Jan. 18, 1955 W. F. HUCK 2,699,939

REGISTERING MECHANISM FOR SHEET-FED PRINTING PRESSES

Filed Aug. 16, 1950 4 Sheets-Sheet 1

Fig. 1

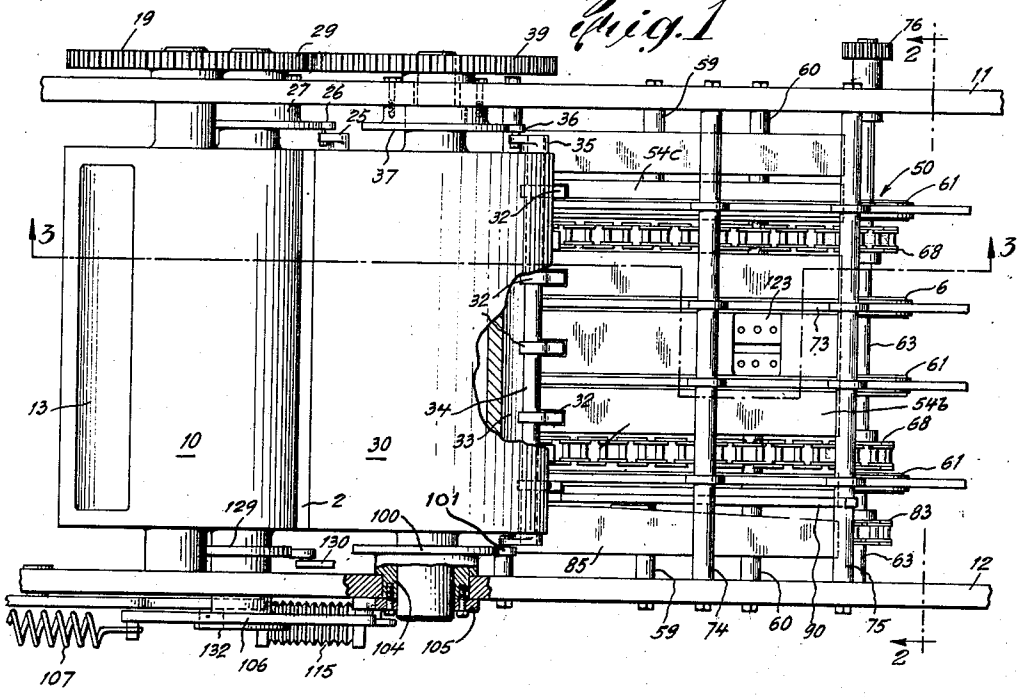
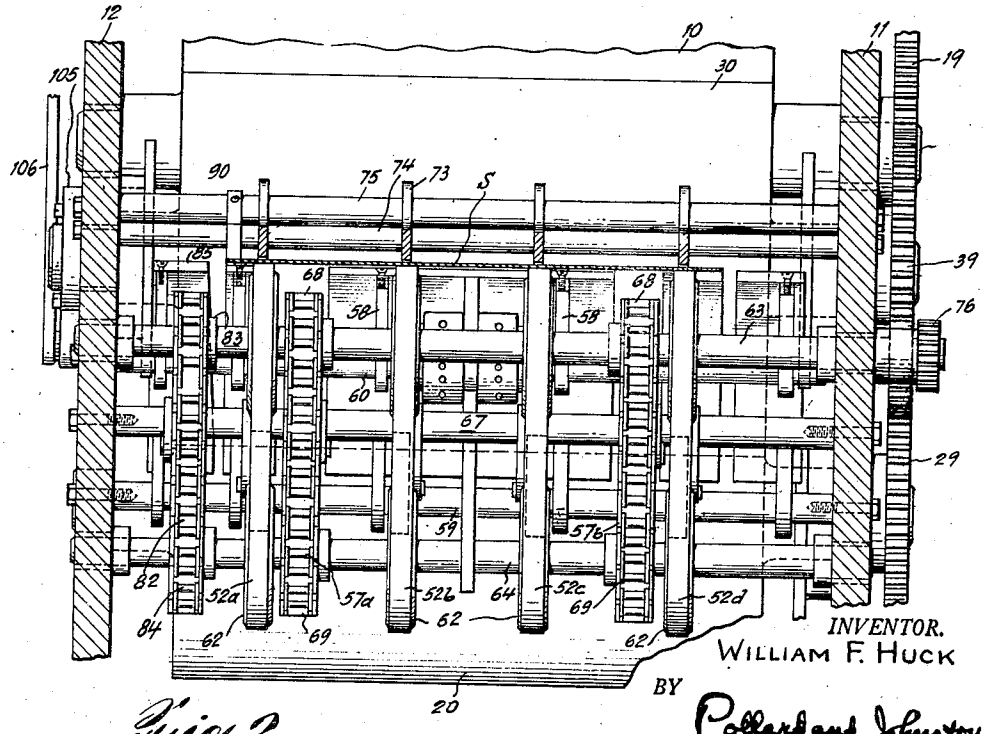


Fig. 2



INVENTOR.
WILLIAM F. HUCK

BY Pollard and Johnston
ATTORNEYS

Jan. 18, 1955 W. F. HUCK 2,699,939

REGISTERING MECHANISM FOR SHEET-FED PRINTING PRESSES

Filed Aug. 16, 1950 4 Sheets-Sheet 2

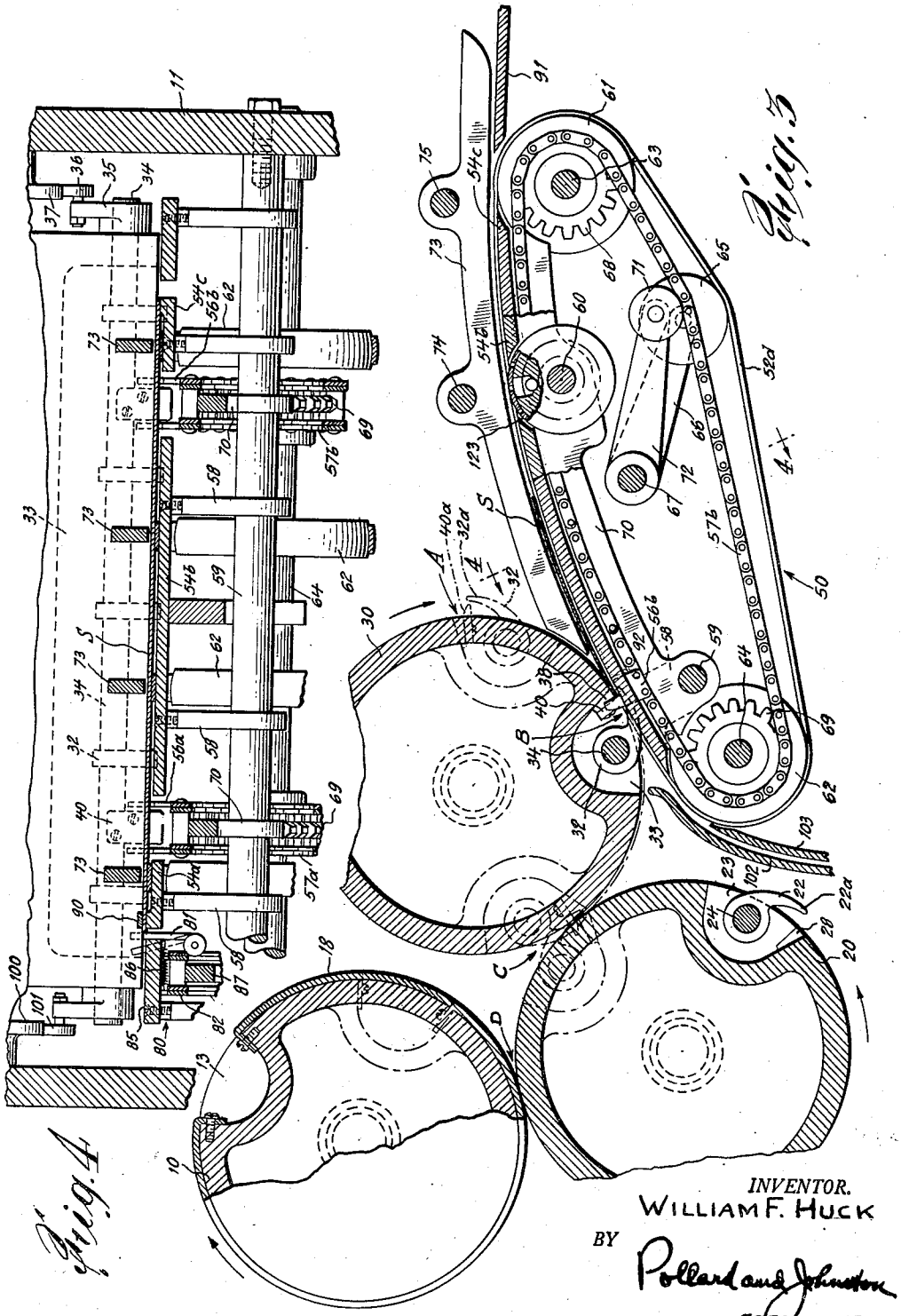


Fig. 4

Fig. 5

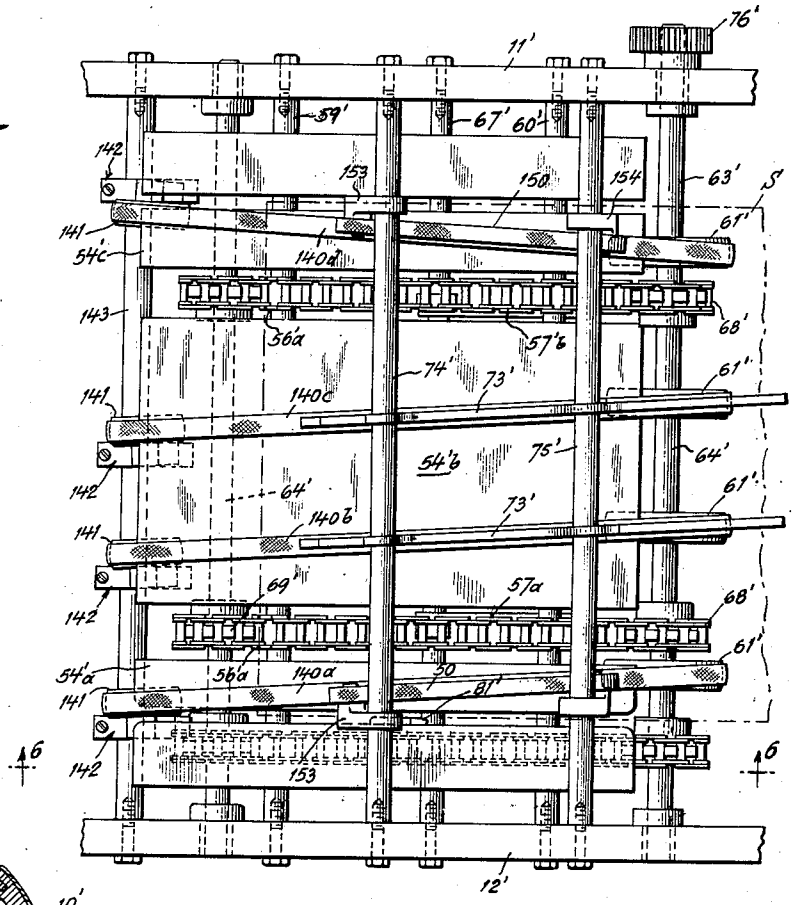
INVENTOR.
WILLIAM F. HUCK
BY
Pollard and Johnston
ATTORNEYS

Jan. 18, 1955 W. F. HUCK 2,699,939

REGISTERING MECHANISM FOR SHEET-FED PRINTING PRESSES

Filed Aug. 16, 1950 4 Sheets-Sheet 3

Fig. 5



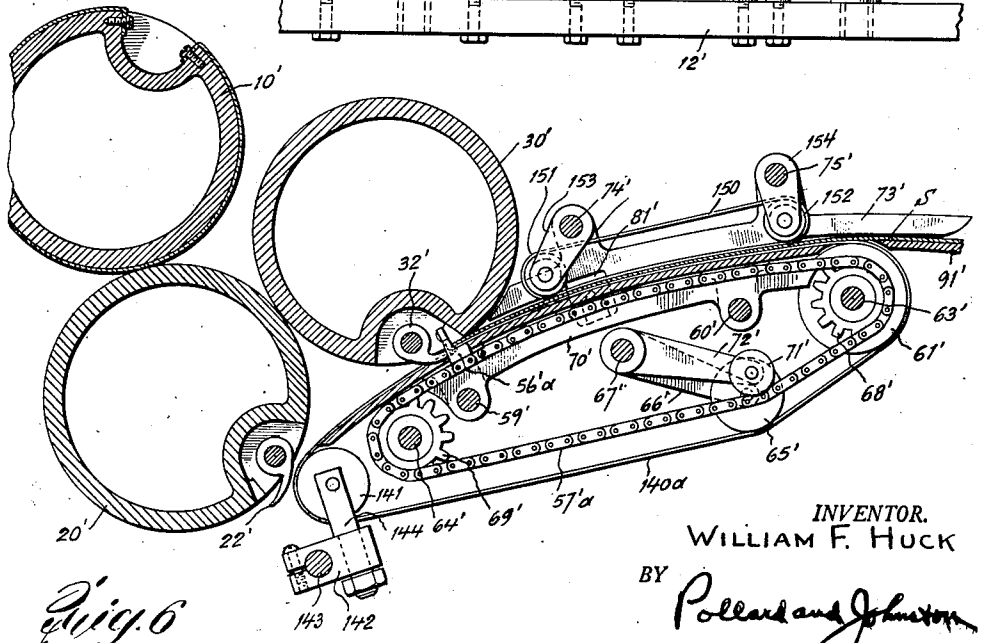


Fig. 6

INVENTOR.
WILLIAM F. HUCK
BY Pollard and Johnston
ATTORNEYS

Jan. 18, 1955 W. F. HUCK 2,699,939

REGISTERING MECHANISM FOR SHEET-FED PRINTING PRESSES

Filed Aug. 16, 1950 4 Sheets-Sheet 4

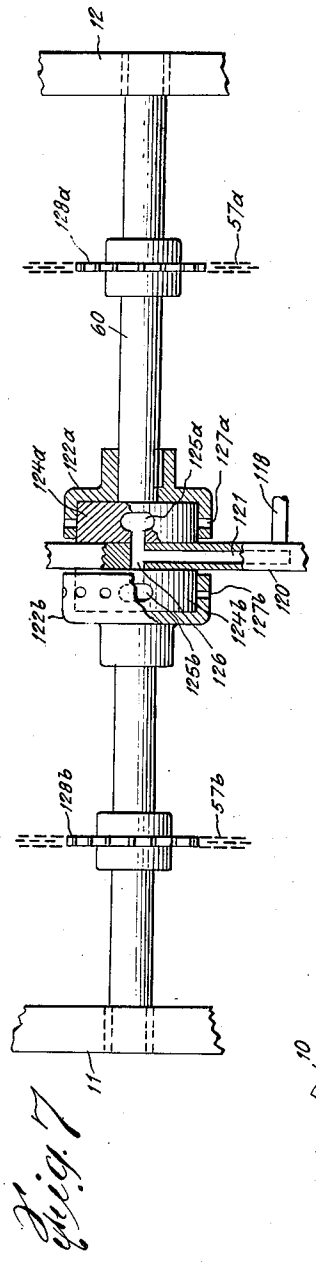


Fig. 7

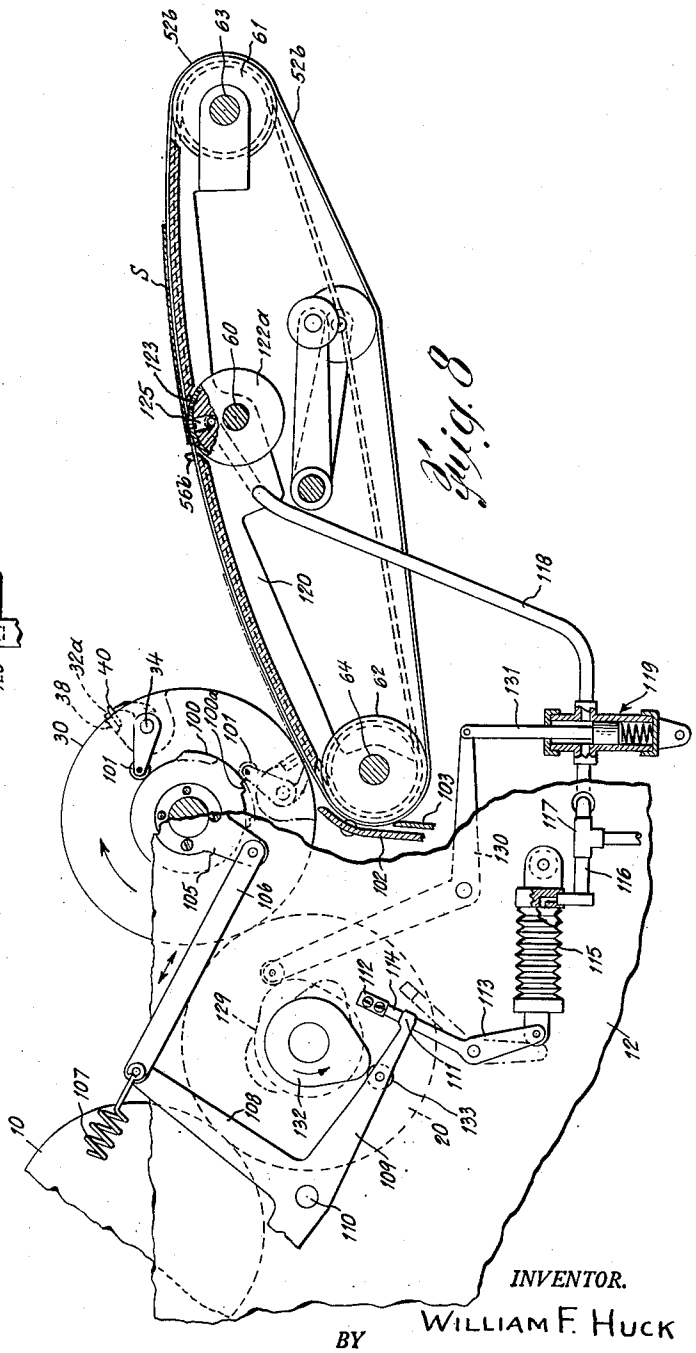


Fig. 8

INVENTOR.
WILLIAM F. HUCK
BY
Pollard and Johnston
ATTORNEYS

United States Patent Office 2,699,939
Patented Jan. 18, 1955

2,699,939

REGISTERING MECHANISM FOR SHEET-FED PRINTING PRESSES

William F. Huck, Forest Hills, N. Y., assignor to Huck Company, New York, N. Y., a copartnership

Application August 16, 1950, Serial No. 179,781

17 Claims. (Cl. 271—48)

This invention relates to sheet feeding and registering mechanisms for sheet fed rotary printing presses or analogous apparatus to which sheets must be fed successively at very high speeds. The invention may be applied advantageously for the feeding of limp sheet material, such as paper, that cannot be propelled satisfactorily by pushing its trailing edge, and also for feeding stiffer sheets of cardboard, metal or the like.

The general purpose of this invention is to provide improved sheet feeding and registering mechanisms by which sheets can be fed successively to a rotating printing press cylinder or the like at unusually high speeds and still can be assured of registering accurately with register points on the cylinder, all without buckling or wrinkling the sheets or indenting their edges.

According to this invention each sheet is brought into register while it is being advanced to the press and accelerated to cylinder surface speed; whereas, in known sheet registering mechanisms for paper fed presses and the like, a slowing down or even a stoppage of sheet motion is generally required in order to establish a register position, after which the registered sheet must be accelerated to approach cylinder surface speed before it can be gripped to a spinning press cylinder. An exception to this exists in practice only in very large presses which make use of a special register cylinder operated at full press speed.

A specific object of this invention is to provide a sheet feeding and registering mechanism wherein sheets are accelerated and advanced successively to a gripping or take-up zone at the periphery of a rotating cylinder by slidable frictional engagement with a sheet supporting conveyor which contacts a face of each sheet and brings the sheet up to a desired speed and a desired register position as it approaches the take-up zone.

Another object is to provide a mechanism of the character described, wherein both the leading edge and a side edge of each advancing sheet are brought simultaneously into accurate registering positions as the sheet is moved at high speed to a take-up zone, the side edge registration being effected by an even lateral pressure on a side edge of the sheet while the sheet is being advanced by slipping facial contact with a conveyor of tapes or the like moving it into the take-up zone.

A further object of the invention is to provide a sheet feeding and registering mechanism wherein sheets are advanced successively to a take-up or gripping device on a rotating cylinder by frictional contact with a conveyor which moves the sheets through a convex path tangential to the surface of the cylinder, the resulting convexity of an advancing sheet serving to stiffen it and increase its resistance to buckling, wrinkling or side edge indentation.

Another object of the invention is to provide a sheet feeding and registering mechanism wherein sheets are fed successively to a take-up device on a rotating cylinder by facial contact with a conveyor moved at a linear speed greater than the surface speed of the cylinder, and wherein the leading edge of each advancing sheet is brought to a register position by advancing it into contact with register members which are moved into the take-up zone at a speed less than the conveyor speed.

Another object is to provide a rotary printing press equipped with a sheet feeding and registering mechanism of the nature described, from which any sheet being advanced by the mechanism in mistimed or unregisterable relation to the press cylinder rotation will be automatically

ejected without passing between the press cylinders or interfering with continued high speed press operation.

Still another object of this invention is to provide a sheet feeding and registering mechanism which will accelerate sheets to cylinder surface speed while propelling them successively to a gripping or take-up device on a press cylinder and at the same time will bring the leading and side edges of each sheet into register positions, all by the action of conveyor tapes running in sliding contact with the sheet. According to embodiments of this nature, some of the propelling tapes can be arranged advantageously in paths slanted from the general direction of sheet travel so as to move the sheet laterally to and then along a register guide contacting its side edge, while at least one of the tapes near the opposite side of the sheet is arranged in a path slanted toward that side so that the divergent tapes will keep the sheet smooth and prevent buckling thereof.

It is also an object of this invention to provide a sheet feeding and registering mechanism of generally improved construction and arrangement, and one which is durable and economical in construction as well as practical, serviceable and efficient in its use.

The foregoing and other objects, features and advantages of this invention will be apparent from the following detailed description and the accompanying drawings of illustrative embodiments, while the distinctive novelty of the invention will be defined in the appended claims.

In the drawings, wherein like reference characters designate corresponding parts:

Figure 1 is a top plan view of one embodiment of the invention as applied to a sheet fed rotary printing machine;

Figure 2 is an enlarged transverse vertical section through the apparatus, taken on line 2—2 of Figure 1;

Figure 3 is an enlarged longitudinal vertical section, taken on line 3—3 of Figures 1 and 2;

Figure 4 is a fragmentary sectional view of the sheet conveyor, taken on line 4—4 of Figure 3;

Figure 5 is a fragmentary top plan view of another embodiment of the invention, in which side edge registration and control of each advancing sheet are effected in a special manner;

Figure 6 is a longitudinal vertical sectional view, taken on line 6—6 of Figure 5, showing a sheet fed rotary printing machine equipped with the feeding and registering mechanism of Figure 5;

Figure 7 is a top plan view, partly broken away, of a portion of a detecting mechanism according to the present invention; and

Figure 8 is a side elevational view, partly broken away and in section, of an embodiment of this invention including a sheet detecting and rejecting mechanism.

The drawings illustrate sheet fed rotary printing presses which comprise in known working relation a printing cylinder **10**, an impression cylinder **20** and a transfer cylinder **30**. These cylinders are disposed between side frame members **11** and **12**, with stub shafts on their ends journalled in bearings carried by the frame members. Cylinder **10** carries a printing plate or form **18** in known manner and forms a printing couple in zone D (Fig. 3) with the adjacent impression cylinder **20**, while the transfer cylinder **30** runs in contact with the impression cylinder at a location away from the printing couple.

The transfer cylinder serves to carry sheets successively from a take-up zone B (Fig. 3), where each sheet is registered and gripped to its surface, to the line of its contact with the impression cylinder in a transfer zone C (Fig. 3). At that line, the leading edge of the sheet is released by transfer cylinder grippers **32** and simultaneously engaged by impression cylinder grippers **22**, so that the sheet is thereafter carried on the impression cylinder and through the printing couple in known manner.

To accommodate their respective grippers, the impression and transfer cylinders are formed with longitudinal grooves **23** and **33**, respectively, which house rock shafts **24** and **34**, respectively, journalled in the ends of the cylinders. Rock shaft **24** carries the impression cylinder grippers **22**, and rock shaft **34** carries the transfer cylin-

der grippers **32**. At one end these rock shafts extend beyond the cylinder ends and carry radial arms **25** and **35**, respectively, which have cam followers or rollers **26** and **36**, respectively, fixed to their outer ends. Stationary cams **27** and **37**, respectively, are fixed to frame member **11** and guide the cam followers of the respective arms. rock shafts and grippers as the cylinders **20** and **30** rotate.

Thus the impression cylinder grippers **22** are rocked from an open position as shown in full lines in Fig. 3 to a closed position where their ends **22***a* bear against an abutment **28** along the trailing edge of groove **23**, so as to grip the leading edge of a sheet to the impression cylinder. Similarly, the transfer cylinder grippers **32** are rocked from an open position indicated by broken lines at zone A in Fig. 3 to a closed position indicated in full lines at the sheet take-up zone B. In closed position the free ends **32***a* of grippers **32** bear on the surface of an abutment **38** extending along the trailing side of groove **33**, and they project over the abutment surface beyond the plane of the trailing faces **40***a* of register stops **40** which project radially from the periphery of the transfer cylinder from suitable mountings within groove **33**.

The projecting stops **40** and abutment **38** provide register points at the surface of the transfer cylinder, to which the leading edge of a sheet advancing to this cylinder in the take-up zone B is first to be registered both frontwise and sidewise and then to be held by closing movement of the grippers **32**. Having been thus registered and gripped to the transfer cylinder surface, the sheet is carried onward by it to zone B and there transferred to the impression cylinder for continued movement on the latter through the printing zone D. For reasons given more fully in a copending application, Serial No. 133,192, filed December 15, 1949, the faces **40***a* of register members **40** are preferably curved as an involute of a circular section of the transfer cylinder surface so that the leading edge of a sheet contacting them as the cylinder rotates may move with them in continued register at the same speed as the cylinder surface speed.

As indicated in Figs. 1 and 2, the stub shafts of cylinders **10**, **20** and **30** which are journalled in frame member **11** extend through that member and carry meshing spur gears **19**, **29** and **39**, respectively, by which the rotation of the several cylinders is synchronized so that the longitudinal peripheral grooves or recesses **33** and **23** of cylinders **30** and **20** lie opposite to each other in transfer zone C, and so that groove **23** similarly lies opposite to the longitudinal peripheral groove or recess **13** of printing cylinder **10** in the printing zone D. The printing cylinder groove **13** accommodates attachments for holding the printing plate or form **18** to the surface of cylinder **10**.

The feeding and registering of sheets to the transfer cylinder **30** are effected by means of mechanism indicated generally at **50**, which extends from a suitable sheet feeder (not shown) through a path leading tangentially to the surface of cylinder **30** in the take-up zone B. This mechanism includes a travelling frictional sheet conveyor or support, which in this embodiment comprises a plurality of laterally spaced parallel endless tapes **52***a*, **52***b*, **52***c* and **52***d* guided in the desired path of the sheet by laterally spaced, fixed, parallel feed table elements **54***a*, **54***b* and **54***c*. The mechanism also includes leading edge register members **56***a* and **56***b* which are arranged in a line across the sheet path and advanced in said path ahead of a sheet therein by supporting endless chains **57***a* and **57***b*, respectively, as well as registering means indicated generally at **80** which extends along a side of said path so as to engage and position a side edge of a sheet advancing therein.

The feed table elements **54***a*, **54***b* and **54***c* are longitudinally arcuate with the top surfaces thereof preferably being convex so that the top runs of the continuous tapes **52***a*, **52***b*, **52***c* and **52***d* travelling over these top surfaces follow a curved, preferably convex, path. The feed table elements are positioned so that the top runs of the endless tapes extend tangentially to the surface of transfer cylinder **30** in take-up zone B, and the table elements are supported in that position by support members **58** secured to their under sides and having depending ears carried by lateral members **59** and **60** which are mounted at their opposite ends on the frame members **11** and **12**. The tapes **52***a*, **52***b*, **52***c* and **52***d* are made to follow closed paths by pulleys **61** and **62**, tangential to the forward and rearward marginal portions, respectively, of the feed table elements, and over which the tapes are trained. Pulleys **61** and **62** are fixed on lateral, rotatable shafts **63** and **64**, respectively, having their opposite ends journalled in bearings carried by the frame members **11** and **12**, and respectively disposed below the forward and rearward ends of the feed table elements. Thus the tapes travel from the pulleys **61** over the top surface of feed table elements **54***a*, **54***b* and **54***c*, past the take-up zone B, in which zone they are substantially tangential to the transfer cylinder surface, and then over pulleys **62** for a return or lower run back to pulleys **61**. In order to maintain the tension of the tapes, a tensioning pulley or roller **65** bears downwardly on the lower run of each tape and is mounted rotatably at the free end of an arm **66**, of suitable weight, which is pivoted on a shaft **67** carried at its opposite ends by the frame members and extending between the upper and lower runs of the tapes.

The endless chains **57***a* and **57***b*, supporting the leading edge register members, are vertically registered with the longitudinal spaces between the side edges of the central feed table element **54***b* and the inside edges of the side table elements **54***a* and **54***c*, respectively. Each of the chains is trained over sprockets **68** and **69** fixed on shafts **63** and **64**, respectively, and, as seen in Fig. 3, the pitch diameters of sprockets **68** and **69** are substantially smaller than the diameters of pulleys **61** and **62**. Thus the linear speed of the endless chains is less than the linear speed of the tapes and the upper runs of the chains are disposed below the upper sheet supporting surfaces of the feed table elements. The upper runs of the chains **57***a* and **57***b* are guided to travel along paths parallel to the sheet supporting surfaces of the feed table, and hence parallel to the path of a sheet advancing on the latter, by chain guide members **70** having suitably curved top edges over which the upper runs engage, and formed with depending ears mounted on the lateral members **59** and **60**. Chains **57***a* and **57***b* are tensioned by rollers **71**, bearing downwardly on their lower runs, and rotatably mounted on the free ends of suitably weighted arms **72** which are pivoted on shaft **67**.

The register members **56***a* and **56***b* each replace a link of the chains **57***a* and **57***b*, respectively, and have portions extending outwardly to project upwardly, when on the upper run, through the spaces between the feed table elements ahead and in the path of a sheet advancing on the latter.

The sheets successively advanced over the feed table elements, by frictional engagement with the tapes, and into leading edge engagement with the register members, are made to lie smooth and follow the contour of the feed table elements by longitudinally extending top guides **73** positioned above the feed table and formed with suitably arcuate lower edges engageable with the top surface of a sheet on the feed table. The guides **73** are supported from cross-members **74** and **75** carried by the frame members **11** and **12**.

In order to provide for the movement of tapes **52***a*, **52***b*, **52***c* and **52***d* and register members **56***a* and **56***b* in timed relation to the rotation of the printing, impression and transfer cylinders, a spur gear **76** is fixed on an end of shaft **63** extending through frame member **11**, and driving means (not shown) mesh with gear **76** to rotate shaft **63** in a counterclockwise direction, as viewed in Fig. 3, and are further synchronized with the driving means (not shown) for rotating the cylinders **10**, **20** and **30** so that the register members **56***a* and **56***b* are facially aligned with the register elements **32** carried by transfer cylinder **30** in the take-up zone B. The respective driving means for the cylinders and for the feeding and registering mechanism **50** effect a single rotation of the cylinders for each complete passage of the register members and tape through their respective closed paths of travel, and shafts **63** and **64** are preferably spaced apart a distance sufficient to make the lengths of chains **57***a* and **57***b* greater than the circumferences of the cylinders **10**, **20** and **30** so that the chains, and hence the register members, in completing one cycle during a single rotation of the cylinders, will move at a linear speed greater than the surface speed of the cylinders.

The registering means **80** in this embodiment for engaging and positioning a side edge of a sheet advancing to the take-up zone B over the feed table elements preferably includes a side register member **81** moving with register members **57***a* and **57***b* and carried by an endless

chain 82 running in a vertical plane at the outside edge of side feed table elements 54a (Fig. 4). Chain 82 is trained over sprockets 83 and 84 fixed to shafts 63 and 64, respectively, and moves at a speed the same as that of chains 57a and 57b. Side register member 81 is pivoted for rocking about a longitudinal axis so as to be movable laterally at the side of the path of travel of a sheet on the feed table while moving toward the take-up zone B.

The side register member 81 is gradually moved laterally toward the side feed table element 54a during its movement to the take-up zone by a cam plate 85, positioned above the top run of chain 82, and formed with an inside edge slanted toward the side of the sheet path and engaging the pivoted register member 81. A suitable spring 86 connects to side register member 81 and to the supporting link of chain 82 for maintaining the side register member in contact with the slanted edge of cam plate 85.

To complete the structure of side registering means 80, a chain guide member 87, similar to guide members 70, supports the upper run of chain 82, and guide member 87 and supporting brackets 88 carrying cam plate 85 are mounted on the cross-members 59 and 60.

To prevent buckling or indentation of the side edge of the sheet against which the register member 81 acts, and to stiffen the marginal portion of the sheet adjacent that edge, a cantilever spring member 90 is mounted on cross-member 75 and extends towards the take-up zone B to bear resiliently on the surface of that marginal portion of the sheet.

A feed table 91, being part of a suitable sheet feeder, otherwise not shown, extends under the receiving ends of the top guide members 73 with clearance being provided therebetween to accommodate the thickness of a sheet.

The operation of that portion of the device illustrated in Figures 1–4, and described above, is as follows:

A sheet S is moved forwardly over the feed table 91, and under the ends of the top guide members 73, until the leading edge of the sheet is frictionally engaged by the tapes 52a, 52b, 51c and 52d. The top guide members 73 act upon the top surface of the sheet S and keep the latter in frictional contact with the tapes. Since the tapes are moving forwardly at a linear velocity greater than that of the leading edge register members 56a and 56b, the leading edge of the sheet will be moved into contact with the register members. After such contact is effected, there will be continuous relative motion, or slipping, between the tapes and the sheet S, as the latter moves towards the take-up zone B and is restrained in such movement by the leading edge register members 56a and 56b.

During the progressive movement of the sheet S towards the take-up zone, the side register member 81 moves forwardly in contact with the slanted edge of cam 85 and the latter moves the register member 81 laterally against the adjacent side edge of the sheet S to effect the lateral registration of the sheet during the forward movement thereof. The cantilever spring 90 resiliently engages the top surface of the sheet S adjacent the side edge contacted by the side register member 81 for stiffening the edge and preventing the buckling thereof under the influence of the forces exerted on the edge by the side register member. Furthermore, by reason of the slipping of the tapes relative to the sheet, after the latter has engaged the register members 56a and 56b, the coefficient of friction between the sheet and the tapes is decreased thus diminishing the resistance to the lateral movement of the sheet by the side register member 81.

When the leading edge of the sheet S is at some intermediate point along the length of the feed table elements, the grippers 32 and the register elements 40 of the transfer cylinder 30 are disposed in the position shown in broken lines in Figure 3, and identified by the character (A). The grippers in this position are open or spaced outwardly from the point on the transfer cylinder surface at which the sheet is to be gripped to the cylinder. When the cylinder 30 arrives at the position, shown in full lines at B in Figure 3 and referred to as the take-up zone, the leading edge register members 56a and 56b and the leading edge register elements 40 come into facial alignment, with the leading edge of sheet S contacting the trailing faces 40a of elements 40. Since the register members 56a and 56b have a linear speed greater than that of the register elements 40, members 56a and 56b soon move away from the leading edge of the sheet. However, the sheet still is frictionally engaged by the faster moving tapes, which keep the leading edge in firm contact with the register elements 40. Meanwhile, the moving side register member 81 also will have progressed along the forward portion of the slanted edge of cam 85 so as to effect accurate lateral registration of the side edges of the sheet by the time its leading edge registers against elements 40.

When the sheet S has thus been brought into the desired registered position, the grippers 32 are rocked to closed position by the coaction of cam 37 and cam follower 36 carried by arm 35 fixed to gripper shaft 34. The leading edge of the sheet then is clamped firmly by grippers 32 to the surface of the transfer cylinder. Further rotation of transfer cylinder 30, with sheet S secured to the surface thereof, carries the leading edge of the sheet to the position indicated at C, which has been referred to as the transfer zone. It will be noted that zone C is disposed upon a line extending through the axes of transfer cylinder 30 and impression cylinder 20. That is, the leading edge of sheet S, when in the transfer zone C is disposed tangentially to, and in contact with, impression cylinder 20. During the rotation of cylinder 30 from take-up zone B to transfer zone C, the impression cylinder, and more particularly the grippers 22 thereof, move from the position shown in full lines to the position illustrated in broken lines on Figure 3. The grippers 22 during this movement are disposed in open position, but at zone C the cam 27 rocks the grippers 22 to closed position upon the leading edge of sheet S, and simultaneously cam 37 opens grippers 32 of the transfer cylinder to release the sheet from the latter. Since cylinders 30, 20 and 10 rotate together by reason of meshing gears 39, 29 and 19 fixed thereto, the registration of sheet S, established at the take-up zone B is maintained during and after the transfer of the sheet to the transfer cylinder. Continued rotation of impression cylinder 20 carries the leading edge of sheet S between impression cylinder 20 and the leading edge of plate 18, secured to printing cylinder 10, for the printing operation, during which the meeting surfaces of printing member 18 and cylinder 20 hold the sheet in proper position.

As the grippers 22 rotate beyond the printing zone between cylinders 10 and 20 they are moved to open or release position, thus clearing the leading edge of the sheet so that, when printed, the sheet will pass freely out of the printing zone to a suitable receiver.

The operation of the device as described above assumed that the sheets delivered to the receiving end of the feeding and registering mechanism 50 were properly timed so that the excessive speed of the tapes would effect the advancement of each sheet into leading edge contact against the slower moving leading edge register members at a point substantially ahead of the take-up zone. However, for various reasons the delivery of the sheet to the mechanism 50 may be mistimed or delayed, so that the sheet is advanced to the take-up zone without being properly registered. It is important that such an unregisterable sheet be rejected and not passed through the press cylinders.

Accordingly, further mechanism has been provided for this purpose, as illustrated in Fig. 7 and Fig. 8 of the drawings, to reject unregisterable sheets, that is, sheets delivered to the feeding and registering mechanism 50 in such relation to the register members 56a and 56b that the sheets cannot be registered by the latter before reaching the take-up zone B. This further mechanism operates to prevent the closing of grippers 32 in the take-up zone in response to the presence of an unregisterable sheet on the feed table elements and includes a radial cam 100 (Figs. 1 and 8), having a profile similar to that of cam 37, and mounted rotatably about the stub shaft of cylinder 30 journalled in frame member 12. A cam follower 101 mounted on a radial arm fixed to rock shaft 34 engages cam 100 so that the grippers 32 are maintained in open position during the period when follower 36 and follower 101, or either of them, engage the raised portions of their respective cams. During the normal operation of the feeding and registering mechanism, that is when a registerable sheet is present on the feed table elements, the movable cam 100 is positioned in alignment with cam 37 when the leading edge of the sheet reaches the take-up zone B so that the grippers are closed upon the registered sheet in zone B to hold such sheet to the surface of transfer cylinder 30, as described above. However, when an unregisterable sheet is present on the

feed table elements, cam **100** is displaced clockwise, as viewed in Fig. 8, to the broken line position so that cam follower continues to engage the raised portion of cam **100** until the grippers **32** have been moved beyond the take-up zone. Thus, the unregisterable sheet is not gripped to the surface of cylinder **30** and is instead deflected downwardly, as by the guide plates **102** and **103** at the discharge ends of the tapes, to pass into a suitable receptacle (not shown).

According to a further feature of preferred embodiments of this invention, the closing movement of the grippers **32** in the take-up zone B (Fig. 3) is brought about in two steps, the first of which confines the leading edge of a sheet when the sheet reaches register stops **40** against buckling or deforming away from the adjacent surface of the cylinder **30** but still leaves the sheet edge free for a suitable interval to undergo further registering movement in firm contact with the register stops. The second closing step then clamps the registered leading edge tightly to the axis of the cylinder at abutment **38**. For this purpose, as indicated in Figure 8, the cam or cams controlling grippers **32** not only have a high surface as appears at **100** to hold the grippers fully open as they enter the take-up zone B, but they also may be formed with an intermediate surface **100***a* against which follower **101** is held for a suitable interval just before the grippers reach the desired final closing position by movement of the cam follower to the low surface of the cam.

To provide for the displacement of cam **100**, as set forth above, a sleeve **104** is formed integral therewith and extends through frame member **12** concentric with the stub shaft of cylinder **30**. A radial arm **105** is secured on the outer end of sleeve **104** and connects pivotally to a link **106**. A spring **107** is secured at one end by suitable means (not shown) to the frame member **12**, and at its other end is secured to link **106** to constantly urge the cam **100** to its broken line or displaced position of Fig. 8.

To prevent the movement of cam **100** to its displaced position while the grippers **32** are in the take-up zone, except when an unregisterable sheet is present on the sheet supporting surface, a bell crank having legs **108** and **109** is pivoted at **110** on frame member **12**, with leg **108** being connected at its free end to link **106** and with leg **109** being formed with a lug **111** at its free end. An abutment **112** is fixed on frame member **12**, and a rock lever **113**, pivoted adjacent its center on frame member **12**, is formed with a projection **114** which normally extends between lug **111** and abutment **112** (full line position of Fig. 8) to prevent swinging of the bell crank and movement of link **106** by spring **107** and thus to prevent displacement of cam **100** when a registerable sheet is present on the feed table elements.

The mechanism for operating rock lever **113** includes a bellows **115** connected at one end to the rock lever and at the other end to a fixed pivot on frame member **12**. As seen in Fig. 8, the projection **114** of the rock lever is disposed in blocking position when bellows **115** is contracted, and is moved to the broken line position, out of the path of travel of lug **111**, when the bellows is expanded. The expansion and contraction of bellows **115** is preferably controlled by air pressure, or to be more exact the degree of the vacuum therein. For this purpose a conduit **116** extends from a T-fitting **117** to the bellows with one branch of the fitting **117** being connected to a suitable vacuum source (not shown), and with the other branch of the fitting being connected to a conduit **118** extending to a detecting station at the feeding and registering mechanism **50** and having a suitable slide valve **119** interposed therein. It is apparent that the pressure within bellows **115** is at its lowest value when conduit **118** is closed either by the plunger of valve **119** or by a sheet at the detecting station, and that the pressure in the bellows increases, as a result of the entrance into the latter of air at atmospheric pressure, when the conduit **118** is unobstructed either by the valve plunger or by a sheet at the detecting station.

For the purpose of detecting the presence of an unregisterable sheet on the feed table elements a centrally disposed, longitudinal frame **120** is disposed at the underside of central feed table element **54***b* and is supported on rotatable shaft **60**, which is journalled in bearings carried by frame members **11** and **12**, and on cross-member **59**. Frame **120** is formed with a longitudinal passage **121** to which conduit **118** connects. Inwardly opening bell-shaped members **122***a* and **122***b* are fixed on shaft **60** and rotate therewith at the opposite sides of frame **120**, with the central feed table element **54***b* having an opening **123** into which the wide portions of members **122***a* and **122***b* extend to positions flush with the top surfaces of tapes **52***a*, **52***b*, **52***c* and **52***d*. Cylindrical members **124***a* and **124***b* are fixed to the opposite sides of frame **120** and extend into bell-shaped members **122***a* and **122***b*, respectively. Members **124***a* and **124***b* are formed with radial bores **125***a* and **125***b*, respectively, opening substantially at the line of tangency of the wide portions of members **122***a* and **122***b* with the upper surfaces of the tapes, and an axially extending passageway **126** communicates the radial bores **125***a* and **125***b* with the passage **121**. The bell-shaped members **122***a* and **122***b* are formed with circumferentially spaced openings **127***a* and **127***b* positioned to successively register with the open ends of bores **125***a* and **125***b* respectively. Sprockets **128***a* and **128***b* are fixed on shaft **60** and engage chains **57***a* and **57***b* to rotate shaft **60** and thereby intermittently open conduit **118** as openings **127***a* and **127***b* register with the radial bores.

Since a registerable sheet on the feed table has a predetermined relation to the position of the register members **56***a* and **56***b*, and hence relative to the positions of the cylinders **10**, **20** and **30**, it is possible by opening valve **119** at a time when a registerable sheet would be advanced to a position overlying the opening **123** to determine the presence of an unregisterable sheet on the feed table. For this purpose, a radial cam **129** is fixed to the stub shaft of cylinder **20** at the inside of frame member **12** and engages a cam follower carried by one arm of a pivoted bell-crank **130**. The other arm of bell-crank **130** is suitably connected to the stem **131** of valve **119**. Thus, the cam **129** operates to depress the valve plunger, against the force of spring **132** in the valve housing, for opening conduit **118** during a predetermined interval corresponding to the presence of the leading portion of a registerable sheet in a position overlying the opening **123**. It can be seen that a registerable sheet closes the openings **127***a* and **127***b* and prevents the entrance of air at atmospheric pressure into bellows **115** through conduit **118**. However, an unregisterable sheet is not yet in position to close openings **127***a* and **127***b* when valve **119** is opened, that is during the detecting period, and the pressure in bellows **115** rises accordingly to extend the latter and remove rock lever **113** from its blocking position.

In order to separate lug **111** from abutment **112** during the detecting period so that the projection **114** may move therebetween in response to the presence of a registerable sheet on the feed table, a radial cam **132** is fixed on the stub shaft of cylinder **20** outside the frame member **12**, and engages a cam follower **133** on bell-crank arm **109** to rock the lug **111** away from the abutment **112** when cam **129** is operative to open valve **119** (as shown in full lines in Fig. 8).

The operation of the sheet detecting and rejecting mechanism is as follows:

1. In the case of a registerable sheet, the sheet S is advanced toward the transfer cylinder by frictional engagement with the tapes. When the valve plunger moves downwardly under the action of cam member **129**, thus opening conduit **118**, the leading portion of sheet S covers opening **123** in table element **54***b* and the openings **127***a* and **127***b* in the rotating bell-shaped members. Since these openings are closed, the pressure in conduits **118** and **116** continues low, and bellows **115** is compressed or retracted for moving projection **114** into the path of travel of the free end of arm **109**, which arm has been depressed by cam **132**. When cam member **132** rotates further, positioning its portion of lesser radius opposite the roller **133** as shown in broken lines in Fig. 8, projection **114** prevents the counter-clockwise rotation of the bell-crank under the influence of spring **107**. Therefore, cam member **100** will remain in the position shown in solid lines on Figure 8, to thereby effect closing of the grippers **32** upon the leading edge of the sheet S after the latter has been properly registered and moved into contact with the register elements **40** on the transfer cylinder, all in the manner set forth in the description of operation of the feeding and registering mechanism.

2. In the case of an unregisterable sheet, that is a sheet overly delayed in reaching the detecting position at which opening **123** is formed in feed table element **54***b*, cam member **129** effects the downward movement of the

valve plunger at a predetermined moment, as previously set forth, to thereby open conduit **118**. However, at that predetermined moment an unregisterable sheet will not be in a position to cover openings **127***a* and **127***b*, and air will enter conduit **118** through openings **127***a* and **127***b* in the bell-shaped members as these openings successively register with the radial bores **125***a* and **125***b*, respectively. Thus the pressure in conduits **118** and **116** will increase causing the extension of bellows **115**. Extension of bellows **115** moves projection **114** out of the path of travel of the end of arm **109**, and now further rotation of cam member **132** with the impression cylinder to the broken line position of Fig. 8 will permit counter-clockwise movement of the bell-crank by spring **107**. Link **106** communicates such bell-crank movement to radial arm **105** for displacing cam **100** to the position shown in dotted lines on Figure 8. Cam **100** in this displaced position holds grippers **32** open until after they have been moved clear of the leading edge of the advancing sheet. Thus the sheet S, if unregisterable, is not taken-up by the grippers **32** on the transfer cylinder **30** and passes downwardly to a suitable receptacle as previously indicated.

Figures 5 and 6 illustrate a modification of the sheet feeding and registering mechanism provided according to the invention wherein the side registration and control of each sheet are effected in a special manner. Parts in these figures which correspond to parts already described are designated by corresponding but primed reference characters.

In the embodiment of the invention illustrated by Figs. 5 and 6, the feed and registering of sheets to the transfer cylinder **30'** are effected by means of mechanism which extends from a suitable sheet feeder (not shown) through a path leading tangentially to the surface of cylinder **30'** in a take-up zone. This mechanism, being similar in many respects to that already described, includes a travelling frictional sheet conveyor or support, which comprises a plurality of endless tapes **140***a*, **140***b*, **140***c* and **140***d* guided in the desired path of the sheet by laterally spaced, fixed, parallel feed table elements **54'***a*, **54'***b* and **54'***c* similar to the feed table elements previously described and bearing corresponding primed numerals. The mechanism also includes leading edge register members **56'***a* and **56'***b* which are arranged in a line across the sheet path and advanced in said path ahead of a sheet therein by endless supporting chains **57'***a* and **57'***b*, respectively, with the chains being driven and guided in the manner heretofore described. The present embodiment is distinguished from that illustrated in Figs. 1–4 in that certain of the propelling tapes, specifically tapes **140***a*, **140***b* and **140***c*, are arranged in paths slanted from the general direction of sheet travel so as to move a sheet thereon laterally to and then along with a side register member **81'** carried by a supporting chain **82'** for movement with the leading edge register members and guided by the straight inner edge of a plate **85'** so that the side register member **81'** moves parallel to the general direction of sheet movement, as contrasted with the lateral movement imparted to the side register member of the first described embodiment, while at least one of the tapes near the opposite side of the sheet, in this case tape **140***d*, is arranged in a path slanted toward that side so that the divergent tapes keep a sheet thereon smooth and prevent the buckling thereof.

Tapes **140***a*, **140***b*, **140***c* and **140***d* are trained, at the receiving ends of the feed table elements, over pulleys **61'** fixed on rotatable shaft **63'**, and at the discharge ends of the feed table elements, which extend beyond the take-up zone, are trained over pulleys **141** which are individually mounted on brackets **142** carried adjustably by a lateral support **143**. Thus, each of the brackets **142** is laterally spaced relative to the related one of the pulleys **61'** to impart the desired slant to the path of travel of the tape trained thereover. The structure for mounting each of the pulleys **141** on the respective bracket **142** preferably includes an annularly adjustable fork **144** so that the plane of rotation of pulley **141** may be disposed in the slanted plane of travel of the respective tape. The tapes **140***a*, **140***b*, **140***c* and **140***d*, as well as the chains carrying the leading edge and side register members, are tensioned by means similar to that described before and bearing corresponding primed numerals.

Top guide members **73'**, supported by cross-members **74'** and **75'**, are positioned above the central feed table element **54'***b* in alignment with each of tapes **140***b* and **140***c* and engage the top surface of a sheet to keep the latter smooth and conforming to the convex path of travel.

Diverging endless tapes **150** are positioned above the opposite side portions of the path of the sheets to engage the latter and are arranged in paths which are vertically aligned with the tapes **140***a* and **140***d*. Tapes **150** are trained over pulleys **151** and **152** which are rotatably on the lower ends of arms **153** and **154**, respectively, and the arms are pivotally suspended from the overhead cross-members **74'** and **75'**.

In operation of the device shown in Figs. 5 and 6, a sheet S to be printed is passed forwardly over the table **91'** into the space between the back ends of the upper guides **73'** and the upper runs of the tapes **140***a*, **140***b*, **140***c* and **140***d*. Registration of the leading edge of the sheet S is obtained in the same manner as set forth in the description of the first embodiment, and side registration of the sheet is obtained as follows:

The tapes **140***a*, **140***b* and **140***c*, frictionally engaging the lower surface of the sheet S, move the sheet laterally towards the frame member **12'**, as well as forwardly towards the transfer cylinder **30'**. The tape **140***d*, simultaneously engaging a marginal portion of the sheet nearer to frame member **11'**, tends to move that portion laterally toward member **11'**, i. e. towards the right hand side of the press. Since the three tapes **140***a*, **140***b* and **140***c* exert a greater combined lateral force than the single tape **140***d*, the overall movement of the sheet is forward and towards the left-hand side of the press, and as this movement occurs the tape **140***d* serves to draw the sheet taut and keep it even across its full width (if the sheet is one that bunches or twists easily). The diverging upper tapes **150**, engaging the top surface of the sheet S adjacent the opposite side edges of the latter, urge the sheet into contact with the tapes **140***a* and **140***d*, and by reason of their divergence they also assist in smoothing the sheet. The side register member **81'** carried by the chain **82'** moves forward with the sheet and engages the side edge thereof so as to limit the lateral movement of the sheet to the desired point of side registration thereof.

Thus the lateral positioning of each sheet being fed to the transfer cylinder is effected positively by the friction of feed tapes acting upon surfaces of the sheet, as well as by the moving side register element which acts upon a side edge thereof. The spreading and smoothing forces applied to sheet S and their effectiveness in either lateral direction may be controlled by adjusting the tension of the respective top tapes **150** relative to the underneath tapes **140***a*, **140***b*, **140***c* and **140***d*.

With such an arrangement very limp sheets, of paper or other light material, can each be kept evenly spread out and accurately registered with the rotary cylinder to which it is to be gripped, as it is fed for printing, and the printing operations can be carried out on such sheets at extraordinarily high speeds.

For the purpose of clarity, the sheet detecting and rejecting mechanism, previously described, has not been illustrated in Figs. 5 and 6, however, such mechanism is intended for use with either the first or second embodiment of the sheet feeding and side registering mechanism.

Having thus described preferred embodiments of the present invention, it is to be understood that the invention is not limited to such precise embodiments, as obviously modifications and changes may be effected therein without departing from the scope and spirit of the invention which is intended to be defined in the appended claims.

What is claimed is:

1. In a sheet fed printing press or the like, a rotary sheet-carrying cylinder having at its surface projecting stops the trailing edges of which provide register points movable through a take-up zone to receive therein the leading edge of a sheet fed thereto, said edges lying substantially on an involute of the cylinder surface sloping away from said leading edge in said zone, a mechanism for speedily feeding sheets into said zone and registering them with said stops comprising front register members movable into said zone ahead of an advancing sheet, means for advancing said members so that their trailing edges align with said stop edges in said zone, a travelling side register member, a relatively fixed cam along the sheet path for guiding said side register member, means for advancing the side register member along said cam

toward and in said zone in sustained contact with a definite part of a side edge of the advancing sheet, a travelling frictional sheet conveyor for advancing sheets into said zone, said conveyor supporting and having slidable contact with a face of each sheet, and means for moving said conveyor at a speed exceeding the speed of said register members to advance a sheet into leading edge engagement with said front register members while a side edge of the sheet is in contact with the advancing side register member.

2. In a sheet fed printing press or the like, a rotary sheet-carrying cylinder having at its surface projecting stops the trailing edges of which provide register points movable through a take-up zone to receive therein the leading edge of a sheet fed thereto, said edges lying substantially on an involute of the cylinder surface sloping away from said leading edge in said zone, a mechanism for speedily feeding sheets into said zone and registering them with said stops comprising front register members movable into said zone ahead of an advancing sheet, means for advancing said members so that their trailing edges align with said stop edges in said zone, a travelling side register member, a relatively fixed cam along the sheet path for guiding said side register member, means for advancing the side register member along said cam toward and in said zone in sustained contact with a definite part of a side edge of the advancing sheet and at the forward speed of the front register members, a travelling frictional sheet conveyor for advancing sheets into said zone, said conveyor supporting and having slidable contact with a face of each sheet, and means for moving said conveyor at a speed exceeding the speed of said register members to advance a sheet into leading edge engagement with said front register members while a side edge of the sheet is in contact with the advancing side register member.

3. In a sheet fed printing press or the like including a sheet-carrying surface having register points moved repeatedly through a take-up zone to receive therein the leading edge of a sheet fed thereto, a mechanism for speedily feeding sheets into said zone and registering them with said surface comprising front register members movable into said zone ahead of an advancing sheet, means for advancing said members so that they align with said points in said zone, a travelling side register member, a relatively fixed cam along the sheet path for guiding said side register member, means for advancing the side register member along said cam toward and in said zone in sustained contact with a definite part of a side edge of the advancing sheet, a travelling frictional sheet conveyor for advancing sheets into said zone, said conveyor supporting and having slidable contact with a face of each sheet, said conveyor and an advancing sheet thereon moving into said zone in a longitudinally convex path so that the sheet travels in a bowed condition, and means for moving said conveyor at a speed exceeding the speed of said register members to advance the sheet into leading edge engagement with said front register members and facilitates the lateral registration of the bowed sheet by said side register member.

4. In a sheet fed printing press or the like including a sheet-carrying surface having register points moved repeatedly through a take-up zone to receive therein the leading edge of a sheet fed thereto, a mechanism for speedily feeding sheets into said zone and registering them with said surface comprising front register members movable into said zone ahead of an advancing sheet, means for advancing said members so that they align with said points in said zone, a travelling frictional sheet conveyor for advancing sheets into said zone, said conveyor supporting and having slidable contact with a face of each sheet, said conveyor and an advancing sheet thereon moving into said zone in a longitudinally convex path so that the sheet travels in a bowed condition, means for moving said conveyor at a speed exceeding the speed of said front register members to advance a sheet into leading edge engagement with said members, and means along a side of the path of an advancing sheet to register the bowed sheet laterally as it approaches said zone in slipping contact with said side registering means comprising a relatively fixed cam presenting a side surface extended along said path and into said zone, a travelling side register member positioned by said cam surface, and means for moving said side register member along said surface in sustained registering contact with a side edge of the advancing sheet.

5. A mechanism as described in claim 4, said conveyor moving parallel to the path of the sheet, said cam surface having a backward portion slanted gradually toward said path and merging into an advanced portion parallel thereto.

6. A mechanism as described in claim 4, said conveyor comprising a plurality of tapes of which at least one moves in a path slanted toward said side registering means so as to bring an advancing sheet into contact therewith.

7. In a sheet fed rotary printing press or the like comprising a sheet carrying cylinder rotatable through a take-up zone to receive therein the leading edge of an approaching sheet, a longitudinally convex sheet feed table extending into said zone in a position substantially tangential to the cylinder and a plurality of continuously moved endless tapes having portions supported on and extending arcuately along convex portions of said table to advance sheets in bowed and thus stiffened condition into said zone by slidable frictional contact with a face of each sheet.

8. In a sheet fed rotary printing press or the like comprising a sheet carrying cylinder rotatable through a take-up zone to receive therein the leading edge of an approaching sheet, a longitudinally convex sheet feed table extending into said zone in a position substantially tangential to the cylinder, a plurality of continuously moved endless tapes having portions supported on and extending arcuately along convex portions of said table to advance sheets in bowed and thus stiffened condition into said zone path by slidable frictional contact with a face of each sheet, and concavely curved guide means spaced above and extending substantially parallel to said tapes to prevent buckling of a sheet thereon.

9. In a sheet fed printing press or the like comprising a sheet-carrying cylinder having register points rotatable through a take-up zone to receive therein the leading edge of an approaching sheet, a longitudinally convex sheet feed table extending into said zone in a position substantially tangential to the cylinder, a plurality of continuously moved endless tapes having portions supported on and extending arcuately along convex portions of said table to advance sheets in bowed and thus stiffened condition into said zone by slidable frictional contact with a face of each sheet, front register members movable along said path ahead of a sheet advancing therein, a side register member movable along said path in sustained contact with part of a side edge of such sheet, means for moving said members faster than the cylinder surface speed but in such timed relation thereto that the front register members align with said register points in said zone, and means for moving said tapes faster than said register members.

10. In a sheet fed rotary printing press or the like, a rotary sheet-carrying cylinder having register elements and gripping means thereon, a sheet conveyor leading tangentially into a take-up zone adjacent the surface of said cylinder and including a travelling support for frictionally advancing a sheet fed thereto, register members moved in the conveyor path so as to be engaged by the leading edge of a sheet on said support, means for driving said cylinder and said register members in timed relation so that the latter come into facial alignment with said register elements in said take-up zone, driving means for said support moving it at a linear speed exceeding that of said register members to bring a sheet into leading edge engagement with the latter, means normally operating said gripping means in said take-up zone adjacent the position of alignment of said register elements with said register members, shiftable means to render said gripping means inoperative, a sheet detector including a sheet contacting element adjacent a part of said conveyor remote from said cylinder, means for moving said element in contact with a sheet advancing over said conveyor, means for actuating said shiftable means when said register members reach a predetermined advanced position relative to said sheet contacting element, and means then responsive to contact between said element and a sheet on said conveyor to inactivate said actuating means.

11. In a sheet fed printing press or the like including a rotary sheet-carrying cylinder, a travelling sheet support for frictionally advancing a sheet fed thereonto to a take-up zone adjacent the surface of said cylinder, said sup-

port extending to said zone in an arcuate path so as to curve longitudinally a sheet thereon to increase the lateral rigidity of the sheet, leading edge register members movable ahead and in the path of such sheet, means for so moving said members in timed relation to the support movement and the cylinder rotation, registering means including a side register member movable along a side of the sheet path, and means for so moving said side register member synchronously with the movement of said leading edge register members and in sustained contact with a bowed side edge of a curved sheet advancing on said support.

12. In a sheet feeding and registering mechanism for a sheet fed rotary printing press or the like, a travelling support for frictionally advancing a sheet fed thereonto to a take-up zone, said support and a sheet thereon extending to said zone in a longitudinally curved path, a register member movable along a side of the path of a sheet on said support for engaging and registering a bowed side edge of the advancing sheet, and a longitudinally fixed bearing member positioned over said support having in said path adjacent said register member an elongated portion yieldably biased against said support so as to bear slidably upon and thus stiffen the adjacent side margin of such sheet.

13. In a sheet feeding and registering apparatus for a sheet fed rotary printing press or the like including a rotary sheet-carrying cylinder, a table presenting a longitudinally convex surface in substantially tangential relation to the cylinder, a plurality of continuous tapes trained over and along said surface in a convex path and forming a frictional support for advancing a sheet thereon to the surface of the cylinder, means for moving said tapes in timed relation to the cylinder surface movement, leading edge register members movable ahead and in the path of a sheet on said tapes, means for moving said register members in timed relation to the tape movement but at a lower speed, a register member movable along a side of said path so as to engage a side edge of the advancing sheet, and means for moving said side register member synchronously with said leading edge register members.

14. In a sheet fed rotary printing press or the like comprising a sheet-carrying cylinder having cooperative means thereon for registering and for gripping the leading edge of a sheet to its surface, a conveyor operative as said cylinder rotates to advance a sheet into leading edge engagement with said registering means in a take-up zone adjacent said surface, control means normally operating said gripping means in said take-up zone to grip the leading edge of a registered sheet to said surface, and means operative in response to the presence of an unregisterable sheet on said conveyor to displace said control means so as to prevent the operation of said gripping means in said take-up zone, including a sheet contacting element adjacent a part of said conveyor remote from said cylinder, means for moving said element in contact with a sheet advancing on said conveyor, means for actuating said displacing means when the conveyor reaches a predetermined advanced position relative to said sheet contacting element, and means then responsive to contact between element and a sheet on said conveyor to inactivate said actuating means.

15. In a sheet-fed printing press or the like comprising a rotary sheet-carrying cylinder having register stops and movable grippers thereon for registering and gripping the leading edge of a sheet advanced thereto in a take-up zone, means operative as the cylinder rotates the grippers into said zone to hold the grippers in open position, a continuously moved frictional conveyor for slidably engaging a face of a sheet so as to advance the sheet into leading edge engagement with said stops beneath the open grippers, a side register member moved with and in sustained contact with part of a side edge of the sheet in said zone, means operative as the grippers advance in said zone to move them first to a semi-closed position so as to confine the leading edge of a sheet contacting said register stops against movement away from the cylinder surface yet leave the sheet free to slide in its own plane, and means operative after an interval of further cylinder rotation to close the grippers tightly upon said leading edge, said register stops projecting from said cylinder in fixed positions relative thereto and presenting trailing edges for engagement by said leading edge which lie on an involute of the cylinder surface sloping away from said leading edge in said zone so that the sheet is unchanged in speed as the grippers act upon the sheet.

16. In a sheet fed rotary printing press or the like comprising a cylinder rotatable through a sheet takeup zone to receive therein the leading edge of a sheet fed thereto, a sheet feed table presenting a longitudinally convex surface extending into said zone in substantially tangential relation to said cylinder, and a flexible conveyor supported on said surface and movable continuously therealong in a convex path to carry a sheet into said zone in a bowed condition.

17. In a sheet fed rotary printing press or the like comprising a cylinder rotatable through a sheet takeup zone to receive therein the leading edge of a sheet fed thereto, a sheet feed table presenting a longitudinally convex surface extending into said zone in substantially tangential relation to said cylinder, a flexible conveyor supported on said surface and movable continuously therealong in a convex path to carry a sheet into said zone in a bowed condition, and concavely curved guide means disposed over and along said conveyor to hold a sheet moving thereon to said path.

References Cited in the file of this patent

UNITED STATES PATENTS

671,377	Harris	Apr. 2, 1901
1,029,159	Westerbeck	June 11, 1912
1,066,528	Randolph	July 8, 1913
1,562,271	Aldrich	Nov. 17, 1925
1,567,361	Dudley	Dec. 29, 1925
1,615,590	Low	Jan. 25, 1927
2,200,367	Harrold	May 14, 1940
2,219,892	Gibson	Oct. 29, 1940
2,231,914	Huck	Feb. 18, 1941
2,245,396	Harrold	June 10, 1941
2,248,079	Harrold	July 8, 1941
2,362,205	Huck	Nov. 7, 1944
2,395,444	Belluche	Feb. 26, 1946
2,406,006	Eckhard	Aug. 20, 1946
2,488,551	Nordquist	Nov. 22, 1949
2,508,608	Huck	May 23, 1950