June 16, 1964 P. F. GOOD 3,137,497

SHEET LOOSENING METHOD AND APPARATUS

Filed Jan. 23, 1961 2 Sheets-Sheet 1

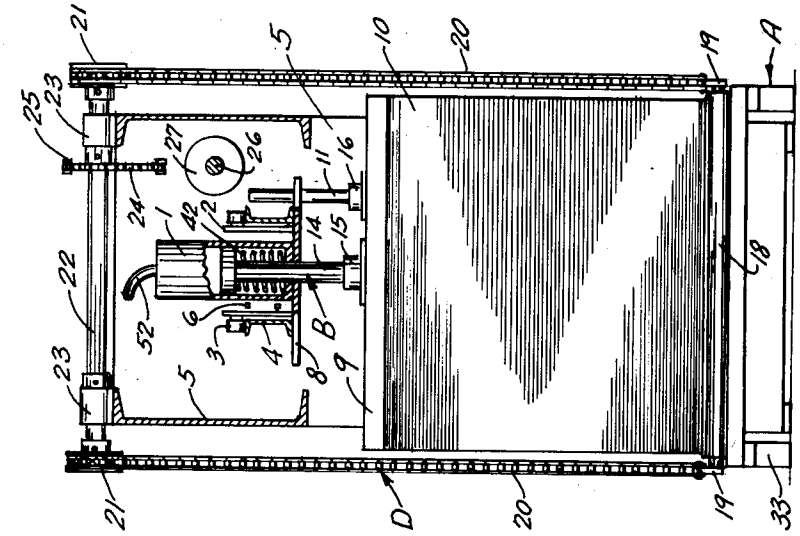


FIG. 2

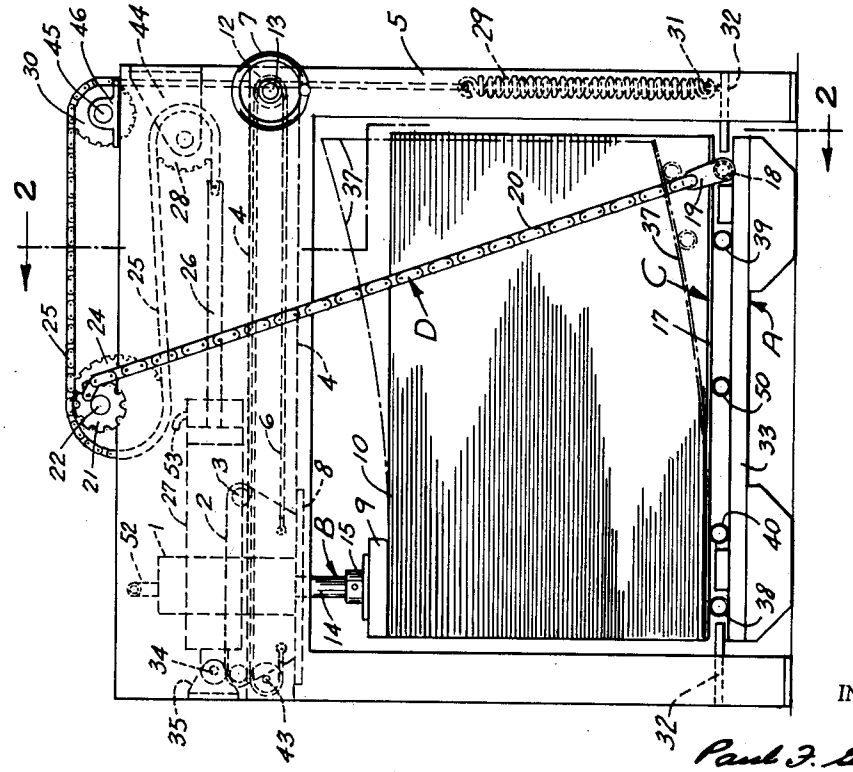


FIG. 1

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SHEET LOOSENING METHOD AND APPARATUS

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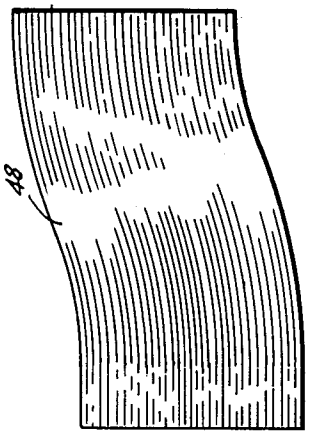


FIG-6

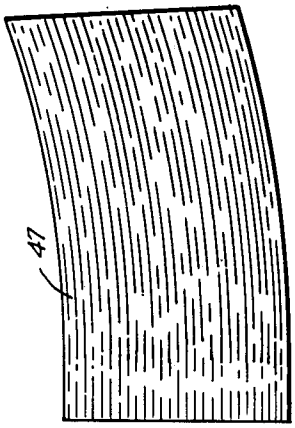


FIG-7

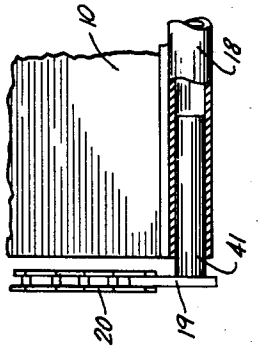


FIG-5

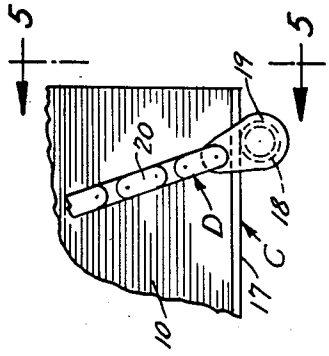


FIG-4

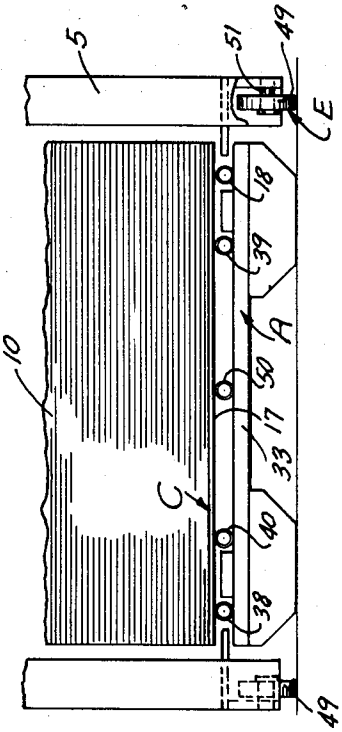


FIG-3

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SHEET LOOSENING METHOD AND APPARATUS

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4 Claims. (Cl. 271—13)

The present invention relates to a method and apparatus for use in loosening stacks of flexible sheet materials, such as printed and varnished sheets of cardboard that are used in the manufacturing of cardboard cartons.

Many of the cardboard cartons manufactured are used to package consumer products. For this reason the manufacturers improve the sales appeal of their cartons by attractively printing and varnishing the carton. The varnish adds luster to the carton and protects the outer surfaces against deterioration during the shipping and marketing of the packaged product. It is customary to print and varnish large sheets of cardboard and stack them into piles on wooden skids for drying and subsequent die-cutting. It is the usual practice to print and varnish only one side of the sheets of cardboard; therefore, when the sheets are stacked the upper, printed and varnished surface of each sheet is in contact with the untreated bottom surface of the adjacent sheets. Because of this, as the varnish dries there is a tendency for the exposed fibers of one sheet to adhere to the varnished surface that it contacts. To prevent or reduce this, it is customary to manually loosen the sheets of cardboard during the drying period. For some jobs this manual loosening of the stacks of sheets must be repeated several times. If the stacks are allowed to set too long after printing some of the fibers of the sheets will permanently adhere to the varnish and will mar the attractiveness of the carton. To manually loosen the stacks of sheets requires two operators, one at each end of the stack. They grasp the ends of a small group of sheets, manipulate the sheets by rolling and bending, and then place the loosened group of sheets on a second skid. This process is repeated many times until the entire skid-load of sheets is loosened.

Loosening of the stacks of sheets in this manner is very time consuming and requires careful handling of the sheets to assure that the stacks will be straight enough for proper automatic feeding into the die-cutting machines.

It is accordingly among the objects of my invention to provide a method and apparatus that can loosen an entire skid-load of sheets without removing the sheets from the stack, keep the sides of the stack straight during the loosening process, reduce the time required to loosen the sheets to a small fraction of the time presently required, and improve the appearance of the printed surfaces of the sheets. A further object is to provide a sheet loosening apparatus that can be easily changed to accommodate skid-loads of sheets which vary in length, width, and height. A still further object is to provide a sheet loosening apparatus that can be easily positioned over skid-loads of sheets, such as a row of skids that are to be processed successively.

Additional objects and advantages will become apparent from the following description taken in conjunction with the drawings, in which:

FIGURE 1 is a front elevation view of apparatus embodying the invention;

FIGURE 2 is a transverse vertical section taken approximately on the line 2—2 of FIGURE 1;

FIGURE 3 is a partial front elevation of apparatus similar to FIGURE 1 but showing a modified version of the apparatus;

FIGURE 4 is an enlarged detail view of part of the apparatus shown in FIGURE 1;

FIGURE 5 is a transverse elevation taken on the line 5—5 of FIGURE 4;

FIGURE 6 is a schematic elevation of a stack of sheets showing a double curvature shape;

FIGURE 7 is a schematic elevation of a stack of sheets, similar to FIGURE 6, but showing a single curvature shape.

The apparatus provided by the present invention, in general, comprises: (1) means for supporting the stack of sheets to be loosened, (2) means for clamping certain selected portions of the stack of sheets, (3) means for manipulating the unclamped portions of the stack of sheets, (4) means for forcing the sheets to bend substantially in a predetermined curvature during the manipulating operation, (5) means for easily changing the apparatus to accommodate a variety of sizes of stacks of sheets, (6) means for easily moving the apparatus into operating position over the skid-loads of sheets.

As can be seen by referring to FIGURES 1 through 5, the sheet loosening apparatus consists broadly of a frame 5, a stack supporting means generally designated as A, a stack clamping means generally designated as B, a stack curvature control maens generally designated as C, a stack manipulating means generally designated as D, and an apparatus conveying means generally designated as E, FIGURE 3.

The stack supporting means A can be a modification of the conventional type of skids normally used for transporting and storing stacks of sheet materials.

The stack clamping means B consists of a powered cylinder 1 mounted to the lower plate 8 of cartridge 2. Carriage rollers 3 are rotatably mounted to the carriage 2 to provide a means for easily moving the carriage along the length of the stack of sheets 10 as desired. The carriage rollers 3 engage the upper surface of tracks 4 secured at their ends to the frame 5. The positioning of carriage 2 along the length of the stack of sheets 10 is accomplished by means of handwheel 7, shaft 13, sprocket 12, chain 6, and idler sprocket 43. Handwheel 7 and sprocket 12 are secured to a shaft 13 rotatably mounted to the frame 5. Idler sprocket 43 is rotatably attached to the frame 5. Clamping pressure is applied to the stack of sheets 10 by supplying any suitable pressure medium, such as air or hydraulic, through a flexible hose 52, to the upper chamber of the clamping cylinder 1. Mounted to the lower end of the cylinder rod 14 is a flange 15 to which is secured a pressure bar 9. Transverse alginment of the pressure bar 9 is maintained by means of a flange 16 attached thereto and guide pin 11 extending through a guide hole in the lower plate 8 of carriage 2. A return spring 42 is provided to raise the pressure bar 9 from the stack of sheets 10 when the fluid pressure is relieved from the clamping cylinder 1. When the clamping cylinder 1 is exerting clamping pressure on the stack of sheets 10, the lower plate 8 of carriage 2 is forced upwardly against the lower surfaces of tracks 4. This normally prevents any movement of the carriage 2 along tracks 4 during the lifting and manipulation of the stack of sheets 10. For some applications it may be desirable to provide the upper surface of plate 8 and the lower surfaces of tracks 4 with friction increasing means such as sand-blasting or serrating the mating surfaces.

The stack curvature control means C consists of a flexible plate 17 with several transverse tubes 18, 38, 39, 40, and 50 attached thereto. The thickness of the plate 17 can be selected to produce a double or a single curvature stack of sheets during the manipulation of the stack. The required thickness for any given application can best be determined experimentally, but will depend upon the material used for the plate 17, the material and stiffness of the sheets being loosened, the difficulty of loosening the sheets, and the curvature pattern desired. Thinner

and more flexible plates will produce a stack having a double curvature as shown in FIGURE 6; while thicker and stiffer plates will produce a stack having a single curvature as shown in FIGURE 7. Although the single curvature method is preferred, the double curvature method of loosening the sheets is adequate for lightly stuck sheets, but is not satisfactory for stacks of sheets that are tightly stuck together because some of the areas of the stack will not be properly loosened. A further disadvantage of the double curvature method results from the buckling and slight separation of some areas of the sheets during the loosening manipulation of the stacks. This separation tends to pull fibers from the bottom untreated surface of the sheets. With the single curvature method the sheets maintain tight contact with each other during the manipulation and the fibers remain lodged in their original positions. The primary difference in the two methods is that with the double curvature method the separation of the sheets lifts or pulls the adhered fibers from their original positions, while the single curvature method produces a shearing action to free the fibers from their adhesive contacts with the varnish.

The manipulating means D consists of a manipulating cylinder **27**, activated by connecting the supply pipe **53** to any suitable fluid power supply, such as air or hydraulic. This cylinder **27** lifts and manipulates the stack of sheets through cylinder rod **26**, chain **25**, sprocket **28** rotatably attached to the frame **5** by bracket **44**, eccentric sprocket **24** keyed to a shaft **22** rotatably mounted to frame **5** by means of bearings **23**, sprockets **21** keyed to the shaft **22**, chains **20** connected at their upper ends to sprockets **21** and connected to the curvature control plate **17** by means of adaptors **19**. Said chain **25** extends over sprocket **30** keyed to a shaft **45** rotatably mounted and secured at its ends to frame **5** by bearings **46**. The lower end of the chain **25** is attached to a tension spring **29** mounted to frame **5** by means of a lug **31** and a retainer plate **32**. The tension provided by the spring **29** returns the manipulating cylinder **27** to its starting position when the cylinder is deenergized and also keeps the chain **25** tight at all times and thereby assures that the chain will remain in engagement with the teeth of the eccentric sprocket **24**. The eccentric sprocket **24** is made such that the teeth of the sprocket are eccentric to the shaft **22** on which it is mounted. This provides increased mechanical advantage at the start of the lifting stroke where the manipulating load is greatest.

Retainer plates **32** are provided to prevent lifting of the skid A as the stack of sheets **10** is lifted and manipulated.

As heretofore shown and described, the curvature control plate **17** is preferably located at the bottom side of the stack of sheets **10**. However, a similar plate can be used on the top side of the stack instead of at the bottom side; or else two thinner plates can be used in combination, one on the bottom side of the stack and the other on the top side. Plates mounted on the top side of the stack should extend below, and be clamped by, the clamping cylinder **1** to be effective as a curvature control means. Similarly, the lower plate must extend below the clamped area of the stack to be effective.

The apparatus conveying means E consists of wheels **49**, FIGURE 3, rotatably mounted to the frame **5** by means of the axles **51**. The addition of the wheels to the sheet loosening apparatus permits the prepositioning of a row of stacks such that the apparatus can be positioned easily and quickly over a skid-load of sheets without the use of a lift truck for handling the skids of sheets.

In operation, a skid-load of sheets **10** is placed into loosening position as shown in FIGURES 1 and 2. The chains **20** are attached to the curvature control plate **17** by inserting the bars **41** of the adaptors **19** into the ends of the tube **18**. The clamping cylinder is energized and the pressure bar **9** lowers to clamp the stack of sheets. With the sheets clamped the unclamped end of the stack of sheets **10** is raised and lowered one or more times, as required to loosen the sheets, by alternately energizing and deenergizing the manipulating cylinder **27**. After the manipulating is completed the clamping cylinder **1** is deenergized and the pressure bar **9** is raised from the stack of sheets by means of the return spring **42**. To loosen the left-hand end of the stack, see FIGURE 1, the chains **20** are repositioned to lift the left-hand end of the stack of sheets **10** by inserting bars **41** of the adaptors **19** into the ends of the tube **38**. The clamping cylinder **27** is moved to the right-hand end of the stack by turning the hand-wheel **7** counterclockwise as required. The clamping cylinder is again energized to clamp the right-hand end of the stack of sheets **10**. With the stack clamped the left-hand end of the stack of sheets is lifted and lowered one or more times, as required to loosen the sheets by alternately energizing and deenergizing the manipulating cylinder **27**. After the manipulation is completed the clamping cylinder **1** is deenergized and the pressure bar **9** is again lifted from the stack of sheets by means of the return spring **42**. The chains **20** are disconnected from the curvature control plate **17** and the loosened skid-load of sheets is replaced by another skid-load.

For short stacks of sheets it is desirable to place the stack about midway between the legs of the frame **5** and then use tubes **39** and **40** instead of tubes **18** and **38** as described above.

The operation of the apparatus shown in FIGURE 3 is similar to the aforesaid operation except that the paper loosening apparatus is moved into position over the skid-load of sheets instead of positioning the skid-loads of sheets into the apparatus.

Having now described the means by which the objects of my invention are obtained, I claim:

1. An apparatus for separating sheet articles in a stack of said articles comprising means for supporting the stack of articles, means for clamping a portion of said stack at a position adjacent an edge of said stack, means for inducing slippage between adjacent sheets in said stack at the unclamped portion thereof, said means including an uninterrupted flexible plate member disposed along the bottom of said stack above said supporting means and adapted to be bent toward said stack.

2. An apparatus as in claim 1, further comprising shifting means for positioning said clamping means adjacent the opposite edge of said stack.

3. An apparatus as in claim 1, said means for inducing slippage further comprising lifting means, and connecting means for selectively attaching said lifting means to said plate member along the length thereof to bend different portions of said plate.

4. An apparatus as in claim 3, said connecting means further comprising spaced parallel transverse members attached to said plate member, and adaptor bars attached to said lifting means and engaged with one of said transverse members.

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