reduced portion of shank 73 and held endwise by plate 77 and bolt 78 in the end of the shank. Gear 76 meshes with gear 68, previously described, and is provided with adjustable backlash gear 79 to eliminate looseness between impression cylinder 10 and form cylinder 11.

The outer race of bearing 74 is clamped in an eccentric 80 by two sleeves 81, 82 secured to the eccentric by screws 83. Eccentric 80 is rotatably journaled in frames 22, 25 and held against endwise movement by a plurality of gibs 84.

At its opposite end cylinder 10 is provided with shank 85 which also carries a roller bearing 86 held on the shank by plate 87 and screw 88. The outer race of said bearing is supported without clamping in an eccentric 89 whose outer end is covered by plate 90 and whose inner end carries a sealing ring 91. Eccentric 89 is held against endwise movement by gibs 92.

Eccentric 89 is formed with an ear 93 for a purpose later to appear, and a second ear 94 which is connected by link 95 to arm 96 keyed on shaft 97, which is a power throw-off shaft of the kind usually employed in printing presses to move one printing cylinder away from another. A further arm 98 is keyed to the other end of shaft 97 and connected by link 99 to an ear on eccentric 80 similar to ear 94.

When shaft 97 is moved from the solid line position of Fig. 1 to the dotted line position by the trip mechanism of the machine, not shown, eccentrics 80, 89 are rotated clockwise a short dis-

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tance, and in so doing, raise cylinder 10 away from form cylinder 11.

Impression cylinder 10 is equipped with a series of sheet grippers 99' mounted on shaft 100 journaled in the cylinder and operated to open and close grippers 99' at the proper times to receive and release a sheet, all in the usual manner of sheet-fed machines. The grippers 99' preferably are located in known manner just below the periphery of the cylinder when gripping a sheet in order that they may clear the form cylinder 11 as they pass the latter.

Sheet handling mechanism

Referring to Fig. 1, 101 is a feed board over which sheets are fed either completely separated or in lapped relation, and 102 are the usual guides against which the sheets are front registered and which are periodically lowered from their operative position to clear each sheet as it is drawn into the press. Adjacent guides 102 is a sheet feeding device 103 of any known or suitable kind, preferably provided with grippers 104, and mounted on anti-friction bearings 105 in frames 106. Preferably, feeding device 103 is driven with intermittent rotation including decelerating and accelerating periods and is operated so that grippers 104 close on each sheet while they are at rest and then accelerate the sheet to the speed of the press before releasing it, all in known manner as exemplified in Kaddeland et al., Patent No. 2,192,916.

Between feeding device 103 and impression cylinder 10 of unit A is a feeding transfer drum 107, the shaft 108 of which is journaled at its ends in anti-friction bearings 109 supported in the upper side frames 24, 25 and held in place by caps 110. Drum 107 has a gripper shaft 111 and grippers 112 of known construction, and the grippers are operated at proper times by cams, not shown, to close upon a sheet presented to them by grippers 104 and to release the sheet to grippers 99' of impression cylinder 10.

A gear 113 is keyed to shaft 108 and arranged to mesh with and be driven by gear 76 of impression cylinder 10. A backlash gear 114 meshing with backlash gear 79 is also provided for removing slack between drum 107 and cylinder 10.

The frame members of printing unit A are joined at an overhead elevation to the frame members of unit B by means of stationary conveyor side frames 115, 116. These frames are bolted to frame member 106 at face 117 and to upper frame members 24, 25 of units A and B at faces 118, 119 respectively, by bolts, not shown. They are also joined transversely of the press by cross members 120 secured to frames 115, 116 by bolts 121 and by spacer bars 122 and bolts 123.

Frames 115, 116 through the intermediacy of devices to be later described support a sheet conveyor indicated generally at 124 in Fig. 1, by which sheets are conveyed in register from unit A to unit B. Conveyor 124 comprises a pair of parallel chains 125, 126 and a plurality of gripper units 127 secured thereto at appropriate intervals for taking successive sheets from one unit and transferring them to the next.

Chains 125, 126 comprise the usual side links 128 and pins 129, but, contrary to usual practice, each pin 129 carries three independently rotatable rollers 130 for a purpose which will later appear. At the points of the conveyor where gripper units 127 are secured to chains 125, 126 three of the pins 129 are made longer than the

rest and carry flanged sleeves 131, 132 held in place by cotter pins 133, see Fig. 17. Each of the groups of three sleeves 131, 132 supports an end plate 134, one for each end of the gripper unit, in the manner best shown in Figs. 14 and 17. End plate 134 is arranged with two parallel slots 135 in the general direction of the pitch line of the chain, and one slot 136 midway between the other slots and at right angles thereto. Sleeves 131 fit slidably in slots 135, and sleeve 132 in slot 136. By means of this construction the position of end plate 134 transversely of the pitch line of the chain is determined by sleeves 131 and its position longitudinally of the pitch line by sleeve 132. At the same time the sleeves are free to slide in their slots to accommodate themselves to the various degrees of curvature of the chain path.

Each of the end plates 134 is formed with a lateral extension 137 which is provided with a beveled end surface 138 and beveled side portions 139, 140 for purposes of registration, as will be hereinafter explained. Extensions 137 are secured by screws 141 to the end portions of gripper support bar 142 which extends across the press from one chain to the other. Centrally of bar 142 a plate 143 is secured by screws 144, this plate being provided with beveled portions similar to bevels 139, 140 of plate extensions 137. Gripper bar 142 is provided with integral bearing portions 145, 146 in which is journaled gripper shaft 147. Secured to this shaft at appropriate intervals are a plurality of grippers, each of which comprises a dog 148 fixed to shaft 147 by a screw 149, a gripper finger 150 loose on shaft 147 and straddling dog 148, a spring socket 151 pivoted at 152 to dog 148, and a compression spring 153 bearing against the bottom of socket 151 and against a shouldered pin 154 to force the latter against the head of pin 155 set in the rear part of gripper finger 150. Socket 151 bears against a raised portion 153 of bar 142, and finger 150 bears against contact area 157 of contact bar 158. Dog 148 is provided with lug 159 for raising finger 150 when shaft 147 is turned, and the arrangement of parts is seen to be such that spring 153 exerts less force on finger 150 the farther the latter is lifted off of contact 157, owing to the decrease in the length of the lever arm on which the spring force is applied. An arm 160 carrying a cam roller 161 is also keyed to shaft 147 and extends through an opening 162 in bar 142 for cooperation with gripper opening mechanism to be presently described. Arm 160 is formed with a lug 163 adapted to engage bar 158 to limit the movement of shaft 147 in one direction, and also has an ear 164 carrying a pin 165 to which is pivotally secured spring socket 166 whose other end rests on portion 158 of bar 142. Spring 167 bears against the base of socket 166 and against the shoulder of a pin 168 which, in turn, bears against the head of a pin 169 in arm 160 to urge the lug 163 against the bar 158 when no opposing force is acting upon arm 160. The spring 167 and associated parts are substantially identical with spring 153 and associated parts illustrated in Fig. 16.

The chains 125, 126 of conveyor 124 are trained about sprockets 170, 171 each of which comprises two rows of teeth spaced apart, which sprockets are fixed to a normally rotating member 172 70 which may be referred to as a take-off drum. This member may, if desired, be in the form of a shaft bearing spaced disks of known construction and provided with suitable means for supporting the working parts hereinafter described. The drum 75

172 is provided with integral shanks 173, 174 on reduced portions of which are mounted roller bearings 175, 176 carried in eccentric sleeves 177, 178. Sleeves 177, 178 are rotatably mounted in 5 frames 24, 25, and frame caps 179, 180, respectively, and are held against endwise movement by gibs, not shown. The ends of eccentric sleeve 177 are sealed by a plate 181 and sleeve 182, and the ends of sleeve 178 by sleeves 183, 184, which 10 serve to clamp the outer race of bearing 176 to sleeve 178.

Shank 174 has a reduced portion 185 extending beyond bearing 176 to which is keyed gear 186 having a hub 187 which confines the inner 15 race of bearing 176 against the shoulder of shank 174. Gear 186 meshes with gear 76 on impression cylinder 10 and has a backlash gear 188 meshing with backlash gear 79.

Eccentric sleeve 177 is provided with an ear 20 189 to which is pivotally connected one end of rod 190 whose other end is pivotally connected to ear 93 of eccentric 89.

Eccentric sleeve 178 likewise is provided with an ear 191 joined by a rod 192 to ear 93' of eccentric 80. By means of rods 190 and 192 eccen- 25 trics 177 and 178 are made to follow the movements of eccentrics 89 and 80 when the latter are rotated by throw-off shaft 97.

The eccentrics 89 and 80 are so designed that 30 operation of throw-off shaft 97 moves impression cylinder 10 away from form cylinder 11 in a direction substantially at right angles to the line joining its center and the center of feeding transfer drum 107, and eccentrics 177 and 178 are so 35 designed that take-off drum 172 moves in a substantially vertical direction a sufficient distance to maintain its desired relation to cylinder 10. These movements are not sufficient to destroy the mesh of driving gears 68, 76, 113, 186, nor to im- 40 pair the transfer of sheets from drum 107 to cylinder 10.

Each gripper unit 127, as it comes into association with drum 172, is clamped thereto in accurately determined position longitudinally of 45 the press by the following mechanism, viewed best in Figs. 8 and 10. Near each end of drum 172 and also at its center, slots are provided to accommodate pairs of blocks 193 which are secured to the drum by screws 194. Adjacent sur- 50 faces of the blocks of each pair are milled out to form an opening 195 through which certain operating parts project. Each block 193 has two upstanding projections 196 with oppositely disposed inclined surfaces 197 which, in combination with the surface 198 between them, form a channel 55 with inclined sides having fixed and accurately determined relation to the drum 172. Blocks 193 are so proportioned and located that end plate extension 137 and central plate 143 of the gripper units 127 fit accurately in the said channels, beveled surfaces 139 engaging inclined surfaces 197 and the bottom of the plate extension 137 en- 60 gaging the land 198. The inclines 197 are of such steepness that the plate extensions 137 and plate 143 may move freely into and out of engagement with the blocks 193 while at the same time providing sufficient inclination to enable the plate 143 and extensions 137 to be readily forced into proper position against surfaces 198. Each pair 65 of blocks 193 carries at its ends two pins 199 on which are pivotally mounted clamp jaws 200 in the opening 195. The lower ends of jaws 200 are pivotally connected by links 201 to pins 202 in one end of a link 203, the other end of which is pivotally connected to a lever 204 keyed to shaft

205. As stated above, there are three pairs of blocks 193, and each pair has associated therewith a pair of jaws 200 and connections therefrom to shaft 205 as just described.

Shaft 205 is rotatably journaled in the end walls of drum 172 and projects from said drum toward the gear side of the press to carry an arm 206 having a cam roller 207 which follows groove 208 of cam plate 209. The latter plate is loosely mounted on cylindrical projection 210 of sleeve 183 and is slidably held against the inner face of frame 25 and cap 180 by gibs 211. Plate 209 is further provided with a groove 212 extending substantially in the direction of movement of drum 172 when the latter is moved by the throw-off mechanism, and this groove slidably engages a block 213 rotatably carried upon an eccentric pin 213' which is adjustably mounted in frame cap 180. By the arrangement just described, cam plate 209 is enabled to follow the bodily movements of drum 172 without substantially changing the relation of cam groove 208 thereto, and therefore without substantially altering the operation of the locking jaws 200. Furthermore, the eccentricity of pin 213' permits a slight rotary adjustment of cam plate 209 for timing purposes. The locking mechanism just described is proportioned so as to clamp each gripper unit 127 to drum 172 shortly after the gripper unit starts its arcuate travel around the drum and to release each unit shortly before it leaves said arcuate travel, and specifically, the locking mechanism maintains each gripper unit so locked during the time its grippers are taking a sheet from the grippers of the impression cylinder 10. Before each gripper unit is locked to drum 172, its position relative thereto is determined by the chains 125, 126 and sprockets 170, 171. During the time the gripper unit is locked to the drum, it is desirable that the influence of the chains and sprockets upon the exact position of the unit be eliminated. For this reason the three grooves 340 of sprockets 170, 171 which accommodate the three rollers on the same pins with sleeves 131, 132 are cut slightly deeper and wider than the other grooves of the sprocket (Fig. 13) so that these three rollers are free to assume a position determined by the position of plates 137, 143 in blocks 193.

The position of gripper units 127 transversely to the direction of sheet travel while they are passing over the drum is accurately fixed by means of beveled blocks 214 which are secured to sprockets 170, 171 by screws 215. Blocks 214 engage beveled surfaces 138 of plate extensions 137 and the parts are so proportioned that when plates 137, 143 are locked in the grooves of blocks 193, the gripper units 127 are rigidly held against end play by the blocks 214.

While gripper units 127 are locked in drum 172 by the mechanism described above, gripper fingers 150 are opened and closed by the following mechanism at proper times to receive a sheet from impression cylinder grippers 99'. In one end of drum 172 is a rotatable stub shaft 216 to the inner end of which is keyed an arm 217 having a cam face 218 adapted to engage roller 161 carried by each gripper unit 127, drum 172 being provided with an opening 219 through which arm 217 and arm 160 may project. To the outer end of shaft 216 is keyed a cam arm 220 carrying a roller 221 which is urged against gripper operating cam 222 by spring 223 surrounding spring rod 224 which is guided in perforated ear 225. Cam 222 is formed in a plate 226 which is loosely mounted on cylindrical projection 227 of sleeve 182 and is

loosely held against the inner face of frame 24 and cap 179 by gibs 228. Plate 226 has a groove 229 similar to groove 212 of plate 209 for slidably engaging block 230 pivotally mounted on an eccentric stud in cap 179 in the manner described with respect to block 213. By the mechanism just described gripper 150 are opened and closed at proper times during rotation of drum 172. Furthermore, cam 222 is enabled to follow the bodily movements of drum 172 in response to the throw-off shaft 97, whereby the gripper operation remains substantially unchanged in all positions of the drum.

The conveyor 124 at the other end of its elongated path cooperates with another normally rotating member 231 referred to as a feeding transfer drum which in construction and operation is similar to the take-off drum 172. No eccentric mounting is provided for drum 231; however, shanks 232, 233 thereof carry roller bearings 234 which are mounted directly in frames 24, 25 and their associated caps 235, 236. Drum 231 has fixed thereto sprockets 237, 238, and a gear 239 and associated backlash gear 240 are keyed to shank 233 for driving the drum from the adjacent impression cylinder gear 76. Drum 231 is provided with similar locking, registering, and gripper operating devices similar to those described above in connection with drum 172. Appropriately proportioned cams 241 and 242 are also provided for effecting the desired operation of these devices.

Chain tracks

Between the take-off drum 172 and feeding drum 231 the chains 125, 126 are supported by chain tracks whose mounting and operation will now be described with particular reference to Figs. 4 to 7, inclusive.

As the advancing upper run of chain 126 (see Fig. 5) leaves sprocket 171, it is guided between stationary tracks 243, 244 which are secured to the arched side frame 116 by screws 245. It then passes between the upper tracks 246, 247 which are secured by screws 248 to a movable frame 249 resiliently supported as described below. At the point where chain 126 approaches sprocket 238, it is guided between stationary tracks 250, 251 which are secured by screws 252 to frame 116.

The lower run of chain 126, as it leaves sprocket 238, is guided between tracks 253, 254 which are secured by screws 255 to a movable frame 256 that is resiliently mounted as described below. Tracks 253, 254 extend upward and across the space between adjacent units and downward to guide the chain to sprocket 171.

At each lower end of movable chain frame 249 is a dovetail block 257 fastened to frame 249 by screws 258. Blocks 257 are arranged to slide vertically between beveled guides 259 secured to frame 116. Lower chain frame 256 is similarly provided with dovetail blocks 260 which are arranged to slide vertically between beveled guides 261 secured to frame 116. Frame 256 has a third beveled block 262 at its upper central portion which slides between guides 263 bolted to frame 116. At the upper central portion of frame 249, a rack 264 is secured by screws 265. The teeth of this rack engage the teeth of an intermediate pinion 266 which is provided with flanges 267 arranged to bear against shoulders 268 of rack 264 to maintain proper engagement of the rack and pinion teeth. Pinion 266 is rotatably mounted on a sleeve 269 carried on tie rod 270 and clamped against frame 116 by

split collar 271 and screw 272 in the end of rod 270. On the side opposite rack 264 pinion 266 engages the teeth of a rack 273 which is slidably carried on a rod 274 and urged downward on this rod by compression spring 275 confined between the rack 273 and a pair of adjustably located nuts 276 at the top of rod 274. The latter rod extends downwardly through block 262 on the lower frame and has a collar 277 below the block which lifts the block and its frame when the rod is lifted. Racks 264 and 273 are confined between guide blocks 278, 279 secured by screws 280 to frame 116, which blocks also act as spacers to maintain frame 249 at the proper distance from frame 116. The arrangement is such that frame 249 and rack 264 secured thereto are free to slide vertically between blocks 278, 279 and collar 271, and pinion 266 is free to rotate under the influence of racks 264 and 273.

By means of the mechanism described, lower frame 256 is enabled to move in a vertical direction and carry with it the conveyor chain supporting tracks 253, 254, and the upper frame 249 is enabled to move vertically and carry with it tracks 246, 247, thus permitting shortening or lengthening of the lower and upper runs of the conveyor. Furthermore, by means of the resilient connections comprising block 262, rod 274, spring 275, rack 273, pinion 266, and rack 264, any vertical movement of one of the frames 249, 256 tends to cause movement of the other frame in the opposite direction. For example, the downward movement of frame 256 pulls rod 274 downward, thus urging spring 275 downwardly against rack 273, which tends to rotate pinion 266 counter-clockwise, as viewed in Fig. 5; rack 264 is thereby urged upwardly, carrying with it frame 249. The strength of spring 275 is sufficient to overcome the effect of the weight of frames 256 and 249 and produce the desired amount of tension in the conveyor chain 126. The arrangement of the racks and pinions is such as to tend to produce equal vertical movements of the two frames in opposite directions when force is exerted on the conveyor chain, tending to depress one of the frames. On the other hand, spring 275 tends normally to hold both frames raised, acting directly on the lower frame through rod 274 and indirectly on the upper frame, that is, through the racks and pinion. A single spring thus suffices to resiliently support both frames.

At the operator's side of the press similar arrangements are provided for supporting chain 125 of the conveyor 124. These arrangements will not be described since they are duplicates of those described above with reference to the gear side of the press for supporting chain 126, except to point out that in Fig. 4 the upper track 281 corresponds to track 247, and frame 282 corresponds to frame 249.

It is to be noted that during a part of the time each gripper unit 127 is locked to take-off drum 172, another one of the gripper units 127 is locked to feeding drum 231. Furthermore, by means of the driving connections previously described, drums 172 and 231 are both driven positively and without backlash from the common main driving shaft comprising rigidly connected segments 54, 61, 62, etc. Thus conveyor 124 is positively driven at two points of its elongated path. Owing to inaccuracies of manufacture and adjustment of the parts during assembly, the angular positions of drums 172 and 231 will not exactly correspond within the limits for registration of the printing,

nor will the spacing between adjacent gripper units 127 always be the same. By means of the resilient chain supporting means described, variations in the length of the upper and lower runs of the conveyor caused by such inaccuracies are compensated for and both runs are kept properly taut at all times.

Owing to the angular direction of movement of impression cylinder 10 when the printing impression is thrown off, there is a slight change in the rotational relation of this cylinder to the form cylinder 11. The rotational relation to take-off drum 172 is also affected, as may be readily seen. This effect, combined with the vertical displacement of the drum 172, may result in a lengthening of both the upper and lower runs of the conveyor 124 or the lengthening of one and the shortening of the other in varying amounts depending upon the precise direction and amount of the throw-off movement. If both runs are lengthened, the force latent in spring 275 will cause the latter to expand and raise both the upper and lower sets of chain tracks and in all cases the connections described will operate to maintain the upper and lower runs of the conveyor taut.

In order to effectively confine the chains 125, 126 between their tracks, these tracks are specially formed to cooperate with the three chain rollers 130 as shown in Fig. 17. The track on one side, for example track 246, is provided with two runways 283 which engage the outside rollers, and the track on the other side, for example track 247, is provided with a single runway 284 engaging only the center roller. The arrangement of runways is such that each roller tends to rotate in one direction only as it travels from take-off drum 172 to feeding drum 231, and vice versa, and looseness between the tracks and chain is eliminated.

In their travel from one printing unit to the next, the sheets are carried by the upper run of the conveyor 124 with their printed side facing downward, as may be seen by noting the arrangement and direction of rotation of the cylinders. In order to properly support the sheets during this interval and in order to properly condition them for subsequent printing, devices employing air and heat are provided, which will now be described.

Air blasts

Above the upper run of the conveyor a series of spaced smooth bands 285 of shape conforming to the conveyor path are supported by brackets 286 on cross rods 287 which are fixed in frames 249, 282. Bands 285 therefore move vertically with the upper run of conveyor 124. Adjacent take-off drum 172, fixed bands 288 are supported on rods 289, 290 fixed in frames 24, 25 and 115, 116, respectively, and adjacent feeding drum 231, fixed bands 291 are supported on rods 292, 293 fixed in frames 24, 25 of unit B and frames 115, 116 respectively. The bands 288, 285 and 291 being spaced apart may be said to constitute perforate guide means.

The sheets are supported and blown against the bands 288, 285, 291 during part of their travel by air blasts emitted from a series of cross pipes 294, which are provided with openings such as holes 295 directed toward these sheets. It is important to note that the use of holes rather than slots in pipes 294 is essential in this type of sheet supporting device. The use of slots produces a region of downwardly traveling air between each pair of pipes which tends to suck the sheet down-

ward, thus producing a corrugated contour to the sheet and even causing control of the sheet to be lost. Spaced holes, however, provide a distribution of air which eliminates the tendency to suck the sheet down between pipes and provides full support throughout the length and breadth of the sheet.

Pipes 294 are plugged at one end and at the other end open into a manifold 296 fastened by screws 297 to the arched side frame 116. During the remainder of the travel of these sheets, they are supported and blown against the bands by blasts emitted from similar pipes 298, which are plugged at one end and open at the other into the manifold 299 fastened to frame 116 by screws 300.

Air under sufficient pressure to support the sheets is supplied to manifolds 296, 299 through branch ducts 301 and 302, respectively, duct 301 being provided with an electrical heating jacket 303 to heat the air in cases where this is desirable. The branch ducts stem from a common air duct 304 provided with a deflector plate 305 by which the amounts of air directed into the branch ducts 301, 302 may be adjusted. Main duct 304 is connected to blower 306 which is driven by a motor 307, the blower and motor being supported on a plate 308 secured by screws 309 to base spacer block 27, and having a leg 310 resting on the floor.

By the arrangement described, the sheets are effectively supported in their travel from one unit to the next, and during their travel they are treated first by heated air which aids in volatilizing and driving off the volatile constituents of the ink which have been applied by the preceding unit and then by air at a cooler temperature, such as room temperature, which assists in dissipating the volatile gases, solidifying the ink and in general conditioning the sheets for the next printing.

Under some circumstances it is desirable to heat the sheets to a higher temperature than is possible with the heated air, or to provide means for burning the volatile constituents of the ink as they are driven off. For this purpose pipes 311 are provided which extend outwardly through manifold 296 and are connected through mixing device 312 to a common pipe 313 which is connected to a source of gas supply, not shown.

By this arrangement flames may be directed from pipes 311 toward the sheets, as shown in Fig. 5

The above description has been directed mainly to the arrangement of printing unit A, the devices for introducing sheets into unit A, the devices for conveying the sheets from unit A to unit B, and the means for supporting and conditioning the sheets during their passage between these units. It is to be understood that the arrangements for taking the sheets from unit B and conveying them to unit C are the same as those described in connection with units A and B, and that further similar printing units together with similar interconnecting means may be employed in any number which may be desired. From the last such unit, for example unit C in the illustration, the sheets are preferably taken by conveyor 314, differing in the path which it follows, but of similar construction to conveyors 124, and carried over the working space adjacent unit C to a delivery unit D (Fig. 21) where they are deposited and stacked by known devices, not shown. The delivery unit D comprises a base portion similar to the bases of the printing units and accurately and rigidly joined thereto by one of the spacer blocks 27.

The operation of the above described embodiment of the invention has been largely explained in connection with the preceding description, but for convenience is summarized as follows:

Sheets are taken individually from the feed board 101 by feeding device 103 and transferred to feeding transfer drum 107 by which they are transferred to grippers 99 of impression cylinder 10 of unit A. By the latter cylinder they are carried into contact with form cylinder 11, from which they receive a printed impression. From impression cylinder 10 they are accurately transferred to gripper units 127 of conveyor 124, each gripper unit as it receives a sheet being accurately locked against beveled blocks 193 and 214 of drum 172 by jaws 200. The sheets are carried by the upper run of conveyor 124 upwardly and over the working space adjacent unit A and downwardly toward unit B. During this travel the printed side of the sheets is down and blasts of heated air from pipes 294 and cooled or unheated air from pipes 298 are directed against the sheets to dry the printing and support the sheets against guides 288, 285, 291. As each gripper unit approaches unit B, it is locked in accurate register to feeding drum 231 and while so locked, it transfers its sheet to the grippers of impression cylinder 10 of unit B. The latter cylinder carries the sheet into contact with form cylinder 10 of unit B from which it receives a second printed impression in register with the first impression. From impression cylinder 10 of unit B the sheets are transferred in register to the second conveyor 124 by which they are conveyed to unit C for a third impression. The sheets are similarly conveyed through additional printing units if such are provided, and from the last unit the sheets are conveyed, as by conveyor 314 for example, to a delivery point.

During operation of the machine, the locking of gripper units 127 into the take-off and feeding drums 172 and 231 causes slight variations in the length of the upper and lower runs of conveyor 124. Such variations are taken up and both runs kept taut by the spring 275 and associated connections supporting the movable chain tracks.

If the feed of sheets is stopped or a sheet is presented to stops 102 out of alignment the trip mechanism with which such presses are provided will be caused to operate. This will result in oscillation of shaft 97 which in turn will raise cylinder 10 out of contact with form cylinder 11 and will raise take-off drum 172 a substantially similar amount. Under such conditions the force latent in the compression spring 275 will act to move the upper and lower chain tracks and maintain the conveyor chains taut.

If it is desired to remove a form cylinder 11 from the machine, the press is turned to bring cylinder 11 to the position shown in Fig. 3, a truck or other device is moved along the floor into the working space between units, bars 50 are inserted under ball bearings 38, 42, frame caps 48, 48 are removed and cylinder 11 is moved along bars 50 to the truck. If the operator desires to inspect the printing cylinders or inking mechanism or make adjustments during operation of the machine he enters the working space between units for this purpose.

During assembly of the press, the sections of the main drive shaft are moved into such relative relation that all of the printing units are substantially in the same angular position at all times. The sections are then clamped together in fixed relation through couplings 60. Backlash

gear 58 of worm wheel 57 is adjusted to remove play between the latter and worm 56; backlash gears 79, 188, and 240 are likewise adjusted to remove play in the drive, so that there can be no momentary reversal of direction or sudden change of speed of the impression and form cylinders and so that the take-off and feeding drums are accurately driven in relation to their associated impression cylinders.

Another form of the invention is illustrated in Fig. 22. In this form the sheets are conveyed through the successive printing units A', B', C', and to the delivery unit D' by a single endless conveyor, designated generally as 330, which has a forward moving run for conveying the sheets from one unit to the next over the working spaces between units and a return run extending from the delivery unit over the printing units to the first printing unit. The conveyor 330 comprises gripper units 127' of similar construction to gripper units 127 of the earlier described form of the invention, supported on chains 331 at each side of the machine. The latter chains pass around and are driven by sprockets 332 secured to each end of impression cylinders 10' thereby carrying the sheets between the latter and form cylinders 11', 17' by which they are printed. The gripper units 127', as they travel around each impression cylinder are registered therewith and locked in a recess therein by mechanism of similar construction to that by which gripper units 127 are registered and locked to the feeding transfer drum 231, such changes in the details thereof being made as are required by the fact that cylinder 10' is an impression cylinder. For example, when locking mechanism of the kind above described is employed, I may omit the central one of the three pairs of clamping jaws and associated mechanism and employ for the printing impression only that portion of the cylinder which lies between the two outer pairs of clamping jaws.

As each gripper unit 127' reaches the impression cylinder 10' of unit A' it is locked thereto in register and while so locked receives a sheet from feeding transfer cylinder 107' which is constructed and operated in like manner to cylinder 107. Thereafter the sheet travels through the successive printing units to the delivery unit without being released from the gripper unit 127' until it is deposited upon the delivery pile. Between units the sheets travel with their printed side down and are supported by air blasts against sheets bands, as in the first described form of the invention.

The portions of the conveyor 330 by which the sheets are carried from one unit to the next are supported by suitable chain tracks 333 preferably resiliently carried by the frame of the machine by means not shown to compensate for slight changes in the length of the chains 331 between printing units due to manufacturing variations and differences in the position of the printing units. The return run of the conveyor 330 is supported by any suitable means, as by tracks 334 secured to the machine frame.

Having thus described my invention, I claim:

1. In a rotary multicolor printing press for printing on sheets, a plurality of printing units each comprising an impression cylinder, a printing cylinder and a rigid frame for supporting said cylinders, said frames being spaced apart to form a working space between adjacent units, means for conveying sheets in register from one unit to the next over said working space, and

means at one lateral end only of said printing units for rigidly joining said spaced apart frames, said working space being substantially unobstructed at the other end beneath the conveyor.

2. In a rotary multicolor printing press for printing on sheets, a rigid base adapted to rest on a floor for supporting the working parts of the press, said base extending longitudinally of the press and having a plurality of horizontal transversely projecting portions spaced apart to provide an unobstructed floor area between adjacent projecting portions, a printing unit supported on each of said projecting base portions, and means for conveying sheets in register from one unit to another over the floor area between them at an elevation sufficient to provide a working space between the units, entrance to said working space being substantially unobstructed at the side of the press corresponding to the ends of said transversely projecting base portions.

3. In a rotary multicolor printing press for printing on sheets, a plurality of printing units each comprising an impression cylinder, a printing cylinder, and a rigid frame for supporting said cylinders, said units being spaced apart to form a working space between them, the frame for one unit being provided with movable bearing blocks arranged to permit removal of the corresponding printing cylinder therefrom transversely to its axis into said working space, means for conveying sheets in register from one unit to the next over said working space, and means at one lateral end only of said spaced apart printing units for rigidly joining the frames thereof, said working space being unobstructed at the other end substantially from floor level upward to said conveying means, whereby a cylinder carriage arranged to rest on the floor may be moved into said working space to receive a cylinder removed from said frame.

4. In a multicolor printing press for printing on sheets, spaced printing units, a drive member, separate driving connections between said member and each of said units, a flexible endless conveyor having sheet grippers for conveying a sheet from one unit to the next including means for registering the sheet grippers first with one unit and then with the other, and resilient means for supporting and tautening the advancing and returning runs of said conveyor adapted to permit either run to lengthen and the other to shorten under the influence of said registering means while maintaining both runs taut.

5. In a rotary multicolor sheet printing press having first and second printing couples, an endless conveyor arranged between the couples to transfer sheets in register from the first to the second couple comprising a pair of parallel chains and a series of sheet gripper units carried thereby, means for driving both said printing couples, means for registering each gripper unit successively with the first couple to receive a sheet therefrom, means for registering each gripper unit successively with the second couple to deliver a sheet thereto, movable supporting means for the advancing run of said conveyor movable supporting means for the returning run thereof, and connections between said supporting means tending to cause movement of either of said supporting means in one direction in response to movement of the other of said supporting means in the opposite direction.

6. In a rotary multicolor sheet printing press having first and second printing couples, an end

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less conveyor arranged between the couples to transfer sheets in register from the first to the second comprising a pair of parallel chains and a series of sheet gripper units carried thereby, means for driving both said printing couples, means for registering each gripper unit successively with the first couple to receive sheets therefrom, means for registering each gripper unit successively with the second couple to deliver sheets thereto, movable supporting means for the advancing run of said conveyor, movable supporting means for the returning run thereof, each of said supporting means being arranged to define an upward and a downward path for the corresponding run of the conveyor, and connections between said supporting means tending to cause upward movement of either of said supporting means in response to downward movement of the other of said supporting means.

7. In a rotary multicolor sheet printing press having first and second printing couples each comprising an impression cylinder and a printing cylinder, throw/off means for moving each impression cylinder away from its associated printing cylinder for interrupting the printing operation, an endless conveyor arranged between said couples to transfer sheets from the first to the second impression cylinder, a first rotating member adjacent the first impression cylinder around which said conveyor travels to take sheets from the first impression cylinder, a second rotating member adjacent the second impression cylinder around which said conveyor travels to deliver sheets to the second impression cylinder, means for moving one of said rotating members bodily to an extent substantially corresponding to the movement of its adjacent impression cylinder and resiliently interconnected supporting means for the advancing and returning runs of said conveyor including spring means arranged to produce movement of the supporting means for both runs in the same direction when said movable rotating member is moved.

8. In a rotary multicolor sheet printing press having first and second printing couples, each couple comprising an impression cylinder and a printing cylinder, an endless conveyor arranged between said couples to transfer sheets from the first to the second impression cylinder, said conveyor carrying sheet grippers, a first rotating member adjacent the first impression cylinder around which said conveyor travels to take sheets from the first impression cylinder, an eccentric mounting for said first impression cylinder, throw-off means for turning said eccentric mounting to move said impression cylinder away from its associated printing cylinder for interrupting the printing operation, an eccentric mounting for said first rotating member, connecting means between said eccentrics for communicating throw-off movement from said impression cylinder to said first rotating member, whereby the latter moves with the impression cylinder on throw-off, means associated with said first rotating member for opening and closing the sheet grippers as they pass over said first rotating member, said last-named means comprising a cam plate, and guide means for said cam plate permitting movement thereof with said first rotating member upon operation of the throw-off mechanism to maintain the gripper opening and closing means in operative condition.

9. In a rotary multicolor sheet printing press having a plurality of printing couples spaced apart, a conveyor for conveying sheets from

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one couple to another comprising a pair of parallel chains, certain of the links of each chain having pins of greater length than the width of the chain, a support member on each chain, said support member having a central slot elongated in a direction transverse to the pitch line of the chain and two slots, one on each side of said central slot, elongated in a direction parallel to said pitch line, said longer pins of the chain extending into said slots, a shaft carried by said opposed support members, and sheet grippers on said shaft.

10. In a rotary multicolor sheet printing press having a plurality of printing couples spaced apart, a conveyor for conveying sheets from one couple to another comprising a pair of parallel chains, each chain having at spaced points groups of three pins of greater length than the width of the chain, the groups of long pins of one chain being arranged opposite the groups of the long pins of the other chain, support members for each chain having three slots for the reception of the long pins of a group, the central slot being at right angles to the outer slots and at least one of the slots being in the pitch line of the chain, a shaft carried by each pair of opposed support members, and sheet grippers on said shaft.

11. In a machine having a plurality of separated operating stations for performing operations consecutively on individual sheets, said separated stations having transverse base elements rigidly connected along one side of the machine, with unobstructed floor space elsewhere between said base elements, a printing unit at one station arranged to print on the sheets and comprising an impression cylinder and a printing cylinder therebelow cooperating therewith, a first flexible endless conveyor adapted to receive sheets from a prior operating station, convey them at overhead elevation toward the printing unit and present them in register to said impression cylinder at the rate of one sheet for each revolution of the latter, and a second endless conveyor adapted to receive the sheets from said impression cylinder and convey them toward a succeeding operating station at overhead elevation.

12. Mechanism as claimed in claim 11 in which the conveyors are arranged to convey the sheets from one operating station to the next by means of their upper runs.

13. Mechanism as claimed in claim 11, in which the conveyors are arranged to convey sheets from one operating station to the next by means of their upper runs, guide bands above the path of the sheets, and means for playing upwardly directed streams of air against the sheets to hold them against said bands and to facilitate the drying of the ink thereupon.

14. Mechanism as claimed in claim 11 in which the printing cylinder is arranged with its center line below the horizontal center line of the impression cylinder, and in which the conveyor which presents sheets to the impression cylinder is made to travel around a rotating feed drum while presenting a sheet, and the conveyor which receives sheets from the impression cylinder is made to travel around a rotating take-off drum while receiving a sheet, said feed and take-off drums being located with their center lines above the horizontal center line of the impression cylinder.

15. In a multicolor printing press for printing on sheets, spaced printing units, a flexible end-

less conveyor for conveying sheets from one unit to the next, said conveyor comprising a pair of parallel chains, pairs of sprockets over which said chains run, drums joining each pair of sprockets, said chains carrying at spaced points transverse gripper members, and means on each drum for engaging and accurately positioning a gripper member as it passes over the drum, the sockets between certain of the teeth of each sprocket being enlarged in order to permit the gripper members to be held by the drum during a part of their travel thereover independently of the chains.

16. In a rotary multicolor sheet printing press having first and second printing couples spaced apart, an endless conveyor for transferring sheets from one couple to the other, said conveyor comprising two parallel chains, upper and lower tracks for said chains, each chain link having three rollers, the two outer rollers running on one track and the intermediate roller running on the other track, whereby the chains are accurately guided with a minimum of friction.

17. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units carried thereby, each unit comprising a support bar having end portions slidably supported at a plurality of points by said chains, a normally rotating member, sprockets for said chains secured for rotation with said member, and means rotating with said member adapted to engage each bar in succession at a plurality of points between said end portions for clamping said bars to said member in accurately determined relation thereto during a portion of a rotation thereof.

18. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units carried thereby, a normally rotating member, sprockets for said chains secured for rotation with said member, and means rotating with said member adapted to engage each gripper unit in succession at three points, one near each end thereof, and one intermediate the ends thereof, for clamping said units to said member in accurately determined relation thereto during a portion of a rotation thereof.

19. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units carried thereby, a normally rotating member around which said chains and gripper units are adapted to travel, provided with two oppositely disposed inclined surfaces and a flat surface therebetween, said surfaces extending axially of said rotating member and lying substantially midway between said chains, and means acting in succession upon said gripper units to hold the same firmly in contact with said three surfaces simultaneously during a portion of a revolution of said rotating member.

20. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units carried thereby, a normally rotating member around which said chains and gripper units are adapted to travel, provided with a channel having two oppositely disposed inclined surfaces and a flat surface therebetween, said channel extending axially of said rotating member and lying between said chains, said gripper units being provided with surfaces mating with the surfaces of said channel, and a pair of clamping jaws on said rotating member acting successively upon said gripper units to exert force parallel to said inclined surfaces for pressing said units into firm contact with the inclined

side walls and bottom wall of said channel during a portion of a revolution of said member.

21. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units carried thereby, a normally rotating member around which said chains and gripper units are adapted to travel, a pair of clamping jaws on said rotating member acting successively upon said gripper units to secure the same in accurate position relative to said rotating member during a portion of a revolution thereof and means rotating with said rotating member for operating said jaws comprising a pair of links one end of each of which is connected to one of said jaws and the other end to a member common to the two links, said links being movable into substantial alignment with each other whereby said jaws are firmly held in clamping position.

22. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units supported thereby, each gripper unit comprising a plurality of grippers spaced lengthwise of the unit, a normally rotating member around which said chains and gripper units are adapted to travel, clamping devices carried by said rotating member and adapted to engage each of said gripper units at a plurality of points along its length, including at least one point between the endmost grippers, to clamp the unit to said member during a portion of a revolution thereof, and means for operating said clamping devices.

23. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units carried thereby, a normally rotating member around which said chains and gripper units are adapted to travel, mounting means for said member permitting bodily movement thereof transversely to the axis thereof, means rotating with said member operable to clamp said gripper units in succession to said rotating member for a portion of a revolution thereof, a cam at one end of said rotating member for operating said clamping means and mounting means for said cam arranged to permit bodily movement thereof corresponding substantially to the bodily movement of said rotating member whereby operation of said clamping means is effected in various positions of said rotating member.

24. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units carried thereby, a normally rotating member around which said chains and gripper units are adapted to travel, a frame, eccentric boxes in said frame for supporting the ends of said rotating member, means for rotating said eccentric boxes to move said member bodily, means rotating with said member operable to clamp said gripper units in succession to said member for a portion of a revolution thereof, a normally stationary cam at one end of said member for operating said clamping means, a bearing concentric with said member on which said cam is loosely mounted and guide means for said cam arranged to permit bodily movement thereof while preventing substantial axial and rotative movement thereof.

25. In a sheetbed printing machine, a plurality of printing units, a flexible endless conveyor adapted to take sheets from one unit and convey them printed side down at overhead elevation to the next unit, perforate guide means above the path of the sheets, and means for playing upwardly directed streams of air against the sheets to hold them up against said guide means during their travel between units.

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26. In a sheet fed printing machine, a plurality of printing units, a flexible endless conveyor adapted to take sheets from one unit and convey them printed side down to the next unit, said conveyor having an overhead upper run for moving sheets and an overhead return lower run, perforate guide means above said upper run, and air conductors entering the space between runs from one side thereof, said conductors having upwardly directed ports for playing streams of air against the sheets to hold them up against said guide means and to facilitate the drying of the ink thereupon.

27. In a sheet fed printing machine, a plurality of printing units, a flexible endless conveyor adapted to take sheets from one unit and convey them printed side down at overhead elevation to the next unit, said conveyor having an overhead upper run for moving sheets and an overhead return lower run, perforate guide means above said upper run, means for playing upwardly directed streams of air against the sheets to hold them against said guide means, and means disposed between said runs for heating the sheets as they travel from one unit to the next.

28. In a sheet fed printing machine, a plurality of printing units, a flexible endless conveyor adapted to take sheets from one unit and convey them printed side down to the next unit, said conveyor having overhead upper and lower runs, a manifold at one side of the space between said runs, means for supplying air under pressure to said manifold, and a plurality of ported conductors connected with said manifold extending into said space between runs for playing upwardly directed streams of air upon the sheets travelling from one unit to the next.

29. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units carried thereby, a normally rotating member, sprockets for said chains secured for rotation with said member, an operating element in said member extending lengthwise thereof, means operatively connected with said element for engaging and clamping each gripper unit in succession to the rotating member at points on opposite sides of the longitudinal center of said member, and cam and cam follower means at one end only of said member for actuating said element during a portion of each rotation of said member.

30. In a machine of the class described, a pair of parallel chains, a plurality of sheet gripper units carried thereby, a normally rotating member, sprockets for said chains secured for rotation with said member, a rock shaft in said member extending lengthwise thereof, means operatively connected with said rock shaft for engaging and clamping each gripper unit in succession to the rotating member at points on opposite sides of the longitudinal center of said member, and cam and cam follower means at one end only of said member for actuating said rock shaft during a portion of each rotation of said member.

31. A rotary multicolor printing press for printing on sheets comprising a plurality of single color printing units spaced apart to provide working space effective from floor level upwardly and capable of accommodating the press operator between adjacent units, means for conveying sheets in register from one unit to the next over said working space, and a rigid frame for the units extending continuously along one side of the press and having a plurality of horizontal laterally pro-

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jecting portions for supporting said spaced units, said projecting portions being arranged to provide free and substantially floor level access for the operator to said working space.

32. A rotary multicolor printing press for printing on sheets, comprising a plurality of units, one at least of which is an intaglio unit, each of said units including an impression cylinder, a form cylinder with its center below the center of the impression cylinder of that unit, and framing for supporting the ends of said cylinders, the framing of said intaglio unit being spaced from the corresponding framing of an adjacent unit to form a working space between said last mentioned units and being provided with removable bearing blocks arranged to permit removal of the form cylinder of said intaglio unit transversely to its axis into said working space, means at one lateral end only of said printing units for rigidly joining said spaced apart frames, said working space being substantially unobstructed at the other end, and conveying means arranged and operated to convey sheets under positive control through said units and over said working space.

33. In a rotary multicolor printing press for printing on sheets, a plurality of printing units each comprising an impression cylinder, a printing cylinder and a rigid frame for supporting said cylinders, a delivery unit and a supporting frame therefor, said frames being spaced apart to form working spaces between adjacent printing units and between the final printing unit and said delivery unit, means for conveying sheets over said working spaces in register from one printing unit to the next and from the final printing unit to the delivery unit, and means at one lateral end only of said printing units for rigidly joining said spaced apart frames, the working spaces being substantially unobstructed at the other end beneath said conveyor.

CHRISTEN R. KADDELAND.

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