# United States Patent

**Ruud**

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


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[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 | Gjostein | 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 |



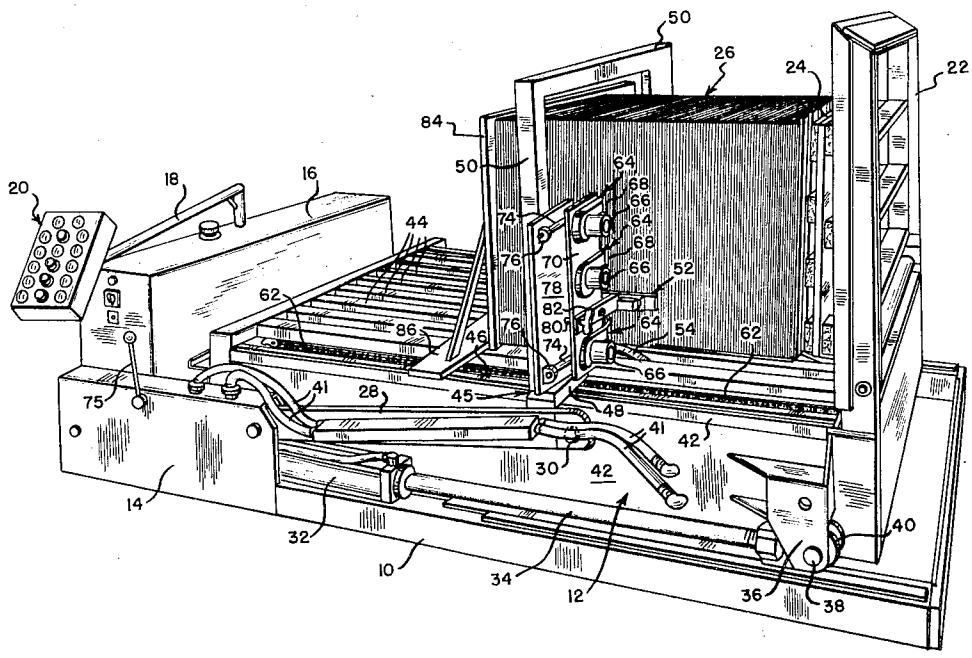
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[57] **ABSTRACT**

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**



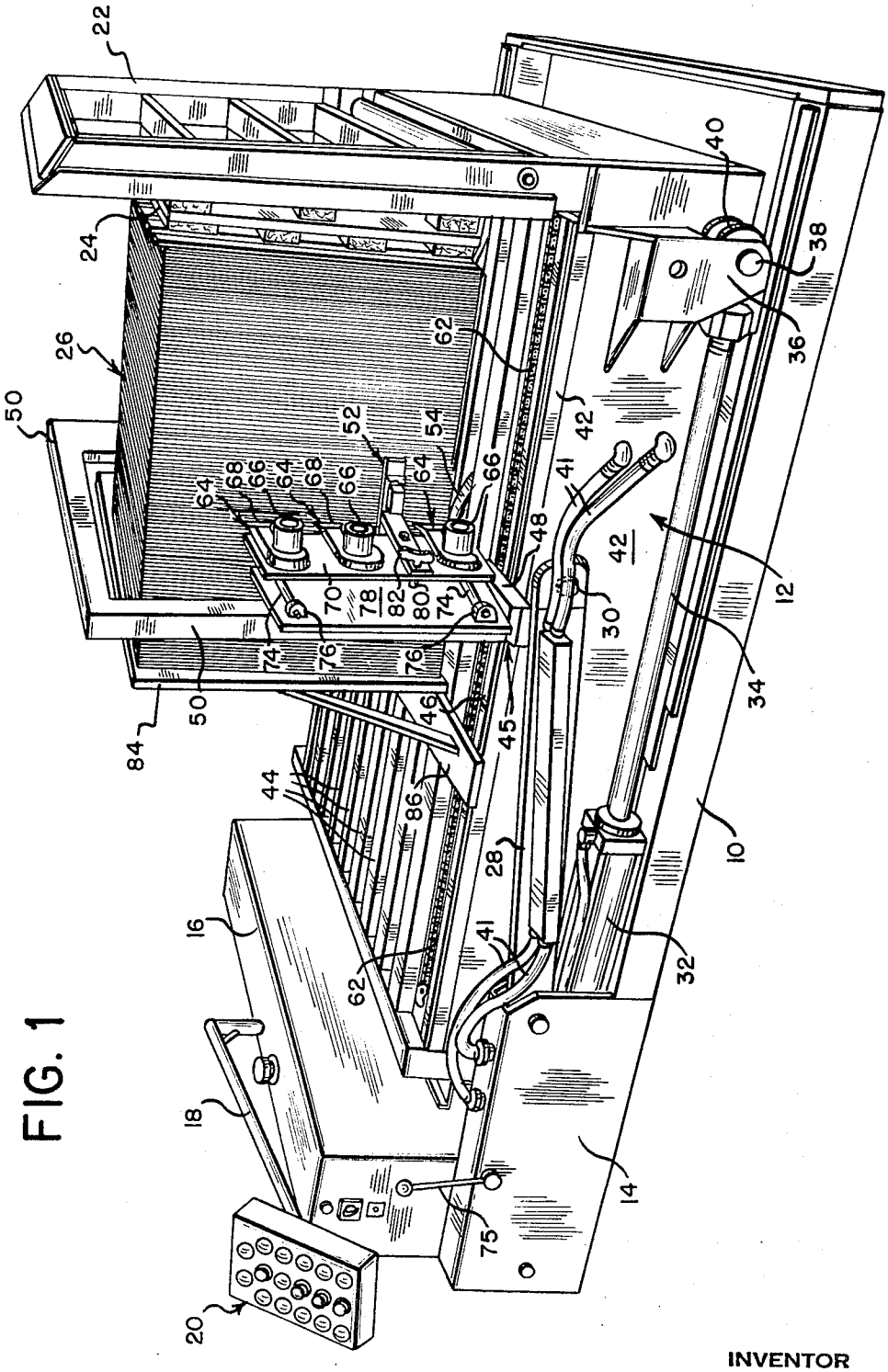



FIG. 1

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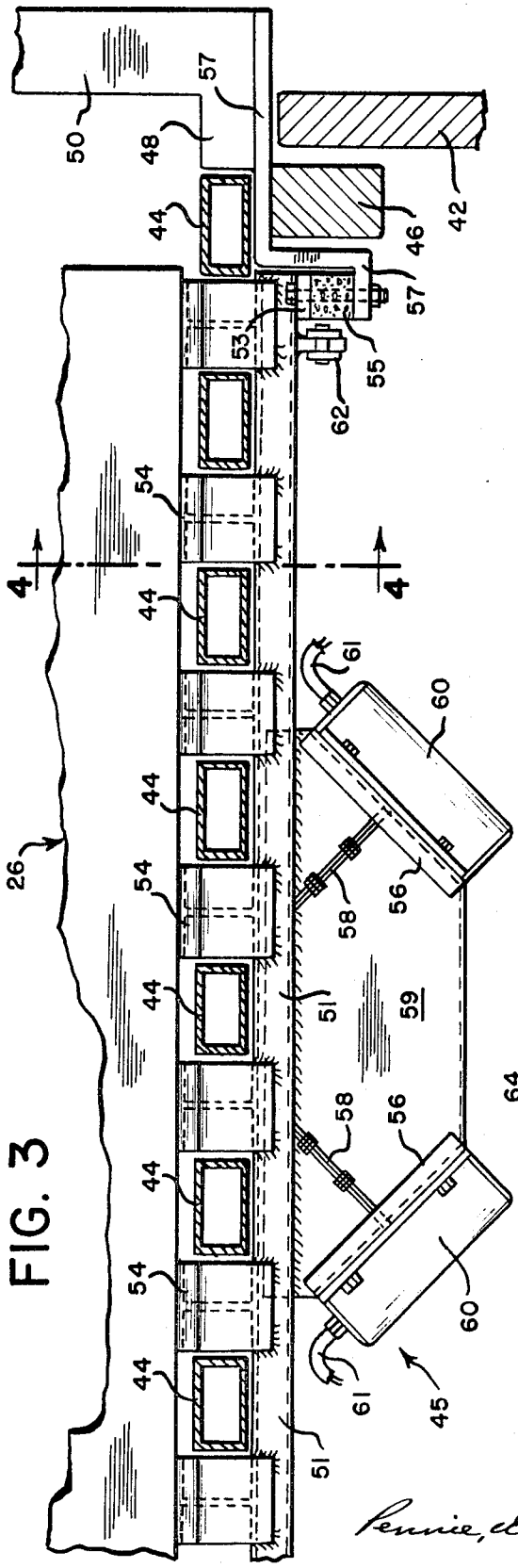



FIG. 3

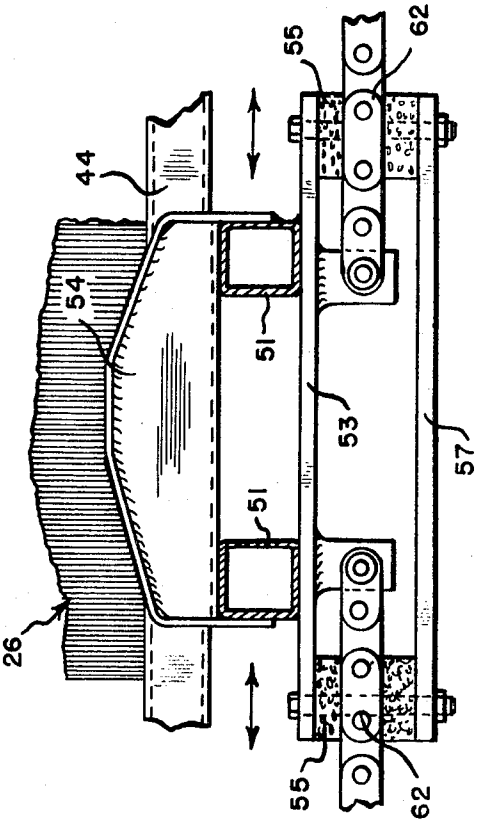



FIG. 4

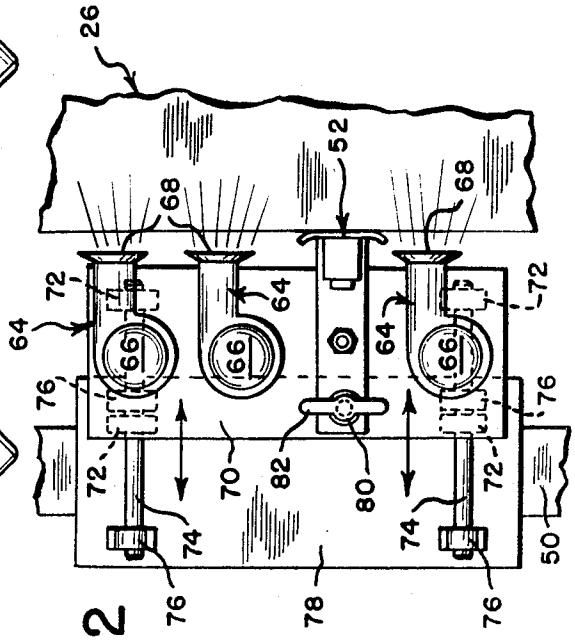



FIG. 2

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# 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



FIG. 4 is a broken diagrammatic detail view of the vibrator assembly, crown blocks and transverse beam structure, taken on the line 4—4 in FIG. 3.

## 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 vibrator 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** 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 spaces between the support beams **44**. The respective ends of each crown block **54** are carried on and welded to the spaced beam members **51**, the ends of each of which are welded to a 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 dance the sheets on the crown blocks **54** to the left, 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 type of program. The hydraulic cylinder and piston units **32** are controlled by a lever **75**. An end board top plate **84** 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 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 aeration reduces the pressure to which the sheets in the lower part of the pile are normally subjected. Thus the danger of ink offsetting scuffing or smearing caused by mechanical separation is eliminated. The sheets are virtually floated in a layer of warmed, vibrated air, and aeration 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 then 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 aeration 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**.

I claim:

**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 comprises a high frequency vibrator.

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

**4**. An apparatus as claimed in claim **1**, wherein the sheet-lifting means comprises a transverse beam structure extending under the surface portion of the support, and means connected to at least on 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.

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