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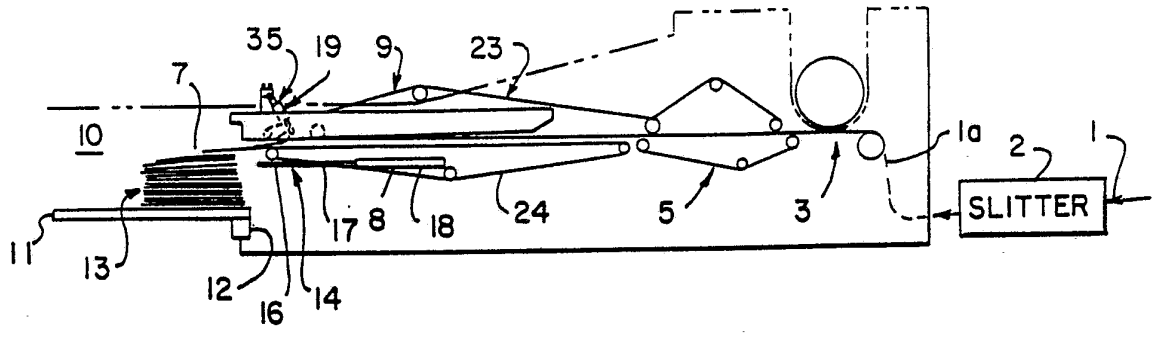
(54) Title: SHEET CONTROL APPARATUS AND METHOD FOR SHEET STACKER



(57) Abstract

This invention solves the problem that when a temporary support is inserted across a stacker, that stacker may damage vertically falling sheets. In the invention, a vertically movable table (11) is located such that the conveyor propels the sheets falling downwardly to form a pile of sheets thereon. A fork unit (14) moves inwardly across the stacker as a temporary support during pile removal. A brake (48) and clutch (49) unit is connected to the pulleys. A sheet control includes pivoted fingers (20) aligned with the belts (24) and secured to a shaft. An actuating unit (35) pivots the shaft to move the fingers into engagement with said aligned belts on the downstream side of the pulleys. To reduce or eliminate sheet damage, a pneumatic control provides a conjoint control to actuate said brake and pivot the finger shaft for momentarily stopping sheet movement in synchronism with the actuation of the fork. Thus, no sheets will be in the area of the moving fork.

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SHEET CONTROL APPARATUS AND METHOD FOR SHEET STACKER

Background Of The Present Invention

This invention relates to a sheet control apparatus and method for sheet-fed stackers.

In the processing of flexible sheet members formed of paper, film or the like, the individual sheets are often assembled at the end of the line in a vertical stack. The successive sheets are discharged into a vertical stacker of a predetermined number of sheets. The stack is removed and a new stack initiated. A mechanism is provided to temporarily support the first sheet in the next stack, or sheets are diverted into alternate sheet receiving devices. In in-line systems, a temporary support in a form of a fork is interposed between the last sheet in a formed stack and the first sheet of the new stack. After removal of the form stacked, the main support structure is returned to its supporting position and in so moving picks up the sheets from the temporary support, which is removed to allow the accumulated sheets to move into the main stacker, and the system recycles. With high speed systems, the first sheet in a stack tends to move into the stacking receiver with its leading edge dropping into the position of the incoming temporary support, which is is moving at a relatively high speed. The leading end of the temporary support often engages the first sheet with a possible disruption and damage. Engagement with the sheet can create, for example, wrinkles or folds of the sheet tending to interfere with the appropriate formation of a neat and acceptable stack of sheets. This then results at best in a lost or improper product in the stack.

Summary Of The Invention

The present invention is directed to a down stacker apparatus which establishes reliable formation of a succeeding stack during removal of an immediately

preceeding stack. Generally, in accordance with the present invention, a retard unit momentarily engages at least the first sheet in each succeeding stack and establishes a period for introducing a support for the succeeding stack. In one embodiment, a temporary reciprocating support moves into the vertical stacking path and a retard unit engages the sheet moving into the stacker apparatus to momentarily retard the sheet movement. The retard unit is operative for a sufficient period to prevent damaging overlying relationship of the incoming edge and the support.

In one system, shingled sheets move on a conventional belt conveyor, a plurality of flexible fingers are located in aligned relation with the laterally spaced belts. The fingers are rotatably, and preferably, mounted for adjustable angular positions projecting downwardly and upstream of the sheet movement. A motor unit is actuated in sychronism with the temporary support pivoting the fingers to move the outer ends into engagement with the aligned sheet and belt. The fingers preferably engage a trailing portion of the aligned sheet. Preferably, the belt conveyor includes end discharge pulleys which are crowned and mounted to a common drive shaft. A drive unit is coupled by a clutch and brake unit to the drive shaft and the unit momentarily brakes the pulleys as the fingers engage the sheet. The combination of the braked conveyor and the fingers clamping the sheet to the belt or tape can establish a momentary stoppage of the sheet into the stacker to allow proper movement of the initial sheet into the stacker.

The fingers may advantageously be formed as a thin strip of a spring steel and aligned with the conveyor belt on the crowned pulley. The pivot support is reliably and positively moved between a release position and a sheet clamp position by an air cylinder connected by a pivot arm to the finger shaft.

Description of the Drawings

In the drawings:

Fig. 1 is a diagrammatic plan view of a sheet forming and stacking apparatus;

Fig. 2 is a side elevational view of Fig. 1;

Fig. 3 is an enlarged fragmentary plan view of a sheet control unit shown in Figs. 1 and 2 and illustrating one embodiment of the invention;

Fig. 4 is a fragmentary side view of Fig. 3 with parts broken away and sectioned to show detail of contruction;

Fig. 5 is a sectional view taken generally on line 5-5 of Fig. 3;

Fig. 6 is a schematic of a pneumatic control for the sheet control system shown in Figs. 1-5; and

Figs. 7 is a view similar to Fig. 5 of the coupling between the conveyor and the stacker and illustrating the holding position of the illustrated embodiment.

Description Of The Illustrated Embodiment

Referring to Figs. 1 and 2, a sheet forming and stacking apparatus for processing a web 1 of paper or the like includes a slitter 2 for longitudinally severing the web 1 into parallel webs 1a and 1b and a sheeter unit 3 for severing the webs into individual sheets 4 moving as a continuous stream to a fast tape transfer conveyor 5. A shingling unit 6 receives the sheets 4 and establishes a significant overlap of the sheets 4 to form a flow of overlapped or shingled sheets 7 in accordance with known processing. The shingling unit 6 includes a bottom slow tape or belt conveyor 8 and a top fast belt conveyor 9 for controlled transfer of the shingled sheets 7, and sequential transfer of the individual sheets 7 into a vertical stacker unit 10. The sheets 7 are propelled from the end of the slow tape conveyor 8 and dropped by gravity onto a vertically movable plate unit 11 of

stacker unit 10. Plate unit 11 is vertically movable through a suitable motor unit 12, such as a D.C. motor and acme screw, pneumatic cylinder unit or other suitable devices for dropping the same for removable of a sheet pile or stack 13 in unit 10. To maintain a continous processing line, a temporary horizontal support unit 14 is mounted for movement over the receiver during the stack removal and temporarily stores the first sheets 7 in the next stack 15, as shown in Fig. 7. The illustrated support unit 14 is a fork device including a plurality of generally spaced fork fingers 16 connected at one end to a cross member 17. A pneumatic cylinder unit 18 is coupled to member 17 for selective positioning between the retracted position and an extended support position shown in Figs. 5 and 7.

In accordance with the teaching of this invention, a sheet retard or stop unit 19 is mounted to the downstream end of the batch conveyor unit 6. The illustrated stop unit 19 includes fingers 20 which are normally spaced from the slow tape conveyor 8 and the sheets 7 moving into the stacker unit 10. The stop unit 19 is actuated in synchronism with the movement of the fork support 14 into position for initiation of a new sheet stack 15. The stop unit 19 momentarily holds the first sheet 7 of the new sheet stack 15 to permit movement of support 14 into position without adverse engagement with the first sheet 7 of the new stack 15. With high speed feeding of the shingled sheets 7, the final sheet 7, at the instance of transfer, is dropping into the receiver with the leading portion 21 of the following initial sheet 7 of the next stack 15 also falling into the receiver unit. The leading portion 21 is subject to interception by the leading end of forks 16, as shown in phantom Fig. 7. The initial sheet or sheets 7 of the new stack 15 may be damaged, an erroneous number of sheets 7 fed into the

stacks or the like if the interception is permitted. The stop unit 19 functions to momentarily interrupt the flow of sheets 7 at the proper moment to prevent the flow of the initial sheet 7 into the path of support 14 and forks 16. The sheet 7 is then released to maintain essentially a continous flow of the sheets 4 and 7, and without interruption of the operation of the upstream web processing apparatus.

The present invention is particularly directed to the provision of an appropriate stop unit 19.

In Figs. 3-5, the conveyor unit 6 includes top and the lower conveyors 9 and 8 respectively include a plurality of laterally spaced and endless tapes or belts 23 and 24, respectively. The top conveyor tapes 23 are fast speed tapes while the lower belt 24 are slow speed tapes. The lower conveyor unit 8 includes driven crowned pulleys 25 at the discharge end. A guide pulley 26 of the top conveyor is located slightly downstream of the crowned pulley 25 and a hold-down pulley 27 is located slightly upstream of pulleys 25 and holds the sheets 7 in pressure engagement with the bottom belts 24. The crowned pulley 25 are secured to a driven shaft 27a which is coupled by a brake and clutch unit 28 (shown in Fig. 1) to the main line drive, not shown, to selectively drive and stop the pulley 25, and thereby the slow tape belts 24. The top conveyor 9 includes a U-shaped frame unit 29 pivoted to the main frame 30 as at 30a. The tape pulley 26 is secured to the outer end of the frame 30 and supports the endless top belts 23 in alignment with the belts 24 of the lower conveyor 8. Frame 30 may be raised relative to conveyor 8 as shown in Fig. 4.

The hold down unit 19 is secured to the U-shaped frame unit 29 with the fingers 20 properly located beneath the tape roller unit 26 and immediately above the slow tapes or belts 24 and the crowned pulleys 25.

In Figs. 3-5, a finger shaft 32 is pivotally mounted at the opposite ends to the opposite frame plates 33 of the frame unit 29. Finger shaft 32 and a shaft for the holding down rollers 27 are mounted to bracket 32a which is secured to the inside of frames 33. Each finger 20 is similarly secured to a flat 34 on the shaft 32 by a screw 34a, and projects downwardly and downstream of shaft 32. The finger 20 is shown as a flat strip-like member of a flexible material, such as a suitable spring steel, abutting the flat 34. The finger 20 is aligned over the crowned pulley 25 and thus engages the sheet 7 in alignment with the raised portion of the crowned pulley 25. An air cylinder unit 35 is mounted to the one frame plate 33 of unit 29 by a bracket 36. The cylinder assembly 35 includes a cylinder 37 pivotally attached by a pivot unit 37a to bracket 36 and projecting upstream of the conveyor unit 6. A piston rod 38 extends upstream of the finger shaft 32. A pivot arm 39 is connected to the outer end of rod 38 by a suitable pin unit 40. The arm 39 extends downstream to the shaft 32 and is adjustably secured thereto by an integral L-shaped collar 41 which encircles the shaft and has a clamping bolt 41a for releasably collapsing the collar onto the shaft.

With the piston rod 38 extended, the fingers 20 are located in upwardly spaced relation to the sheet path at the discharge end of the conveyor unit 8, as shown in Fig. 5.

Retraction of piston rod 38 pivots shaft 32 counterclockwise as shown in Figs. 4 and 5 and rotates the fingers 20. The outer end portions of fingers 20 are rotated into tangential engagment with the crowned pulleys 25 to the downstream side of the uppermost roller surface, as shown in phantom in Fig. 5 and in Fig. 7 at 42.

The finger air cylinder unit 37 includes a pair of lines 43 connected, as shown in Fig. 6, to an

air source 44 by a switching valve 45 for connecting the opposite ends alternatively to positive air pressure and to return for selectively extending and retracting the piston rod 38. The air valve 45 includes a powered control unit 46, such as a solenoid, to selectively alternate the air pressure connection and thereby the finger positions. Generally, the control unit 46 actuates the clutch and brake unit 28 for the crowned pulley 25 and the finger cylinder 37 in time relation and to the actuation of the temporary support unit 14 to establish a desired control of the movement and placement of the first sheet 7 in the next succeeding stack 15 in stacker 10.

Fig. 6 is a schematic illustration of the pneumatic control as applied to the brake/clutch unit 28 and the finger control cylinder 37. The brake/clutch unit 28 is diagrammatically illustrated including a friction brake 48 and a friction clutch 49. The friction brake 48 includes a pneumatically positioned brake operating element 50. When positive pressure is applied to the brake element 50, the brake 48 is set and provides a rapid stopping of the pulleys 25. The friction clutch 49 is provided with a pneumatically positioned clutch operating element 51, and when set, couple the pulleys 25 to the driven shaft to rapidly accelerate and drive the pulleys 25 and the interconnected belts 24. Fluid lines 52 are connected respectively to the brake operator element 50 and pneumatic clutch operator element 51. The cylinder unit 37 has its lines 43 connected in parallel with the lines 52 connected to the element 50 and the element 51 respectively.

The control valve 45 is coupled to the positive supply 44 and to the common line to the brake operator and the retraction line of the finger cylinder 37. When positive pressure is applied via the valve 45, the brake 48 is set and the cylinder 37 is actuated

to retract piston rod 38 and move the fingers 20 into holding engagement with the sheet 7 against the tapes 24 and pulleys 25. Conversely, when the valve 45 is de-energized or reset, it connects exhaust 53 to the brake 48 and to the cylinder 37 thereby extending the cylinder unit to release the sheet 7 from fingers 20 and simultaneously releases the brake 48 and sets clutch 49 to re-establish the drive through the energized brake/clutch unit 28.

In summary, with the processing line operating, the retard unit 19 is operated in conjunction with the slow tapes 24 of the conveyor 8. During the forming of a stack 13, fingers 20 are retracted and the clutch 49 is energized. After a predetermined number of sheets 7 have been placed onto the table 11, the table 11 is dropped and the temporary support 14 shoots outwardly into overlying relation to the preset batch of sheets in stack 13, and in position to support the next incoming sheets 7. The stack is removed and the slotted table moves upwardly through the forks, picks-up the accumulated sheets 7 in stack 15 and the support 14 is retracted, whereupon the above cycle is repeated.

In Fig. 7, simultaneously with the shooting out of the forked support 14, the brake unit 48 is energized to essentially stop the sheet conveyor's belts 24 and the retard unit 19 is actuated to pivot the fingers 20 downwardly, with the outer ends engaging and forcing the sheet 7 against the slow tapes 24 for a momentary period. During this period, the outer ends of the forks 16 or such other support structure provided, move outwardly to the point where the held sheet 7 can be released and move into the stacker 10 without damaging engagement with the forks 16. The sequence of actuating the several elements for momentary stopping sheets 7 is readily operated almost instantaneously, and within milliseconds, including the

momentary holding or retarding of the sheet movement. The brake 48 may be first set followed by immediate actuation of the fingers, which then engage the sheet 7 in alignment with the belts 24 without any significant movement of the sheet 7 between fingers 20 and pulleys 25. The fingers 20 and brake 48 may be operated together or even in reverse sequence within the broadest aspects of this invention.

The system is readily adapted as a retrofit kit to stacking devices. The usual existing clutch can be readily replaced with a conventional clutch/brake unit and with an appropriate pneumatic control system, such as shown in Fig. 6.

The illustrated embodiment of the invention includes readily available and fabricated parts and components which can be conveniently and readily assembled with existing machines as well as newly fabricated machines.

Although shown in the preferred embodiment with the special braking of the belt conveyor and the holding fingers aligned with and engaging the several belts, other systems can be readily provided to momentarily retard including full stopping of the initial sheet or sheets of a stack within the teaching of the present invention. For example, vacuum operable means may be coupled to the sheet or sheets to retard movement with or without conjoint control of the sheet conveyor. Partial path change means may be provided to retard the movement into the stacker.

I claim:

1. A sheet processing apparatus including a vertical stacker for receiving successive sheets and having a support member interposed above a completed sheet stack to initiate a new stack and a conveyor mounted immediately upstream of said stacker for carrying sequential sheets and discharging said sequential sheets into said stacker, the improvement characterized by a sheet control unit coupled to said conveyor and operable to engage an initial sheet to be discharged as the initial sheet of a stack, said sheet control unit operating to momentarily retard the movement of said initial sheet into said stacker during the selected movement of the support member into said stacker.

2. The apparatus of claim 1, wherein said conveyor includes horizontal and laterally spaced endless belts defining a planar sheet support, said belts having common aligned discharge ends with the leading portion of each sheet dropping downwardly and forwardly into the stacker, said sheet control unit including sheet retard elements mounted above the discharge ends of said belts and vertically movable toward and from engagement with the sheets passing over said discharge ends to establish said momentary retard of the sheet.

3. The apparatus of claim 2, wherein said control unit includes a pivot shaft mounted above and in spanning relation to said belts, fingers secured to said pivot shaft in laterally spaced relation and in alignment with said belts, a power unit having an actuating arm connected to said shaft for pivoting of said shaft between a first position with said fingers spaced upwardly of said belts and a second position with said shaft pivoted to move the outer ends of said fingers into engagement with said aligned belts.

4. The apparatus of claim 3, wherein said fingers project downstream from said shaft with the outer ends of said fingers overlying said pulleys for selective movement into engagement with said belts on the downstream side of said pulleys.

5. The apparatus of claim 2, wherein said stacker includes a vertically movable table located to receive said sheets, said support member being a temporary planar structure mounted adjacent the upper end of said stacker for movement into overlying relationship to said table for initiating a new stack.

6. The apparatus of anyone of claims 1-5, including a brake unit to selectively brake said conveyor and reduce the movement of said conveyor, and an actuator coupled to actuate said brake unit in timed relation to the said sheet control unit.

7. The apparatus of claim 6, including a clutch unit coupled to said conveyor and an actuator unit in synchronism with actuating said brake means.

8. The sheet processing apparatus of claim 1, wherein said sheet control unit includes a member selectively positioned to engage said initial stack.

9. The apparatus of claims 3 or 4, wherein said shaft includes a chordal flat aligned with and opposed to said belts, and means securing said fingers to said flats.

10. The method of stacking a horizontal stream of sheets into the stacker by propelling said sheets into the stacker with the sheets dropping by gravity onto a vertically moving support and moving a temporary support above a completed stack in said stacker to receive the initial sheets of a new stack, the improvement characterized by momentarily engaging the sheet to be propelled into said stacker as the first sheet on said temporary support to permit

location of said support without adverse engagement with said sheet.

11. The method of claim 10, including the step of momentarily braking said conveyor during said engaging step.

FIG. 1

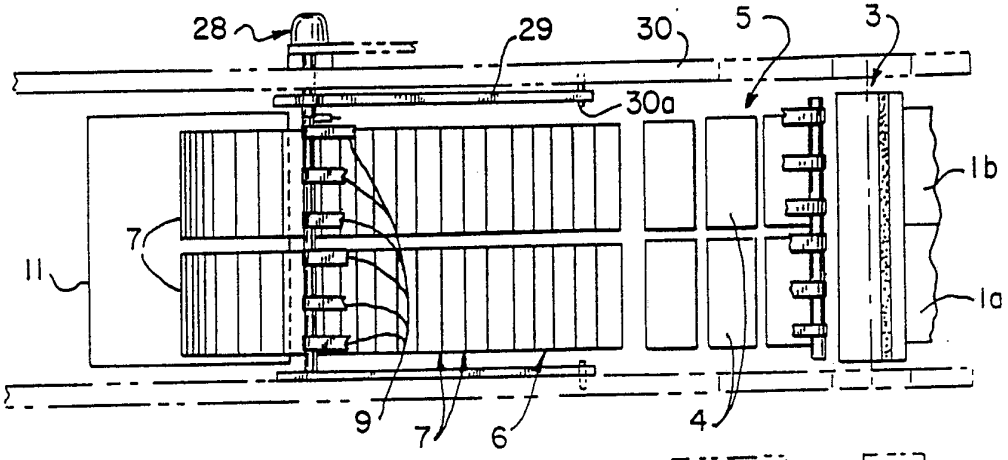
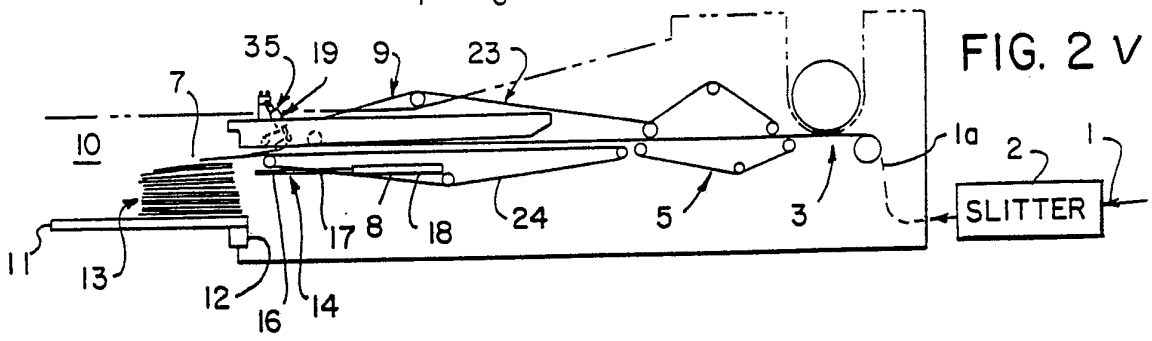


FIG. 2



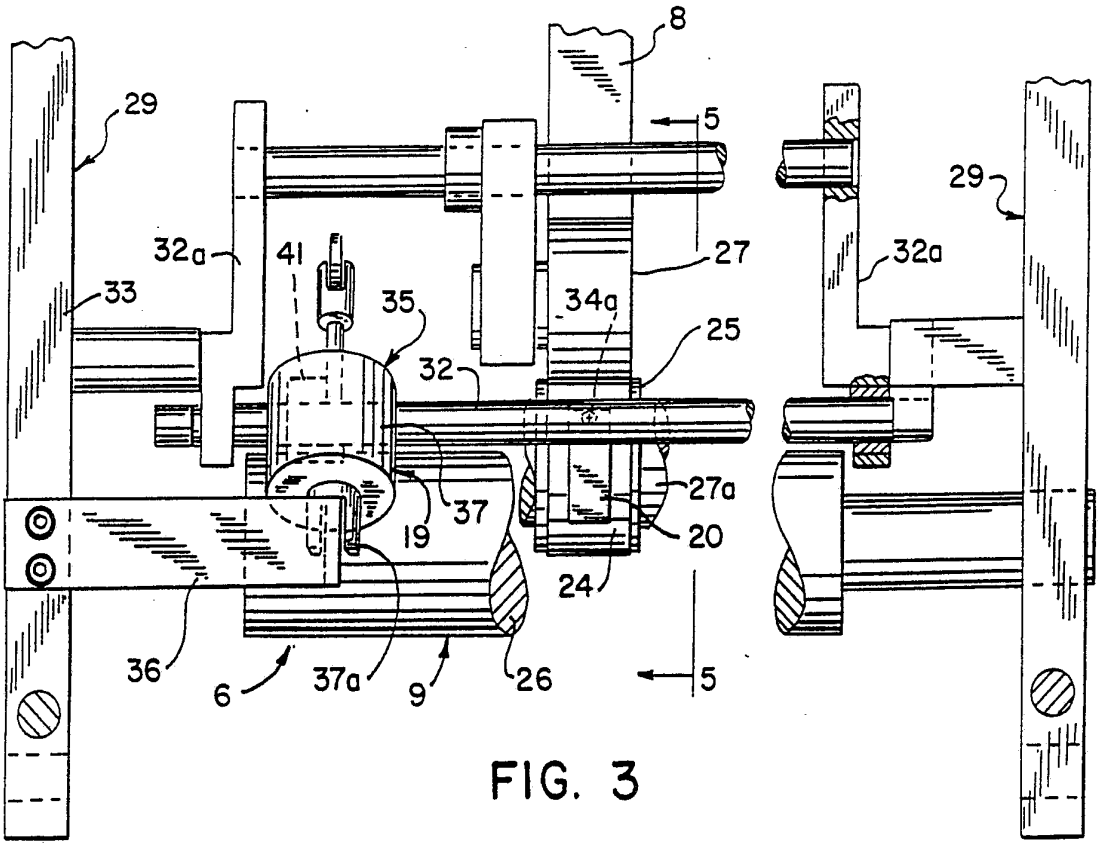
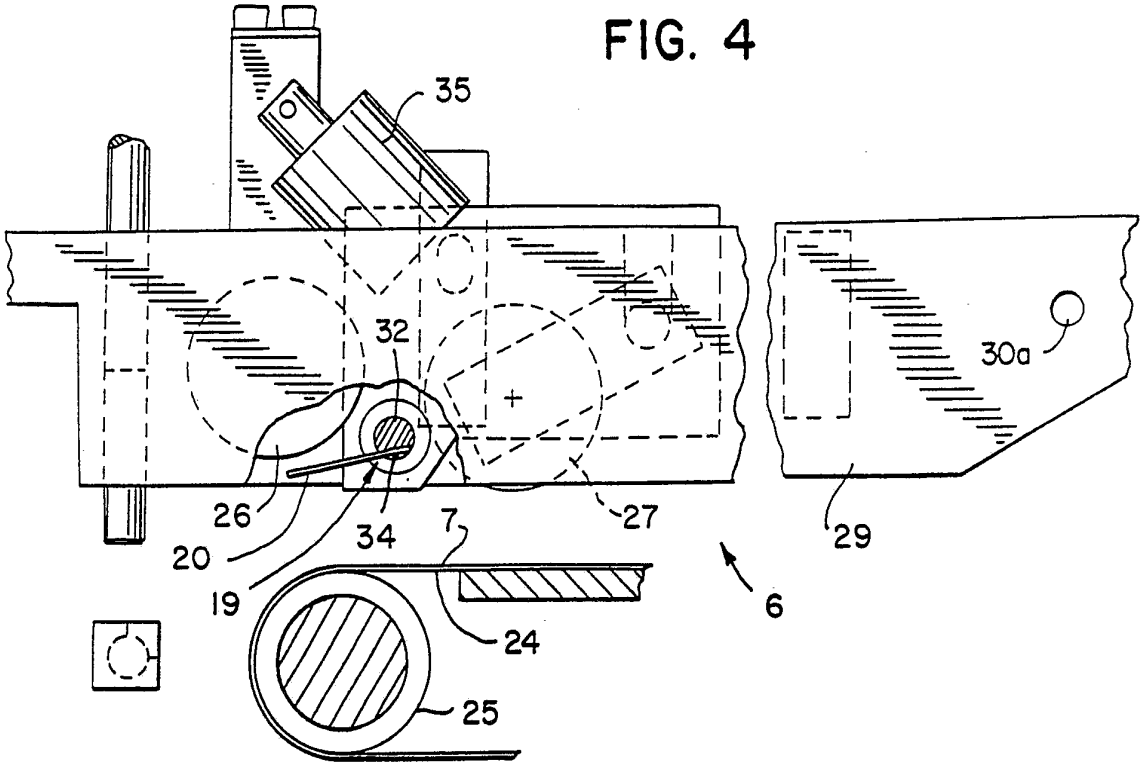


FIG. 3

FIG. 4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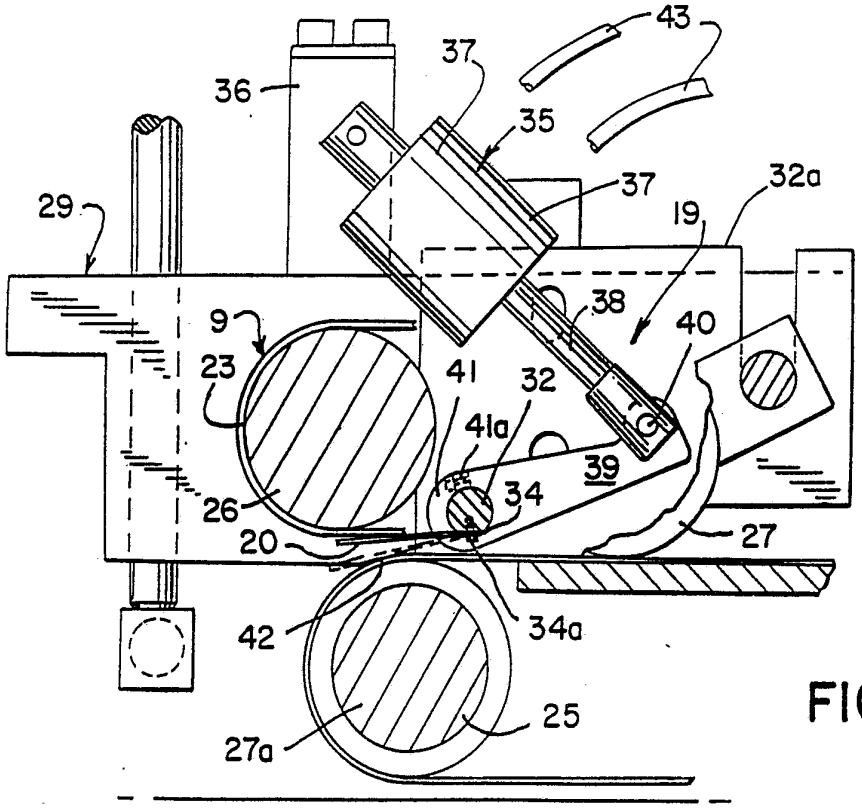
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FIG. 5

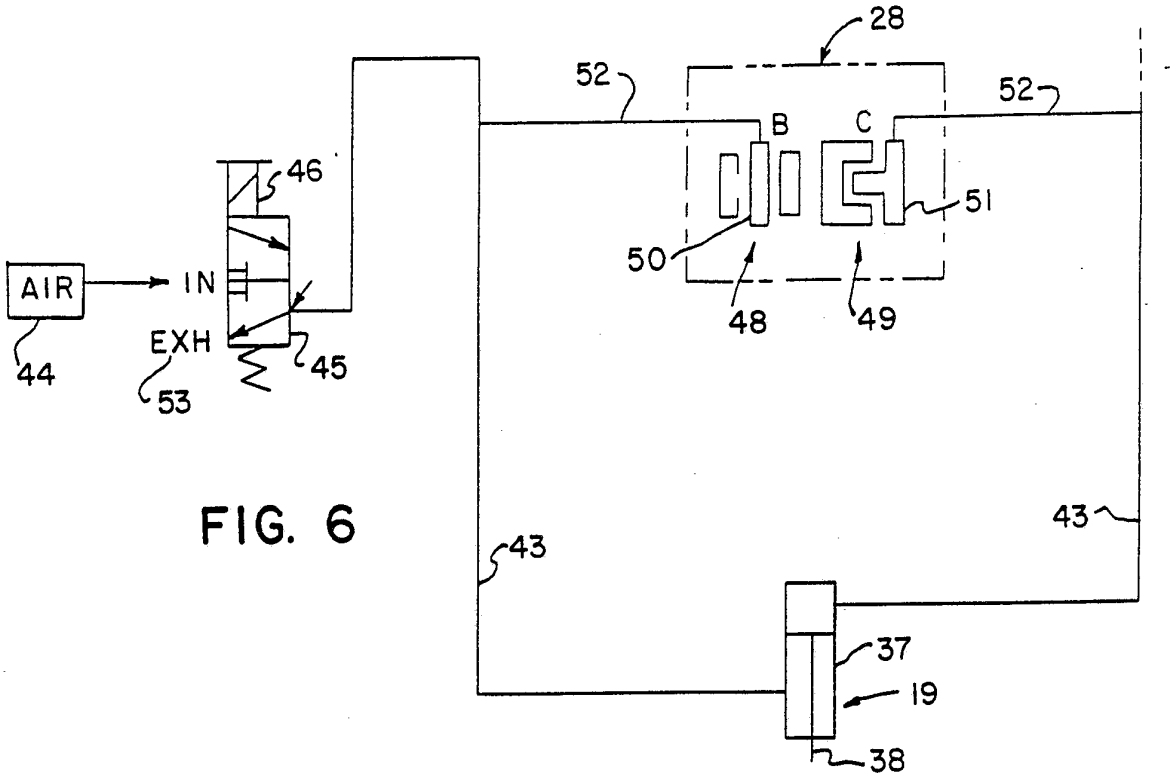
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FIG. 6

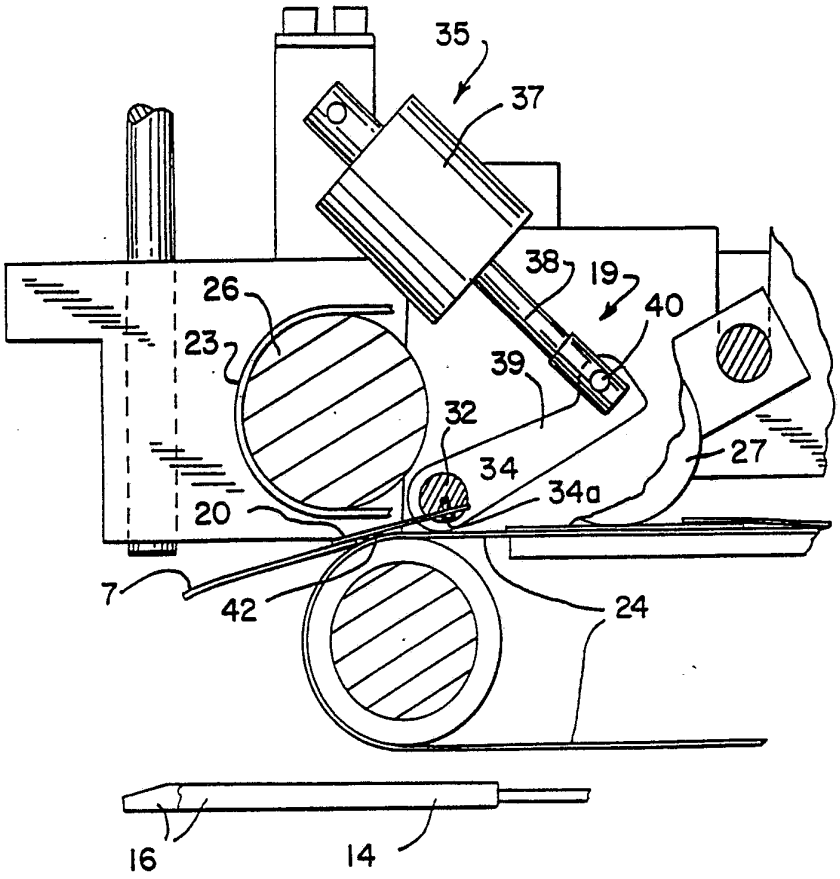
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FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/US91/00062

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5) : B65H 29/68

US CL : 271/182,198,213; 414/790.8

II FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System [5]	Classification Symbols
US	271/182,183,198,202,203,213,216-218,258 414/790.8

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched [6]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	US, A, 3,006,258 (JOOHEM) 31 OCTOBER 1961.	
A	US, A, 4,133,523 (BERTHELOT) 09 JANUARY 1979.	
A	US, A, 4,424,966 (CHANDHOKE) 10 JANUARY 1984	
A	US, A, 4,541,763 (CHANDHOKE, ET AL.) 17 JANUARY 1985.	
A	US, A, 4,667,953 (HIRAKAWA, ET AL.) 26 MAY 1987.	
A	US, A, 4,669,720 (ROSATI) 02 JUNE 1987.	
A	US, A, 4,712,787 (PRINCIOTTA, JR. ET AL.) 15 DECEMBER 1987.	
A,P	US, A, 4,934,687 (HAYDEN ET AL.) 19 JUNE 1990	

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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
02 APRIL 1991	16 APR 1991
International Searching Authority [1]	Signature of Authorized Officer [20]
ISA/US	STEVEN REISS