

June 24, 1969

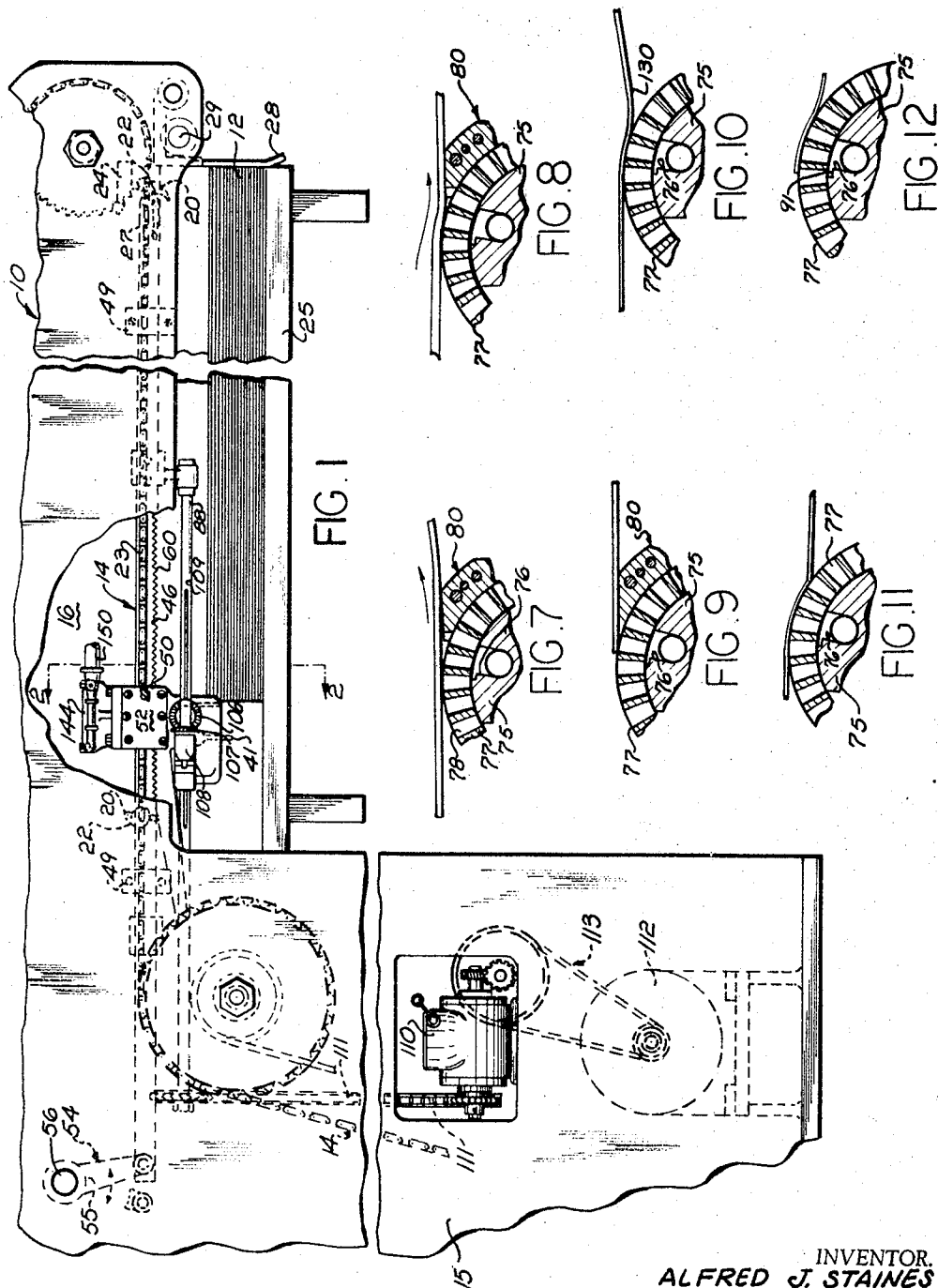
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3,451,670

SHEET SLOWDOWN MECHANISM

Filed Nov. 6, 1967

Sheet 1 of 3



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Sheet 2 of 3

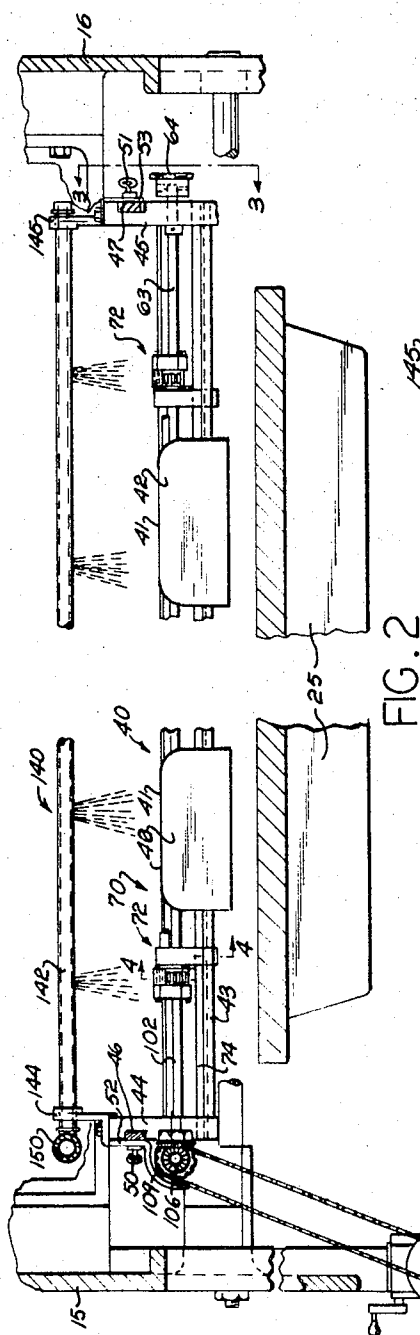


FIG. 2

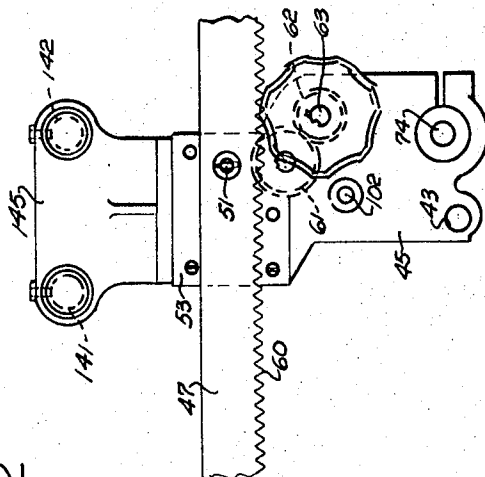


FIG. 3

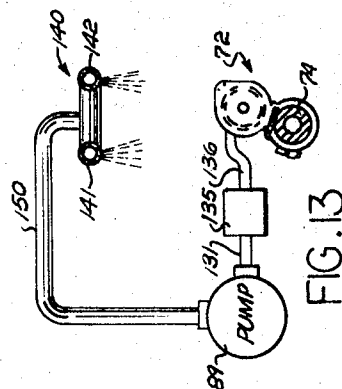


FIG. 13

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SHEET SLOWDOWN MECHANISM

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Sheet 3 of 3

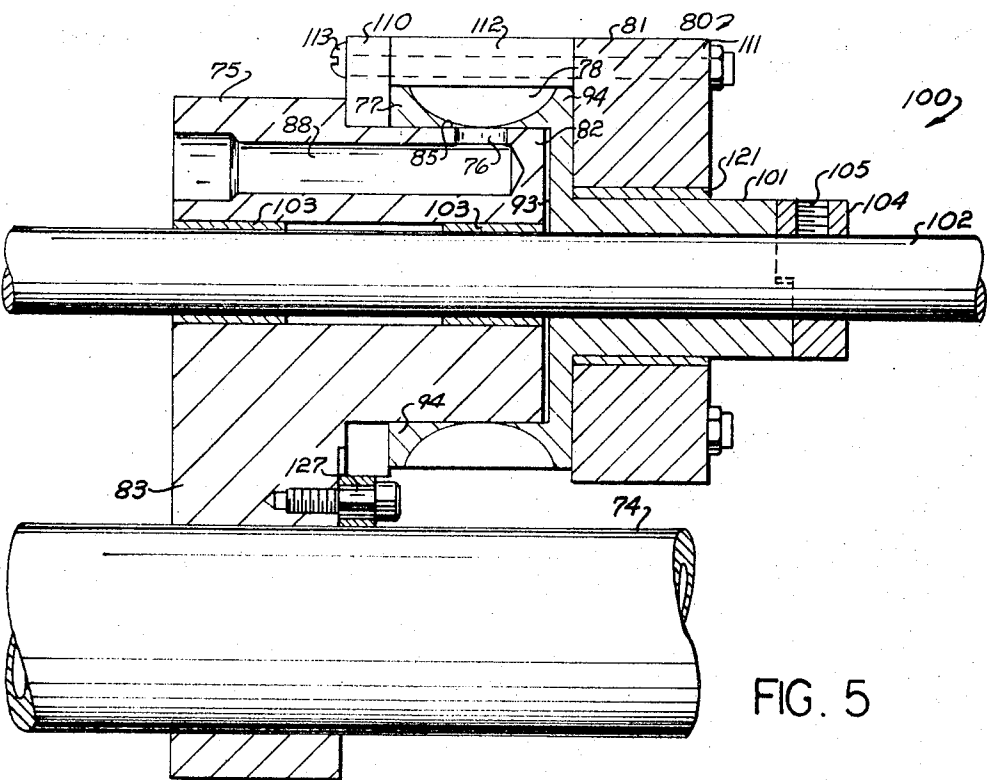


FIG. 5

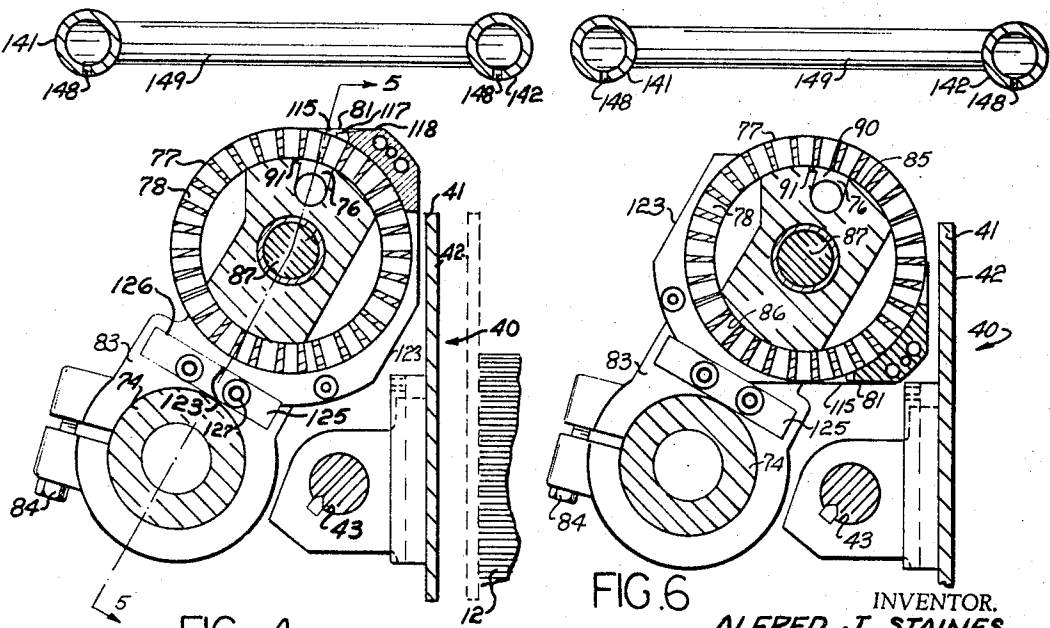


FIG. 4

FIG. 6

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SHEET SLOWDOWN MECHANISM

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10 Claims

ABSTRACT OF THE DISCLOSURE

A sheet slow-down mechanism which includes a rotatable driven vacuum wheel operable to apply a braking force to flexible moving sheets to reduce the speed of the sheets is provided. An adaptor unit operable to reduce the speed of rigid, relatively heavy sheets straddles the vacuum wheel and is rotatable relative to the drive shaft of the vacuum wheel between inoperative and operative positions. A sheet blow-down means moves the sheets downwardly relative to the vacuum wheel and adaptor unit and the exhaust of a vacuum pump for applying a suction to the vacuum wheel and adaptor unit is directed to the blow-down means to provide the air blast.

The present invention relates to a sheet slow-down mechanism for reducing the rate of speed of a moving sheet, and more particularly to a sheet slow-down mechanism which is selectively operable to reduce the rate or speed of either flexible relatively light sheets or rigid relatively heavy sheets after the sheets are released by moving grippers.

Known sheet slow-down mechanisms employ a rotary vacuum wheel which is connected with a vacuum source and is operable to draw a moving sheet into engagement therewith to effect a reduction in the speed of the moving sheet. Such a slow-down mechanism is shown in United States Patent No. 2,657,052. While such mechanisms have operated satisfactorily in reducing the rate of speed of flexible sheets which bend and readily conform to contour of the wheel, they have not been satisfactory for reducing the rate of speed of relatively heavy sheets, commonly and hereinafter referred to as boards, since the boards will not readily conform to the peripheral contour of the vacuum wheel and have a relatively high inertia due to the weight thereof and thus require a relatively greater braking force to be applied thereto to effect slowing thereof.

To reduce the rate of speed of moving boards, suction members separate from the vacuum wheel and which are adapted to be attached and detached from the slow-down support structure have been provided. These suction members usually have a planar board engaging surface surrounding a vacuum port and a suction in the port draws the board against the board engaging surface as it is moved thereover. These suction members, however, have not been very satisfactory in operation. Because of the high inertia of a moving board, a high vacuum braking force must be applied to the boards to slow them when the equipment with which the slow-down mechanism is associated is conveying the boards at a normal speed. However, when the conveying speed of the boards is reduced, the inertia thereof is likewise reduced and the vacuum braking force sometimes is so great that it causes the slower moving board to cling to or "hang-up" on the suction member. The clinging board blocks the vacuum from acting on the subsequently conveyed boards. Thus, no or little vacuum braking is applied to the subsequently conveyed boards and due to this failure, the board may become crumpled causing a disarrangement of the pile even when the clinging board

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is removed. Various techniques for alleviating these problems, such as varying the vacuum pressure, the port size and the area of the board engaging surface, have not been entirely satisfactory.

Accordingly, an important object of the present invention is the provision of a new and improved sheet slow-down mechanism which overcomes the above-noted problems, is of a highly practical and economical construction, and is selectively operable to reduce the rate of speed of either flexible relatively light sheets or rigid relatively heavy boards.

Another object of the present invention is the provision of a new and improved sheet slow-down mechanism for reducing the rate of speed of moving rigid relatively heavy boards and which includes a suction means located adjacent the path of board travel for drawing the moving boards thereagainst to apply a braking force thereto and a cooperably associated rotatable wheel engageable with the boards to move the same relative to the suction means when the latter clings or hangs up on the suction means to effect removal therefrom.

A further object of the present invention is the provision of a new and improved sheet slow-down mechanism which is selectively operable to reduce the rate of speed of either flexible relatively light sheets or rigid relatively heavy sheets after the sheets are released by moving grippers and which includes a rotatable vacuum wheel operable to slow the relatively flexible sheets and an adaptor means for slowing the relatively rigid heavy sheets and which adaptor means is supported for movement between an inoperative position at which the adaptor means is located when flexible sheets are being conveyed and an operative position at which the adaptor means is located when the rigid sheets are being conveyed.

A still further object of the present invention is the provision of a new and improved sheet slow-down mechanism having an air blast blow-down for moving a sheet downwardly relative to a suction slow-down member and wherein the air blast blow-down is automatically controlled by the position of the sheet relative to the slow-down mechanism.

Another object of the present invention is the provision of a new and improved sheet slow-down mechanism, as noted in the next preceding paragraph, wherein a vacuum pump has its exhaust outlet connected to the blow-down mechanism and air is directed through the exhaust outlet and to the blow-down mechanism when the vacuum pump draws air through the suction slow-down member so that the blow-down timing is controlled by a sheet covering and uncovering a suction port of the suction member.

Yet another object of the present invention is to provide a new and improved sheet slow-down mechanism for reducing the rate of speed of moving flexible sheets upon being released by grippers moving through a path at a given speed, and which includes a vacuum wheel for gripping the sheets upon being released by the grippers and which is rotatable at a surface speed less than the speed of the moving sheets and an air blow-down means for directing an air blast against the sheets to move the latter downwardly against the vacuum wheel, and wherein the vacuum wheel and air blow-down means are of a construction and arrangement such that they effect only a slight drag on the sheets while they are being gripped by the grippers and moved thereover prior to being released whereby marking of the underside of the sheets and/or smudging of the printed material thereon, if the sheet is printed, is prevented or substantially minimized.

The invention further resides in certain novel constructions and arrangements of parts, and further objects and advantages thereof will appear from the following detailed description of the preferred embodiment

described with reference to the accompanying drawings, which form a part of the specification, and in which like reference characters designate corresponding parts throughout the several views and wherein:

FIG. 1 is a fragmentary side elevational view of a sheet delivery apparatus embodying the slow-down mechanism of the present invention;

FIG. 2 is a fragmentary sectional view of the apparatus of FIG. 1 taken approximately along line 2—2 of FIG. 1;

FIG. 3 is an enlarged view of part of the apparatus shown in FIG. 2 and looking in the direction of the arrows 3—3 of FIG. 2;

FIG. 4 is an enlarged sectional view taken approximately along line 4—4 of FIG. 2;

FIG. 5 is a sectional view on a larger scale taken approximately along line 5—5 of FIG. 4;

FIG. 6 is a sectional view like that shown in FIG. 4 but showing certain parts thereof in a different position;

FIGS. 7—9 are fragmentary sectional views of part of the slow-down mechanism of the present invention and showing a board moving thereover in different positions relative thereto;

FIGS. 10—12 are fragmentary sectional views of part of the slow-down mechanism of the present invention and showing a flexible sheet moving thereover in different positions relative thereto; and

FIG. 13 is a schematic view illustrating the vacuum circuit for the slow-down mechanism of the present invention.

The present invention provides a novel sheet slow-down mechanism for reducing the rate of speed of a moving sheet. Although the novel sheet slow-down mechanism of the present invention could be used in or with various kinds of apparatus in which it is desired to reduce the rate of speed of a moving sheet, it is especially adapted for use in a sheet delivery apparatus wherein moving sheets are to be slowed down prior to being deposited onto a pile, and for the purposes of illustration, is shown in the drawings as being embodied in a sheet delivery apparatus 10 for a printing press.

The sheet delivery apparatus 10 is adapted to deliver printed sheets from a printing press (not shown) to a delivery pile 12. The sheet delivery apparatus 10 includes an endless chain conveyor 14 supported by a pair of spaced side frames 15, 16 for conveying the printed sheets from the printing press to a position above the pile 12. The conveyor 14 is operated in timed relationship with the printing press so that the leading edges of the sheets are gripped by moving grippers 20 mounted on gripper bars 22 extending transversely of the conveyor 14. The conveyor 14 conveys the sheets from the printing press along its lower run 23 until the grippers 20 engage a stationary cam 24 which functions to open the grippers 20 to release the sheets being conveyed thereby. The gripper bars 22 are spaced apart a distance somewhat greater than the maximum length of the sheet which the sheet delivery apparatus 10 is designed to handle.

Beneath the lower run 23 of the conveyor 14 there is a pile support platform 25 upon which the sheets drop by gravity upon being released by the grippers 20. The sheets upon being released by the grippers 20 are deflected downwardly toward the pile 12 by fingers 27. The sheets are guided or aligned at the front edge of the pile 12 by pile guides 28 secured to a rod 29 extending transversely between the side frames 15 and 16.

When the sheets are dropped onto the pile 12 they are jogged into correct lateral alignment by suitable side jogger plates, omitted from the drawings for the sake of simplicity. The sheets are also jogged endwise to place them in endwise alignment by a jogger means 40 which is reciprocally movable through forward and return strokes in a direction parallel to or substantially parallel to the direction of the sheet travel.

The jogger means 40 comprises a plurality of jogger

plates 41 located at space transverse locations between the side frames 15, 16 of the delivery apparatus 10. The jogger plates 41 have vertically disposed, planar sheet engaging surfaces 42 and are mounted on a horizontally disposed support shaft 43 extending transversely of the side frames 15, 16 and having its opposite ends secured to support brackets 44, 45 (see FIG. 2). The support brackets 44, 45 are respectively supported adjacent their upper ends on horizontally disposed support slides or members 46, 47, the support slides 46, 47 in turn being slidably supported by spaced brackets 49 respectively fixed to the side frames 15, 16 of the delivery apparatus 10. The support brackets 44, 45 are adapted to be clamped to the support slides 46, 47 by thumb screws 50, 51 in threaded engagement with side plates 52, 53 having their upper and lower ends secured to the brackets 44, 45 respectively.

The jogger plates 41 are adapted to be reciprocated through their forward and return strokes toward and from the pile guides 28 by an actuating means 54 operatively connected with the rearward or left ends of the support slides 46, 47, as viewed in FIG. 1. The actuating means comprises a pair of levers 55 having one end pivotally connected to the adjacent rearward end of the support slides 46, 47 and the other end fixed to a shaft 56. The shaft 56 is rotatably supported in the side frames 15, 16 and is adapted to be rotated in opposite directions to cause the levers 55 to be oscillated to and fro by a suitable drive means (not shown) operatively connected with the shaft 56.

From the foregoing, it should be apparent that when the levers 55 are oscillated to and fro, the support slides 46, 47 are reciprocated to and fro in a direction of sheet travel. Movement of the support slides 46, 47 to and fro causes the support brackets 44, 45 and the jogger plates 41 to be reciprocated toward and from the front pile guides 28. The actuating means 54 is actuated in timed relationship with the delivery apparatus 10 so that the jogger plates 41 are reciprocated through their forward and return strokes for each sheet handled by the conveyor means 14 and preferably so that the jogger plates 41 are at the end of their forward stroke or at the beginning of their return stroke when the grippers 20 release the sheets. The jogger plates 41 engage the dropped sheets during their forward stroke to move them into endwise alignment with the pile 12.

The jogger means 40 is adjustably positionable longitudinally of the support slides 46, 47 so that different size sheets can be jogged into endwise alignment. To this end, the support slides 46, 47 on their underside are each provided with gear teeth to form a rack 60. The racks 60 are each in meshed engagement with a pinion gear 61 rotatably supported by the adjacent brackets 44, 45. Each of the pinion gears 61, in turn is in meshed engagement with the drive gear 62 fixed to a shaft 63 having its opposite ends rotatably supported by the brackets 44, 45.

The jogger means 40 is adjusted longitudinally of the support slides by backing off the thumb screws 50, 51 to unclamp the brackets 44, 45 from the support slides 46, 47 and then rotating a handwheel 64 fixed to one end of the shaft 63. Rotation of the handwheel effects rotation of the shaft 63 and the gears 62 and 61, which in turn causes the brackets 44, 45 and the jogger plates 41 carried thereby to be moved longitudinally relative to the support slides 46, 47.

In accordance with the provisions of the present invention, a novel sheet slow-down mechanism 70 is provided for reducing the rate of speed of the moving sheets prior to their being deposited onto the pile 12. The slow-down mechanism 70 is carried by the support brackets 44, 45 and is selectively operable to reduce the rate of speed of both highly flexible relatively light sheets, such as paper, and relatively rigid heavy sheets or boards. The sheet slow-down mechanism 70 is oper-

able to grip the trailing end of each sheet at the time its forward end is being released by the grippers 20 and to slow down or reduce the rate of speed of the moving sheet so that the sheet is gently deposited on the pile 12. The sheet slow-down mechanism 70 is effective to prevent the moving sheets from crashing into the front pile guides 28 at a high velocity due to the forward momentum or inertia they possess upon being released by the grippers 20 and thus, prevents the forward edge of the sheets from crumpling and/or being damaged.

The sheet slow-down mechanism 70 comprises a plurality of slow-down devices 72 disposed beneath the lower run of the conveyor 14 and located at spaced transverse locations between the side frames 15, 16 of the delivery apparatus 10. Each of the slow-down devices 72, in the illustrated embodiment, is an assembled unit which is clamped on a horizontally disposed support shaft 74 having its opposite ends fixed to and supported by the support brackets 44, 45. Since each of the slow-down devices 72 is of an identical construction, only the left-most slow-down device 72, as shown in FIG. 2, will be described in detail.

The slow-down device 72, in general, comprises a non-rotatable vacuum shoe member 75 having a vacuum port 76 located adjacent the path of sheet travel and a rotatable vacuum wheel 77 having a plurality of peripherally spaced slots 78 open to the atmosphere and which are successively placed in communication with the vacuum port 76 in response to rotation of the wheel 77 to create a suction at the periphery of the wheel 77. The vacuum wheel 77 is partially disposed adjacent the path of sheet travel and is operable to grip flexible sheets to reduce their rate of speed and then release the same for deposit onto the pile 12. The slow-down device 72 further comprises a suction or adaptor means 80 movable relative to the vacuum shoe member 75 between an inoperative position remote from the path of sheet travel and an operative position for effecting a reduction in the rate of speed of moving boards. When the adaptor means 80 is in its operative position, the boards are braked thereby to reduce their rate of speed.

The vacuum shoe member 75 has a projecting or hub portion 82 extending parallel to the shaft 74 and a depending leg 83 at one end of the projecting portion 82. The depending leg 83 at its end remote from the projecting portion 82 is in the form of a split clamp and is adapted to be clamped to the shaft 74, as by suitable screws 84. The projecting portion 82 has opposed outer peripheral surface portions 85, 86 which are cylindrical and concentric with respect to the axis of rotation 87 of the vacuum wheel 77. The vacuum port 76 extends generally radially inwardly from the peripheral surface 85 and communicates with an axial passageway 88 in the vacuum shoe 75. The passageway 88 in turn is connected with a vacuum pump 89 (shown schematically in FIG. 13) to apply a vacuum at the port 76. As best shown in FIGS. 4 and 6, the vacuum port 76 is disposed forwardly or to the right of a vertical plane passing through the axis 87 of rotation of the vacuum wheel 77 and includes a main port portion 90 and a recess portion 91. The main port portion 90 is of a constant diameter and its side wall extends parallel to a line passing through the center of the passageway 88 and the axis of the shaft 87. The recess portion 91 extends along the periphery of the surface 85 in a direction opposite the direction of sheet travel and is of a substantially lesser depth than the main port portion 90.

The vacuum wheel 77 is rotatably supported by the stationary member 75 and is partially disposed within the path of sheet travel. The vacuum wheel 77 is cup shaped at one end to provide an axially extending recess 93 which slidably receives the projecting portion 82 of the vacuum shoe 75 and an annular outer wall 94 which surrounds the projecting portion 82. The peripherally spaced slots 78 are located in the outer wall 94. The

slots 78 are outwardly divergent, radial through slots which successively communicate with the vacuum port 76 upon rotation of the vacuum wheel 77.

The vacuum wheel 77 is rotated relative to the stationary member 75 in the direction of sheet travel, or in a clockwise direction, as shown in FIGS. 4 and 6, by a drive means operatively connected with an integrally formed sleeve portion 101 at the other end of the vacuum wheel 77. The drive means comprises a drive shaft 102 which is rotatably journaled in the vacuum shoe member 75 by bushings 103. The drive shaft 102 is rotatably supported at its opposite ends by the support brackets 44, 45. The drive shaft 102 is drivingly connected with a sleeve portion 101 of the vacuum wheel 77 by a drive collar 104 in driving engagement with the sleeve 101 and which is removably secured to the shaft 102 by a set screw 105.

The drive shaft 102 at one end is fixed to a bevel gear 106 which is in constant mesh with a bevel gear 107 rotatably journaled on a sleeve 108 carried by the support bracket 44. The sleeve 108 is drivingly connected with a shaft 109 having its opposite ends rotatably supported by the side frames 15 via a splined connection. The splined connection between the sleeve 108 and shaft 109 permits the support bracket 44, 45 to be adjustably positioned longitudinally relative to the support arms 46, 47 while maintaining a driving connection with the shaft 109. The shaft 109 is drivingly connected with a conventional or suitable variable speed transmission 110 by a chain and sprocket drive 111, the variable speed transmission 110 in turn being drivingly connected to an electric motor 112 via a V-belt drive 113.

The vacuum wheel 77 is rotated by the drive means so as to have a peripheral or surface speed which is substantially less than the speed of the moving sheets being conveyed by the conveyor 14. Although the surface speed of the vacuum wheel 77 can be varied by suitably adjusting the variable speed transmission 110, the surface speed of the vacuum wheel 77 is preferably set to the weight and speed of the stock, but with the maximum set speed being approximately $\frac{1}{2}$ of the maximum speed of the conveyor 14.

As previously mentioned, the slow-down device 72 also includes a suction or adaptor means 80 cooperably associated with the vacuum wheel 77 for reducing the rate of speed of moving boards. The adaptor means 80 straddles the vacuum wheel 77 and has its sheet engaging surface 81 disposed substantially tangentially of the periphery of the vacuum wheel 77. The adaptor means 80 comprises a pair of generally annular side members 110, 111 disposed on the opposite sides of the vacuum wheel 77 and a cross member 112 located radially outwardly of the periphery of the vacuum wheel 77. The side and cross members are bolted together by bolts 116 to form a unitary structure. The side members 110, 111 have flat peripheral surface portions and define with the cross member 112 a U-shaped planar sheet engaging surface 81. The side members 110 and 111 are made from a suitable wear resistant antifriction material so as to enable the vacuum wheel to freely rotate relative to the adaptor means 80.

The sides 110, 111 and the cross member 112 define a vacuum chamber 115 located between the sheet engaging surface 81 and the periphery of the vacuum wheel 77. The vacuum chamber 115 is open to the atmosphere and communicates with the slots 78 in the vacuum wheel 77. The vacuum chamber 115 includes a main chamber portion in communication with the periphery of the vacuum wheel 77 and a recessed portion 117 surrounding the first portion and which is of a lesser depth than the first portion. The recess portion has a tapered bottom surface 118 which converges toward the main portion proceeding from the sheet engaging surface 81 toward the main portion of the vacuum chamber 115. The provision of the tapered recess portion enables the boards

as they are drawn against the adaptor means 80 to more or less conform to the contour of the bottom surface 118 to prevent air from leaking between the board and the sheet engaging surface 81 to the vacuum chamber 115.

The adaptor means 80 is movable between operative and inoperative positions shown in FIGS. 4, 6, respectively. When in its operative position, the sheet engaging surface 81 extends substantially parallel to the direction of sheet travel and it operates to reduce the rate of speed of moving boards. When in its inoperative position, the sheet engaging surface 81 is remote from the path of sheet travel so that only the vacuum wheel 77 is disposed within the path of sheet travel. The adaptor means 80 is moved to its inoperative position when it is desired to reduce the rate of speed of very flexible sheets. To this end, the side member 111 is rotatably journaled on the sleeve portion 101 of the vacuum wheel 77 by a bushing 121 and the side 110 is slidably disposed on the outer peripheral surfaces 85, 86 of the projecting portion 82 of the stationary member 75.

The adaptor means 80 is adapted to be locked or retained in both its operative and inoperative positions when moved thereto to prevent relative rotation between the adaptor means 80 and the stationary member 75. To this end, the side member 110 is provided with a pair of spaced flats 123, 124 as peripherally spaced locations and the leg 83 carries a stop member or key 125 having a flat surface 126 which is adapted to engage either the flat 123 or 124 to prevent rotation of the adaptor means 80 relative to the stationary member 75. The key 125 is mounted on the depending leg 83 of the stationary member 75 by a pair of screws 127.

When it is desired to move the adaptor means 80 relative to the stationary member 75 between its operative and inoperative positions, the set screw 105 of the drive collar 104 is backed off and the drive collar 104, vacuum wheel 77 and adaptor means 80 are moved axially of the shaft 102 toward the right, as viewed in FIG. 5, until the respective flat 123 or 124 of the side member 110 is disengaged from the flat 126 on the key 125. The adaptor means 80 is then rotated to its other position and moved along with the vacuum wheel 77 axially of the shaft 102 toward the left until the other flat on the side member 110 thereof engages the flat 126 on the key 125. Then the collar 104 is moved axially of the shaft toward the left until it engages the cooperating key on the drive sleeve portion 101 and the set screw 105 is tightened. From the foregoing, it should be apparent that the adaptor means 80 can be readily and easily moved between its operative and inoperative positions and that it is of a relatively simple and economical construction.

When it is desired to reduce the rate of speed of moving boards being conveyed by the conveyor 14 of the delivery apparatus 10, the adaptor means 80 is moved to its operative position, as shown in FIG. 5, in which position the sheet engaging surface 81 thereof is disposed parallel to the path of sheet travel. The vacuum wheel 77 is then rotated and the vacuum pump 89 started to create a vacuum in the vacuum chamber 115 of the adaptor means 80. As the moving board is being held by the grippers 20 and being conveyed over the slow-down device 72, the vacuum created in the vacuum chamber 115 will draw the board against the sheet engaging surface 81. When the grippers 20 release the front edge of the boards, the vacuum force in the vacuum chamber 115 will draw the board into tight engagement with the sheet engaging surface 81 (see FIG. 8) and grip or apply a braking force to the board to reduce the rate of speed of the same. The boards upon being drawn into tight engagement with the sheet engaging surface 81 continues to move forwardly toward the pile 12.

If a board clings or hangs up on the surface 81, as discussed above, the vacuum wheel effects movement off of the sheet engaging surface 81 and onto the pile. Specifi-

cally, the vacuum wheel 77 engages the trailing end of the board and effects movement of the same forwardly relative to the adaptor means 80 while the vacuum force is being fully applied thereto to maintain the sheet in engagement with the adaptor means 80. As the vacuum wheel 77 moves the board relative to the adaptor means 80, the trailing edge of the board will begin to uncover the recess portion 91 of the port 76 whereupon air will leak or flow from the atmosphere toward the port (see FIG. 9).

The advantages of the present construction are that the problems of board "hang-up" experienced with prior art devices are completely overcome or minimized. These problems are overcome by the provision of the vacuum wheel 77, which effects movement of the board forwardly relative to the adaptor means 80 in the event of a board hanging up.

It should be noted that the entire slow-down mechanism 70 is also reciprocated to and fro in a direction parallel to the direction of sheet travel along with the jogger means 40, since it is also supported by the support brackets 44, 45. The reciprocating movement of the slow-down mechanism 70 and the jogger means 40 is preferably timed with respect to the operation of the delivery apparatus such that the jogger means 40 and slow-down mechanism 70 are either at the end of their forward stroke or are beginning their return stroke when the grippers 20 release the sheets or boards. Since the slow-down mechanism 70 is moving through its return stroke when the boards are tightly drawn against the adaptor means 80, an additional slow-down effect is achieved, since the slow-down mechanism 70 is moving in a direction opposite to the direction of the momentum of the boards upon being released. The board deposited onto the pile 12 is jogged into endwise alignment by the jogger plates 41 during the next forward stroke of the jogger means 40.

When it is desired to reduce the rate of speed of very flexible sheets, the adaptor means 80 is moved from its operative position to its inoperative position, shown in FIG. 6. When in this position the moving flexible sheets will be drawn into engagement with only the vacuum wheel 77. FIG. 10 shows the relative position of a flexible sheet with respect to the slow-down device 72 while it is held by the grippers 20 and being moved thereover by the conveyor 14. Due to the disposition of the vacuum port 76, a slight flow of air, as indicated by the arrow 130, from the atmosphere between the flexible sheet and the wheel 77 toward the port 76 takes place. Due to this slight air flow, only a partial vacuum force is exerted on the flexible sheet so that a slight drag on the sheet is effected to place the sheet under a slight tension while it is being held by the grippers 20. By exerting only a slight drag on the sheet, marking of the sheet on its underside and/or smudging of the ink, if the underside is printed, is prevented or substantially minimized.

When the grippers 20 releases the flexible sheet, the sheet will be drawn into tight engagement with the periphery of the vacuum wheel, as shown in FIG. 11, and no air flow from the atmosphere to the port 76 will occur. The rate of speed of the moving flexible sheet upon being released by the grippers 20 will be reduced by the vacuum wheel 77. As the sheet is being moved forwardly toward the pile 12 by the wheel 77, its trailing edge begins to uncover the recess portion 91 of the vacuum port 76 whereupon a slight air flow through the slots 78 in the wheel 77 to the port 76 takes place. As the wheel 77 continues to rotate the trailing edge progressively uncovers more of the port 76 to progressively decrease the vacuum force acting on the sheet until the trailing edge of the sheet is disposed in a radial plane passing through the approximate center of the port whereupon the vacuum force will no longer be sufficient to hold the sheet on the wheel 77 and thus, the sheet will be released and move forwardly onto the pile 12.

A vacuum is created in each of the vacuum ports 76 of the stationary members 75 of each of the slow-down devices 72 by the vacuum pump 89. The vacuum pump 89 has its inlet connected by a conduit 131 to a distributor manifold 135 having a plurality of outlets, one for each of the slow-down devices 72, which are connected by flexible hoses 136 to the respective passageway 88 in the stationary members 75 of the devices 72.

The slow-down mechanism 70 also includes a blow-down or air blast means 140 disposed above the slow-down devices 72 for directing air under pressure against the upper side of the sheets to force the sheets downwardly into engagement with the sheet engaging surface 81 of the adaptor means 80 or the vacuum wheel 77 and to deflect the sheets downwardly onto the pile 12 upon being released by the slow-down devices 72. The blow-down means comprises a pair of spaced conduits or pipes 141, 142 extending transversely of the side frames 15, 16, the conduits 141, 142 being located rearwardly and forwardly of the slow-down devices 72, respectively. The pipes 141, 142 are connected at their opposite ends to supports 144, 145 respectively bolted or otherwise secured to the upper end of the brackets 44, 45. The pipes 141, 142 are provided with a plurality of longitudinally spaced nozzle-like openings 148 on their bottom side through which air supplied thereto under pressure is directed downwardly and transversely of the direction of movement of the sheets. The pipes 141, 142 are preferably in communication with one another by suitable cross pipes 149.

Another feature of the present invention is that operation of the air blast means 140 is intermittent and automatically controlled so as to occur prior to the sheets being gripped by the slow-down devices 72 and after the trailing edge of the sheets uncovers the ports 76. To this end, the pipe 141 is connected via a flexible hose 150 to the exhaust or outlet of the vacuum pump 89. Thus, air is directed from the nozzle-like openings 148 of the pipes 141, 142 only when the vacuum port 76 in the stationary member 75 is in communication with the atmosphere.

From the foregoing, it can be seen that an air blast is directed from the nozzle-like openings 148 transversely of the direction of sheet travel while the sheet is being moved over the slow-down device 72 by the grippers 20 on the conveyor 14 to force the sheet into engagement with the wheel 77. This is due to the fact that as long as the grippers 20 are holding the sheets (see FIG. 10) a slight leakage of air from the atmosphere to the port 76 takes place. However, when the grippers 20 release the sheet and it is drawn into tight engagement with the wheel 77, the port 76 no longer communicates with the atmosphere and thus, no air blast occurs since no air is exhausted by the vacuum pump 89. An air blast is again established against the sheet and against the next sheet being conveyed by the conveyor 14 upon the trailing edge of the sheet being moved by the vacuum wheel to a position such that it partially uncovers the recessed portion 91 of the vacuum port 76. This insures that just prior to the time that the sheet is released from the vacuum wheel 77 or adaptor means 80, an air blast is directed thereagainst to move the same downwardly toward the pile 12 in addition to the gravitational force acting thereon.

The advantages of connecting the blow-down means 140 to the exhaust of the vacuum pump 89 are that no separate compressed air source is required, that the intermittent air blast will always be properly timed for each sheet. Moreover, no adjustable timing valves are required which would require adjusting upon adjustment of the slow-down mechanism.

The pressure of the air blasts can be readily controlled by providing a suitable release valve in the exhaust line between the vacuum pump and inlets 147 which automatically opens when the pressure of the air is above a predetermined pressure.

It should also be noted that since the slow-down devices 72 comprise an assembled unit and are clamped to

the shaft 74, they can be adjusted transversely between the side frames relative to each other and the side frames by merely loosening the screws 84 and repositioning the units relative to the shaft 64. Additionally it can be seen that by supporting the blow-down means 140 from the brackets 44, 45, which also support the slow-down devices 72 and the jogger plates 40, 41 that the blow-down means will always be properly positioned relative to the devices 72.

From the foregoing, it should be apparent to the hereinafore enumerated objects and others have been accomplished and that a novel sheet slow-down mechanism for use in reducing the speed of moving boards and/or to reducing the speed of both flexible sheets and moving boards has been provided. While the illustrated embodiment of the present invention has been described in considerable detail, it is hereby my intention to cover all constructions, modifications and arrangements coming within the ability of those skilled in the art and within the scope and spirit of the present invention.

Having described my invention, I claim:

1. In a mechanism which is selectively operable to reduce the speed of a moving substantially rigid relatively heavy sheet or a moving flexible relatively light sheet after the sheet is released from moving grippers which move the sheet through a path, sheet slow-down means including a vacuum wheel mounted adjacent the sheet path and having vacuum passageways opening to the atmosphere adjacent said path, means for rotating said vacuum wheel in the direction of sheet movement and at a speed less than the speed at which a sheet is moved by the grippers, means for applying a vacuum to said passageways to secure a flexible sheet around a circumferential portion of said vacuum wheel thereby effecting a slowing of the flexible sheet, means for slowing a rigid sheet including a rigid sheet slow-down adapter means having a sheet engaging surface, means supporting said adapter means in first and second positions and for movement between said positions, said adapter means when in said first position being remote from said path and positioned thereat when flexible sheets are being conveyed and said adapter means when in said second position being adjacent said sheet path and positioned thereat when rigid sheets are being conveyed, the sheet engaging surface of said adapter means defining a vacuum chamber located radially outwardly of said vacuum wheel and having an area open to the atmosphere adjacent said sheet path when said adapter means is in said second position, and said vacuum chamber having an opening in communication with said vacuum passageways in said vacuum wheel to thereby have a vacuum applied thereto to effect drawing of a rigid sheet against the sheet engaging surface of said adapter means to effect slowing of said rigid sheet.

2. A mechanism as defined in claim 1 wherein said sheet engaging surface lies substantially tangential to the outer periphery of said vacuum wheel and substantially parallel to said sheet path when said adaptor means is in its second position, and wherein said outer periphery of said vacuum wheel engages any rigid sheet which clings on said sheet engaging surface and effects movement of such rigid sheet from said sheet engaging surface.

3. A mechanism as defined in claim 2 wherein said adaptor means straddles said vacuum wheel, and said vacuum wheel periphery rotates through said vacuum chamber.

4. A mechanism as defined in claim 3 wherein said vacuum chamber is at least in part defined by bottom surface which converges toward said sheet path as it extends in the direction of sheet movement.

5. A mechanism as defined in claim 1 wherein said means for applying a vacuum to said passageways comprises a nonrotatable vacuum shoe communicating with a source of vacuum and said vacuum passageways in said vacuum wheel, said means for rotating said vacuum wheel comprises a drive shaft drivingly connected to the vacuum

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wheel and extending through said vacuum shoe and rotatable relative thereto, and said adaptor means has a portion encircling said drive shaft and supported thereby.

6. A mechanism as defined in claim 5 wherein said adaptor means comprises a pair of generally annular side members disposed on opposite axial sides of said vacuum wheel, and a stop member associated with one of said side members and said vacuum shoe for preventing rotation of said adaptor means.

7. A mechanism as defined in claim 6 further including means for preventing axial movement of said vacuum wheel and adapter means axially relative to said drive shaft and releasable to permit axial movement of said adapter means and vacuum wheel in one direction relative to said drive shaft to a position free of said stop members and at which said adapter may be rotated between its first and second positions and then moved axially of said drive shaft in a second direction wherein it again is held from rotation by said stop member.

8. A sheet slow-down mechanism for reducing the rate of speed of a moving sheet after it is released by moving grippers which move the sheet through a path comprising means defining a vacuum chamber which is open to the atmosphere adjacent the path of sheet travel, said means having a relatively flat sheet engaging surface over which the sheet moves, means for applying a vacuum to said

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chamber to draw the sheet against said sheet engaging surface to apply a braking force to the moving sheet, and a rotatable wheel member operatively associated with said means and engageable with a sheet on said sheet engaging surface to effect movement of such sheet from said surface.

9. A sheet slow-down mechanism as defined in claim 8 wherein said sheet engaging surface lies substantially tangential to the outer periphery of said rotatable wheel and substantially parallel to said sheet path and wherein said rotatable wheel comprises a vacuum wheel having vacuum passageways which open to the atmosphere adjacent the sheet path.

10. A sheet slow-down mechanism as defined in claim 8 wherein said means having a sheet engaging surface comprises an adapter unit movable between a first inoperative position and a second operative position and having said sheet engaging surface in a position parallel to and adjacent said sheet path when in said operative position.

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