[54] METHOD AND APPARATUS FOR RESTACKING STACKS OF PAPER, CARDBOARD AND THE LIKE SHEETS

[72] Inventor: Gunnar Ruud, Guru Popp A/S, P.O. Box 50, 1701, Sarpsborg, Norway

[22] Filed: Oct. 16, 1970

[21] Appl. No.: 81,444

[52] U.S. Cl. ........................................ 271/61, 34/150, 34/164, 271/89

[51] Int. Cl. ........................................... B65H 31/40

[58] Field of Search ................................. 271/89, 61, 18, 26, 26 E; 34/150, 164, 33, 38; 214/6 S

[56] References Cited

UNITED STATES PATENTS
2,626,147 1/1953 Gjestin .................................. 271/26 X
2,692,774 10/1954 Sidman ................................ 271/44 X
3,239,944 3/1966 Gebert .................................. 271/89 X
3,418,725 12/1968 Ruud .................................. 271/89 X

FOREIGN PATENTS OR APPLICATIONS
1,169,963 5/1964 Germany ................................ 271/89

A machine for processing and restacking stacks of sheets of printed or unprinted paper, cardboard and the like, including a support, means for holding the sheets of a stack on edge, in a substantially vertical position on the support, sheet lifting means movable along the support successively under the sheets of the stack, side sheet guide means having a face located adjacent the position of the side edges of the sheets of the stack above the support with its face in a position to be engaged by the adjacent side edges of the sheets, means for vibrating the sheet lifting means for in turn vibrating, loosening and separating the sheets of the stack at the position of the sheet lifting means, means for positioning the vibrating means and controlling its effect on the lifted sheets for moving them in a direction to cause their said side edges to contact the face of the side guide means, thereby stacking the sheets of the stack with the side edges in alignment. The support of this unit comprises a plurality of spaced parallel beams, the sheet lifting means and the vibrating means comprises a plurality of lifting shoes located between beams and projecting above their upper surfaces, and the vibrating means is an electromagnetic vibrator for controlling the stacking of the sheets.

12 Claims, 4 Drawing Figures
METHOD AND APPARATUS FOR RESTACKING STACKS OF PAPER, CARDBOARD AND THE LIKE SHEETS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to improvements in apparatus units for restacking stacks of sheets of printed or unprinted paper, cardboard and the like for cleaning, aerating and aligning the sheets of the stack.

2. Description of the Prior Art

The prior art is represented by the applicant's U.S. Pat. No. 3,418,725, which discloses and claims a method and apparatus for mechanical aeration of stacks of cardboard, paper and other sheet material for preventing them from sticking together. According to the disclosure of this patent, a stack of sheets is positioned on a support with the sheets substantially vertical and with their lower edges resting on the support. In this position the lower edges of the sheets are acted on by a lifting means to successively raise and lower the sheets in relation to each other. The apparatus for processing the stacks of sheets includes a mechanical vibrating means which acts on the sheet lifting means, and there is a nozzle for supplying air at the top of the raised sheets.

In the use of the apparatus disclosed in the applicant's patent, certain deficiencies have been found and one of the primary objects of the present invention is to overcome these deficiencies and provide a unit which will effect restacking of the sheets in a manner such that they are positively moved, so that the vertical edges of the sheets being restacked, at least along one side of the stack, are positively acted on and brought into alignment.

SUMMARY OF THE INVENTION

The improvements of the present invention primarily relate to the provision of a novel sheet support and cooperating sheet lifting means carried on a frame connected to a side sheet guide, or stacking bar which moves along the stack with the sheet lifting means and which includes a face located adjacent the position of the side edges of the sheets of the stack, above the support, in a position to be engaged by the adjacent side edges of the sheets.

Another important improvement provided by the present invention comprises a cooperating vibrating assembly means, preferably including an electromagnetic vibrator mounted on and acting on the sheet lifting means so as to effectively and rapidly dance the sheets, and means for aerating the sheets from opposite sides. Furthermore, the vibrator is positioned with respect to the sheet lifting means to positively move and direct the sheets so that their edges adjacent the side sheet guide move into contact with the face of the guide and are aligned in a plane coinciding with the surface of the face of the guide.

The invention also preferably includes narrow vertically elongated air nozzles movable along the stack with the sheet lifting means and directed toward the side edges of the sheets of the stack at the position where they are lifted by the lifting means.

BRIEF DESCRIPTION OF THE DRAWING

The invention includes other features cooperating with those described above as pointed out more in detail hereafter in connection with the accompanying drawings illustrating one embodiment of the invention.

In the drawings:

FIG. 1 is a perspective view of the restacking machine at a particular stage during the processing and restacking of the stack now shown with the sheets in edgewise position on the support of the unit;

FIG. 2 is an enlarged detail view of mounting means for the blowers and side guide shown in FIG. 1;

FIG. 3 is a view, partly in section of the bottom of the support showing the underneath structure of the sheet lifting and vibrating means with two vibrators; and...

DESCRIPTION OF THE PREFERRED EMBODIMENT

The machine shown in FIG. 1 is illustrated in an operative position, in which a stack of sheets on edge is in the process of being restacked, aerated and cleaned. The unit comprises a base 10, adapted to rest on a floor, carrying a tiltable support or platform 12. The base also carries a fixed side housing 14 provided with controls and connections as shown and also an end housing 16 for enclosing motors and control equipment connected electrically through a conduit 18 to a master control box 20 provided with operating buttons, knobs or other actuating devices as diagrammatically illustrated.

The platform 12 is provided with a rigid end framework and stack-receiving platform 22 which is rigidly mounted at the right-hand end of the support 12. The support 12 and the receiving support 22 are tiltable as a unit so that the stack of sheets to be processed, carried on a pallet rack 24 are stacked onto the end support 22 when it is in a horizontal position, after which the supports 12 and 22 are pivoted to the position shown in FIG. 1, so that the stack 26 is brought to rest on the support 12 with the sheets in edgewise position.

The pivoting of the rigid structure comprising the supports 12 and 22 is effected by hydraulic units and link arrangements comprising, at each side of the support 12, a link 28, one end of which is pivoted at a fixed position of the base 10, while the other end is pivoted on the pin 30 at about the midpoint of the support 12. The hydraulic units for effecting the tilting comprise a hydraulic cylinder and piston unit 32 at each side, fixed to the base 10, and provided with a piston rod 34 extending therefrom and pivoted to a bracket 36 on the right-hand end of the support 12 by a pin 38, which also carries a roller 40 movable along at the top of the base 10. Hydraulic fluid lines 41 connect with the units 32 in a known manner. When the units 32 are operated to tilt the supports 12 and 22 to a position in which the platform 22 is located within the frame of the base 10, the piston rods 34 are pulled into the respective units 32 which moves the rollers 40 and the end portion of the support 12 to the left, thereby lifting the support 12 to an upright position, so that a stack of sheets may be removed from the support 12 or a new one located thereon. At an intermediate position the supports 12 and 22 and the stack of sheets 26 are supported by the links 28 and the rollers 40. In the reverse operation, the piston rods 34 are let out of the units 32 to pivot the support 12 to the horizontal position as shown in FIG. 1. Somewhat similar movements are described in the applicant's patent mentioned above.

The support 12 comprises a frame structure having opposite side beams 42 and a plurality of spaced horizontal floor beams 44, the bottoms of which are located at a level somewhat above the top surfaces of the side beams 42. This relationship provides for a transverse beam structure 45 (FIGS. 3 and 4), for the sheet lifting and vibrating assembly means, the ends of which are respectively supported by fixed slide bars 46. An attachment 48 at the respective sides is connected to the beam assembly 45 and movable therewith. The attachments 48 carry the legs of a U-shaped post structure 50 supporting a stacking bar 52 at each side, one of which is shown in FIGS. 1 and 2. Means is provided for locating the face of the stacking bar 52 at the desired position for engagement by the edges of sheets being restacked.

The beam structure shown in FIGS. 3 and 4 and as extending transversely across under the support beams 44 comprises a pair of spaced beam members 51 on which crown block type shoes 54 are mounted. The entire series of these crown blocks shown in FIG. 3 with their crown-like top portions projecting somewhat above the upper surfaces of the support beams 44 alternate therewith and lift the sheets somewhat above the level of the beams.
These are the means by which the sheets are lifted as the series of aligned crown blocks is moved longitudinally of the sheets between the support beams. The respective ends of each crown block 54 are welded on to and welded to the spaced beam members 51, the ends of each of which are welded to plate 53, the extending ends of which carry bolts extending through rubber blocks 55 and a wide support plate 57.

At each end of the structure 45, only one being shown, the plate 57 extends upwardly along the slide bar 46 and across to rest on the top of the slide bar 46 and under the attachment 48 and frame structure 50. The members 48, 50 and 57 are welded together to make the U-frame rigid. Provision is made for vibrating the beam structure 45 and the attached crown blocks 54, and accordingly, as shown in FIG. 3, the transverse beam structure 45 carries two spaced bracket members, each including a plate 56 projecting downwardly at a 45° angle in the manner shown. These plates 56 are each provided with a brace 58, and the plates 56 and 58 are secured by web plates 59, welded respectively to the inside of the beams 51. An electromagnetic vibrating unit 60, the structure and operation of which are conventional, is mounted on either plate 56 and provided with a current supply line 61. In the positions illustrated, the vibration of the right vibrator 60 would be effective to vibrate the sheet on the crown blocks 54 on the left side, so that they would line up against the stacking bar 52 on that side of the apparatus. If the electromagnetic vibrator 60 at the left is used, the sheets will be driven toward the right.

The transverse beam structure and vibrator assembly 45, with its crown blocks 54 and the U-frame 50 connected thereto, are movable together along the slide support bars 46 by means of a chain 62, at each side of the support 12, having its ends attached to the transverse beam structure 45 and extending over sprockets, not shown, at the respective ends of the support 12, one of which may be driven, or around a sprocket driven by a motor, not shown. This type of drive arrangement for driving both chains at the same rate is conventional, and other means may be provided for moving the entire vibrator assembly lengthwise back and forth along the support 12, so that the crown block shoes 54 lift the sheets of the stack in succession.

A stacking bar 52 is carried by each leg of the U-frame 50 at the respective sides of the machine. Only one is used at a time, for example the one shown in FIG. 1. The air for aerating the sheets above the lifting shoes 54 comprises three blowers 64 at each side independently operated by an electric motor 66. Each blower 64 delivers a large volume of air through a vertically elongated nozzle 68. The motors 66 are all controllable individually or in groups at the respective sides from the control board 20.

As shown in FIGS. 1 and 2, the stacking bar 52 is fixed to a steel plate 70, on which the three blowers are also mounted in fixed positions, one below the stacking bar and two above with their nozzles 68 projecting to the right to a point slightly back of the face of the stacking bar. The arrangement is such that the blowers deliver the air directly into both sides of the stack of sheets as they are lifted and danced by the vibrator. The steel plate 70 is movable manually to the right and left in FIG. 2 to set the face of the stacking bar at the position desired for the sheets being stacked. The plate 70 carries fixed spaced brackets 72 at its back which in turn are fixed to upper and lower slide bars 74 slidable in spaced roller bearings 76 mounted on a steel plate 78 attached to the leg of the U-frame 50. The plate 78 may be movable vertically on the U-frame and set at the desired height.

The plate 70 carrying the blowers 64 and the stacking bar 52 is movable toward and away from the position of the stack of sheets in straight line motion, since the slide bars 74 guide the plate 70 in its forward and back movements. When the stacking bar 52 is set at the desired position for stacking, the plate 70 is locked in position with respect to the stationary plate 78 by means of a threaded rod 80 threaded in the stacking bar 52 and plate 70 and adapted to engage the plate 78 to lock the plate 70 in the desired set position. The rod 80 carries a handle 82 used to effect the locking and unlocking of the plate 70.

The control board 20 is provided with means for actuating the described devices in accordance with a definite or revised program of operation. The hydraulic cylinder and piston units 32 are controlled by a lever 75. An end board top 22 is vertically arranged to engage the end of the stack of sheets 26 opposite that of the end frame 22. The top plate 84 is movable along slightly above the support beams 44 toward and away from the stack of sheets 26 by any suitable means actuated by control buttons on the control board 20. Chains, like the chains 62, or other equivalent means may be employed. Each end of the top plate 84 preferably carries a slide means 86 resting on the slide bar 46 and engaging the bottom of the bar or braced to provide stability.

In a typical cycle of operations, a pile of printed or unprinted sheets of paperboard, paper or the like is positioned in the machine by means of an ordinary fork lift when the end support 22 is in horizontal position. It is possible to position a pile of sheets in the machine from any of the three open sides of the platform 22. When the pile of sheets is in the desired position with the sheet edges at one side against the support beams 44, the top plate 84 is automatically lowered to the top of the pile so that it exerts just sufficient pressure to keep the pile stable while it is turned through an angle of 90°, so that the support 12 is in horizontal position.

After this turning operation is completed, the top plate 82 is moved away from the stack a few inches to permit loosening of the sheets. Following this the aerating and aligning cycle begins. The vertical position of the sheets during aerating reduces the pressure to which the sheets in the lower part of the pile are normally subjected. Thus the danger of ink offsetting or smearing caused by mechanical separation is eliminated. The sheets are virtually floated on a layer of warmed, vibrated air, and aerating and restacking can take place within a period of ten minutes after the sheets have been printed, without danger of offsetting the printed image.

The whole processing operation takes less than three minutes with an automatic cycle, and during this time the unit comprising the crown blocks, stacking bars and air nozzles are moved forward and back from one end of the stack to the other. One pass along the stack from the pallet rack 24 to the end plate 84 may be sufficient to blow out all of the dust and completely aerate and separate the sheets of the stack. In these operations effective cleaning and aerating is achieved without de-lamination through a combination of high volume, low pressure air blast and high frequency vibration. Perfect stacking of the sheets against the stacking bar 52 by the use of the electromagnetic vibrator is achieved when it is oriented so that the sheets are in effect danced preferentially toward the stacking bar 52 at either side, as desired.

As the crown blocks are moved along under the sheets of the stack, it is easy for an operator to spread the sheets slightly at that point and remove any damaged or misprinted sheets while the air blast and vibration are continuing.

The wave effect achieved by the vibrator and air nozzles provides a smooth profile which moves along underneath the vertical sheets in both directions, gently raising and separating them under the influence of high frequency vibration. During this cycle large volumes of air are injected from both sides of the pile and the sheets of the pile are accurately aligned against the selected guide stacking bar.

The electromagnetic vibrators 60 are mounted so that their effective vibration for moving the sheets is toward the plates on which they are mounted. A 45° angle has been found sufficient to give a satisfactory and rapid driving force to a particular side. A satisfactory vibrator has been found to be one having a vibration rate of 3,600 vibrations per minute, supplied with single phase 220 v. AC current. The rate of vibration is adjustable by using a rheostat.

While the invention has been illustrated in the drawings to show the use of two electromagnetic vibrators, it will be understood that a single vibrator may be used and transferred
from one plate to the other, when the stacking is to be toward a different side of the machine. Furthermore, a single vibrator may be provided on a support pivoted to the vibrator beams, so that it can be swung from one 45° angle to the other. A pivoted vibrator of this type can be set at any desired angle from 35° to 55°. An angle of 45° has been found sufficient to give a very rapid movement of the sheets against the stacking bar. The use of rubber blocks 55 or equivalent means restricts the vibration to the vibration assembly.

Two or more blowers 64 may be provided on the plate 70 and the control board 20 may be set up as a panel and connected to the machine by cable. The hydraulic oil tank, pump and motor are advantageously located in the housing 16.

1. In an apparatus for re-stacking a stack of sheets of printed or unprinted paper, cardboard sheets and the like including a support, means for holding the sheets of the stack on edge in a substantially vertical position on the support, and sheet-lifting means movable along the support and successively under the sheets of the stack, wherein the improvement comprises a side sheet guide means having a face located adjacent the position of the side edges of the sheets of the stack above the sheet-lifting means with its face in a position to be engaged by the adjacent side edges of the sheets, means for vibrating the sheet-lifting means for in turn vibrating, loosening and separating the sheets at the position of the sheet-lifting means, and means for positioning the vibrating means and controlling its effect on the lifted sheets for moving them in a direction to cause their said side edges to contact the face of the side guide means thereby restacking the sheets of the stack with their side edges in alignment.

2. An apparatus as claimed in claim 1, wherein the vibrating means includes a high frequency electromagnetic vibrator carried by the sheet-lifting means.

3. An apparatus as claimed in claim 1, wherein the vibrating means comprises a transverse beam structure extending under the surface portion of the support, and means connected to at least one end of said transverse beam structure for supporting the side sheet guide means in a position above the support.

5. An apparatus as claimed in claim 2, wherein the means for supporting the side sheet guide means comprises a post member extending vertically when the support is in horizontal position, and vertically elongated air nozzle means supported on said post member and directed inwardly therefrom toward the side edges of the sheets.

6. An apparatus as claimed in claim 1, wherein the support comprises a plurality of laterally spaced support beams, the sheet-lifting means including a transverse beam structure extending under the support beams, and crown blocks attached to the upper portion of the transverse beam structure alternating with the support beams and having their crown portions located slightly above the surface of the support beams.

7. An apparatus as claimed in claim 6, wherein the vibrating means comprises an electromagnetic vibrator securely mounted on the under side of the transverse beam structure and set at an angle for directing its vibrating force toward the side of the sheet guide means.

8. An apparatus as claimed in claim 6, wherein the support includes a slide bar extending lengthwise of each side parallel to the support beams, and means connected to the ends of the transverse beam structure resting on the slide bar at each side of the support.

9. An apparatus as claimed in claim 8, wherein the means for supporting the side sheet guide means includes a post member attached to and supported by the means resting on the slide bar.

10. An apparatus as claimed in claim 9, including a sheet stacking bar supported by the post member and a series of blowers mounted in vertical arrangement on the post having nozzles directed toward the edges of the sheets of the stack above the sheet-lifting means.

11. An apparatus as claimed in claim 10, wherein the stacking bar and blowers are mounted on a first plate carried by the post member, said plate being movable toward and away from the edges of the sheets of the stack.

12. An apparatus as claimed in claim 11, including a second plate mounted on the side of the post parallel to the first plate, means for mounting the first plate on the second plate for straight line movement, and means for locking the first plate against movement from a set position.