This invention relates to sheet delivery mechanism for printing presses or the like, and more particularly to devices of this character which are adapted to be driven at variable speeds, whereby the printed sheets may be received from the impression or take-off cylinders or other sheet handling members of the press at approximately the linear speed of the same and discharged onto the delivery board or table at a reduced speed.

In the operation of modern high speed printing presses, it has been found that if the printed sheets are projected onto the delivery pile at the same linear speed as the peripheral velocity of the impression cylinder, the sheets strike the rear jogger board with such force that the forward or gripper edges thereof are frequently damaged, often so much as to impair the registry of the sheets in cases where it is necessary to pass them through the press a second time.

Several proposals have been advanced with the object in view of obviating this difficulty, and these proposals have involved the use of various intermittently operated devices, cam and linkage driven conveyors, and deliveries which are operated at variable speeds by means of elliptical gearing. All of these attempted solutions of the problem have been found to be objectionable in the exceedingly large number of operating parts required, the unnecessarily great amount of space occupied by these complicated mechanisms adjacent the delivery end of the press, and the practical difficulties and expense attendant upon the manufacture of these devices; especially those employing cams, elliptical gears, and other irregularly shaped elements which require special machinery and processes in their production.

It is, therefore, one of the principal objects of the invention to provide a novel and improved delivery device which is of simple, compact, and inexpensive construction, easy to manufacture by the use of ordinary machine tools, and which at the same time will embody mechanism for varying its linear velocity during its cycle of movement to effect the purpose desired.

It is a further object of the invention to provide in a delivery device of this type means for adjusting or controlling the variations in delivery speed in accordance with the size of the sheet being delivered or the nature of the material of which it is composed.

Another object of the invention is to provide a novel variable speed gearing assembly which is particularly adapted for use in converting the uniform motion of the impression cylinder or other moving part of a printing press into the variable cyclic motion required in the proper and efficient operation of the delivery mechanism.

A more particular object of the invention is the provision, in such a gearing assembly, of means for adjusting the same to vary the points at which the maximum and minimum velocities of the ultimate driven element thereof occur during its cycle of movement.

The invention in its preferred embodiment contemplates the provision of a sheet delivery comprising an endless tape conveyor which extends from a point adjacent the impression cylinder of the printing press to a point from which the sheets may be successively discharged against the rear jogger board and onto the delivery pile where they may be stacked and lowered in the usual way. The conveyor preferably comprises upper and lower series of tapes which are passed about rollers at each end of the device; certain of the rollers being provided with pins which mesh with the driven gear of the variable speed gearing interposed between the conveyor and the source of uniform motion from which it is operated; this source of motion being conveniently the impression cylinder gear.

The variable speed device in this embodiment comprises a multiple planetary system, each part of which is adapted to develop a motion which is variable during any given cycle, the motions being compounded and transmitted to the driven member which in turn imparts the resultant variable motion to the conveyor. The initial motion developed by the gearing is effected by a driving crank pin or other similar element which pursues a closed cyclic orbit without retracement during any single cycle—that is, in a continuous forward direction—this orbit in the present form of the invention being a prolate epicycloid. This driving element is itself made to actuate, through certain other planetary gearing, another driving element which also follows a cyclic path or orbit without retracement, but preferably somewhat out of phase with the first named driving element. In the present embodiment the second element also describes a prolate hypocycloid. This second driving element is operatively connected with the conveyor so that the variable angular velocity representing the combined effects of the movements of the two driving elements is transmitted thereto. Adjusting means are also provided in connection with certain members of the planetary system for varying the points of maximum and minimum velocity during the cycles of movement of the device.

A still further object of the invention is the
provision of novel means whereby the delivery conveyor may be readily and quickly disconnected from its drive, and whereby it may be swung away from the press in two planes of movement, so that access may be had to parts of the press lying beneath the delivery mechanism.

Other objects and features of novelty will be apparent from the following specification when read in connection with the accompanying drawings in which one embodiment of the invention is illustrated by way of example.

In the drawings:

Figure 1 is a view in side elevation of the delivery end of a press of the bed and cylinder type, to which a novel delivery device embodying the principles of the present invention has been applied.

Figure 2 is a plan view of the same portion of the press and sheet delivery shown in Figure 1.

Figure 3 is a view in vertical longitudinal section through the variable speed drive for the delivery device, and taken on line 3--3 of Figure 4, certain parts being broken away for the sake of clearness of illustration.

Figure 4 is a horizontal sectional view through the same device taken substantially on line 4--4 of Figure 3.

Figure 5 is a fragmentary vertical longitudinal sectional view taken on line 5--5 of Figure 4.

Figure 6 is a fragmentary horizontal sectional view taken on line 6--6 of Figure 3.

Figure 7 is a view in perspective of the delivery end of the press showing clearly the manner of accommodating means for moving the sheet delivery device away from the main body of the press as for the purposes of inspection, cleaning, or repair, or for obtaining access to the printing form on the bed of the press.

Figure 8 is a chart showing graphically the curves depicting the velocity ratios of the various driving and driven elements.

Figure 9 is a diagram showing the paths of the two crank pins, referred to broadly herein as the driving elements, and

Figure 10 is a diagrammatic view showing one method of driving the impression cylinder gear.

Referring now more particularly to Figures 1, 2, and 7 of the drawings, the numeral 10 designates the main supporting frame of the printing press to which the novel sheet delivery is applied; only the delivery end of the press being shown for the purposes of illustrating the present invention. The press is one of the reciprocating bed and cylinder type and the form carrying bed is indicated at 12 in Figure 7. The impression cylinder, by means of which the sheets are successively presented to the bed for receiving the impression, is indicated at 15 in Figures 1 and 2 of the drawings and is supported for rotation in suitable bearings in the upper side frames, a portion of one of which is shown at 16.

A supplemental delivery frame 20 is secured to the delivery end of the press frame for swinging movement in a horizontal plane to and from its 35 operative position. The press frame 10 is provided with suitable upper and lower brackets 21 and 22 which carry a vertical pinion rod 23 upon which is adapted to rotate the brackets 24 and 25 formed on the frame 20 of the delivery assembly 26 as illustrated by way of a triangular configuration as shown in Figure 7 and is provided with the horizontally extending side frame portions 27 and 28 upon which are carried the pile or stack lowering mechanism which 75 may comprise the truck 29, the gear 30 and other more or less conventional structure for guiding, supporting, and lowering the pile of printed sheets indicated at 32.

The delivery conveyor, which in the present embodiment comprises an endless tape and roller conveyor, is indicated generally by the reference numeral 35. The rigid frame of the conveyor device comprises the side members 36 and 37 which are braced by means of the cross rods 38 and are provided at one end with the hinge brackets 39 10 and 40, each of which is provided with outwardly extending trunnions which are rotatably mounted in bearings in the delivery side frames 27 and 28. The bracket trunnion 39 rotates in the bearing 42, and the bracket 40 is provided with a trunnion shaft 43 which passes through a suitable bearing in the side frame 28. The trunnion shaft 43 is provided exteriorly of the side frame 28 with a sheave 45 about which passes a cord 46, one end of which is secured as at 47 to a portion of the sheave 45, the other end being secured as at 48 to a sheave 49 which is loosely mounted upon the pindle shaft 23 and is urged downwardly by the coil spring 50 which surrounds the shaft and is adapted to be compressed between the sheave 49 and the bracket 21. The cord 46 is passed around the sheave 45 in such a manner as to continually exert a pressure thereon so as to urge the sheave and the pindle 43 in a clockwise direction as viewed in Figure 1. Thus the spring 50, acting through the mechanism just described, serves to counterbalance the weight of the conveyor frame 35 and to facilitate the lifting of the frame away from the operative position shown in Figures 1 and 2 to the raised position shown in Figure 7, or in broken lines in Figure 1. It will be readily understood that when access to the form 12 or other mechanism of the press which normally lies beneath the sheet delivery is desired, the delivery conveyor 35 may be readily swung upwardly to its raised position and then the entire delivery and pile supporting frame 20 swung horizontally away from the press to the positions shown in Figure 7.

At each end of the delivery conveyor 35 there are disposed upper and lower shafts which carry the rollers about which the upper and lower conveyor tapes are adapted to run. The lower tape rollers are indicated at 52, and the lower tapes themselves are shown at 54. The upper tape driving shafts are indicated at 55 and carry the pulleys 56 about which the upper tapes or bands 57 are passed. At the discharge end of the conveyor the upper pulleys 56 are loosely mounted on the rear fixed shaft 38. The forward or receiving end of the pivoted tape conveyor is provided with end brackets 58 and 59 which are adapted to be received in the sockets or rests 60, one of which is shown clearly in Figure 7, in order to support the conveyor in its proper operative position for receiving the printed sheets from the impression cylinder and for operative connection with the driving transmission which is carried by the main part of the press.

In order to retain the conveyor 35 in its raised position, there is provided a latch member 62 pivoted to the side frame member 27 as at 63 and having a notch 65 formed therein for the reception of the pin 66 carried by the trunnion bracket 39 of the conveyor. As shown in broken lines in Figure 1 of the drawings, when the conveyor is in its raised position, the pin 66 is received within the notch 65 and the latch member 62 serves to prevent the conveyor from falling. When the conveyor is in operative position, 75
a projection 61 on the rear end of the latch 62 abuts the undersurface of a ledge 68 on the frame 27 and serves to maintain the latch in a horizontal idle position. Numerous auxiliary devices may, of course, be provided in connection with the novel sheet delivery arrangement, such as, for example, the gas burner 70 and the apron 71.

In order to take the printed sheets from the impression cylinder 15 and properly guide them to the tape conveyor device 35, there is provided the following mechanism. A series of presser rollers 75 which are carried by the arms 76 which are supported from the cross shaft 77 carried by the press frame 10. The stripper fingers 80 which serve to separate the sheets from the impression cylinder 15 are carried by a shaft 81. A transverse sheet delivery roller shaft 82 is carried in suitable bearings in the frame 10 and is driven by mechanism which will presently be described. The delivery rollers 84 are carried by this shaft, and the delivery tension rollers 85 are disposed in running contact with certain of the rollers 84 and assist in delivering the printed sheet from the impression cylinder. These rollers 85 are carried by the arms 86 which are free to swing on the shaft 71. The collars 88 secured to the shaft 77 between the bifurcated rear ends of the arms 86 serve to maintain the rollers 85 in the proper laterally spaced positions.

The sheet delivery roller shaft 82 is provided upon its outer end with a gear 90 which meshes with the toothed section 91 of the cluster gear 92, this cluster gear being rotatably mounted upon the shaft 93 and having a toothed portion 95 which meshes with and is driven by the impression cylinder gear 96 as shown in Figure 2 of the drawings. The rollers 84 are thus driven at a constant peripheral speed corresponding to that of the impression cylinder 15. The impression cylinder mounted on shaft 95 is rotatable with its gear 96 in the usual manner. Gear 96 is driven at a constant angular velocity by a primary source of power, such as a motor (not shown). For further details reference may be had to Patent No. 1,777,092.

The driving connections from the impression cylinder gear 96 to the conveyor mechanism 35 will now be described. Secured as by means of the bolts 98 to the portion 16 of the main press frame is the housing 100 to which a cover plate 101 is secured as by means of the bolts 102. A stub shaft 104 is adjustably rotatably mounted in the bearings 105 and 106 formed in the housing 100 and the cover plate 101 respectively, and serves to support the various elements of the transmission mechanism about to be described.

A main driving gear 110 is freely rotatable on the shaft 104 and meshes with the toothed portion 111 of the cluster gear 92 so as to driven thereby. The gear 110 carries a pin 112 upon which the planet pinion 113 is adapted to rotate; this pinion 113 being continually in mesh with the sun gear 115 which is keyed with the shaft 104. At a predetermined distance from the axis of the planet pinion 113 there is provided a driving element or crank pin 116 upon which is carried a rectangular block 118. A rotatable plate or arm 120 is provided adjacent its center with a bearing 121 and is freely rotatable upon the shaft 104. One end of the arm 120 is provided with a slot 122 within which the block 118 is adapted to reciprocate during the operation of the device. Upon the opposite end of the arm 120 there is provided a circular opening 124 which is adapted to receive the hub 125 of the planetary pinion 126 which also meshes with the sun gear 115 during operation of the transmission. The pinion 125 may be provided with an extended hub portion 127 on the side opposite to the bearing hub 125, the outer surface of which may bear against a corresponding surface of the main driving gear 118 in order to properly position the pinion with respect to the gear members of the gearing assembly. Eccentrically carried by the pinion 125 at a predetermined distance from its center is the crank pin 130 which carries the rectangular block 131 adapted to reciprocate within the slot 125 of the large driven gear 135 which is free to rotate upon the shaft 104. The gear 125 meshes with the portion 136 of the compound gear 137 fixed to the upper tape or band carrying shaft 55. The other toothed portion 138 of the compound gear 137 meshes with the gear 140 carried by the lower tape shaft 52. Thus, it will be seen that there has been described a continuous driving connection from the impression cylinder gear 96 to the tape 94 and 97 of the delivery conveyor 35. When the delivery frame is raised out of operative position, the toothed portion 138 of the compound gear 137 is lifted out of mesh with the latch gear 135 of the transmission, and thus the driving connection is broken. This disconnection of the driving train may be readily observed in Figure 7 of the drawings.

From the foregoing explanation, it will be clearly apparent how the transmission, which has just been described, transforms the continuous uniform rotary motion of the impression cylinder gear into the variable speed at which the tapes of the delivery conveyor are driven in accordance with the principal object of the present invention. Since the main driving gear 110 of the transmission revolves the planetary pinion 113 around the stationary sun gear 115, the crank pin 116 describes an orbit which in the present embodiment of the invention is epitrochoidal indicated at S in Figure 9 of the drawings. In this diagrammatic figure the pitch circles of the several gears are given the same reference numerals as the gears themselves in the mechanical figures, and the centers of rotation of these gears are indicated by the characters employed in designating the axes or pins upon which they rotate. The driving elements or crank pins 116 and 130, however, are respectively designated A and B in the initial positions which they are made to assume in the diagram in Figure 9, and A' and B' in the positions they occupy when the planetary gear 113 has been moved through one quadrant of its cycle, this angle of movement being indicated at θ. The angle θ is also the angle which the crank A makes with the line connecting the centers 104 and 113. During the movement of the crank pin 116 from position A to position A', the center 125 of the planetary gear 126 is moved from the position shown at the left hand side of the diagram to the position shown in the lower right hand portion of the figure due to the rotation of the sun gear 115 caused by the movement of the crank pin 116. During this movement of the gear, it is revolving around the sun gear 115, and the second driving crank pin 130 moves from the position designated B to position B'. During the complete cycle of movement of the gearing, the crank pin 116 describes the prolate epitrochoidal orbit designated T in Figure 9.
Figure 9. It will be noted that in this particular embodiment the crank pin B is initially disposed 90° (φ) out of phase with the driving crank pin 116 in order to attain the desired variations in the angular velocity of the driven gears. It is readily conceivable, however, that the two planetary systems may be disposed in phase with each other or at any suitable angular displacement, depending upon the specific variations in velocity desired. The angle designated φ is the angle which the crank b makes with the horizontal axis 10—10 when φ equals zero; the angle φ' is the angle which a line drawn through the pin 116 and center 104 makes with the 10—10 axis; and the angle φ'' is the angle which a line drawn through the pin 130 and the center 104 makes with the 10—10 axis, all as clearly shown in the diagram of Figure 9. During the movement of the gearing from the initial points indicated at A and B the angular displacement of the point B has become equal to φ + φ'. Both of the crank pins 116 and 130 are disposed at a distance from the centers of their respective pinions which are less than the radius of the pinions, and therefore the paths or orbits S and T are prolate epicycloids.

The angular velocity of the crank pin 116 and consequently of the slotted arm 120 may be determined according to the following equation:

$$\omega_f = \frac{K^2 + M + 1 - K(M + 2) \cos M \theta}{K^2 + 1 - 2K \cos M \theta} \omega_d$$

where:

- K = ratio of the distance between the centers of the planet pinion 116 and the sun gear 115, to the crank length of the crank pin 116,
- M = the ratio of the sun gear to the planet gear,
- \(\omega_d\) = the uniform angular velocity of the driving gear 110, and
- \(\omega_f\) = the variable angular velocity of the driven arm 120.

In the present construction, as already indicated, an additional planetary system has been combined with the system which has just been worked out. This system is the same as the first one with the exception that the crank lengths are somewhat different and the cranks are disposed 90° out of phase. The variable angular velocity of the large driven gear 135 may be determined by the use of the same general equation as in the case of the first crank pin, thus:

$$\omega_f = \frac{K^2 + M + 1 - K(M + 2) \cos M \phi_1}{K^2 + 1 - 2K \cos M \phi_1} \omega_{df}$$

In this particular design, the gear ratio M = 1, since the diameters of the pinions 113 and 125 are the same as that of the sun gear 115; and the value of K = 3 for the first crank pin and K = 5 for the second crank pin 130, which is carried by the pinion 126 rotated by the arm 120. Therefore, the velocity formulae are solved as follows:

$$\omega_f = \frac{11 - 9 \cos \theta}{10 - 9 \cos \theta} \omega_d$$

and

$$\omega_f = \frac{27 - 15 \cos \phi_1}{26 - 10 \cos \phi_1} \omega_{df}$$

The velocity ratio of the driven gear 135 to the driving gear 110 will be:

$$\frac{\omega_f}{\omega_d} = \frac{\omega_{df}}{\omega_{df}}$$

It will thus be seen that the final angular velocity of the driving element or crank pin 130 and of the final gear 135 of the transmission may be determined, and this represents the variable motion which is imparted through the pinions 131 and 140 to the tapes of the delivery conveyor.

In Figure 9 there are shown curves representing the variable motions of certain parts of the transmission. The curves indicate velocity ratios (driven members to driving members) plotted against the angles through which the main driving gear 110 carrying the pinion 113 passes. The curve I represents the velocity ratio of the crank pin 116, represented at A in Figure 9, as the crank center 112 passes through the angles c. The curve II represents the velocity ratio of the crank pin 130 indicated at B in Figure 9 to the crank A (116). The resultant velocity ratio curve III represents the velocity ratio of the final crank pin 130 or the driven gear 135 to the velocity of the drive gear 110, or the product of the two curves I and II.

The values upon which the curves are based are set forth in the following tabulation:

<table>
<thead>
<tr>
<th>Degrees</th>
<th>(\omega_f/\omega_d) (I)</th>
<th>(\omega_f/\omega_d) (II)</th>
<th>(\omega_f/\omega_d) (III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 or 360</td>
<td>1.000</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>30</td>
<td>0.967</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>60</td>
<td>0.928</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>90</td>
<td>1.000</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>120</td>
<td>1.10</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>150</td>
<td>1.19</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>180</td>
<td>1.23</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>210</td>
<td>1.29</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>240</td>
<td>1.35</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>270</td>
<td>1.40</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>300</td>
<td>1.46</td>
<td>1.038</td>
<td>1.019</td>
</tr>
<tr>
<td>330</td>
<td>1.52</td>
<td>1.038</td>
<td>1.019</td>
</tr>
</tbody>
</table>

It will thus be seen that in the exemplary construction described herein, the ratio of the angular velocity of the conveyor driving gear 135 to the impression cylinder gear 95 varies from a maximum of about 3.2 to a minimum of 0.519 during each cycle. Thus the printed sheets may be received from the impression cylinder at a point on the cycle of movement of the conveyor where the velocity will be at or near its maximum, and the sheets may be discharged from the jogger board at a point during the cycle which is nearer the point of minimum velocity. It will also be noted that the slope of the curve III representing the period of deceleration of the conveyor is longer and more gradual than the opposite slope representing the accelerating movement of the conveyor from its minimum to its maximum relative velocities.

This feature is advantageous in providing a slightly longer period of time during which the sheets are carried at a diminishing speed toward the delivery point, and providing a relatively quick recovery to the maximum speed approximating that of the impression cylinder preparatory to receiving a subsequent sheet.

In order to vary the degree of reduction of the delivery speed with relation to the cylinder speed, the point at which the minimum linear speed of the tapes occurs is shifted along the cycle of movement thereof. This is also useful in accommodating sheets of different sizes as well as varying the speed of discharge of sheets. This shifting of the location of the point of maximum and minimum linear velocities of the conveyors is accomplished by rotating the sun gear
115 and thus displacing the crank pins 116 and 130 a desired distance along their orbits. As already described, the sun gear 115 is keyed to the shaft 184, and upon the projecting end of the 5 shaft 184 there is secured a handle 150 as by means of the clamping bolt 151 which serves to draw the bifurcated ends 152 of the handle member together upon the shaft. The handle member 150 is provided with a segmental slot 155 which is preferably of 120° extent. A pin or stud 156 projects from the housing 100 through the slot 155 and has a clamping hand wheel 157 threaded upon its outer end. By rotating the wheel 157 upon the stud 156 the handle bracket 150 may be freed for rotative adjustment, or clamped tightly in its selected position. By the proper adjustment of the sun gear 115 through the manipulation of the handle 150, as much as a 40% reduction in delivery speed of the conveyor below is attainable.

Among the advantages accruing from the possibility of this adjustment are the following: the sheets are deposited gently in the jogger; the winding over one another; the mitigation and crumpling of the sheets are eliminated; the jogging is made more effective; and the drying time is increased.

It will be understood that various changes and modifications may be made in the exemplary embodiment illustrated and described herein without departing from the scope of the invention as determined by the subjoined claims.

In the broader claims the term "driving elements" is employed to indicate patentable equivalents of the crank pins 116 and 130; sheets are prevented from crumpling over one another; the mitigation and crumpling of the sheets are eliminated; the jogging is made more effective; and the drying time is increased.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a printing press of the class described, having an impression cylinder, means for driving said cylinder at a constant angular velocity, and an endless tape conveyor disposed with its receiving end adjacent said cylinder and its discharge end adjacent the point of delivery of the printed sheets; means having a single connection with said cylinder driving means to drive said conveyor, said means comprising a plurality of trains of epicyclic gearing adapted to convert the uniform velocity of said driving means to a variable velocity and imparting it to said conveyor, whereby the conveyor is adapted to receive a sheet from the cylinder while moving at approximately the peripheral speed of said cylinder and to discharge it at a reduced speed.

2. In a printing press of the class described, having an impression cylinder, means for driving said cylinder at a constant angular velocity, and a conveyor disposed adjacent said cylinder; means having a single connection with said cylinder driving means to drive said conveyor, said means comprising successive trains of epicyclic gearing adapted to convert the angular velocity of said driving means to a variable velocity and impart it to said conveyor, whereby the conveyor is adapted to receive a sheet from the cylinder while moving at approximately the peripheral speed of said cylinder and to discharge it at a reduced speed.

3. In a printing press, in combination, an impression cylinder or the like, a delivery conveyor adapted to receive printed sheets from said cylinder at substantially the peripheral speed of the latter and to deliver them at a different speed, and a plurality of systems of planetary gearing operatively connected in series and disposed between said cylinder and said conveyor and having a single actuating connection only with said cylinder.

4. In a printing press or the like, having a supporting frame, a rotary sheet handling member adapted to be driven at a substantially constant angular velocity, and a delivery conveyor supported upon said frame adjacent said member and adapted to receive a sheet therefrom, the combination of a shaft carried by said frame, a sun gear keyed thereto, a planet gear meshing with said sun gear, a rotatable planet carrier driven from said sheet handling member and supporting said planet gear for revolution about said sun gear, a second planet carrier rotatable about said shaft, a pin and slot driving connection between said planet gear and said second planet carrier, a second planet gear also meshing with said sun gear and carried by said second planet carrier for revolution about said sun gear, a driven member operatively connected with said conveyor, and a pin and slot driving connection between said member and said last named planet gear.

5. In a printing press or the like, having a supporting frame, an impression cylinder, an impression cylinder shaft rotatably mounted in said frame, an impression cylinder gear secured upon said shaft, means for driving said gear at a substantially uniform angular velocity, and a delivery conveyor disposed upon said frame adjacent said impression cylinder to receive the printed sheets therefrom while moving at approximately the same linear speed as the peripheral speed of the impression cylinder and to deliver them at a reduced speed, the combination of a shaft carried on said frame, a sun gear fixed thereon, a planet gear meshing with said sun gear, a rotatable planet carrier driven by said impression cylinder gear at the same angular velocity as the latter, said planet gear being meshing with said sun gear and carried by said second planet for revolution about said sun gear, a driving pinion on said conveyor, a driven gear rotatably mounted on said last named shaft and adapted to mesh with said conveyor pinion, and a pin and slot driving connection between said driven gear and said last named planet gear.

6. In a printing press or the like, in combination, a supporting frame, an impression cylinder, an impression cylinder shaft rotatably mounted in said frame, an impression cylinder gear secured upon said shaft, means for driving said gear at a substantially uniform angular velocity, an endless tape delivery conveyor disposed upon said frame adjacent said impression cylinder to receive the printed sheets therefrom while moving at approximately the same linear speed as the peripheral speed of the impression cylinder and to deliver them at a reduced speed, said conveyer being mounted for swinging movement away from operative position with respect to the press, a shaft carried on said frame, a sun gear fixed
thereon, a planet gear meshing with said sun gear, a rotatable planet carrier driven by said impression cylinder gear at the same angular velocity as the latter and supporting said planet carrier for revolution about said sun gear, a second planet carrier rotatable about said shaft, a pin and slot driving connection between said planet gear and said second planet carrier, a second planet gear also meshing with said sun gear and adapted by said second planet carrier for revolution about said sun gear, a driven gear rotatably mounted on said last named shaft, and a pin and slot driving connection between said driven gear and said last named planet gear, and a conveyor actuating pinion on said said driven gear during operation of the press and conveyor to be disengaged therefrom when said conveyor is swung away from the press.

7. In a printing press or the like, having a supporting frame, a rotary sheet-handling member carried by said frame, means for rotating said member at constant angular velocity, and a delivery conveyor disposed adjacent said member; means for driving said conveyor in timed relation to said member through successive delivery cycles during each of which the speed of said conveyor varies from a maximum approximating the constant speed of the sheet handling member to a minimum at which a sheet is discharged from the conveyor and then back to its maximum speed, said last named means having a single connection with said first named means and comprising a sun gear, two planet gears meshing with and adapted to revolve about said sun gear, means for rolling one of said planet gears around said sun gear at substantially constant angular velocity, means affording a driving connection between said planet gear and the other planet gear for rolling the latter about the sun gear at an angular velocity which varies regularly during each cycle, and means affording a driving connection between said second planet carrier to establish a still further variation in the speed of the latter during each cycle, whereby maximum and minimum speeds of the conveyor are obtained.

8. In a printing press, having a supporting frame, a rotary impression cylinder, means for driving said cylinder at a substantially constant angular velocity, and a delivery conveyor disposed adjacent said member; means for driving said conveyor in timed relation to said cylinder through successive delivery cycles during each of which the speed of said conveyor varies from a maximum approximating the constant speed of the impression cylinder to a minimum at which a sheet is discharged from the conveyor, and then back to its maximum speed; said last named means comprising a frame rigid with said frame, a sun gear rigid with said shaft, a planet carrier rotatable about said shaft, means operatively connecting said planet carrier with said impression cylinder driving means for synchronous movement, a planet gear carried by said planet carrier and adapted to roll about said sun gear in mesh therewith, a crank pin carried by said planet gear and adapted to move in a non-circular orbit about said shaft at a variable angular velocity, a second planet carrier rotatable about said shaft and having a pin and slot driving connection with said second planet carrier at the same angular velocity as said crank pin, a second planet gear carried by said second planet carrier for revolution about said sun gear in mesh therewith, a second crank pin carried by said second planet gear and adapted to move in a non-circular orbit about said shaft at a variable angular velocity which is the resultant of the combined variable velocities produced by the successive planetary movements of said planetary gears and their crank pins, a driven member operatively connected with said conveyor and a pin and slot connection between said last named crank pin and said driven member for imparting said resultant variable velocity to said conveyor whereby said maximum and minimum speeds of the conveyor are obtained.

9. The combination set forth in claim 8 in which said second driven crank pin is given an initial position out of phase with the first named crank pin, whereby the deceleration portion of the cycle of movement of said conveyor is longer than the acceleration portion.

10. The combination set forth in claim 8 in which said shaft is carried in bearings in the frame and is provided with means for rotatably adjusting it through a angle of limited degree, whereby said sun gear and said planet gear may be rotated in order to advance or retract the points of minimum velocity of the conveyor with respect to the points of discharge of the sheets to accommodate the variations in speed of the conveyor to the length of the sheets being printed or to the permissible force of discharge of the sheet.

11. In a device of the class described, a transmission gearing assembly comprising, in combination, a main driving member adapted to rotate at a constant angular velocity, a driven member, a driving element operatively interposed between said members, means operating by said driving member for moving said driving element near an epicyclic orbit, means maintaining a constant operative connection between said driving element and said driven member, whereby said driven member is rotated continuously in one direction through successive similar cycles of movement each of which is at a variable angular velocity.

12. In a device of the class described, a transmission gearing assembly comprising, in combination, a main driving member adapted to rotate at a constant angular velocity, a driven member, a driving element operatively interposed between said members, members operating by said driving member for moving said driving element along a prolate epicyclopoid orbit, means maintaining a constant operative connection between said driving element and said driven member, whereby said driven member is rotated continuously in one direction through successive similar cycles of movement each of which is at a variable angular velocity.

13. In a device of the class described, a transmission gearing assembly comprising, in combination, a main driving member, means for rotating said member at a constant angular velocity, a rotary driven member, a driving element operatively interposed between said members, members operating by said driving member for moving said driving element along a prolate epicyclopoid orbit, means maintaining a constant operative connection between said driving element and said driven member, whereby said driven member is rotated continuously in one direction through successive similar cycles of movement each of which is at a variable angular velocity.
element with said second named element for moving the latter through its orbit, and means for establishing a driving connection between said second driving elements and said driven member.

14. The combination set forth in claim 13 in which the two driving elements are disposed approximately 90° out of phase with each other.

15. In a device of the class described, in combination, a driving member, a driven member, transmission means operatively connecting said members comprising a plurality of trains of epicyclic gearing, means for operatively connecting said epicyclic trains in series, whereby they move in constant phase relation and the variable cyclic motions developed by each train are combined, and means for imparting the resultant variable motion to said driven member.

16. In a device of the class described, in combination, a driving member, a driven member, transmission means operatively connecting said members comprising a plurality of trains of epicyclic gearing, means for operatively connecting said epicyclic trains in series, whereby they move in constant phase relation and the variable cyclic motions developed by each train are combined, means for imparting the resultant variable motion to said driven member, and adjusting means connected with both of said trains of gearing for simultaneously shifting the phases of said trains to cause the points of minimum velocity of said driven member to occur at different points in its cycle of movement.

17. In a device of the class described, in combination, a driving member and a driven member, a double epicyclic gearing assembly, each epicyclic train thereof including a planet gear having a crank pin thereon, the first planet gear being driven by said driving member, operative driving connections between the crank pin of said first train with the planet gear of the second train, and means operatively connecting the crank pin of said second train with the driven member.

18. In a printing press of the class described, in combination, a main frame, an auxiliary sheet delivery frame, pivoted to said main frame for horizontal swinging movement to and from operative position, a conveyor for transferring printed sheets from said press, a supporting frame therefor pivoted to said auxiliary frame for vertical swinging movement to and from operative position.

19. In a printing press of the class described, in combination, a main press frame, a printing couple thereon comprising an impression cylinder and a horizontally reciprocating form bed, a sheet delivery supporting frame disposed at one end of the main press frame, a delivery conveyor carried by said delivery frame and in mainy adapted to occupy a substantially horizontal position wherein its receiving end extends toward the impression cylinder and above said form bed, a horizontal pivot connecting said conveyor with said delivery frame and a vertical pivot connecting said delivery frame with said press frame, whereby said conveyor may be swung upwardly away from the impression cylinder and form bed, and then swung laterally away from said press frame to provide access to the latter.

20. In a printing press, in combination, an impression cylinder rotating at a constant angular velocity, a delivery conveyor adapted to receive printed sheets from said cylinder at substantially the peripheral speed of the latter and deliver them at a reduced speed and means to actuate said conveyor including a unitary variable speed transmission comprising a driving member rotating at a constant angular velocity, a driven member connected to operate the conveyor, and two trains of epicyclic gearing disposed in series connecting said driving and driven members.

21. The combination recited in claim 20 with means to adjust said transmission to cause the point of minimum velocity of said driven member to occur at different points in its cycle of movement.

22. In a printing press, in combination, an impression cylinder rotating at a constant angular velocity, a delivery conveyor adapted to receive printed sheets from said cylinder at substantially the peripheral speed of the latter and deliver them at a reduced speed, and means to actuate said conveyor including a unitary variable speed transmission comprising a driving member, a driven member connected to operate the conveyor, two trains of epicyclic gearing disposed in series connecting said driving and driven members, and single means rotating said driving member at a constant angular velocity.

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