

PATENT SPECIFICATION

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(54) SHEET STACKING MACHINE /

(71) We, I.D. INC., a Corporation organised under the laws of the State of Wisconsin, United States of America, of Cedarburg, Wisconsin 53012, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to sheet stackers such as used in combination with corrugated board making machines or the like to stack the output of the machine in neat stacks and move the stacks away from the machine.

According to the invention a sheet stacker comprises a frame, a lift table movably mounted on the frame for upward and downward movement, and means for raising and lowering the lift table, said means for raising said lift table including at least one hydraulic cylinder coupled to said lift table and pump means for forcing hydraulic fluid into said cylinder to raise said lift table, said pump means including a relatively high capacity pump for raising said lift table at a relatively high speed and a relatively low capacity pump for raising said lift table at a relatively low speed, a plurality of rollers journaled to said lift table and forming the upper surface thereof, a plurality of sprockets coupled to alternate rollers, a drive chain operatively engaged with said sprockets for driving the rollers coupled thereto, a hydraulic motor operatively engaged with said drive chain for driving the same, and hydraulic valve means selectively coupling said low capacity pump to said hydraulic motor to drive the motor at a relatively low speed and selectively coupling said high capacity pump to said hydraulic motor to drive the motor at a relatively high speed.

Further features of the invention will appear from the following description of an embodiment of the invention given by way of example only and with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic perspective view;

Figure 2 is a longitudinal sectional view of the embodiment shown in Figure 1; and

Figure 3 is a detail cross-sectional view taken on the line 3—3 of Figure 2.

Referring to the drawings, the sheet stacker is mounted within a frame 10 which includes four upright posts 12, which are positioned in a rectangular pattern and are joined together on their upper ends by four cross beams 14 which each extend between the upper ends of two corresponding upright posts 12. The lower corners of the upright posts 12 are joined together by two channel members 16 which extend parallel to each other between two adjacent corners of upright posts 12. The space between the bottom ends of the upright posts 12 transverse to the channel members 16 is left open to allow a lift table which is described hereinafter to be lowered to the bottom of the frame 10 for unloading the cardboard sheets stacked thereon.

A lift table 18 is movably mounted within the frame 10 for upward and downward movement therewithin. The lift table 18 has a rectangular base formed by four lower channel members 20 which are welded together at their corners. Two parallel side channel members 22 are joined to opposite ones of the lower channel members 20. A plurality of rollers 24 is journaled between the two channel members 22 to provide a rollable upper surface for the lift table 18. Sprockets 26 are rigidly coupled to one end of every other roller 24 for driving alternate rollers to move a stack of cardboard sheets off the top of the lift table 18 as will be described hereinafter. The lift table 18 fits within the interior of the frame 10 and is supported by a pair of lift chains 28 whose bottom ends 30 are attached to the diagonally-opposite corners of the side channels 22 (see Figure 1). The chains 28 extend upwardly from the corners 30 and are directed in a horizontal direction at the

top of the frame 10 by idler sprockets 32. The upper end of each chain 28 is fastened at a convenient point to the frame 10 and extends around another idler sprocket 34 which is attached to the piston shaft 36 of a hydraulic cylinder 38. To conserve space, the hydraulic cylinders 38 are mounted within frame 10 as shown in Figure 3.

The hydraulic cylinders 38 are provided with hydraulic fluid under pressure through hydraulic conduits 40 which receive hydraulic fluid from a three-way hydraulic valve 42. The hydraulic valve 42 is a solenoid valve which is electrically operated by suitable electrical control signals from a control circuit 44. In one position of the hydraulic control valve 42, hydraulic fluid under pressure is applied to the hydraulic conduits 40 to cause the hydraulic pistons 36 to move toward the corresponding hydraulic cylinders 38. This draws the chains 28 upward and thereby raises the lift table 18. In a second position of the hydraulic valve 42, the hydraulic fluid within the cylinders 38 and hydraulic conduits 40 is blocked off to hold the lift table 18 in the same position. In the third position of the hydraulic valve 42, hydraulic fluid is bled out of the conduits 40 and cylinders 38 via a hydraulic exhaust conduit 45 to a hydraulic reservoir. This lowers the chains 28 and thereby lowers the lift table 18.

The hydraulic fluid for the hydraulic valve 42 is applied via a hydraulic conduit 46 which receives hydraulic fluid from one or both of two hydraulic pumps 48 and 50 which are driven by an electric motor 51. The pump 48 is a relatively low capacity pump used for moving the lift table 18 at a relatively low speed and the pump 50 is a relatively high capacity pump which is used to raise the lift table 18 at a relatively high speed for reasons which will be discussed hereinafter. The hydraulic pumps 48 and 50 are coupled to the hydraulic conduit 46 through two solenoid valves 52 and 54 which are controlled by signals from the control circuit 44. The hydraulic pumps 48 and 50 are coupled to the hydraulic reservoir through hydraulic conduits 56 and 58.

The hydraulic pumps 48 and 50 are also coupled via a solenoid valve 60 to a hydraulic motor 62 which is mounted on the frame 10 as shown in Figure 2. Hydraulic motor 62 drives a chain 64 which engages the sprockets 26 on rollers 24 as shown in Figure 1. Between the sprockets 26 are idler sprockets 26'. The chain 64 is snaked through the sprockets 26 and 26' and is doubled back over an idler sprocket 66 which is rotatably attached to the bottom of one of the channel members 20 so that it moves along with the lift table 18. From idler sprocket 66, the chain 64 passes around another idler sprocket 68, which is rotat-

ably attached to the frame 10, and then returns to the drive sprocket on motor 62. When the motor 62 is energised, it drives the chain 64 and causes every other roller on the lift table 18 to be rotated in the same direction to move a stack of sheets off the lift table 18 as will be described hereinafter.

Since the lift table 18 is relatively large, and may receive an unbalanced stack of sheets such as illustrated in Figure 2, it is desirable to provide an automatic levelling means for holding the lift table 18 level as it moves throughout its range of upward and downward travel. In accordance with this invention, such automatic levelling means includes two torsion bars 70 which are journaled through the channel members 20 on opposite sides of the lift table 18 and project laterally therefrom. Two sprockets 72 and 74 are rigidly attached to both ends of both torsion bars 70 as shown in Figure 1. Each pair of inner sprockets 72 is operatively engaged with an inner levelling chain 76 which is attached at both ends to the frame 10 and extends between the two sprockets 72, passing around the underside of the rear sprocket 72 and passing over the top side of the forward sprocket 72. The upper ends of inner levelling chains 76 are attached to frame 10 at attachment points 78 which are located above the rear sprockets 72. The lower ends of the inner levelling chains 76 are attached to the frame 10 at attachment points 80 which are located below the corresponding forward sprockets 72. Each of a pair of outer levelling chains 82 is attached at both ends to the frame 10 on opposite sides thereof and extends between two of the outer levelling sprockets 74, the chain 82 passing under the front sprocket 74 and passing over the rear sprocket 74. The upper ends of the chains 82 are attached to the frame 10 at attachment points 84 which are positioned above the corresponding front outer sprockets 74. The bottom ends of the chains 82 are attached to the frame 10 at attachment points 86 which are located under the outer rear sprockets 74.

Adjustment means may be attached to chains 76 at points 78 and to chains 82 at points 84 to permit the lift table 18 to be manually levelled.

The above described torsion bars 70, sprockets 72 and 74, and levelling chains 76 and 82 act to keep all four corners of the lift table 18 at the same level throughout its range of upward and downward travel. If any one of the corners should drop or rise with respect to the other corners, this drop or rise will be communicated through the torsion bars 70 to the other side of the lift table and through the chains 76 and 82 to both of the other corners of the lift table 18 so that an upward or downward movement of any one corner will cause an equal up-

ward or downward movement on all of the three remaining corners so that the four corners of the lift table 18 will always move in synchronism and thereby maintain the table in a level condition even if an unbalanced load is applied thereto.

Referring to Figure 2, a conveyor belt 88 carrying sheets 90 of paperboard, cardboard, corrugated board or the like enters the upper portion of the cubical frame 10 and deposits the sheets in a stack 92 on the top of the lift table 18. A sheet stop member 94 serves to limit the forward movement of the sheets 90 so that they form an even stack. A photocell and light source 96 and mirror 98 (see Figure 1) are attached to opposite ends of the stop member 94 and serve to generate a signal that causes the lift table 18 to be lowered as will be described hereinafter. The stop member 94 and the photocell 96 and mirror 98 are all attached to a rack and pinion gear 100 by means of which the height of the photocell 96 and its reflecting mirror 98 may be raised and lowered for alignment purposes. The distance between the stop member 94 and the end of conveyor belt 88 may also be made adjustable if desired to accommodate different size sheets in the stacker.

As the sheets 90 approach the end of the conveyor belt 88, they engage rubber idler rollers 102 which press the sheets downward onto the upper surface of conveyor belt 88 to prevent slippage between the upper surface of the conveyor belt 88 and the sheets 90 at the point where they are pushed onto the top of the stack 92. A movable gate member 104 is mounted in front of the idler rollers 102. Gate member 104 is normally spring biased upwardly by a spring 106 but can be pulled downward to block the entry of the sheets 90 into the sheet stacker by means of a solenoid 108. The gate 104 is lowered at the end of an operating cycle to block the entry of sheets 90 into the sheet stacker at a time when the stack 92 is being removed therefrom.

Referring to Figure 2, an operating cycle of the above-described sheet stacker will be described starting with the condition illustrated in Figure 2 in which the sheets 90 are being deposited on the stack 92. As the sheets 90 pile up on the stack 92, they block the beam of light between photocell and light source 96 and mirror 98, which develops an electrical signal that is applied to the control circuit 44. The control circuit 44 then actuates the valve 42 to bleed some of the hydraulic fluid out of the cylinders 38, thus lowering the lift table 18 and the stack 92 until the beam of light from the photocell 96 to the mirror 98 is unbroken again. This lowering of the stack 92 is repeated periodically as the sheets pile up with the effect that the stack 92 grows taller and the

lift table 18 approaches the bottom of the frame 10.

Near the bottom of the frame 10, the lift table 18 engages a microswitch 110 which is electrically coupled to the control circuit 44. The control circuit 44 then sends an electrical signal to the input gate solenoid 108 to draw the gate 104 downward against the upward pressure of spring 106 to halt the inward movement of sheets 90. The circuit then waits for a predetermined delay time to allow the last sheet 90 to reach the stop member 94 and complete the stack 92. Thereafter, the control circuit 44 opens the solenoid valves 52 and 60 to couple the low capacity hydraulic pump 48 to the hydraulic motor 62 and initiate relatively slow drive on the rollers 24 under the stack 92 via the chain 64 and the sprockets 26. The stack 92 then begins to move sideways out of the sheet stacker and onto a pallet or conveyor which is placed at the side of the frame 10 to receive the stack 92. After a short time delay to allow the stack 92 to begin moving relatively slowly out of the side of the sheet stacker, the control circuit 44 opens the solenoid valve 54 to increase the amount of hydraulic fluid driven through the motor 62 to raise the rotary speed of the rollers 24 in order to remove the stack 92 from the lift table in a relatively short period of time. This two-speed feature is an important feature of the invention because the stack 92 must be removed from the lift table 18 in as short a time period as possible to avoid having to shut down the conveyor 88 at the input of the machine or equipment such as a corrugator machine which is coupled to the conveyor belt 88. Since the stack 92 is relatively large, it must be initially moved relatively slowly, but after it is started, it is highly desirable to move it at a faster speed to reduce the unloading time for the machine.

After a predetermined time delay to allow the stack 92 to be completely driven off the lift table 18, the solenoid valve 60 is closed to terminate the drive on the rollers 24 and the solenoid valve 42 is opened to begin moving the lift table 18 upwardly. At this time the solenoid valves 52 and 54 are both open and therefore a relatively high volume of hydraulic fluid pours into the cylinders 38 to raise the lift table 18 at a relatively high rate of speed. As the lift table 18 approaches the end of conveyor belt 88, it closes a microswitch 112 which is wired to the control circuit 44. The closing of microswitch 112 causes the control circuit 44 to switch the solenoid valve 54 off and block the high capacity hydraulic pump 50, thereby substantially reducing the speed at which the lift table 18 is raised. The lift table 18 then continues to move upward at a slow rate until it strikes the bottom of the stop

member 94, which mechanically blocks the lift table 18 from rising any further. The solenoid valve 52 is subsequently closed to remove the hydraulic drive and the solenoid valve 42 is operated in the state to hold the hydraulic fluid in the conduits 40 and cylinders 38 so as to hold the lift table 18 in position. The solenoid 108 is then released and the gate member 104 is lifted to allow the sheets 90 to again pile up the lift table 18.

The above cycle is repeated for the next stack 92 which is accumulated on lift table 18.

Reference is made to Patent application 35459/74 Serial No. 1462128 from which the present application was divided.

WHAT WE CLAIM IS:—

1. A sheet stacker comprising a frame, a lift table movably mounted on the frame for upward and downward movement, and means for raising and lowering the lift table, said means for raising said lift table including at least one hydraulic cylinder coupled to said lift table and pump means for forcing hydraulic fluid into said cylinder to raise said lift table, said pump means including a relatively high capacity pump for raising said lift table at a relatively high speed and a relatively low capacity pump for raising said lift table at a relatively low speed, a plurality of rollers journaled to said lift table and forming the upper surface thereof, a plurality of sprockets coupled to alternate rollers, a drive chain operatively engaged with said sprockets for driving the rollers coupled thereto, a hydraulic motor operatively engaged with said drive chain for driving the same, and hydraulic valve means selectively coupling said low capacity pump to said hydraulic motor to drive the motor at a relatively low speed and selectively coupling said high capacity pump to said hydraulic motor to drive the motor at a relatively high speed.

2. A sheet stacker according to claim 1 wherein said hydraulic motor is mounted on said frame above a corner of said lift table, and further comprising a loop in said drive

chain extending downwardly from said hydraulic motor to said roller sprockets, an idler sprocket journaled to said frame below said corner of said lift table, and a second loop in said drive chain extending downwardly from said roller sprockets to said idler sprocket, whereby movement of said drive chain will drive said roller sprockets regardless of the vertical position of said lift table.

3. A sheet stacker according to claim 2 comprising a second idler sprocket journaled to said lift table above the first mentioned idler sprocket and below said rollers, said drive chain being entrained over said second idler sprocket and extending downwardly from said second idler sprocket to said first mentioned idler sprocket, said drive chain extending upwardly from said first mentioned idler sprocket to said hydraulic motor and extending downwardly from said hydraulic motor to said roller sprockets.

4. A sheet stacker according to any one of claims 1, 2 or 3 wherein said hydraulic valve means includes a first valve coupled in series with said high capacity pump but not said low capacity pump, a second valve coupled in series with said low capacity pump but not said high capacity pump, a third valve coupled in series with both said first and second valves between said first and second valves and said hydraulic cylinder for raising said lift table, and a fourth valve coupled in series with both said first and second valves between said first and second valves and said hydraulic motor, whereby said high capacity pump and low capacity pump can be selectively coupled to said hydraulic cylinder for raising said lift table at a selected one of two speeds and can be selectively coupled to said hydraulic motor for rotating said rollers at a selected one of two speeds.

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member 94, which mechanically blocks the lift table 18 from rising any further. The solenoid valve 52 is subsequently closed to remove the hydraulic drive and the solenoid valve 42 is operated in the state to hold the hydraulic fluid in the conduits 40 and cylinders 38 so as to hold the lift table 18 in position. The solenoid 108 is then released and the gate member 104 is lifted to allow the sheets 90 to again pile up the lift table 18.

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