

Sept. 17, 1963

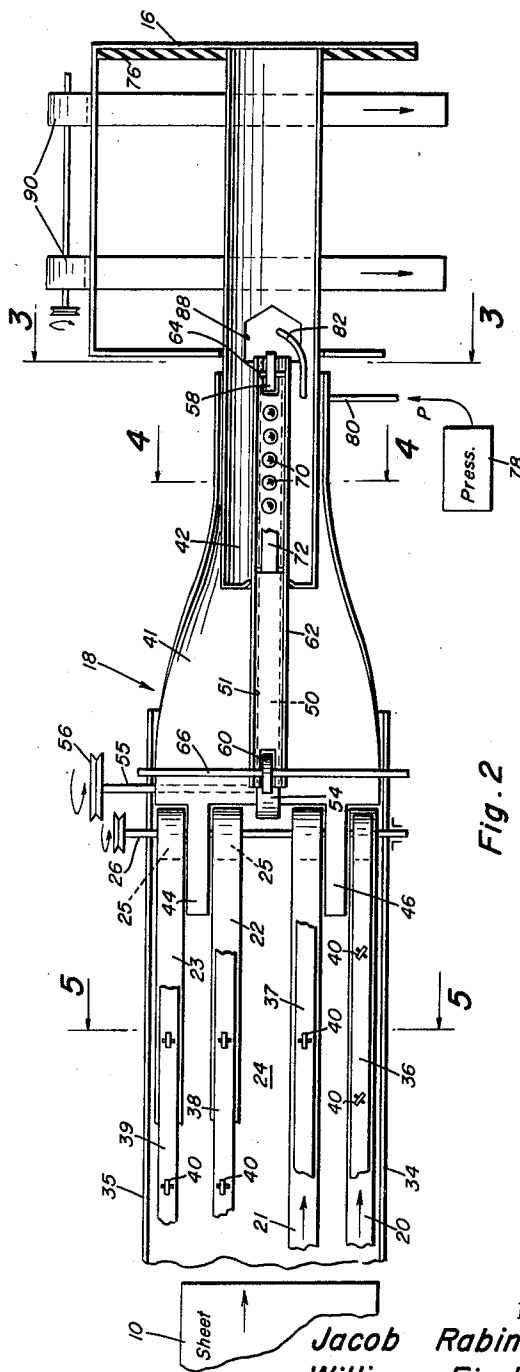
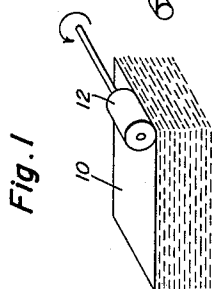
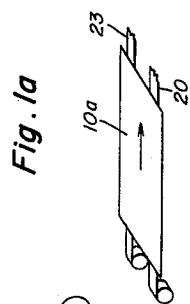
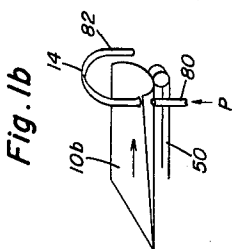
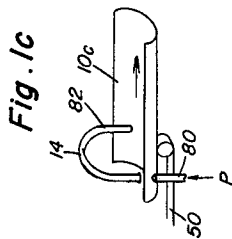
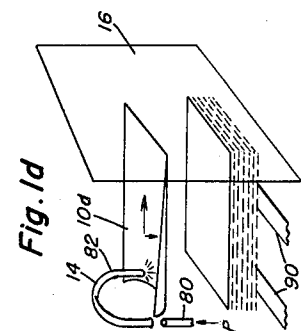
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3,104,101

FLEXIBLE SHEET EDGER AND STACKER

Filed Oct. 23, 1961

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 3

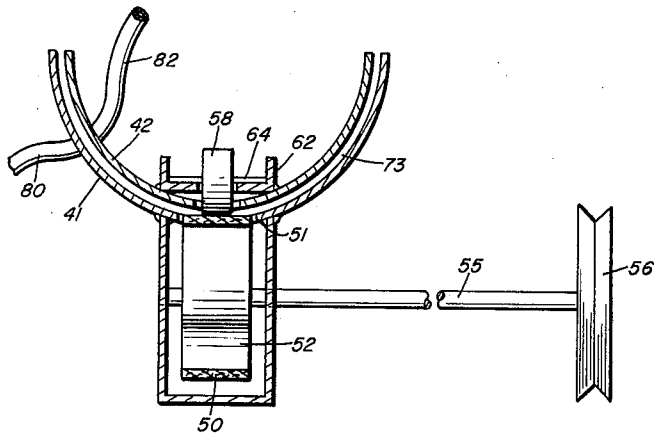


Fig. 4

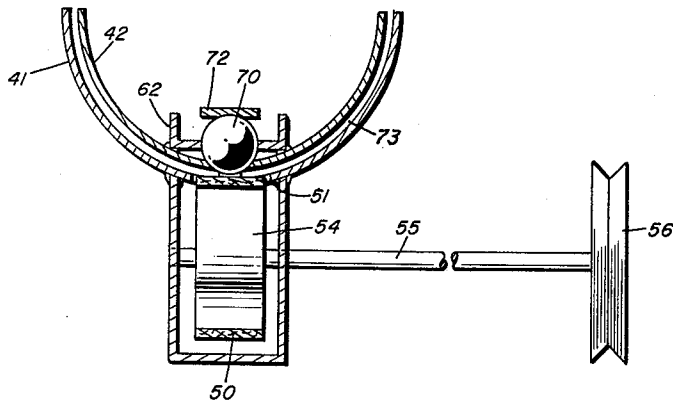
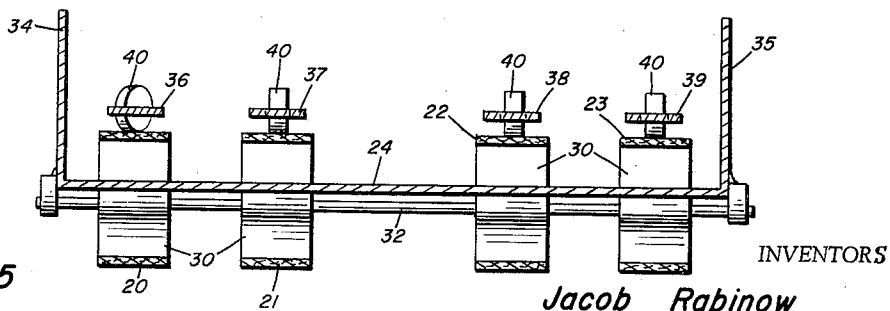


Fig. 5



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FLEXIBLE SHEET EDGER AND STACKER

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4 Claims. (Cl. 271-69)

This invention relates to apparatus for handling flexible sheets, and particularly to such apparatus for transporting the sheets at high rates.

For a number of years there have been continual improvements in the art of transporting, stacking and otherwise handling flat objects, for example cards and paper sheets. Transporting business machine cards present quite different problems from those encountered in handling highly flexible sheets of paper. Equipment which is perfectly satisfactory for cards will not function with highly flexible sheets. For one thing, highly flexible sheets do not have nearly the stiffness of cards, and are likely to flutter, twist and bend when they are transported at high speeds. This is particularly true in those cases where the sheet is not physically carried from one point to another, for instance by a pneumatic drum or head.

An object of this invention is to provide a new technique for stacking flexible sheets at high speeds, where the sheets are individually propelled, one after the other.

In the last years numerous advances in the art of reading by machine have been made so that the need for high speed, flexible sheet transport equipment has become accentuated. Ordinary paper sheet handling and stacking apparatus which is perfectly suitable for paper collating and other paper-handling procedures is not satisfactory for handling sheets in such a manner that they can be read by machine. One reason is that paper collating equipment and the like does not require the precision handling of paper that has been previously handled and mishandled by human beings, as required of reading machines. Another is that ordinary paper handling equipment is incapable of operating at sufficiently high speeds to satisfy the demand of modern reading machines.

The invention is embodied in apparatus for receiving sequentially fed sheets and conveying them edgewise for a predetermined distance, and while being conveyed, transversely curving the sheets in a direction transverse to the direction of travel thereof so as to increase the stiffness of the sheets against bending in a direction parallel to the motion of the sheets. It has been found that when the sheets are so curved, they may be propelled into a receiving station one after the other, with the succeeding sheets coming to rest upon the preceding sheets. Thus, one of the features of the present invention is to transversely curve a highly flexible sheet in a direction transverse to the path of movement of the sheet and to eject or propel that sheet into a receiving station. By handling successive sheets in this way they are stacked at a receiving station and if, as in the illustrated embodiment, the receiving station has a live conveyor for its bottom, the sheets are "shingled" as they are withdrawn by the live conveyor from the receiving station.

A feature of the invention is used to overcome a problem in handling sheets in the above way as explained below. As the sheets are discharged one by one from the discharge end of the conveyor system, they are directed toward and strike an abutment in the sheet receiving station. The pull of gravity is relied on to lower the sheets onto the live conveyor at the bottom of the sheet receiving station. A unique pneumatic system is used to supplement the pull of gravity by directing an air stream against the rear part of the flat surface of each sheet as it is propelled into the receiving station. The air stream is directed downwardly so that the trailing edge portion of the

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sheet is forcefully moved downward during the time that it is being propelled into the receiving station thereby providing ample clearance for the leading edge of the next sheet to enter the receiving station. This feature relies on the sheet itself as a part of a valve mechanism to control the air stream. Thus, no external valving and synchronizing problems are encountered.

Other objects and features of importance will become apparent in following the description of the illustrated form of the invention.

FIGURES 1-1d inclusive are diagrammatic views showing the technique for transport and handling sheets in accordance with the invention.

FIGURE 2 is a diagrammatic top sectional view showing a flexible sheet transport fulfilling the objectives of the invention.

FIGURE 3 is a cross-sectional view on enlarged scale and taken on line 3-3 of FIGURE 2.

FIGURE 4 is an enlarged sectional view taken on line 4-4 of FIGURE 2.

FIGURE 5 is a sectional view taken on line 5-5 of FIGURE 2.

In the drawings, reference is made first to FIGURES 1-1d which diagrammatically illustrate how flexible sheets are handled in accordance with the invention. FIGURE 1 shows a sheet 10 at the top of a stack with suitable means 12 for extracting the top sheet from the stack and propelling it in the direction of the arrow. FIGURE 1a shows sheet 10 in position 10a being conveyed flatwise on a conveyor after it has been fed by the means 12. FIGURE 1b shows sheet 10 in position 10b with the leading edge thereof curved transversely to the direction of motion of the sheet. By curving the sheet in this way it becomes highly resistant to bending in a direction parallel to the motion of the sheet. FIGURE 1b also shows a pneumatic system 14 made of a pair of conduits with confronting ends slightly spaced, between which a portion of the sheet passes. Thus, the sheet acts as a valve for the air under pressure in the pneumatic system. FIGURE 1c shows sheet 10 at position 10c curved transversely along its full length and the pneumatic system 14 still closed or blocked by the sheet.

FIGURE 1d shows sheet 10 at position 10d striking an abutment 16 after it has been ejected by the conveyor shown in FIGURES 1a-1c. Between the positions 10c and 10d the sheet opens the pneumatic system 14 allowing air under pressure to be discharged downwardly on the rear part of the flat surface of the sheet thereby aiding the pull of gravity to move the sheet downwardly into the stack shown in FIGURE 1d.

Device 18 (FIGURES 2-5) is constructed to operate in accordance with the technique diagrammatically shown in FIGURES 1-1d. Sheet 10 to the left of FIGURE 2 is assumed to have been fed from any source, for instance from the stack shown in FIGURE 1. It is conveyed edgewise on a plurality of conveyor belts 20, 21, 22 and 23 whose upper flights move over a supporting surface 24 of the main body or frame of the machine. The four conveyor belts 20-23 are driven by conveyor rollers 25 attached to a shaft 26 (FIGURE 2), while the opposite ends (FIGURE 5) of the conveyor belts are mounted on idler rollers 20 supported by a shaft 32. The shafts 28 and 32, as all other shafts of device 18, are suitably mounted in conventional bearings carried by the main frame of the machine. The bearings and like details are omitted since they are conventional.

The surface 24, i.e., the bottom of the frame of the device, has edge walls 34 and 35 (FIGURE 2) at right angles thereto near belts 20 and 23. Assume for one application that it is desired to edge sheet 10 along wall 34. For this, we have edging strip 36 near wall 34 and guide strips 37, 38 and 39 superimposed over the four

conveyors. The edging and guide strips themselves are conventional and consist of thin strips of metal supporting rollers 40 along the length thereof. The edging strip 35 differs from the other strips 37, 38 and 39 by having the rollers thereof at an angle to the path of movement of the sheet 10 thereby introducing a lateral component of force to the sheet, tending to move it against wall 34.

In handling comparatively stiff sheets, cards, checks, etc. they may be discharge from the discharge end of the conveyor belts 20—23 directly to a compartment. But highly flexible sheets flutter, twist and bend and, in general, do not neatly stack when simply ejected in to a compartment. This problem is solved by the technique diagrammatically shown in FIGURES 1b—1d inclusive and by the following structural features to implement this technique: A pair of formers 41 and 42 are aligned with the discharge end of the conveyor belts 20—23. The former 41 is a flat plate having portions 44 and 46 interlaced with discharge ends of the conveyor belts 20—23 so that the leading edge of the sheet is supported by these portions of the former 41 before the sheet leaves conveyors 20—23. Actually, the former 41 may be an integral part of the surface 24 although shown separate. The discharge end of former 41 is smoothly curved to a semi-circular cross-sectional shape as shown in FIGURES 3 and 4. The former 42 is semi-cylindrical and is nested within but very slightly spaced from the inner surface of the curved part of former 41. Thus, as the sheet enters the throat of the superimposed formers (FIGURE 1b) the leading edge portion of the sheet becomes transversely curved, and as the sheet fully enters the semi-cylindrical portions of the formers the sheet (FIGURE 1c) becomes transversely curved from end to end.

The means for propelling the sheet from the discharge ends of conveyor belts 20—23 into and through the formers, may be varied considerably, an effective means to accomplish this being an endless conveyor 50 (FIGURES 3 and 4) along the center line of the former 41. This endless conveyor is shown best in FIGURES 3 and 4 and is located with its upper flight in an elongated slot 51 in the bottom part of former 41. The endless conveyor 50 has front and rear conveyor rollers 52 and 54, respectively, one of which, for example roller 54 is power operated, this being schematically represented by a shaft 55 and pulley 56. There are means for frictionally engaging the sheet with conveyor 50 as the conveyor propels it. These means consist of a pair of idler rollers 58 and 60 at the ends of a structural support, e.g., channel 62, to which former 42 is fixed. The idler roller 58 is mounted for rotation on a spindle 64 carried by a part of channel 62, and the idler 60 is mounted for rotation on a spindle 66 (FIGURE 2). The spindle 66 is connected pivotally to walls 34 and 35 of the machine frame and allows the channel 62 and former 42 to be pivotally elevated for inspection, maintenance, etc. In addition to the idler rollers 58 and 60, there is a group of spheres 70 pressed downward through apertures in the bottom of channel 62, for instance by leaf spring 72 attached to channel 62 (FIGURES 2 and 4). Thus, the spheres press against the sheet as it is propelled by conveyor 50 through the annular throat 73 defined by formers 41 and 42.

The speed of conveyor 50 is such that when the sheet is discharged from the end thereof it moves with sufficient force to be in free flight or practically free flight, for a short distance (FIGURE 1d). The leading edge of the sheet strikes an abutment 76 which constitutes a part of a sheet-receiving station. The abutment 76 is a resilient pad on wall 16, the latter constituting a part of an open bottom receptacle as shown in FIGURE 2. As shown by the arrows on sheet 10d in FIGURE 1d, the forward movement of the sheet is represented by the horizontal arrow and as the sheet is in free flight it is acted on by the pull of gravity (vertical arrow) tending to move the sheet downwardly. The downward component

of force acting on the sheet may be sufficient to move the sheet downwardly enough and at a great enough rate to allow the succeeding sheet to assume a position above the preceding sheet as the sheets enter the sheet receiving station. However, for high speeds, the force of gravity may not act on the sheet fast enough to clear one sheet from the path of travel of the succeeding sheet. Thus, there are means for applying a vertically downward force on the trailing edge portion of the sheet (at least) as it discharged from the throat 73 between formers 40, 42. These means consist of the pneumatic system shown diagrammatically in FIGURES 1b—1d. The pneumatic system includes a pressure source 78 and a conduit 80 whose passageway conducts the air under pressure across throat 73 (FIGURE 3). Thus, one end of the passageway is valved by the sheet itself as it passes between the superposed formers. Another conduit 82 has an end directly opposing the open end of conduit 80 through an opening in former 42. The extremity of conduit 82 is directed downwardly to form a discharge nozzle through an aperture 83 in the former 42, beyond the discharge end of conveyor 50. The operation of a pneumatic system is now considered obvious especially in view of FIGURES 1b—1d where the sheet is shown blocking the pneumatic passageway until the trailing edge of the sheet passes the aligned openings in the pneumatic passageway after which air is blown through conduits 80 and 82 and onto the top surface of the sheet near the trailing edge thereof. This forceably pushes at least the trailing edge of the sheet downward just before and/or as it strikes the abutment 76. However, when the next sheet passes through throat 73, it will close the pneumatic system, and the pneumatic system will remain closed until the trailing edge of the new sheet moves beyond the aligned openings of the conduits 80 and 82.

FIGURE 1d shows a stack of sheets in the sheet receiving station. This is one possible mode of operation, i.e., to allow the sheets to stack and periodically index the conveyor 90 to empty the sheet receiving station. Another mode of operation is to have conveyor 90 continuously operating in time with the feeding of the sheets such that the sheets become shingled on conveyor 90. A further possibility is to omit conveyor 90 and allow the sheets to stack on a platform. The platform could be periodically lowered as the stack grows.

The various drives for the conveyors are shown diagrammatically as pulleys. It is understood that any kind of suitable drive mechanism may be used. The timing of the conveyors presents no problem and, in fact, the conveyor 50 may be operated at a higher speed than the conveyors 20—23 to assure that there will be only one sheet at a time in the throat 73. Various other modifications, alterations and changes may be made herein without departing from the scope of the following claims.

We claim:

1. In an apparatus for transporting and stacking flexible sheets, means for conveying the sheets edgewise, means including a pair of adjacent nested formers for curving the sheets transversely to the direction of movement of the sheets and for maintaining the curvature in a portion of each sheet as another portion thereof is being discharged from said conveying means, said conveying means including a plurality of sheet pressing members along the length of said formers to assure propulsion of the sheets passing through said formers, the rate of said conveying means being such as to propel the sheet forceably from said conveying means at the discharge end thereof, and pneumatic means operative as the sheet is being discharged from said conveying means for imparting a component of force to the sheet in a direction transverse to the conveyor-discharge force applied to the sheet, said pneumatic means including means defining an air passageway with a discharge end beyond the end of said formers, and an intermediate opening along the length of said passageway ahead of

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said discharge end, and said intermediate opening being valved by said sheets as they are propelled.

2. A flexible sheet stacker comprising a conveyor with a horizontal surface to convey the sheets horizontally with a flat side on the horizontal conveyor, a wall adjacent to said conveyor to provide an edge reference for the conveyed sheets, edging means to edge the sheets against said edge reference as they are being conveyed, a first former having a curved surface in tandem with said conveyor, a second curved former nested with said first former and spaced slightly therefrom to form a sheet-curving passage for the sheets, a second conveyor along the length of said formers to propel the sheets through said passage by contacting one surface of the sheets, pressing means along the length of said second conveyor and said formers to engage the sheets with said second conveyor, and pneumatic means to deflect only the trailing edge portions of the sheets when they have passed through said formers, said pneumatic means including valve means effective to retain the pneumatic means off until a sheet has moved in a manner that the leading edge is distal from the pneumatic means and only the trailing edge portion is exposed to said pneumatic means at which time the pneumatic means are operative to deflect only the trailing edge of the sheet.

3. The subject matter of claim 2 wherein said pneumatic means and said valve means further include a source of pneumatic pressure provided with a pressure conductor terminating at said passage, a second conductor aligned with the end of said pneumatic pressure conductor and spaced therefrom across said passage to provide a space through which the sheets pass as they move through said passage, and said second conductor extending to such a position that the pneumatic pressure stream flows beyond the discharge end of said passage.

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4. A flexible sheet stacker comprising a conveyor to convey the sheets, a first former having a curved surface and arranged in tandem with said conveyor, a second curved former nested with said first former and spaced slightly therefrom to form a sheet-curving passage for the sheets, a second conveyor along the length of said formers to propel the sheets through said passage by contacting one surface of the sheets, pressing means along the length of said second conveyor and said formers to engage the sheets with said second conveyor, pneumatic means to deflect only the trailing edges of the sheets when they have passed through said formers, said pneumatic means including valve means effective to retain the pneumatic means off until a sheet has moved in a manner that the leading edge is distal from the pneumatic means and the trailing edge portion only is exposed to said pneumatic means at which time the pneumatic means are operative to deflect only the trailing edge of the sheet, a sheet receiving structure to receive the sheets propelled by said second conveyor in one direction to the sheets being deflected by said pneumatic means at their trailing edges at an angle to said direction of sheet propulsion, and a resilient shock absorber member in the path of propulsion motion of said sheets so that while the sheets are moving in said direction by the action of said second conveyor, the forward edge of each sheet strikes said shock absorber.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,104,101

September 17, 1963

Jacob Rabinow et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, line 21, for "direction to the sheets" read
-- direction, the sheets --.

Signed and sealed this 7th day of April 1964.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents