DOCUMENT STACKING DEVICE

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This invention relates generally to sheet handling apparatus and particularly to check stacking apparatus.

It is an object of the invention to provide for a high speed sheet handling apparatus, an improved sheet stacking apparatus which will stack sheets on edge with little or no danger of the occurrence of shear jams. Another object of the invention resides in the elimination of stack bulge that tended to create shear jams.

Another object of the invention is to provide for a sheet stacking device having an air jet to urge the trailing edge of a sheet toward the stack, a control system for the air jet responsive to the approach of a sheet so as to insure that the air is applied only to a trailing end portion of the sheet.

Specifically, it is an object of the invention to provide a sheet striker located substantially at the apex formed by the last sheet of the stack and a sheet guideway so as to overcome the tendency of the sheets to bulge and to operate the striker in response to the approach of a sheet.

Other objects of the invention will become apparent from the following description, taken in connection with the accompanying drawings in which:

FIG. 1 is a plan view of sheet stacking apparatus embodying the invention;
FIG. 2 is a vertical cross sectional view, taken along the line 2—2 of FIG. 1;
FIG. 3 is an enlarged fragmentary plan view, taken substantially along the line 3—3 of FIG. 2;
FIG. 4 is an enlarged plan view of certain parts shown removed from the striker and partially in section;
FIG. 5 is a diagrammatic illustration of a control system for certain operating components of the sheet stacking device; and
FIG. 6 is a view similar to FIG. 3 illustrating a check stacking problem caused by stack bulge and overcome by the present invention.

For purposes of illustrating the invention, the drawings show a portion of a document sorter which includes a supporting structure having an elongated bed 20 that is inclined downwardly at one side of the structure. Mounted on the bed 20 and extending longitudinally thereof is a document raceway 22 along which documents, such as bank checks, are transported on edge and at high speed by suitable feed means, such as a belt (not shown). Extending laterally and downwardly from the raceway 22 there is shown one of a number of bins 24 wherein checks, as 25, received from the raceway 22 are stacked on edge. For a more complete understanding of the document sorter, reference may be had to the patents of Felice V. Palasciano, No. 3,022,907, issued February 27, 1962, John W. Smith, No. 2,970,836, issued February 7, 1961, and No. 2,944,515, issued July 12, 1960.

In communication with the raceway 22 a curved guide member 26 guides a check into the bight of a pair of feed rollers 28 and 30 which in turn feed the check downwardly to the bight of a second pair of feed rollers 32 and 34 that are located near the upper end or entrance to the bin 24.

The bin 24 has a stationary side structure and guide for checks entering the bin, the structure being designated generally by the numeral 36. The bin 24 also includes a laterally movable side or stack back-up plate 38. As shown in FIG. 2, the guide 36 is substantially aligned with the bights of the pairs of rollers 28, 30 and 32, 34 to define a path of travel of checks along a line disposed at an acute angle to the back-up plate 38. Preferably, the back-up plate 38 is normal to the raceway 22 and is movable broadside to and away from the guide structure 36, the back-up plate being slidably supported at one end thereof on a shaft 40 and at the other end by a roller 42. A sheet metal bracket 44 supports the shaft 40 and also a pulley 46 for a weight member 50 that is attached by a cord 48 to the movable back-up plate 38. It will be apparent that as the check stack increases in number of checks, the back-up plate 38 is moved by the check stacking action to expand the bin capacity against the action of the weight 50 acting to return the back-up plate to the empty bin position. An upturned flange 51 of the bracket 44 extends along the lower side edge of the bed 20 to retain the checks and thus defines the bottom wall of bin 24.

As shown more clearly in FIG. 2, the guide structure 36 may comprise a lower rail 52, an upper rail 54, and an intermediate rail 56. The intermediate rail 56 and upper rail 54 may be secured at their upper ends by a suitable bracket (not shown) to the bed 20 and at their lower ends to the curved wall 59 of a housing 60 that is formed integral with bracket 44 and partly forms the check guide structure 36. The lower guide rail 52 is preferably formed of sheet metal having a leg or base 62 above bed plate 20 to overlap a similar base flange 61 on the backplate 38, as shown in FIG. 1. The rail 52 extends upwardly from the base 62 in the form of a flange which is formed with a twist as shown to cause a check guided therealong to assume a slight twist the purpose of which is to give added rigidity to the thin flexible sheet. At the feed rollers 32 and 34, upper and lower transversely curved guide plates 61 and 63 respectively overlies the guide structure 36 and cooperate with structure 36 to curve and twist the checks to impart added rigidity thereto.

In the bed 20, within the bin 24, a clearance opening 66 is provided for a worm feed screw 68 that rotates about an axis transverse to the direction of travel of checks entering the bin. The purpose of the feed screw 68 is to move the trailing end of each check over toward the back-up plate 38 in sufficient time to assure that the leading edge of the next check positions behind the preceding check. Any suitable electric motor (not shown) may be provided to drive the feed screw 68 through a suitable belt and pulley drive connection. The motor shaft 70 and a driven shaft 71 onto which the feed screw is fixed for rotation therewith. The worm screw 68 is rotated in a direction counter to the direction of travel of the checks entering the bin 24 or counterclockwise as seen in FIG. 2, the thread of the screw being a left hand thread to move the check laterally toward the back-up plate 38. Consequently, in addition to moving the trailing end of a check away from the guide 26, the worm 68 also functions to decrease the speed of travel of the check.

Positioned between the guide rails 52 and 56 are air nozzles 73 arranged to direct air jets to blow a trailing end portion of each check broadside into threaded engagement with the feed screw 68. In the present construction there are three of the nozzles 73 on a head 75 which is connected to a valve body 76 which in turn is connected to a suitable source of compressed air. A normally open valve member 77 in the valve body 76 is operable to interrupt flow of air to the air jets 73.

Within the housing 60 there is a plurality of vertically spaced friction drive rollers 78 that project through clearance slots in housing wall 59 to engage and feed each check toward the bottom of the bin. The friction rollers 78 are fixed onto a common shaft 80 for rotation together, the shaft being driven by any suitable drive
means in a counterclockwise direction, as viewed in FIG.
3. The rollers 78 are preferably made of a material
having a high coefficient of friction, such as rubber or
rubberized material to grip the checks. Also, the rollers
78 are rotated at a rate such that their surface or pe-
ripheral speed is considerably less than the speed of the
checks when the roller partly functions as a fri-
tion brake to reduce the speed of the checks as well as
insure their full travel to the end 51 of the bin.
I have found that as the number of checks in the bin
24 stack increases, a correspondingly increasing bulge
in the stack develops and eventually prevents travel
of checks down to the feeder rollers 78 and thus to the
bin end wall 51. The stack bulge is toward the stationary
side of the bin and a pressure area is created in the region
of the rollers 78 and curved wall 59 where surface
friction between the bulging last check stacked and the
next check creates the problem, as illustrated in FIG.
6. To overcome this condition, I provide a striker
member 82 which is adapted to give the stack a sharp
blow each time a check is injected into the bin, the
blow being struck where the bulge tends to develop so
as to prevent the development of the bulge to the point
where the bulge may not be observed.
The striker member 82 is positioned along the check
guide structure 36 between the feed screw 68 and the
feed rollers 78, the striker member being pivotally
mounted on the upper end of a tubular spacer member
84 which is mounted on and suitably secured to the bed
plate 20 by screws 94. An arm 86 of the striker member
82 extends from its pivot generally in the direction of travel
of the checks, and normally projects into the path of
check travel, as shown. A thrust member or helical
coil spring 88 is the actuator of the striker member 82,
the spring being under tension and normally holding
the striker arm 86 in the path of check travel. One end of the spring 88 is anchored to the
upright leg 90 of a bracket which has its horizontal
leg 92 fixed securely to the bed plate 20 by screws 94.
Also mounted on the upright leg 90 of the bracket there
is a solenoid 96 the armature of which is connected to
a connection rod 98 to an arm 100 of the striker member
82. To the arm 100 is also connected the stem 102 of
the normally open air controlling valve member 77.
The solenoid 96 is energized in response to the approach
of a check to the entrance to the bin 24, the solenoid
being electrically connected to a photoelectric cell 104
which normally receives light from the usual electric
lamp 106. As shown in FIG. 3, the cell 104 and lamp
106 are mounted on the bed plate on opposite sides of
the entrance to the bin such that passing checks will
block the light from the cell for a short interval.
With reference particularly to FIG. 5, the circuit of the
cell 104 is a well known circuit utilizing a triode
108 having its cathode connected to ground through the
cell and its anode or plate connected to a suitable po-
tential by a conductor containing a relay coil R with a
parallel capacitor 110. A potential divider 112 con-
ected to a suitable biasing source provides for the proper
potential on the triode grid so that the relay coil R
will be energized, in the well known manner, when the
light from lamp 106 is blocked by a check. The relay
coil R has a pair of normally open contacts R1 in series
connection with the solenoid 96. As a consequence,
when the check 24 enters into the light path of the cell,
the solenoid 96 is pulsed, or is energized for the interval required for the check to pass by the cell. This
pulsing of the solenoid causes it to retract the striker
member 82 out of the path of the approaching check,
as illustrated in FIG. 3 by dot and dash lines, and
then release the striker in time for the spring 88 to pivot
the striker arm 86 for its next position. Then, as the
plunger 82 imparts a blow to the stack which prevents
the development of stack bulge, and urges the stack
away from the rollers 78 to insure continued travel of
the checks down to the end of the bin. At the same
time that the striker member 82 is retracted, the solenoid
96 pushes the valve member 77 to closed position to
discontinue flow of air from the air jets, the air flow
being resumed when the striker is released. This action
of the valve member 77 is timed such that the air streams
are applied only to a trailing end portion of the check
as it is only the trailing end portion of the check that
is desired to be urged into feeding relationship with the
feed screw 68. That is, air flow from the jets is inter-
rupted to prevent displacement of the leading edge of
the check from its guideway 36.
While I have described the stock feeding device in considerable detail, it will be appreciated that
many variations of the device may be made without de-
parting from the spirit and scope of the invention.
What is claimed is:
1. In a sheet handling apparatus having means to feed a sheet on edge along a path of travel, a sheet stacking
device comprising a stationary bin side wall defining a
part of the path of travel and inlet to the bin, a bin end
to limit travel of a sheet, a stack back-up member
forming the other side of the bin and biased toward said
stationary bin wall forming therewith an acute angle
having its apex toward the bin end wall, an air jet posi-
tioned along said stationary wall to direct an air stream
transversely to the path of sheet travel to urge a sheet
toward said back-up member, a normally open valve
member controlling said jet, a sheet striker member posi-
tioned along said stationary wall between said air jet
and the bin end wall, said striker member movable
to tamp the sheet stack, a power element operatively
coupled to said striker member for actuating said
striker and said valve member, and a control member responsive to the
passing of a sheet past a predetermined point
eventuate the actuating power element.
2. In a sheet handling apparatus having means to feed a sheet on edge along a path of travel, a sheet stacking
device comprising a stationary bin side wall defining a
part of the path of travel and a stationary side of a
bin having an end wall, a movable back-up member
forming the other side of the bin and biased toward said guide
member, said guide member and back-up member forma-
ing an acute angle therebetween with the apex toward
said end wall, an air jet positioned along said guide
member to direct a stream of air transversely of the path
of travel toward said back-up member, a normally open
electrically operated valve member controlling said air
jet, a switch member positioned along said guide
member to control travel of sheet stack anteriorly to said
air jet and responsive to the
passing of a sheet to close said guide member, and an
electrically operated sheet striker member positioned
along said guide member posteriorly to said air jet
and controlled by said switch member.
3. In a sheet handling apparatus having means to feed a sheet on edge along a path of travel, a sheet stacking
apparatus comprising a stationary sheet guide member
defining a part of the path of sheet travel, said guide mem-
ber forming one side of a bin and inlet thereto, means
forming an end wall of the bin, a movable back-up mem-
ber forming the other side of the bin and biased toward
said guide member, said guide member and back-up mem-
ber converging toward said end wall, an air jet positioned
along said guide member and arranged to direct on air
stream transversely of the path of sheet travel and closer
to said end wall than to said inlet, a normally open valve
member controlling said jet, a sheet striker member posi-
tioned along said guideway between said air jet and said
end wall and operable to strike and urge a sheet toward
said back-up member, an electrically operated actuator
operatively connected to and for actuating said valve
member and the said striker member, and a switch member
positioned at said inlet and controlling said actuator in
response to the passage of a sheet past said switch mem-
ber.
4. In a sheet handling apparatus having means to feed a sheet on edge along a path of travel, a sheet stacking apparatus comprising a stationary sheet guide member defining a part of the path of sheet travel, said guide member forming one side of a bin and inlet thereto, a movable back-up member forming the other side of the bin and biased toward said guide member, means forming an end wall of the bin, said guide member and said back-up member converging toward said end wall, an air jet positioned along said guide member and directing a stream of air transversely across said path of travel in a direction to urge a sheet toward said back-up member, a normally open valve member controlling said jet, a pivotal sheet striker positioned along said guide member posteriorly of said jet and normally projecting into the path of sheet travel, a thrust member normally holding said valve member and striker member in their normal positions, an electrically operated actuator operatively connected to said striker member and said valve, said actuator operable when energized to close said valve member and retract said striker member from the path of sheet travel, and a switch member positioned along said path of sheet travel anteriorly to said jet, said switch member responsive to the passing of a check past a predetermined point to energize said electrically operated actuator.

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