

July 8, 1941.

C. W. HARROLD ET AL

2,248,079

SHEET FEEDING MECHANISM

Filed Sept. 15, 1939

9 Sheets-Sheet 1

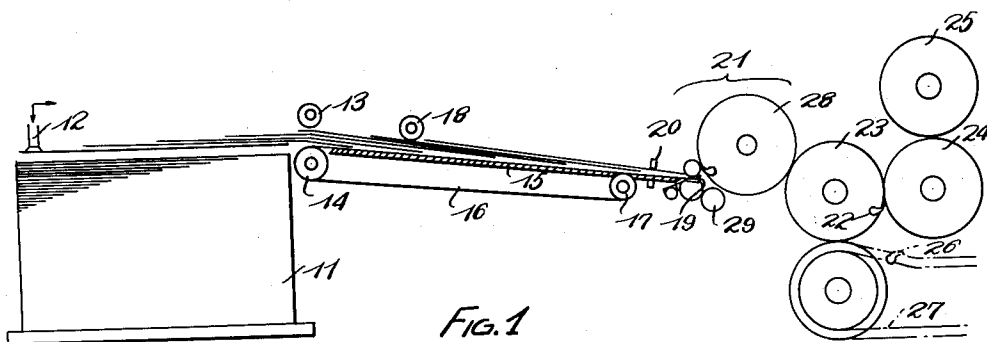


FIG. 1

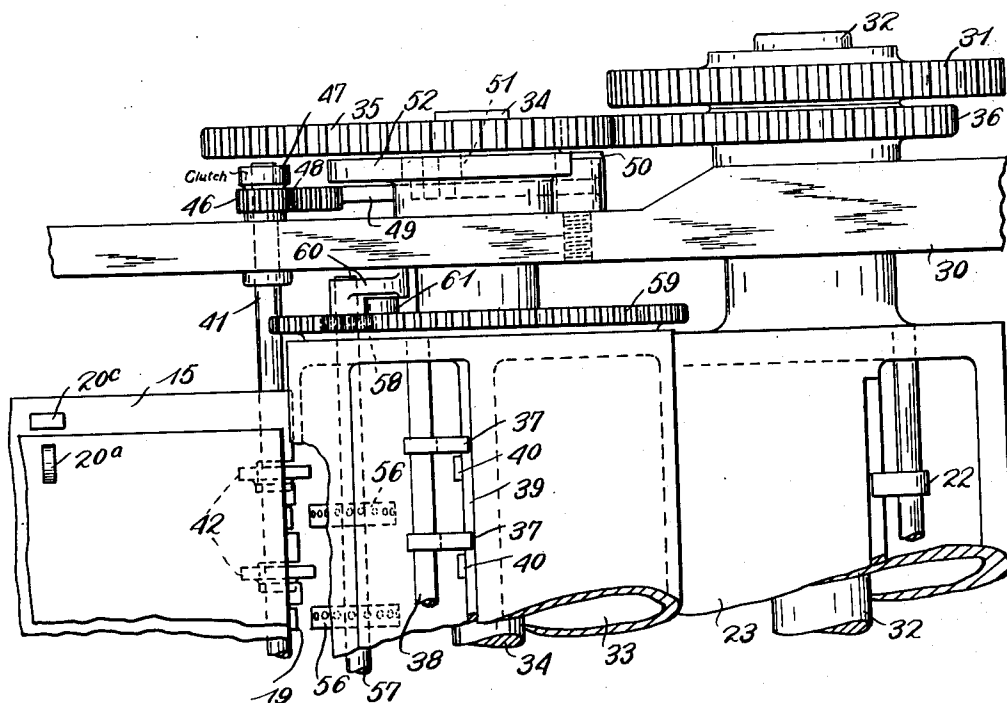


FIG. 4

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9 Sheets-Sheet 2

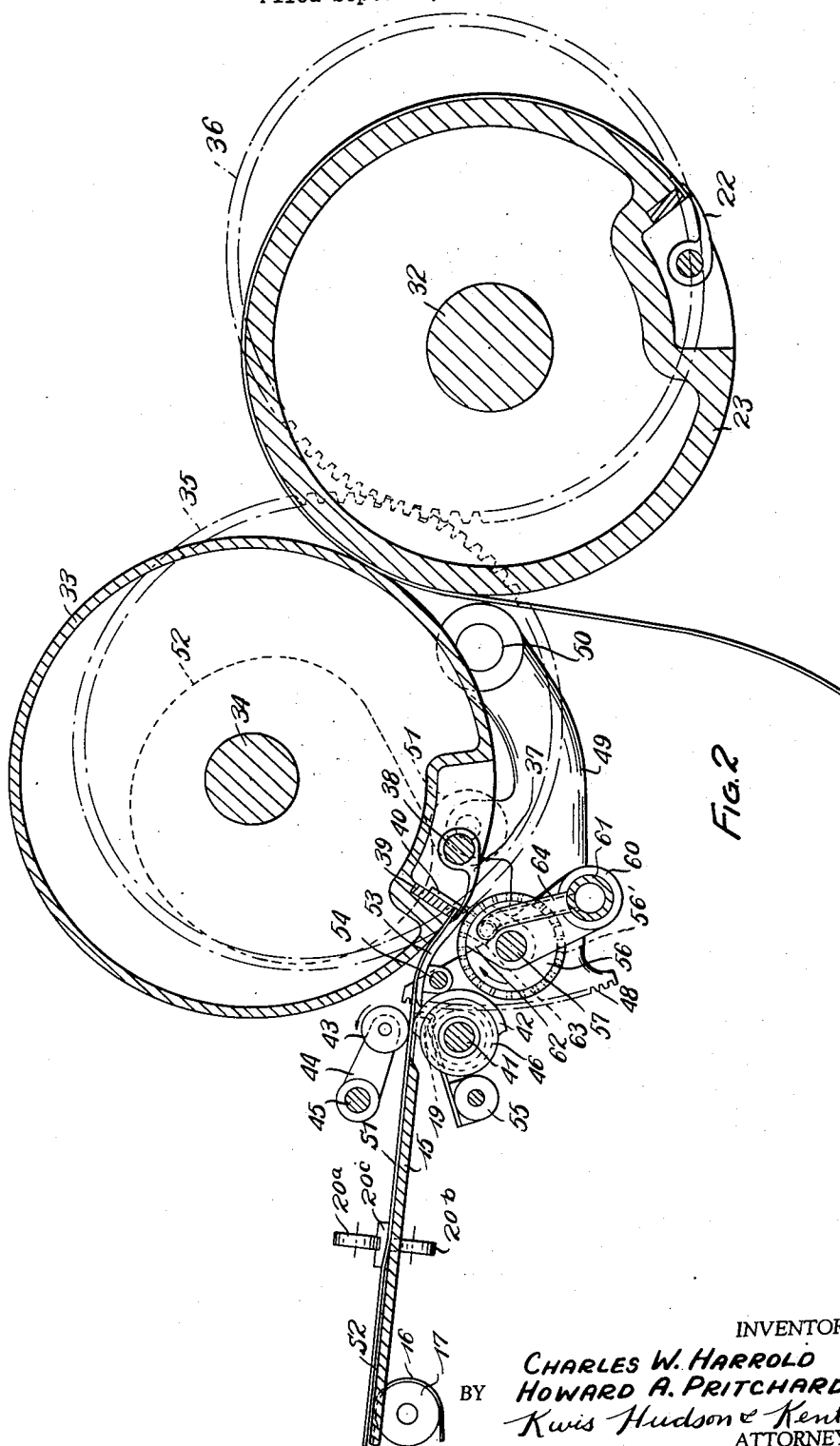


Fig. 2

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9 Sheets-Sheet 3

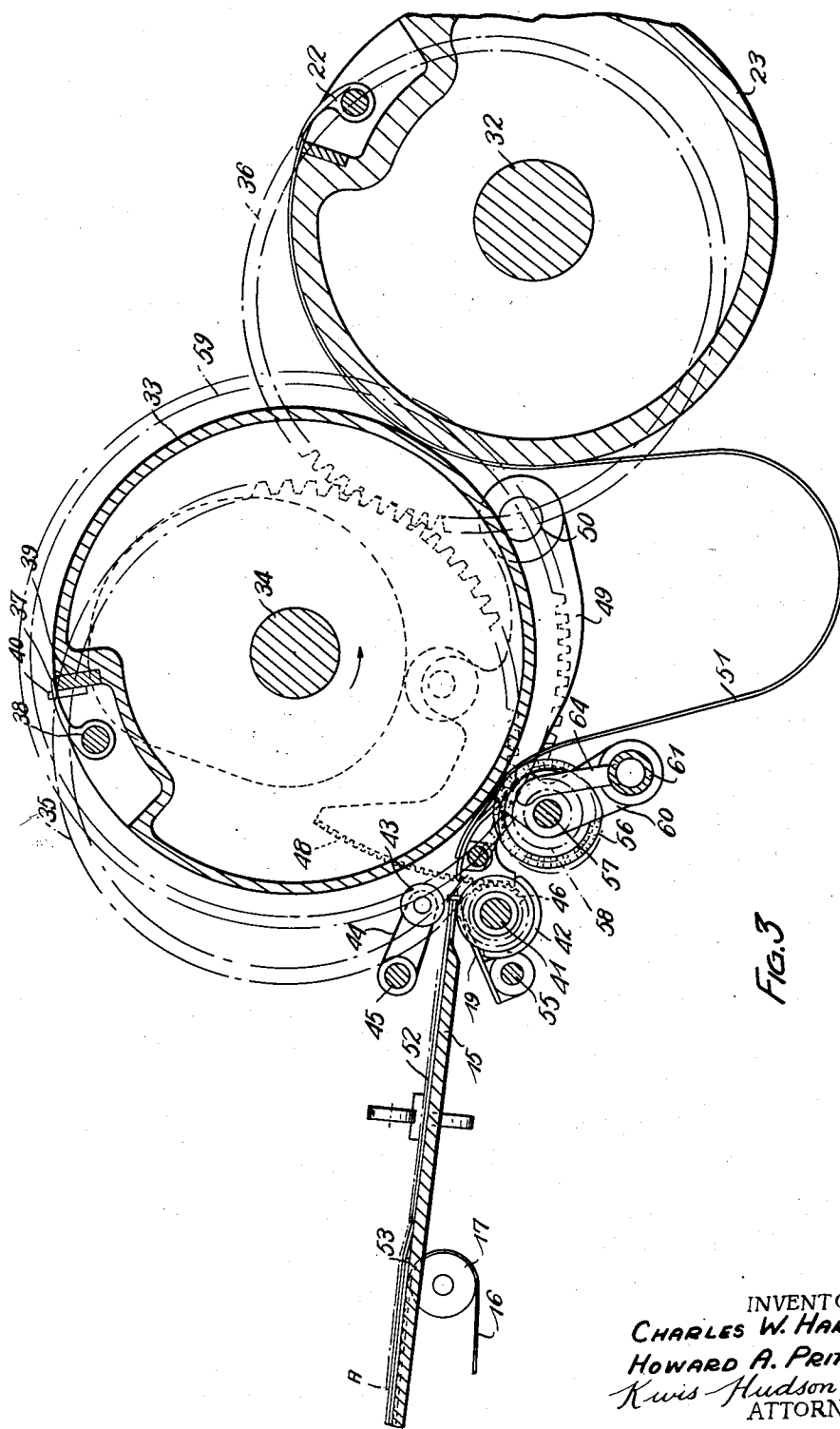


FIG. 3

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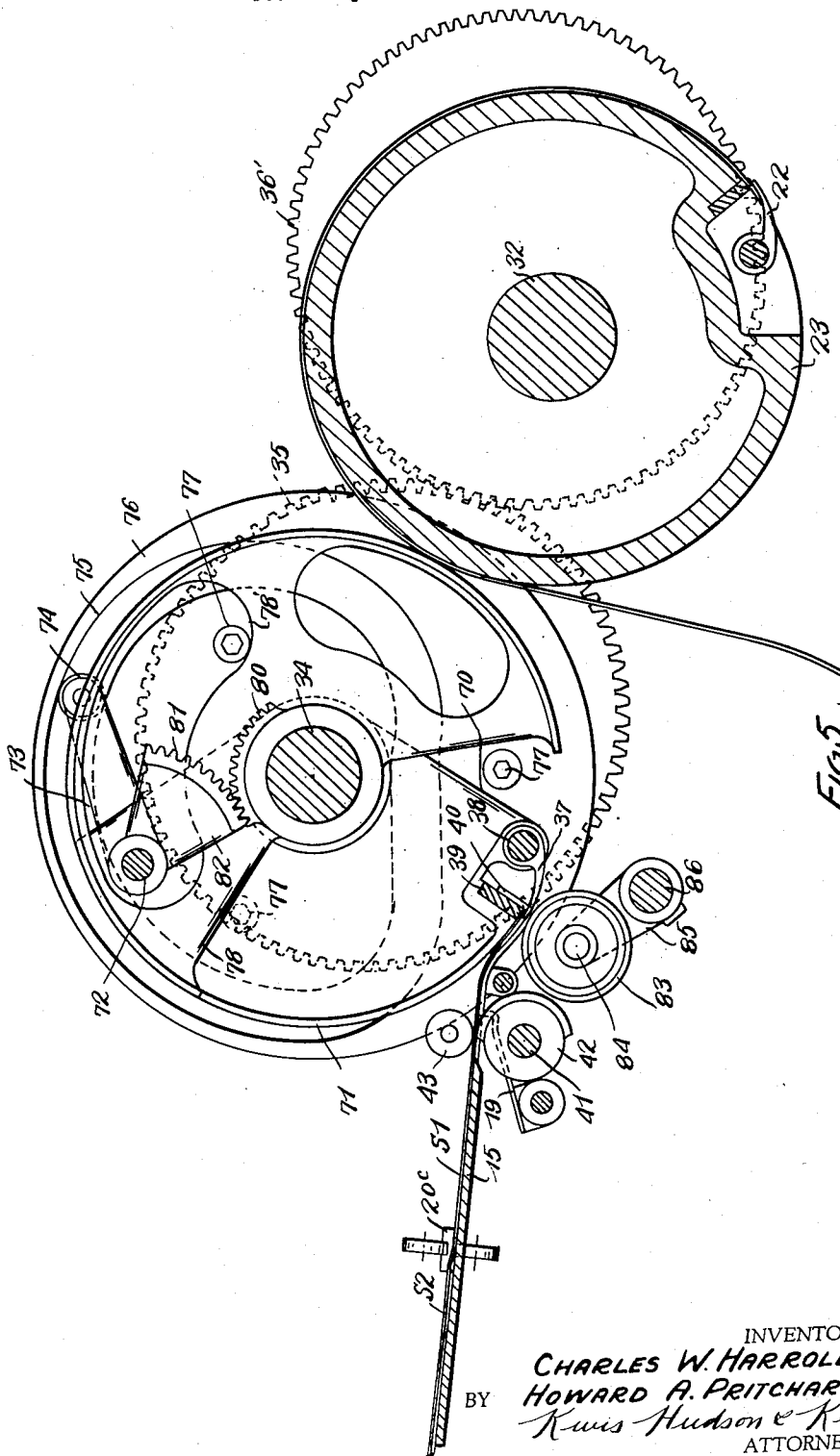
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9 Sheets-Sheet 4



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9 Sheets-Sheet 5

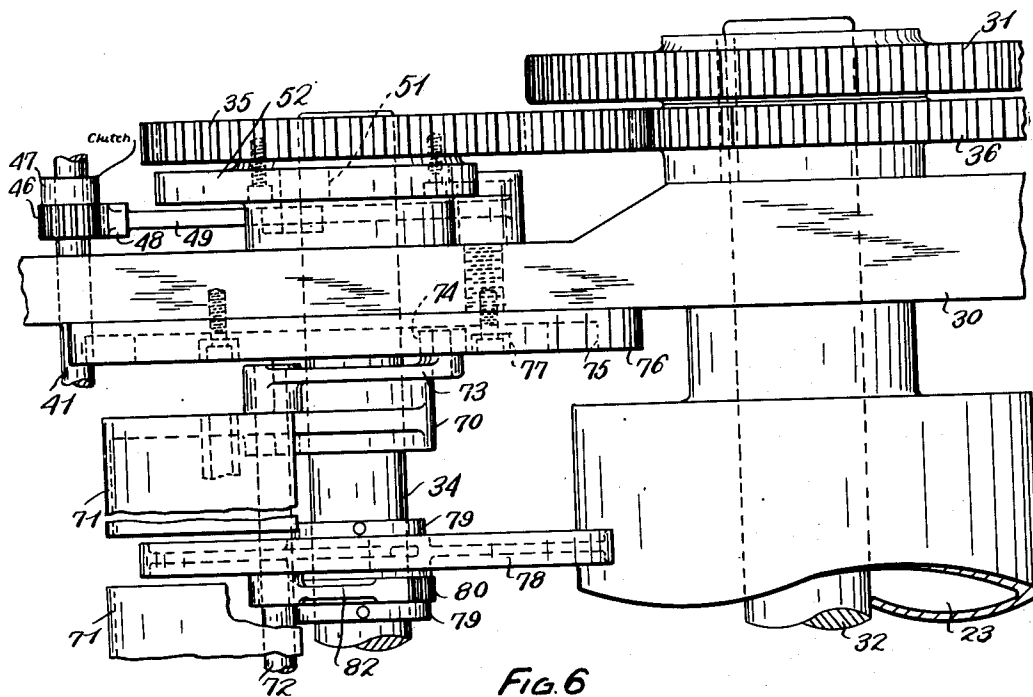


FIG. 6

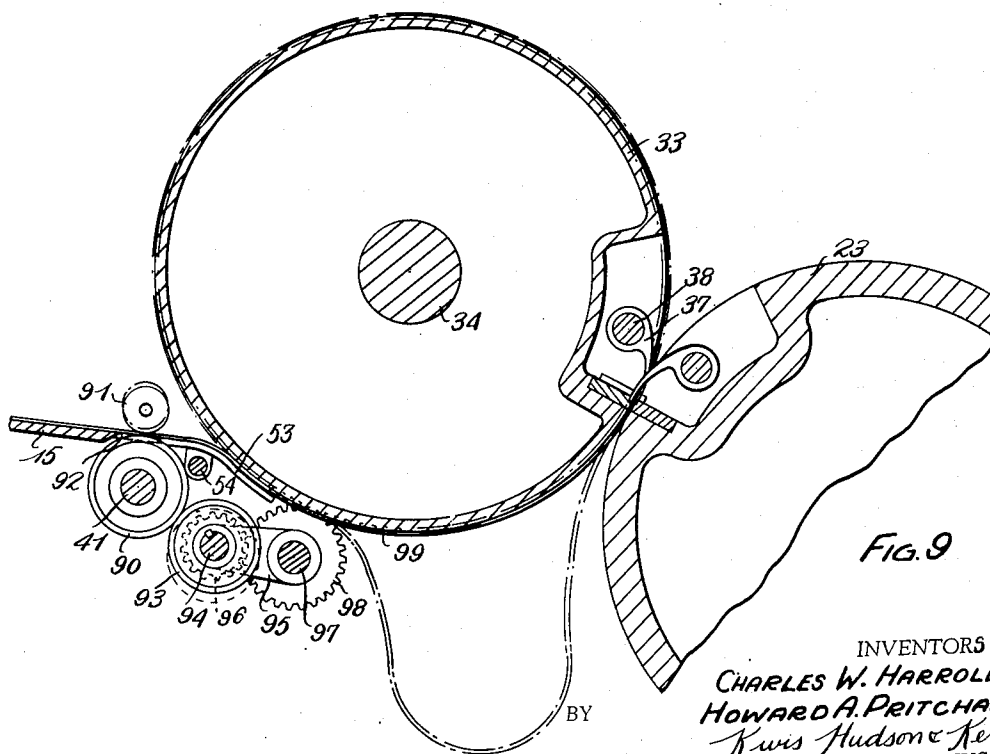


FIG. 9

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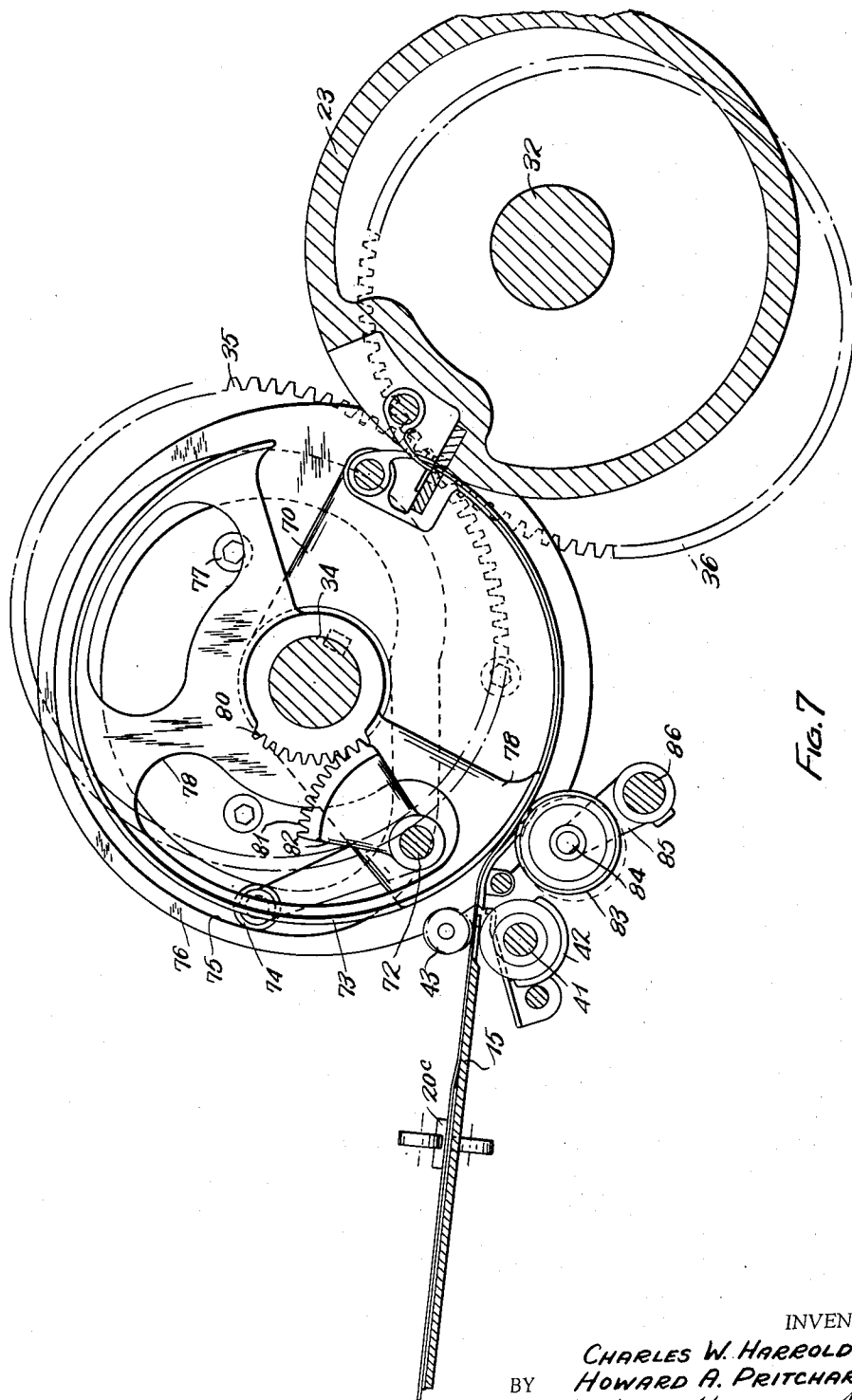
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SHEET FEEDING MECHANISM

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9 Sheets-Sheet 6



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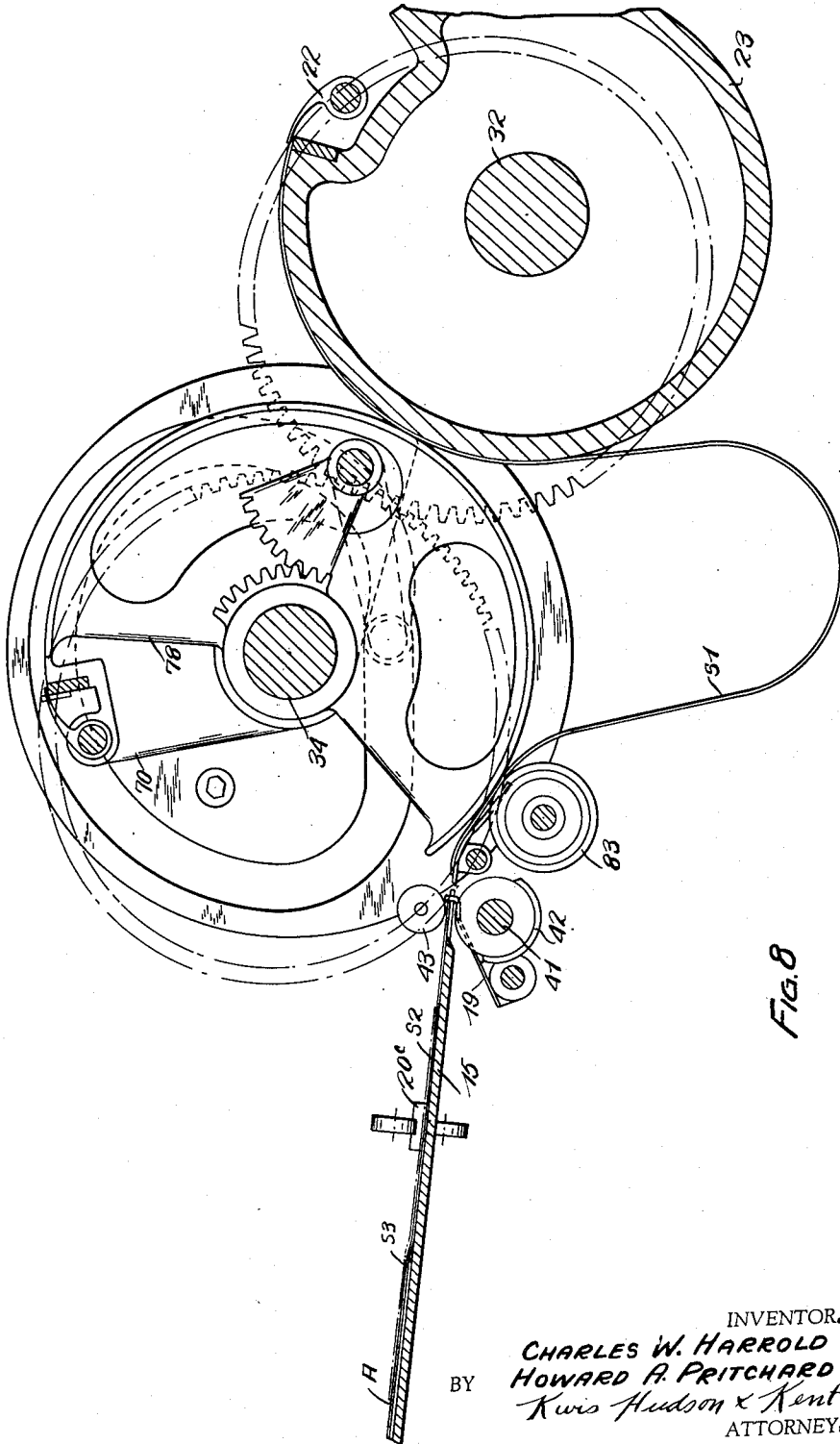
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9 Sheets-Sheet 8

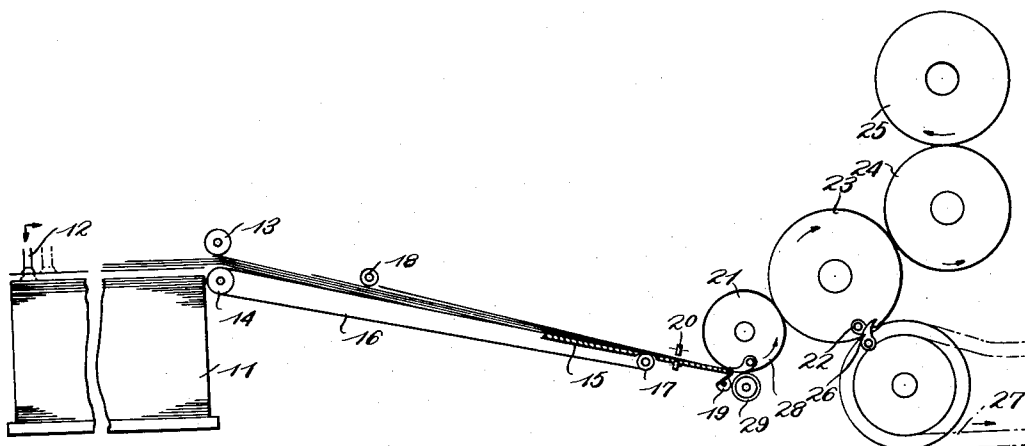


FIG. 10

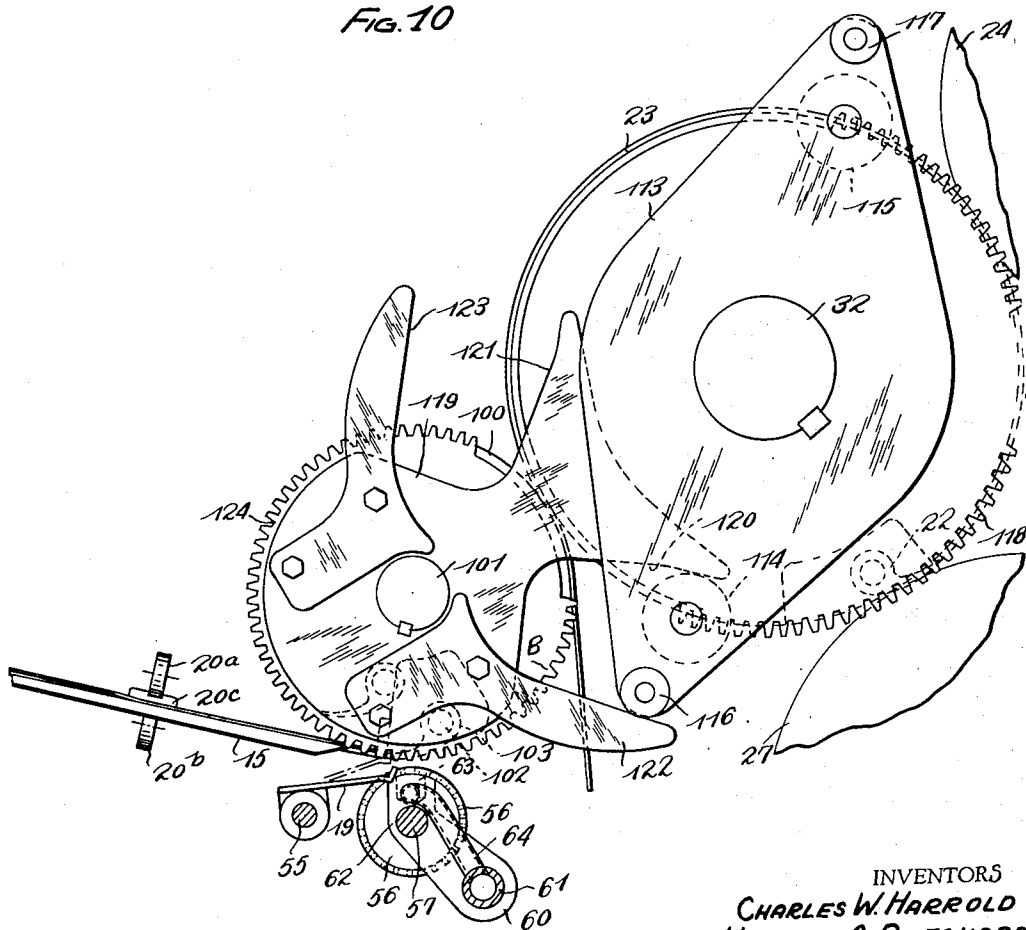


FIG. 11

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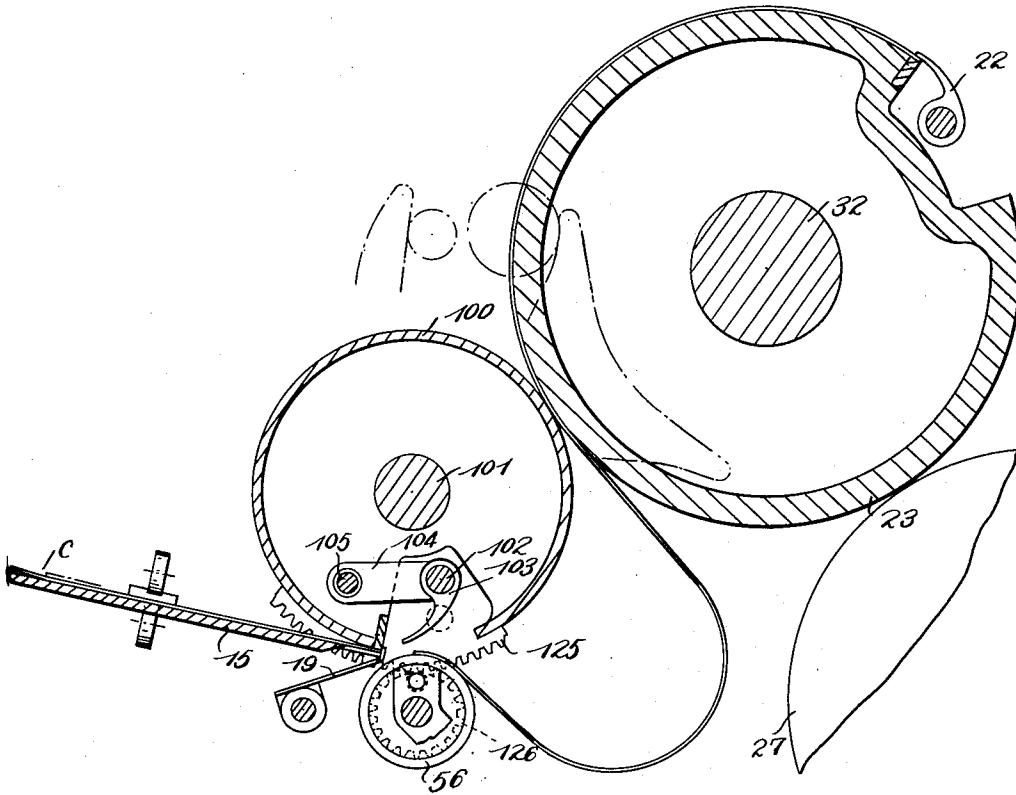


FIG. 12

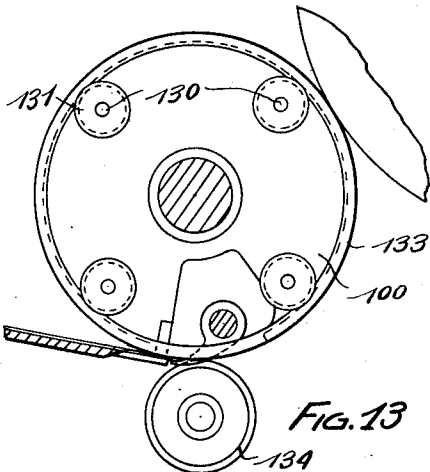


FIG. 13

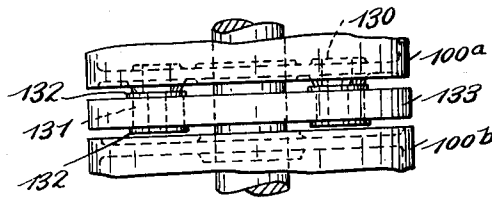


FIG. 14

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UNITED STATES PATENT OFFICE

2,248,079

SHEET FEEDING MECHANISM

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Application September 15, 1939, Serial No. 295,040

16 Claims. (Cl. 271—53)

This invention relates to sheet feeding mechanism for printing presses or other machines operating upon sheet material such as paper, cardboard or the like and has to do particularly with that portion of such machines by which the sheets to be operated upon are removed from the supply of sheets and are presented individually to the operating point of the machine.

The principal object is to provide a machine of the type referred to having increased efficiency over known machines.

More specifically it is an object of this invention to provide mechanism for and methods of handling sheets which will enable the production of an increased quantity of high quality finished product by a machine of given size.

Another object is to provide methods of and means for accurately and reliably presenting sheets in close succession to the grippers of an impression cylinder of a printing press whereby relatively long sheets may be presented to a cylinder of given diameter and a correspondingly large portion of the circumference thereof may be employed for printing.

Another object is to provide means for removing a sheet from lapped relation with a succeeding sheet in such manner as to enable operations to be performed on said succeeding sheet at an earlier point in the cycle of the machine than would be the case if the first mentioned sheet were removed in the usual way.

Another object is to provide means for engaging a moving sheet in an intermediate portion thereof and driving said portion forward at a greater speed than the speed of the leading edge of the sheet for imparting correspondingly greater speed to the rear edge of the sheet.

A further object is to provide in a machine of the type described, methods of and means for reliably transferring sheets from a supply of sheets to a rotating sheet handling cylinder of the machine in rapid succession and with great accuracy whereby the number of high quality sheets produced may be increased.

Another object is to provide methods of and means for transferring sheets from a supply of sheets to a rapidly rotating sheet handling cylinder, such that the sheets are handled at relatively slow speed during their travel from the supply and during registration thereof and are presented at relatively slow speed to slowly moving positive gripping devices of the machine, after which they are accelerated to the speed of the sheet handling cylinder.

In accordance with the foregoing objects, the

invention in its various aspects includes mechanism for removing sheets from a supply and conveying them individually but in lapped relation with each other to a predetermined stationary position where they are at least partially registered, mechanism for advancing the sheets gradually from this stationary position to gripping devices on a rotating sheet handling cylinder, and mechanism for advancing the rear edge of the sheets along the sheet path at greater speed than the leading edge of the sheet for a part of the sheet travel from its stationary position to the work point of the machine.

Other objects and novel features of the invention will be readily understood by reference to the following description and accompanying drawings, in which

Fig. 1 is a diagrammatic view of the pertinent portions of a printing press.

Fig. 2 is an enlarged side elevational view partly in section and with the frame removed, showing one form of sheet transfer mechanism including feed rolls, a continuously rotating transfer member and suction sheet advancing wheels, the gripping devices of the transfer member having just closed on a sheet which has been presented to them.

Fig. 3 is a view similar to Fig. 2 but with the parts in a different position.

Fig. 4 is a partial plan view of the mechanism of Fig. 3.

Fig. 5 is a view similar to Fig. 2 but illustrating segment and roller means instead of suction wheels for advancing the intermediate portion of the sheet.

Fig. 6 is a partial plan view of the mechanism of Fig. 5.

Fig. 7 is a view similar to Fig. 5 showing the relative position of the parts when the leading edge of a sheet is being released to the continuously rotating sheet handling cylinder of the machine.

Fig. 8 is a view similar to Figs. 5 and 7 showing the position of the parts at a later point of the cycle.

Fig. 9 is a diagrammatic elevational view of another form of the invention in which roller means on both sides of the sheet path are utilized to advance the intermediate portion of a sheet.

Fig. 10 illustrates diagrammatically the pertinent portions of a printing press in which the sheets are taken from a position of rest directly by an intermittently rotating transfer member.

Fig. 11 is a side elevational view with the machine frame omitted, showing the intermittent

transfer member of Fig. 10 in position to begin its movement to transfer a sheet.

Fig. 12 is a view similar to Fig. 11 but partly in section and showing the position of the parts when a sheet has just been completely withdrawn from the feed board and the transfer member has just been decelerated to stationary condition preparatory to taking another sheet.

Figs. 13 and 14 are diagrammatic elevation and plan views of a further form of the invention.

Referring to Figs. 1 and 10, the invention is illustrated as applied to a printing press in which sheets are taken from a pile 11 by devices of usual construction such as lifting and forwarding suckers 12 and are fed between forwarding rollers 13, 14 and are carried forward over a feed board 15 by tapes 16 trained around roller 14 and roller 17, wheels 18 resting on the sheets being provided to insure their cooperation with the tapes. Although in certain respects which will hereinafter appear, the invention is applicable to sheets which are completely separated from each other during their passage along the tapes, we prefer to drive roller 13 and tapes 16 at such speed that each sheet is presented to rollers 13, 14 by the lifting and forwarding suckers before the preceding sheet has been completely removed from the pile, so that the sheets are advanced in lapped relation at a speed which is slow compared to the speed at which the sheets are operated upon by the press.

The sheets are advanced to bring each in turn against a stop or stops 19 where they are side registered by a side registering device 20.

The sheets are transferred from the feed board 15 by transfer mechanism generally referred to as 21 to the usual gripping devices 22 of impression cylinder 23 of the press, the latter being illustrated as an offset lithographic press having a blanket cylinder 24 and a plate cylinder 25. After the sheet has passed between impression cylinder 23 and blanket cylinder 24, it is taken by grippers 26 of the usual chain conveyor 27 and transported to a suitable delivery point.

The transfer mechanism referred to may be constructed and operated in a number of ways, some of which are herein illustrated, and may comprise various elements singly or in combination as pointed out in the claims. Preferably, however, it includes a transfer member 28 which is mounted for arcuate movement in the direction of sheet travel, and a sheet advancing device 29 which is arranged to engage the sheet at points intermediate its ends and impel the rear portion of the sheet along the sheet path at a greater speed than the speed of the leading edge of the sheet.

Referring now particularly to Figs. 2 to 4 inclusive, the impression cylinder 23 is supported for rotation in frame 30 of the press and is driven preferably at uniform speed by the usual gearing not shown, acting upon gear 31 fixed to the end of the cylinder shaft 32. In this instance the transfer member 28 is in the form of a cylinder 33 having an integral shaft 34 journaled in frame 30. While under certain conditions cylinder 33 may be made to rotate at constant speed, we prefer to impart variable speed thereto in order to permit the same to take a sheet at relatively slow speed and subsequently deliver the sheet to the impression cylinder at a higher speed. To this end shaft 34 is provided with an elliptical gear 35 which meshes with another elliptical gear 36 fixed to shaft 32. The gears may have any suitable proportions, but as illustrated, they are

such as to impart to the transfer cylinder a minimum speed of one-half and a maximum speed of twice that of the impression cylinder in each revolution.

The cylinder 33 of course need not be a complete cylinder although for simplicity such a cylinder has been shown. Also its position and construction are such as to provide clearance between it and impression cylinder 23 to permit free passage of a sheet while the two cylindrical surfaces are moving at different speeds. Cylinder 33 is provided with grippers 37 mounted on shaft 38 and bearing against a bar 39 fixed in the cylinder, all of which parts may be constructed and operated in any suitable known manner to open and close at the proper time to receive a sheet presented thereto and deliver the same to the grippers of the impression cylinder. The transfer cylinder 33 is also provided with sheet registering stops 40 secured to bar 39 at frequent intervals throughout the length of cylinder 33 to receive sheets forced against them by mechanism described below.

It is to be noted that the grippers 22, 37 are located with their sheet gripping portion on the pitch line of their respective elliptical gears. With this construction both sets of grippers are made to travel at the same speed during the moment when the leading edge of a sheet is transferred to the impression cylinder.

Adjacent transfer cylinder 33 and so located as to advance the sheets against stops 40 when the latter are moving relatively slowly, a series of lower feed rolls 42 and a series of upper feed rolls 43 are arranged in the manner of the well known Harris Press feed rolls to grip the sheets successively between them and feed the sheets forward against stops 40 and into the bite of grippers 37. The lower rolls 42, which preferably have a part of their periphery cut away as illustrated, are fixed on shaft 41 journaled in frame 30. The upper rolls 43 are carried by arms 44 mounted on shaft 45 which is made to oscillate by suitable means not shown so as to raise and lower rolls 43 at desired times. Shaft 41 is provided with a pinion 46 mounted thereon to rotate freely in one direction and connected to the shaft by a clutch, indicated at 47, to drive the shaft in the other direction. Pinion 46 is rotated by an oscillating gear segment 48 on arm 49 pivotally mounted on stud 50 in the frame. Arm 49 carries a follower roller 51 which is pressed by usual spring means, not shown, against a cam 52 which is fixed on shaft 34. The effect of the rotating cam 52 on arm 49 and segment 48, acting through pinion 46 and clutch 47, is to drive shaft 41 and feed rolls 42 in the sheet forwarding direction intermittently and at such rate as to forward each sheet in turn, after it has come to rest against stops 19, toward registering stops 40 on cylinder 33 with the proper speed to permit grippers 37 to pass the leading edge of the sheet in their rotation and thereafter to move the sheet into positive contact with stops 40 with a slight over-feed so that a slight buckle is formed in the sheet. This action assures accurate positioning of the sheet against stops 40 and therefore in relation to the machine as a whole.

It is to be noted that, whereas in prior presses employing feed rolls, the sheet has been accelerated by the feed rolls from rest to a speed slightly greater than the operating speed of the press and fed against stops on the impression cylinder which is moving at full press speed, by means of our invention, sheets are fed forward

at relatively slow speed into contact with relatively slowly moving stops and are thereafter accelerated to full press speed by positive gripping devices.

Extending forwardly of feed board 15 is a series of the usual sheet guides 53 carried by shaft 54 supported in the frame of the machine. The latter shaft is preferably arranged to oscillate slightly at proper times to confine a sheet closely against cylinder 33 when it is being moved into contact with stops 40 and to move away from the cylinder at other times to allow the sheet to pass freely. Stops 19 are mounted on shaft 55 supported in the machine frame and oscillated in the usual manner to raise and lower the stops into and out of operative position as shown in Figs. 3 and 2.

Although the side registering device may be of any suitable design, we have illustrated the same as comprising an upper roll 20a arranged for up and down movement, a lower roll 20b driven in a direction to draw a sheet toward the side of feed board 15 and a guide 20c against which the sheets are drawn. The action of these parts is to engage each sheet after the same has reached stops 19, draw it against guide 20c, and release the sheet before the next sheet reaches the rolls 20a and 20b.

Although the above described mechanism has distinct advantages of its own, as pointed out in the claims, we preferably also employ devices for engaging the sheet after it has begun its travel from the feed board to the impression cylinder whereby the rear portion of the sheet is removed from the feed board and from lapped relation with the next succeeding sheet more rapidly than would be the case if such devices were not employed, the principal purposes being to enable the feeding of a longer sheet or to increase the portion of the cycle of operation during which the means for stopping and side registering the sheet may act, or both. These devices will now be described.

Located adjacent cylinder 33 and in such position as to engage a sheet which is in the act of being carried forward by that cylinder is a plurality of suction wheels 56 fixed on shaft 57 which is rotated in sheet forwarding direction by means of a gear 58 keyed thereto and a driving gear 59 carried by the transfer cylinder 33. The ratio of the gears is such as to cause the peripheries of wheels 56 to move at somewhat higher speed than the surface speed of transfer cylinder 33. Although shaft 57 may be journaled in frame 30 and therefore have no bodily movement, we prefer to mount the same in arms 60 which rotatably support the shaft and are keyed to an oscillatable hollow shaft 61 supported by frame 30, the shaft 61 being oscillated by means not shown to move shaft 57 and its suction wheels toward and away from cylinder 33 at desired times by an amount insufficient to destroy the mesh of gears 58, 59. Certain of the arms 60 are located adjacent suction wheels 56 and are provided with enlarged upper ends 62 shaped to closely fit overhanging flanges 56' of wheels 56 and hollowed out to form pockets 63. These pockets are connected to hollow shaft 61 by pipes 64. Hollow shaft 61 is connected to a source of suction such as a suction pump and preferably a valve is provided in the connections for turning the suction on and off at desired intervals.

The operation of the form of this invention shown in Figs. 1 to 4, inclusive, is as follows. Sheets are removed from pile 11 by suckers 12

and are carried forward at slow speed in lapped relation by tapes 16 until the foremost sheet strikes stop 19 which are then in raised position as shown in Fig. 3. Directly thereafter upper side registering roll 20a descends and presses the sheet against roll 20b which draws the sheet against side guide 20c. During this action lower feed rolls 42 are rotated by action of segment 48 and cam 52 until the leading portion of the full diameter periphery of the roll is in position to contact the sheet. In this position roll 42 is stopped momentarily. After side registration is completed, upper roll 43 descends so as to grip the sheet between the upper and lower rolls while stationary. Upper side register roll 20a is then raised and stops 19 are lowered out of the path of the sheet and cam 52 acting through segment 48 begins to rotate the feed rolls and drive the sheet forward, between the surface of cylinder 33 and guides 53. The timing is such that the sheet, as it nears stops 40 of cylinder 33, is driven slightly faster than those stops and is forced against them with a slight buckle in the sheet. At about the time the parts reach the position of Fig. 2, the grippers 37 close on the sheet and the sheet is released by the feed rolls. Thereafter cylinder 33 continues to rotate at relatively slow speed for a time under the action of elliptical gears 35, 36 and subsequently increases in speed to the speed of the impression cylinder and transfers the leading edge of the sheet to the latter cylinder. When the front edge of the sheet has been taken by grippers 37 and has moved sufficiently past suction wheels 56 to form an arc of suitable extent in advance thereof, these wheels are raised into position adjacent the sheet, and suction is applied through pipe 61 by its valve connection. The wheels thereupon grip the under surface of the intermediate portion of the sheet with a positive gripping action and, owing to their rapid peripheral movement, drive this portion of the sheet forward more rapidly than the leading edge of the sheet is being advanced by cylinder 33 or cylinder 23. As a result a loop is formed in the sheet in the space below the transfer cylinder and the rear edge of the sheet is advanced rapidly off the feed board and off of the next succeeding sheet of the stream, as shown in Fig. 3. In the latter figure the position which the rear portion of the sheet would have occupied if the loop had not been formed is shown in dashed lines, the rear edge being indicated by the letter A.

Immediately after the rear edge of the sheet has been withdrawn from the feed board, stops 19 are again raised to receive the next sheet and the cycle is repeated. Suction to wheels 56 may be cut off at any suitable time after the rear edge of the sheet passes stops 19 but we prefer to maintain suction during the slowing down of cylinder 33 and the consequent slowing down of the wheels so as to maintain control of the rear portion of the sheet for a time. Suction is cut off after the rear edge of the sheet has passed off wheels 56.

It is apparent that, if desired, stops 19 may be raised to operative position and the next sheet fed against them before the rear portion of the outgoing sheet has passed those stops, the raising of the stops resulting in a slight lifting of the latter sheet. Under such circumstances side registration of a sheet may be begun while the same is still partly covered by the outgoing sheet after the latter has passed the side registering point.

The feed rolls 42 may be actuated with the de-

sired movements by other driving means than that shown. The suction wheels 56 may be driven by means and at speeds other than herein described provided the desired increase in sheet speed is attained.

Under some conditions it may be desirable to perform the rapid movement of the rear portion of the sheet by devices engaging both sides of the sheet. Accordingly we have illustrated another form of this part of the invention in Figs. 5 to 8 inclusive. In this form the feed rolls, side register mechanism and front stops function as in the above described form shown in Figs. 2 to 4. The driving connections from impression cylinder 23 to shaft 34 also comprise elliptical gears 35, 36 as in the latter form. The construction of the transfer member, however, differs as described below.

Shaft 34 has fixed in spaced relation thereon a plurality of arms 70 whose outer extremities are formed with curved surfaces 71 to form in effect a portion of a cylinder. These arms carry gripper shaft 38 on which grippers 37 are mounted, also gripper bar 39 and stops 40, these parts functioning in the previously described manner. Arms 70 also rotatably support shaft 72 at one end of which there is keyed an arm 73 having a follower roller 74 which engages the groove 75 of a cam 76 which is secured in stationary position on the frame 30 by screws 77. As shaft 34 and arms 70 rotate in the operation of the machine, shaft 72 is oscillated by the action of cam 76 on arm 73.

Between arms 70 one or more segment wheels 78, having openings 78' to receive shaft 72, are rotatably mounted on shaft 34 and held in place laterally by collars 79. The hub of each segment wheel is provided with a gear segment 80 which meshes with another segment 81 forming part of an arm 82 keyed in proper position on shaft 72. The construction of segments 80, 81, cam 75 and their associated parts is such as to cause segment wheels 78 to oscillate forward and backward relative to shaft 34 as follower 74 travels from the high part of cam groove 75 to the low part and back again.

Suitably located adjacent the sheet path a roller 83, preferably equipped with rubber or other slightly resilient surface, is provided in line with each of the segment wheels 78. These rollers are rotatably carried on pins 84 in the ends of arms 85 which are keyed to shaft 86 carried by the frame of the machine. Shaft 86 is oscillated slightly by mechanism not shown to raise and lower rollers 83 into and out of position to press a sheet against the surfaces of segment wheels 78 at desired times.

In operation this form of device functions as follows. A sheet is fed into the bite of grippers 37 by feed rolls 42, 43 as shown in Fig. 5 and as previously described. At a suitable time thereafter, as for example when the sheet has been transferred to impression cylinder grippers 22 as shown in Fig. 7, shaft 86 is oscillated to bring rollers 83 into position to press the sheet against the forward portion of the outer surface of segment wheels 78. Shortly thereafter roller 74 begins to travel down the cam groove 75 toward the center of rotation and as a result the segment wheels are driven forward more rapidly than the arms 70 and therefore more rapidly than grippers 22 on cylinder 23. This action continues with continued rotation of shaft 34 with the result that when the parts reach the position shown in Fig. 8 the sheet has been completely withdrawn from the feed board and a loop has been formed

in the sheet. As rotation of shaft 34 is further continued, roller 74 begins to travel up the groove 75 away from the center of rotation and segment wheels 78 are gradually returned to the position of Fig. 5. This action as shown is such as to cause the rear portion of the sheet to be retained between rollers 83 and segment wheels 78 for an appreciable part of the time the loop in the sheet is being removed by continued forward movement of cylinder 23.

A further form of device for rapidly advancing the rear portion of the sheet is shown in Fig. 9. In this form the rear portion of the sheet is advanced by driven rollers 90 below the sheet cooperating with idler rollers 91 above the sheet, the latter being raised and lowered at proper times. Rollers 90 are loosely mounted between feed rolls 42 on the feed roll shaft 41 and project into slots 92 provided in the feed board and are driven preferably intermittently by friction wheels 93 keyed to shaft 94 which is rotatably carried in arms 95 and has a gear 96 keyed to one end. Arms 95 are keyed to oscillatable shaft 97 journaled in the machine frame and this shaft loosely carries a gear 98 which meshes with and drives gear 96 and is in turn driven by gear 99 mounted to turn with shaft 34. The transfer member may be varied in form but as shown comprises transfer cylinder 33 as described in connection with Figs. 2 to 4 and is driven in similar manner. The ratio of gears 99, 98, 96 and wheels 93 is such as to drive rollers 90 with a surface speed greater than the surface speed of cylinder 33 by an amount sufficient to remove the sheet from feed board 15 at the desired time.

In operation shaft 97 is turned so as to bring rollers 93 into contact with rollers 90 at about the time shown in Fig. 9. The rear portion of the sheet is thereby driven forward more rapidly than the leading edge thereof into a loop as shown in dotted lines and this is continued until the rear edge passes between rollers 90, 91 and is carried by the momentum of the sheet past the front stops.

A further embodiment of the invention is shown in Figs. 10 to 12 inclusive and will now be described.

Referring to Fig. 10, the previously described arrangements are provided for moving sheets from the pile to stops 19. Transfer mechanism 21 is also provided including a transfer member 28 having arcuate movement in the direction of sheet travel. The transfer member 28 in this instance, however, possesses intermittent rotation and is of smaller diameter than the impression cylinder. Also the organization of the essential parts of the press is somewhat changed, as by raising the blanket and plate cylinders 24, 25 and locating the delivery conveyor farther to the right as shown in Fig. 10 so as to provide unobstructed space below the impression cylinder for forming a loop in the sheets being transferred.

The transfer member comprises a member 100, which for simplicity has been shown as a cylinder, mounted on shaft 101 rotatably journaled in the machine frame. Cylinder 100 supports gripper shaft 102 and grippers 103 through the medium of arms 104 mounted on shaft 105. By mechanism not shown the grippers and gripper shaft are withdrawn into the cylinder as the grippers approach sheet taking position and are again moved outwardly to close on a sheet lying on the feed board 15 at the proper time.

Transfer cylinder 100 is driven with intermittent rotation by means of connections partly on

the impression cylinder 23 and partly on the transfer cylinder. Keyed to shaft 32 is a plate 113 carrying rollers 114, 115, 116, 117. A segment gear 118 is likewise keyed to shaft 32.

To the transfer cylinder is secured a plate 119 formed with cam surfaces 120, 121 in line with rollers 114 and 115. Fixed to plate 119 are cams 122, 123 which are arranged in the proper plane to cooperate with rollers 116, 117. Segment gear 124 also is fixed to rotate with cylinder 100 and meshes with segment gear 118.

As impression cylinder 23 is rotated in the operation of the press the connections just described cooperate to accelerate the transfer cylinder from the stationary condition shown in Fig. 11 to a peripheral speed equal to that of the impression cylinder, this speed being reached when roller 114 reaches the line joining the centers of the two cylinders. Segment gear 118 then comes into mesh with gear 124 to drive the transfer cylinder with constant velocity for a considerable portion of a revolution until roller 115 comes into position to cooperate with cam 121 at which time the gear segments go out of mesh and roller 115 travels out on cam 121 to decelerate the transfer cylinder to a stop. For a more complete description of the operation of this mechanism reference may be had to Harrold et al. Patent 2,192,908, issued March 12, 1940.

At a suitable point adjacent the transfer cylinder suction wheels 56 and their associated mechanism are provided for positively advancing the rear portion of the sheet at higher speed than the speed imparted thereto by the movement of the leading edge of the sheet while held by grippers 103 and 22. These suction wheels are constructed and operated as described with reference to Figs. 2 to 4, their rotation being provided by gear 125 secured to shaft 101 meshing with pinion 126 fixed to shaft 57 as shown in Fig. 12.

In operation sheets are fed in lapped relation against stops 19 and side registered as previously described. The grippers 103 are then closed upon the sheet, the transfer cylinder 100 being stationary at this time. Stops 19 are then lowered and side register roller 20a is raised and the transfer cylinder, together with its grippers and the sheet, starts its forward movement under the influence of driving roller 114. The speed of the transfer cylinder is gradually increased until it reaches the speed of the impression cylinder and thereafter continues at the latter speed for a time until grippers 103 and 22 come opposite each other at which time the sheet is transferred to the impression cylinder. Thereafter the transfer cylinder continues its constant speed travel until it has nearly completed a full revolution and then slows down to a stop again. At a suitable time after the grippers 103 have carried the leading edge of the sheet past vacuum wheels 56 a sufficient distance to permit easy formation of a loop in the sheet, as for example to the position marked B in Fig. 11, these wheels are made to seize the sheet by suction and, by virtue of the rapid rotation imparted to them by their gears 125, 126, to drive the intermediate and rear portions of the sheet forward faster than the leading edge thereof. This results in the formation of a loop shown in Fig. 12 and the removal of the rear edge of the sheet from the feed board and from lapped relation with the next succeeding sheet at an earlier point in the cycle than would otherwise be the case, the position of the rear edge of a sheet handled in the usual

way being indicated by the letter C in Fig. 12. Just prior to the arrival of the next succeeding sheet at the stops 19 and preferably after the rear edge of the preceding sheet has passed over those stops, the latter are raised into operative position and the next sheet is fed against them. After side registration of the latter sheet, transfer grippers 103 seize it and the cycle is repeated.

As an alternative to the use of suction wheels, the form of advancing means shown in Figs. 13 and 14 may be utilized. In this form the transfer cylinder 100 is formed of a plurality of sections 100a and 100b and on one of these sections 100a are provided studs 130 on which are mounted rollers 131 which support between their flanges 132 a ring 133. This ring is free to turn independently of transfer cylinder 100. Below the latter is a driven roller 134 arranged to rotate with speed greater than the normal speed of sheet travel and to press the sheet against the ring 133 at the proper time to form a loop.

In all forms of the invention described herein the extent to which the rear portion of the sheet is advanced beyond its normal position as determined by its leading edge may be varied within wide limits since any degree of such advancement results in a corresponding gain in possible sheet length or the length of time available for registration or both.

The advantages of this aspect of the invention are particularly fully realized in connection with stream feeding of sheets in lapped formation for the reason that the slowly moving sheets may be brought against the stops at the forward end of the feed board immediately after, or even before, the rear edge of a rapidly outgoing preceding sheet has passed those stops, whereas with sheet by sheet feeding sheets must approach the stops at a high rate of speed in order to take advantage of the earlier removal of the outgoing sheet.

It will be seen from the above description that we have provided means by which the efficiency of a printing press of given size may be increased in at least two important respects. By providing a transferring mechanism by which sheets are gripped by feed rolls, gradually accelerated to a speed which is slow compared to the operating speed of the press, registered against slowly moving stops, gripped at this slow speed and subsequently accelerated in completely registered condition to the speed of the press, we have enabled a corresponding increase in the operating speed of the press while maintaining a given quality of product. By providing means for positively advancing the rear portion of a sheet faster than the leading edge thereof during transfer to the impression cylinder we have enabled a corresponding increase in the length of the printed sheet, or an increase in the time available for registration of the sheets, or both.

Other modes of applying the invention in practice will be apparent to those skilled in the art and therefore we wish it to be understood that the scope of our invention is to be regarded as defined exclusively by the appended claims rather than by the foregoing description or the accompanying illustrations.

Having thus described our invention, we claim:

1. In a printing press or like machine, a continuously rotating sheet handling cylinder, a rotary sheet transfer device arranged to take the leading edge of a sheet presented thereto, advance said sheet and transfer the same to said cylinder, means for presenting sheets succes-

sively to said transfer device, and means engaging the surface of an intermediate portion of a sheet taken by said transfer device and driving said portion forward at a greater speed than the speed of said leading edge for advancing the rear edge of the sheet at greater speed than the leading edge thereof, said last mentioned means comprising two rotary members, one on each side of the path of the sheets, arranged to grip the sheet between them, and means for driving at least one of said members with peripheral speed greater than the speed of the forward edge of said sheet.

2. The method of feeding sheets to a continuously rotating sheet handling cylinder of a printing press or like machine comprising advancing sheets successively toward said cylinder, stopping each sheet in turn and preliminarily front registering the same, further advancing each sheet in turn at a lesser speed than the speed of said cylinder, finally front registering each sheet while thus advancing, positively gripping the leading edge of each finally front registered sheet while the same is advancing at said lesser speed, accelerating said gripped leading edge to the speed of the sheet handling cylinder, and transferring the same to said cylinder.

3. The method of feeding sheets to a continuously rotating sheet handling cylinder of a printing press or like machine comprising advancing sheets successively toward said cylinder, stopping each sheet in turn in substantially the same position, gradually accelerating each sheet in turn from rest to a lesser speed than the speed of said cylinder by force applied to the sheet at points progressively further from the front edge thereof, positively gripping the leading edge of each sheet while the same is advancing at said lesser speed, further accelerating said gripped leading edge to the speed of the sheet handling cylinder, and transferring the same to said cylinder.

4. The method of feeding sheets to a continuously rotating cylinder of a printing press or like machine, comprising advancing sheets successively toward said cylinder, stopping each sheet in turn and preliminarily front registering the same, side registering each sheet while stopped, advancing each so registered sheet at a lesser speed than the speed of said cylinder along a defined path, finally front registering each sheet while thus advancing, positively gripping the leading edge of each finally registered sheet while the same is advancing at said lesser speed, accelerating said leading edge to the speed of the sheet handling cylinder, and transferring the same to said cylinder.

5. The method of feeding sheets to a continuously rotating sheet handling cylinder of a printing press or like machine, comprising advancing a stream of lapped sheets toward said machine, stopping each foremost sheet of the stream in turn, side registering said sheet while stopped, thereafter forwarding said side registered sheet so that its leading edge is advancing at a lesser speed than the speed of said sheet handling cylinder, front registering said side registered sheet while thus advancing and while partly lapping the succeeding sheet, accelerating the leading edge of said front and side registered sheet to the speed of the sheet handling cylinder and transferring the sheet to the latter cylinder.

6. The method of feeding sheets to a continuously rotating sheet handling cylinder of a printing press or like machine, comprising ad-

vancing a stream of lapped sheets toward said machine, stopping each foremost sheet of the stream in turn, side registering said sheet while stopped, thereafter advancing said side registered sheet so that its leading edge is advancing at a lesser speed than the speed of said sheet handling cylinder, front registering said side registered sheet while thus advancing and while partly lapping the succeeding sheet, accelerating the leading edge of said front and side registered sheet to the speed of the sheet handling cylinder, transferring the sheet to the latter cylinder, and advancing the rear edge of said sheet at a greater speed than the leading edge thereof during at least a portion of said acceleration and transfer for rapidly clearing the next succeeding sheet of the stream.

7. The method of feeding sheets to a continuously rotating sheet handling cylinder of a printing press or like machine, comprising advancing a stream of lapped sheets toward said machine, preliminarily front registering each sheet in turn by stopping the same while continuing to advance the succeeding sheets, side registering each sheet while so stopped, further advancing each side registered sheet so that its leading edge is advancing at a speed less than the speed of the sheet handling cylinder, finally front registering each sheet while thus advancing, positively gripping the leading edge of each sheet so registered, accelerating the gripped edge of the sheet to the speed of the sheet handling cylinder, and transferring the sheet to the latter cylinder.

8. The method of feeding sheets to a continuously rotating sheet handling cylinder of a printing press or like machine, comprising advancing a stream of lapped sheets toward said machine, preliminarily front registering each sheet in turn by stopping the same while continuing to advance the succeeding sheets, side registering each sheet while so stopped, further advancing each side registered sheet so that its leading edge is advancing at a speed less than the speed of the sheet handling cylinder, finally front registering each sheet while thus advancing, positively gripping the leading edge of each sheet so registered, accelerating the gripped edge of the sheet to the speed of the sheet handling cylinder, transferring the sheet to the latter, and advancing the rear edge of the sheet at a greater speed than the speed of the leading edge thereof during at least a portion of said acceleration and transfer for rapidly clearing the next succeeding sheet of the stream.

9. In a printing press or like machine for operating on sheets, a constantly rotating sheet handling cylinder, a sheet transfer device having variable movement including speeds equal to and less than the speed of said cylinder, said transfer device being arranged to take a sheet while moving at a lesser speed than the speed of said cylinder, to accelerate said sheet and to deliver the same to said cylinder while moving at the speed of the latter, means for advancing sheets successively to a position of rest adjacent said transfer device, and roller means above and below the path of the sheets arranged to grip a sheet in said position of rest and advance the leading edge thereof into position to be taken by said transfer device while the latter is moving at a speed less than the speed of the sheet handling cylinder.

10. In a printing press or like machine for operating on sheets, a constantly rotating sheet handling cylinder, a sheet transfer device having

variable movement including speeds equal to and less than the speed of said cylinder, said transfer device being arranged to take a sheet while moving at a lesser speed than the speed of said cylinder, to accelerate said sheet and to release the same to said cylinder while moving at the speed of the latter, stops arranged to move in unison with said transfer device while the latter is taking a sheet, means for advancing sheets successively to a position of rest adjacent said transfer device, and roller means above and below the path of the sheets arranged to grip a sheet in said position of rest and advance the leading edge thereof against said stops while so moving, said transfer device including sheet grippers arranged to close on a sheet while the same is against said stops.

11. In a printing press or like machine for operating on sheets, a constantly rotating sheet handling cylinder, a sheet transfer device having variable arcuate movement in the direction of sheet travel including peripheral speeds equal to and less than the peripheral speed of said cylinder, said transfer device being arranged to take a sheet while moving at a lesser speed than the speed of said cylinder, to accelerate said sheet and to release the same to said cylinder while moving at the speed of the latter, stops on said transfer device, means for advancing sheets successively to a position of rest adjacent said transfer device, and roller means above and below the path of the sheets arranged to grip a sheet in said position of rest and advance the leading edge thereof at a speed slightly greater than the speed of said transfer device and into contact with said stops while said device is moving at a lesser speed than that of said cylinder, said transfer device including sheet grippers arranged to close on a sheet thus advanced into contact with said stops.

12. In a printing press or other machine for operating on sheets, a constantly rotating sheet handling cylinder having sheet grippers, a non-uniformly rotating sheet transfer cylinder cooperating therewith, means for driving said transfer cylinder with variable rotation including peripheral speed equal to that of the sheet handling cylinder when releasing a sheet thereto and less than the speed of the sheet handling cylinder when taking a sheet, stops on said transfer cylinder, means for advancing sheets in succession to a position of rest adjacent said transfer cylinder, and feed rolls above and below a sheet in said position of rest arranged to grip the same between them and advance the sheet against said stops while the transfer cylinder is rotating at a speed less than the speed of the sheet handling cylinder, said transfer cylinder including sheet grippers arranged to close on a sheet so advanced against said stops and to open for releasing the sheet to said sheet handling cylinder.

13. In a printing press or like machine for

operating on sheets, a constantly rotating sheet handling cylinder, a sheet transfer device having variable arcuate movement in the direction of sheet travel including peripheral speeds equal to and less than the peripheral speed of said cylinder, said transfer device being arranged to take a sheet while moving at a lesser speed than the speed of said cylinder, to accelerate said sheet and to release the same to said cylinder while moving at the speed of the latter, means for advancing sheets successively to a position of rest adjacent said transfer device, and a pair of intermittently rotating feed rolls, one above and one below the path of the sheets, arranged to grip a sheet in said position of rest between them while they are stationary and to thereafter rotate to gradually advance the sheet from its position of rest to a speed corresponding to that of said transfer device and into position to be taken by said transfer device while the latter is moving at a speed less than the speed of the sheet handling cylinder.

14. In a printing press or like machine, means for feeding sheets in lapped formation, transfer means for taking the leading edge of each sheet from the feeding means, and means for first advancing the rear portion of the sheet at greater speed than said leading edge to form a loop in the sheet and thereafter retarding said rear portion of the sheet for maintaining control thereof.

15. In a printing press or like machine, means for feeding sheets in lapped formation, transfer means for taking the leading edge of each sheet from said feeding means, and positively driven non-uniformly rotating roller means arranged and operated to grip the surface of an intermediate portion of each sheet after its leading edge has been taken by said taking means, drive said gripped portion forward at a greater speed than the speed of said leading edge whereby a loop is formed in the sheet and thereafter to slow down the gripped portion of the sheet whereby control of the rear edge of the sheet is maintained during the transfer operation.

16. In a printing press or like machine, a continuously rotating sheet handling cylinder, a non-uniformly rotating sheet transfer device arranged and operated to take the leading edge of a sheet, accelerate to the speed of the sheet handling cylinder, release the sheet to the sheet handling cylinder and decelerate to take another sheet, means for presenting sheets successively to the transfer device, and roller means positively driven with non-uniform rotation by said transfer device, said roller means being arranged and operated to grip the surface of an intermediate portion of a sheet taken by the transfer device, drive said portion forward at a greater speed than the speed of the leading edge of the sheet, and thereafter slow said portion down.

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