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Braen et al.

[11] **3,829,080**

[45] **Aug. 13, 1974**

[54] **FAN-FOLDED PAPER STACKER FOR HIGH SPEED PRINTER**

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[22] Filed: **Aug. 19, 1971**

[21] Appl. No.: **173,213**

Related U.S. Application Data

[63] Continuation of Ser. No. 158,195, June 30, 1971, abandoned.

[52] **U.S. Cl.** ..... **270/61 F**, 226/43, 270/39

[51] **Int. Cl.** **B65h 45/04**

[58] **Field of Search** ..... 270/39, 73, 61 F, 79; 226/43

[56] **References Cited**

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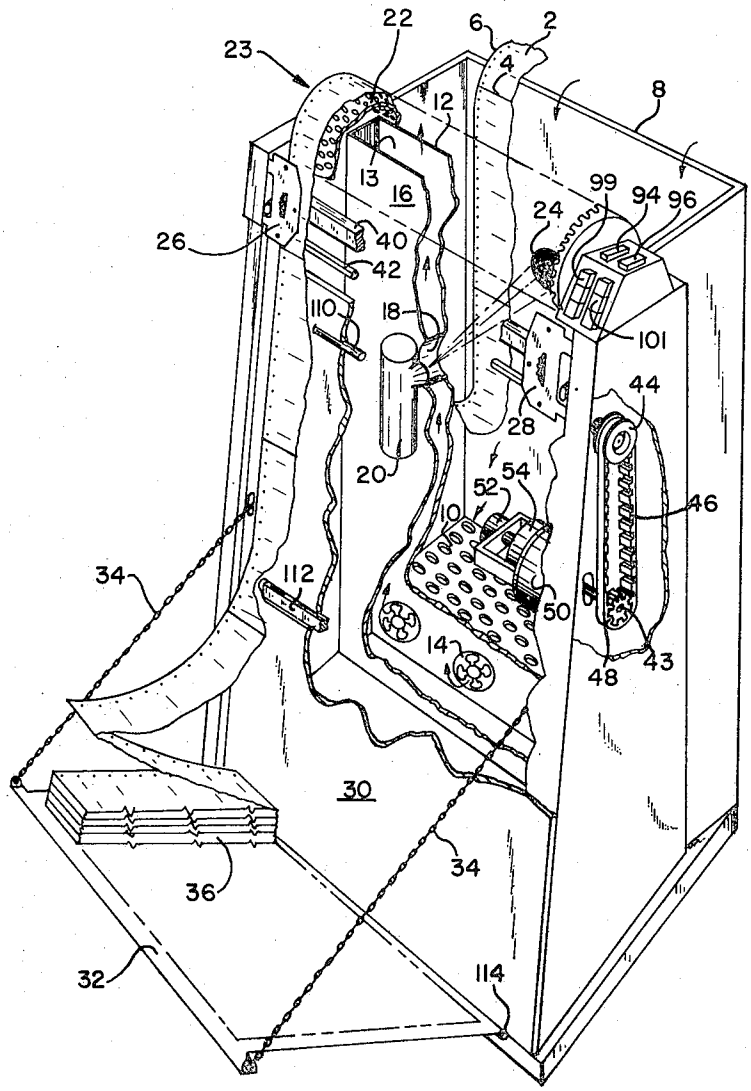
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3,363,895	1/1968	Takashi Abe et al.	270/61 F
3,464,610	9/1969	Koning	270/79 X
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[57] **ABSTRACT**

Fan-folded printout from a high speed printer is stacked by feeding the paper down a vertically inclined surface onto a platform located at an angle with the surface to cause the paper to stack. The paper is fed down the vertically inclined surface by a pair of conventional paper feed tractors engaging edge perforations in the paper. A vacuum chamber buffer is provided between the printer and the inclined surface and when a minimum amount of web is photoelectrically sensed in the buffer, the stacker is conditioned to discontinue stacking when the first fold pointing away from the inclined surface above the top of the stacked paper on the platform is one form length above the top of the stack. The precise time at which to discontinue stacking is determined by tracking the shaft driving the tractors with a counter. Since the top of the stack continually rises, another counter is provided to track the stack's top.

20 Claims, 8 Drawing Figures



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SHEET 1 OF 4

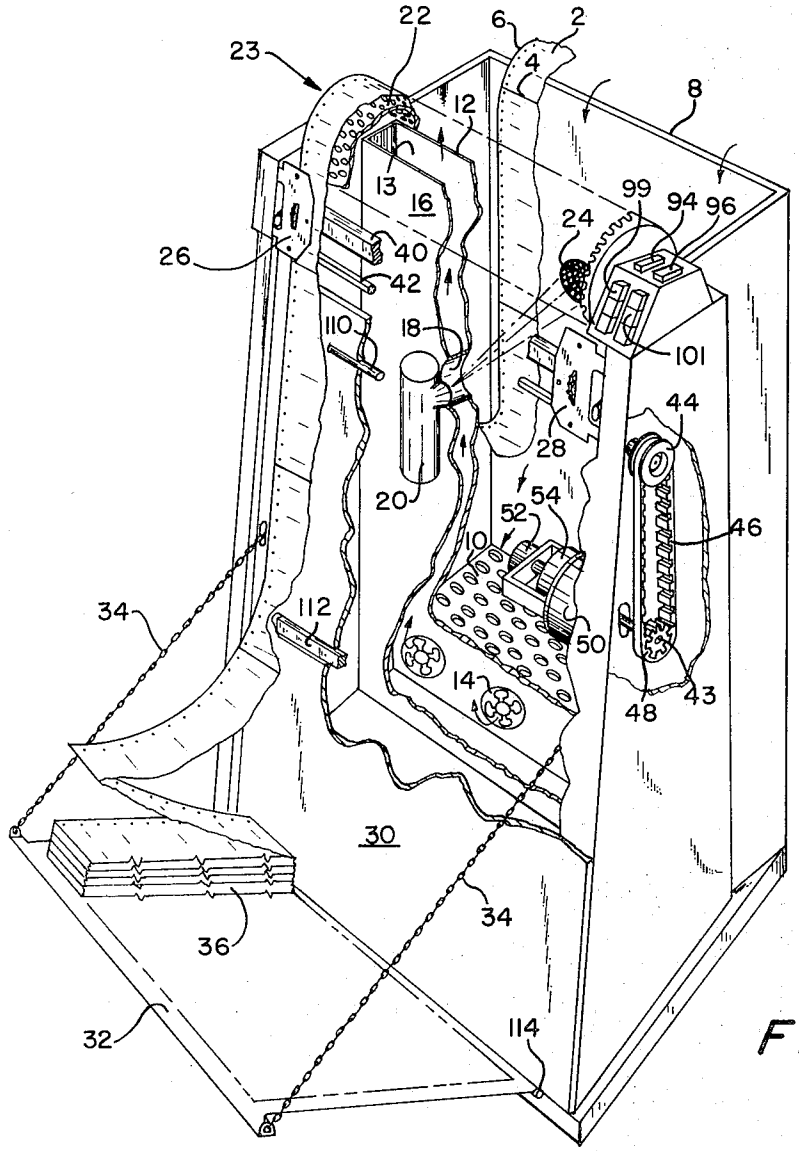


FIG. 1

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BY

ATTORNEY

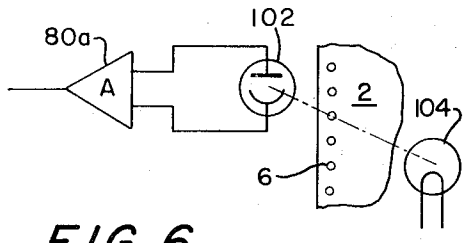


FIG. 6

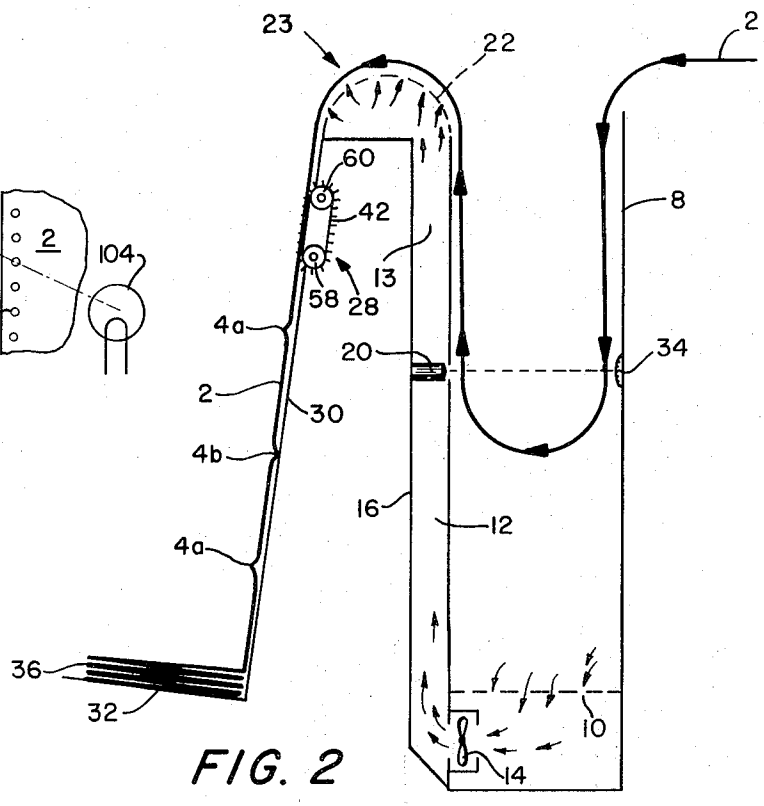


FIG. 2

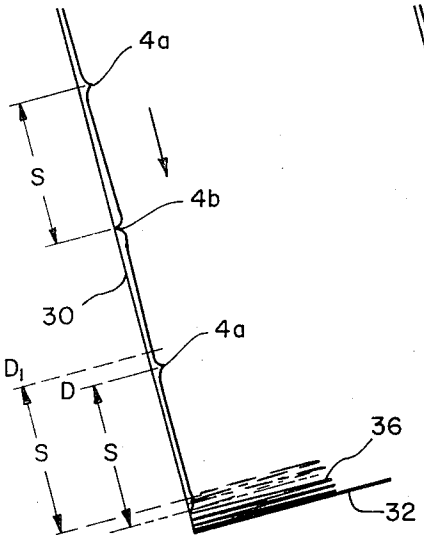


FIG. 3a

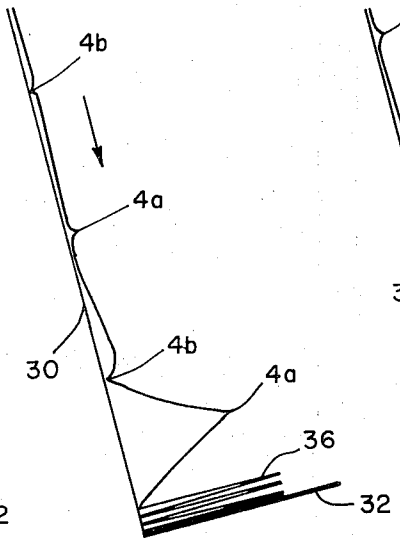


FIG. 3b

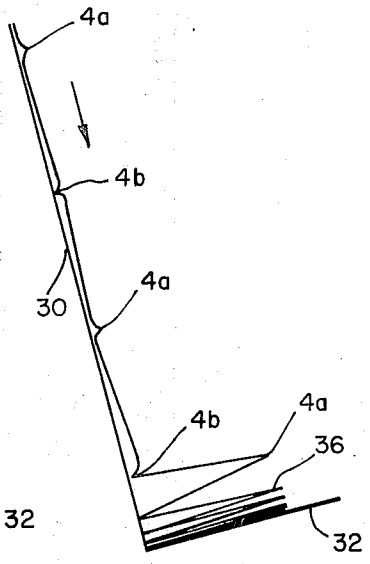


FIG. 3c

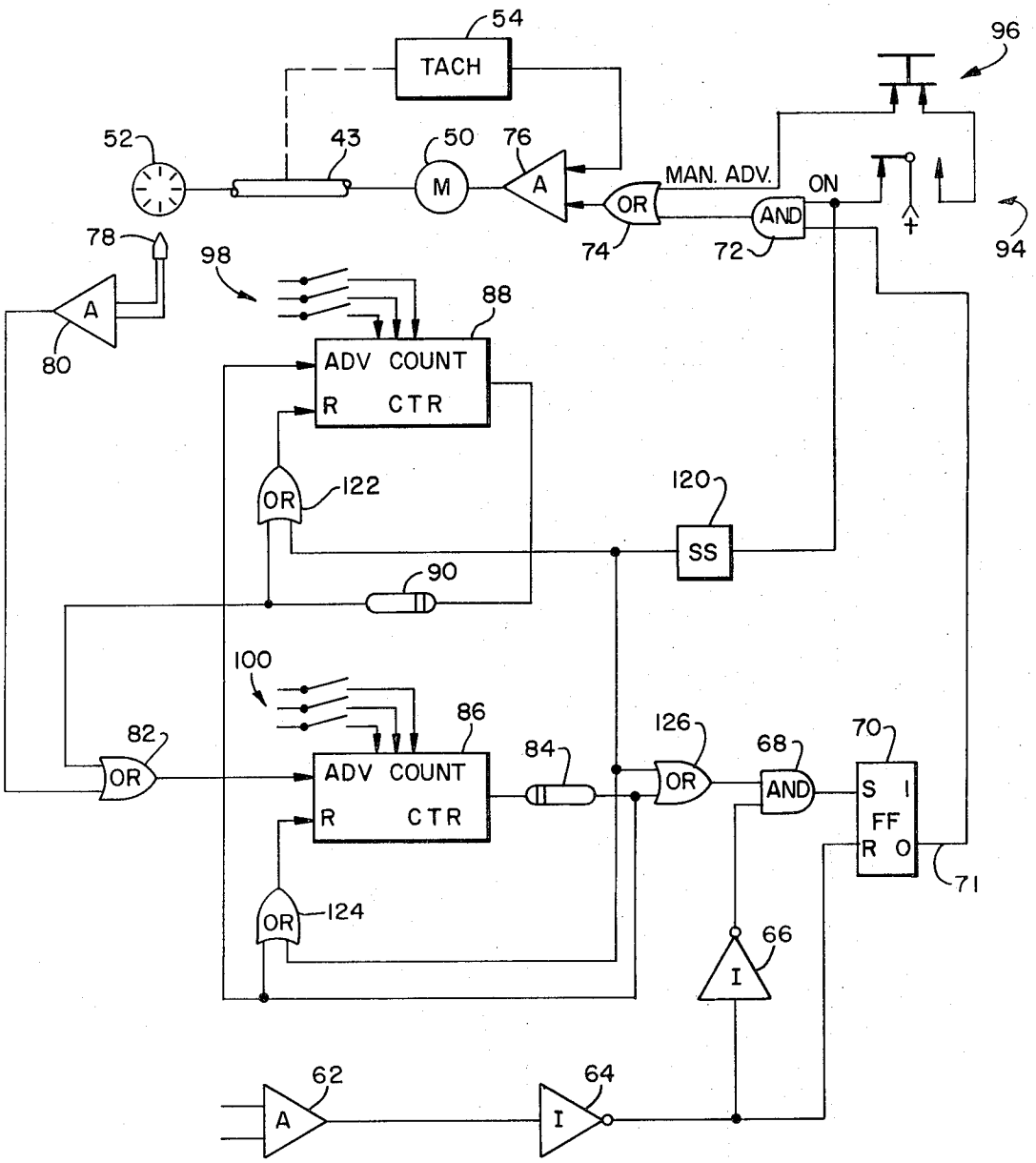

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SS
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86
82
OR
ADV COUNT
R CTR
84
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OR
68
AND
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R O
71
OR
124
66
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FIG. 4

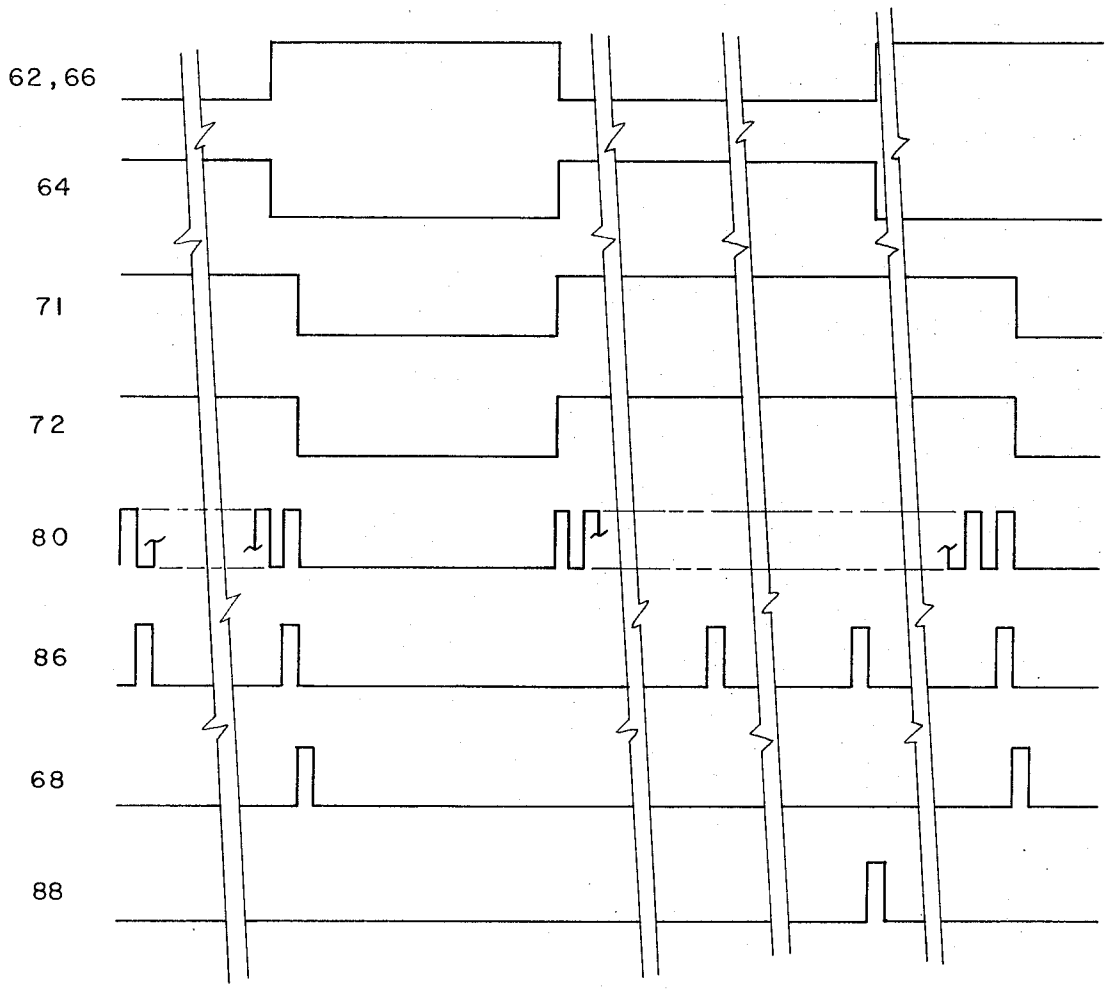


FIG. 5

FAN-FOLDED PAPER STACKER FOR HIGH SPEED PRINTER

This application is a continuation-in-part of U.S. Pat. application Ser. No. 158,195 filed June 30, 1971 for "Fan-Folded Paper Stacker for High Speed Printer," now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to stacking fan-folded webs and, in particular, to stacking fan-folded paper from a high speed printer.

In data processing and communication applications, high speed printers are used to print the rapidly-generated output of data processing machines. The medium on which printing generally is performed is "fan-folded", i.e., elongated webs having transversely extending folds longitudinally spaced with alternate folds pointing in opposite directions. The web is taken into the printer from a stack within which it is tightly folded at the spaced folds. After printing, the web is folded along its folds in a zigzag manner and into a stack. The web generally consists of several sheets of paper interspersed with carbons. It is common practice to identify the web by the number of sheets it contains; for example, a "two part form" contains two sheets sandwiching a single carbon. It is also common practice to print up to "six-part forms." Further, the transverse folds are equally spaced and the distance between two adjacent folds is termed a "form length."

Of course, other machines operate on fan-folded webs. One such machine, called a decollator, separates multi-part forms into their constituent paper sheets and carbons. In one type of decollator, each sheet of fan-folded paper, once separated from the remainder of the form, is fed down an inclined surface onto a platform located at an angle to the surface. This angle is such that the sheet of paper is folded along its folds into a stack as it reaches the platform. Once started, the decollator works continuously until the multi-part form has been completely separated and its constituent sheets of paper stacked. The dynamics of this continuous and constant paper flow down the inclined surface operate to stack the web where the surface and platform meet.

However, the output of a high speed printer is not continuous and constant. The printer will generate printout faster when printing short lines than long ones. When slewing (feeding paper without printing), the paper moves through the printer at an extremely high speed. Further and most important, with the common types of printers, paper is fed from the printer discretely and only after a line has been printed; no paper movement occurs during printing so that, unlike the decollator's, the printer's output is not continuous.

Numerous machines have been designed to stack the fan-folded printout from high speed printers. One example of a previously known paper stacker is provided by U.S. Pat. No. 3,464,610 issued to M. G. Koning On Sept. 2, 1969. The Koning apparatus utilizes a vacuum chamber buffer to initially receive the paper from the printer. The amount of form in the buffer is photoelectrically sensed to control a pair of paper-feed tractors which engage edge perforations in the paper. Besides feeding the paper, the tractors oscillate to fold the web along its folds. The web is dropped vertically into a stack and rides over an air bearing located between the tractors and buffer chamber. However, the Koning apparatus, like others in the industry, does not provide a stacker capable of reliably stacking the fan-folded printout of high speed printers.

SUMMARY OF THE INVENTION

It is the primary object of this invention to provide a fan-folded web stacker which is reliable as well as inexpensive and easily maintained.

It is a further object to provide such an apparatus which may be selectively adjusted to accommodate different fan-folded web thicknesses.

It is a further object to provide such an apparatus which may be selectively adjusted to accommodate different fan-folded webs having various lengths between adjacent folds.

In accordance with the invention, a fan-folded elongated web from a high speed printer is longitudinally fed down a vertically inclined surface onto a platform on which it is stacked. A buffer is provided between the printer and the inclined surface to isolate the variable output of the printer from the rest of the stacker. When a predetermined low amount of web appears in the buffer, the stacker is conditioned to discontinue stacking when the first fold pointing away from the inclined surface above the top of the stack on the platform is one form length, i.e., the distance between adjacent folds, above the top of the stack. At this point, the web may be stopped yet feeding and stacking resumed when additional web occurs in the buffer. In order to ascertain this precise condition for stopping, the paper web is tracked either directly or by monitoring the operation of the member feeding the web down the inclined surface.

Preferably, the web is fed by a pair of spaced apart tractors which engage edge perforations longitudinally spaced along the web. The tractors are conventional and driven by a splined shaft whose rotation is tracked by a counter. In this manner, the web is tracked indirectly. Alternately, the holes in the web may be counted so that the tracking is done directly from the webs.

Since the height of the stack continually rises, the distance above the stack at which the first fold pointing away from the inclined surface must be located also rises. This variation is preferably accommodated by tracking the upper portion of the stack with another counter.

To accommodate forms having different lengths between adjacent folds, means are provided to adjust the first counter so that the paper will be stopped accordingly. Similarly, other adjusting means is provided to operate on the second counter so that forms of different thickness may be accommodated. Obviously a thicker form causes the stack to rise more rapidly.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a perspective view of a preferred embodiment of the paper stacker of the invention.

FIG. **2** is a schematic diagram of the stacker shown in FIG. **1.**

FIGS. **3***a*, **3***b* and **3***c* are schematics illustrating the operation of the paper stacker.

FIG. **4** is a schematic logic diagram illustrating the control circuit of the paper stacker.

FIG. **5** is a waveform diagram illustrating the operation of the circuit shown in FIG. **4.**

FIG. 6 illustrates a modification of the paper stacker shown in the above drawings and constitutes a second preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 2 is a schematic diagram illustrating the operation of the stacker in FIG. 1. As illustrated in these Figures, a fan-folded web 2 is received at the stacker in a vacuum buffer chamber 8. Although a printer is not illustrated, it is contemplated that the web (or paper) 2 constitutes the printout of a high speed printer and the buffer chamber serves to isolate the variable output rate of the printer from the remaining portion of the stacker. As shown, the web has transverse folds which are longitudinally and equally spaced. Alternate folds point in opposite directions so that every other fold is similar to the one illustrated at 4b in FIG. 2 and the remaining folds are similar to those designated 4a in FIG. 2. As shown in FIG. 1, the web is longitudinally perforated with equally spaced holes along both its edges. The web is thus of the type generally used in data processing facilities. The web is removed from the stack for printing by the printer. Within the printer, the web is engaged by conventional paper feed tractors which engage the perforations at the opposite edges of the web. Additionally, the web 2 consists of several sheets of paper interspersed with carbons so that the printer produces multiple copies.

Referring further to FIGS. 1 and 2, the web 2, after being received in the vacuum buffer chamber 8, passes over an air bearing generally designated 23. The paper thereafter is fed down a vertically inclined surface 30 onto a platform 32. A pair of spaced-apart tractors 26, 28 are provided at the upper portion of the surface 30 to engage the edge perforations in the paper and feed the paper down the surface. The tractors are controlled in response to the output of a photoswitch 20.

The vacuum chamber 8 is an essentially rectangular box having a front 12 and bottom 10. The bottom 10 is perforated and beneath the bottom and within front surface 12 apertures are provided to accommodate fans 14 which suck air down the vacuum chamber, through the perforations in bottom 10 and, thereafter, push the air upwardly on the outside of the front 12 of the chamber. The vacuum chamber performs well with different width webs since a wider web will more completely cover the chamber and thus the vacuum created by fans 14 will be more powerful. Conversely, a narrow width web will cover less of the vacuum chamber opening so that less of a vacuum is achieved by fans 14. Obviously, the wide web is stiffer and heavier than the narrow one and requires a greater vacuum. Thus, the vacuum chamber 8 satisfactorily operates with various web widths.

Another chamber 13 is provided as shown in FIGS. 1 and 2. The chamber 13 receives the air from the fans 14 which has been exhausted out of the vacuum chamber 8. This air is forced upwardly within chamber 13. The top of chamber 13 is open with a convex perforated paper guide 22 located there. The exhausting air from chamber 13 goes out its open top and through the perforations in the guide.

As illustrated, the paper is received in the vacuum chamber 8 as a downwardly extending loop since it is pulled downwardly by the vacuum from fans 14. The paper thereafter is formed into a upwardly extending loop as it traverses over the paper guide 22. At 23, the paper is resiliently supported on an air bearing since it is forced upwardly by the air escaping through the perforations in the guide 22.

Thereafter, the perforations in the edges of the paper are engaged by the paper feed tractors 26 and 28. These tractors serve to feed the paper down the vertically extending surface 30. Since these tractors move the web downwardly and the air bearing created by the perforated guide head 22 tends to force the paper upwardly, another web buffer is actually formed by the air bearing 23. This provides sufficient slack in the paper so that it is not roughly pulled over the paper guide head when the tractors are operated.

The photoswitch 20 is attached to the outside of chamber 13 which has a hole therein so that a beam of light may pass from the photoswitch 20 through chamber 13 and across vacuum chamber 8. At the opposite side of the vacuum chamber 8, a reflector 24 is located which is adapted to receive and reflect the light beam. The photoswitch 20 contains a photoelectric cell as well as a light source for generating the beam and light from this source, when directed onto reflector 24, bounces back onto the photocell. When the downwardly extending loop of paper in vacuum chamber 8 is sufficiently long to become positioned between the photoswitch 20 and its reflector 24, substantially no light will be received by the photoswitch's photocell. Of course, when less paper is in the chamber and the loop is not so long, light will be reflected back from reflector 24. Photoswitch 20 thus determines whether or not a predetermined low amount of web is within the buffer 8 and provides an electrical signal in response to such a low amount occurring. The tractors are thereafter controlled to feed or not feed paper in response to the photoswitch by the control circuit of FIG. 4.

Referring to FIGS. 3*a*, 3*b* and 3*c*, the web is shown as it is stacked upon being received from the vertically inclined surface 30 by the platform 32. As shown, the alternate folds in the web point alternately toward and away from the inclined surface as the web is fed downwardly. In FIG. 3*a*, the distance designated S is the distance between adjacent folds, commonly called a form length. The point D in FIG. 3*a* denotes a distance equal to *S* from the top of the stack 36 on platform 32.

FIGS. 3*a*, 3*b* and 3*c* show in sequence the manner in which the web is folded as it is continuously received by platform 32. In FIG. 3*a*, the first fold pointing away from the platform 30 above the top of the stack 36 is at D and exactly one form length above the top of the stack. In FIG. 3*b* this fold has been moved downwardly and away from the inclined surface as the paper on either side of the fold closes about it. FIG. 3*c* shows the situation further along in time with the bottom-most fold almost completely closed and located on top of the stack 36. These Figures illustrate the web's performance when continually being fed down the inclined surface 30.

However, since the output of a data processing printer is not continuous, the web in the stacker cannot always be fed down the inclined surface 30 continuously but, in reality, is periodically stopped. An examination of FIGS. 3*a*, 3*b* and 3*c* show that only the situation illustrated in FIG. 3*a* is stable. If web feeding is stopped in the position shown in FIG. 3*b*, the bottom fold 4*a* will continue to fall pulling portions of the web away from the inclined surface 30 and creating an un-

stable floppy condition. Similarly, to some extent the same consequences would occur should feeding of the web be stopped with the web in the position shown in FIG. 3*c*. If feeding of the web resumed after the web was stopped in either of these two situations the additional web would begin to follow various chaotic paths when placed on top of the unstable conditions. The operator in the data processing facility would thereafter be required to stop the printer and hand-fold the unstacked paper.

However, if feeding of the web is stopped when the web is as shown in FIG. 3*a* and thereafter resumed, the paper will fold as shown sequentially in FIGS. 3*b* and 3*c* and stacking will continue. As shown in FIG. 3*a*, the first fold pointing away from the inclined surface above the stack **36** is at precisely the distance D and equal to one form length *S* above the top of the stack **36**. This location of the first fold pointing away from the surface **30** is critical for stopping and thereafter resuming the stacking operation.

Of course, the point D will rise along the inclined surface **30** as the top of stack **36** rises. Thus, where the web is stopped after some stacking has occurred, the first fold pointing away from the platform must be at the point designated D1 in FIG. 3*a;* D1 denotes a point the distance S above the top of the stack indicated in phantom.

The tractors **26** and **28** illustrated in FIGS. **1** and **2** are controlled by the photoswitch **20** to feed the web in response to the amount in buffer **8** as previously noted. The tractors are further controlled to stop feeding the web only when the first fold pointing away from the surface is at the upper location. More precisely, when the photoswitch **20** indicates that a predetermined low amount of web is in the vacuum chamger **8**, the controls for the tractors are conditioned to stop web feeding at the next instance when the first fold above the top of the stack pointing away from the surface is one form length (S) above the top of the stack. That is, the tractors are controlled to stop the web only when the situation shown in FIG. 3*a* exists. The tractors are also controlled to take into account that the fact that the top of the stack is rising as the paper is stacked.

With respect to the tractors themselves, as shown in FIG. **1**, they are held in place by a mounting bar **40**. As shown in FIG. **2**, each tractor comprises, as is conventional, a pair of spaced apart pulleys **58, 60** around which an endless chain **56** having sprockets is driven. A splined shaft **42** shown in both FIGS. **1** and **2** is drivingly connected to one of the pulleys **58** and the tractors are rotated by rotation of the shaft. As shown in FIG. **1**, the splined shaft is connected to a pulley **44** driven by a driving gear **48** via a toothed belt **46**. Gear **48** is connected to the output shaft of a motor **50** located adjacent the bottom of vacuum chamber **8**. Operation of motor **50** thereby controls paper feeding. Also connected to the output shaft of motor **50** is a tachometer **54** and a strobe disk **52**.

As schematically shown in FIG. **4**, the motor **50** is connected in a feedback servo loop with the tachometer **54** which responds to the motor's shaft **43** and is connected in the feedback loop to the motor's driving amplifier **76**. The strobe disk **52** is also mounted on shaft **43**. The tachometer servo feedback loop is conventional and the strobe disk is as well. The strobe disk is essentially a disk having equally spaced radial indicia which may be sensed in some manner, e.g., optically. The marks are detected by a conventional transducer **78** of some type. The output of the transducer **78** is fed to an amplifier **80** whose output provides a train of pulses whose frequency depend upon the speed of motor **50** and shaft **43**.

As also shown in FIG. **4**, the motor driving amplifier **76** receives an enabling input from the output of an OR gate **74**. The OR gate is conventional in that it provides a high output signal in response to a high signal at either or both of its inputs. Of course, this element and the other logic elements illustrated in FIG. **4** act in a conventional manner on a binary voltage level basis in that the outputs of the circuit elements and their inputs exist at either of two voltage levels, the high voltage level or the low voltage level of the system. When either input of OR **74** is high, the motor driving amplifier **76** is activated and the motor driven to rotate shaft **42** which operates tractors **26** and **28** to feed web down the inclined surface.

The stacker illustrated in FIG. **1** has a control box located at its upper right corner and a button **96** is indicated thereon. Button **96** is designated manual advance and, when pressed, a high signal is applied to the designated input of OR **74** in FIG. **4** to drive the motor **50**. Generally, the manual advance button is depressed when the paper is initially being set up in the stacker; the paper is advanced until a fold pointing away from the surface **30** is the distance S above the platform (and at D).

The other input to OR **74** in FIG. **4** is from the output of an AND gate **72** having two inputs. AND **72** is conventional in that it supplies a high output in response to the simultaneous occurrence of high signals at both its inputs. Referring again to FIG. **1**, a single-pole, double throw switch **94** is shown located adjacent button **96** on the control box. Switch **94** has an "on" and an "off" position and controls the automatic operation of the machine. When switch **94** is placed in the on position a high signal ON is supplied to the designated input of AND **72** enabling it. When switch **96** is off it supplies power to enable the manual advance button **96**. The other input of AND **72** comes from the remainder of the control circuit which controls the motor to feed web in accordance with the invention. The ON input to AND **72** is merely an enabling input to enable the system to function.

The output of the photoswitch **20** in FIGS. **1** and **2** is fed to an amplifier **62** shown in FIG. **4** where it is suitably amplified and shaped. When the web in buffer chamber **8** is such a low amount that light is reflected back from **24**, a high signal is applied to amplifier **62**. Conversely, when light is not reflected because the length of the web loop in buffer **8** is longer, amplifier **62** does not receive a high signal. As noted above, when light is reflected, a predetermined low amount of web is in the buffer and the motor **50** is conditioned to stop. When no light is reflected, the motor is controlled to feed web.

The output of amplifier **62** is fed to an inverter **64**. Inverter **64** feeds its output to another inverter **66** and to the reset input (R) of a flip-flop **70**. The inverters are conventional elements in that they always provide an output signal (high or low) opposite to their input signal (low or high). The flip-flop **70** is also a conventional element having set (S) and reset (R) inputs and corresponding outputs designated 1 and 0. The flip-flop cir-

cuit is bistable in nature and its outputs are always at opposite voltage levels. When a low to high voltage level transition is presented at the set (S) input, the 1 output goes high and the 0 output goes low unless the outputs are already in such a state in which case the output levels do not change. When a low to high transition is presented at the reset (R) input, the 0 output goes high and the 1 output goes low unless the outputs already exist in such a state. The flip-flop's 0 output is fed over a lead 71 which joins the remaining input of AND 72.

Thus, when the loop of web in the vacuum chamber 8 of FIG. 1 drops below the photoswitch, amplifier 62 provides a high to low input to inverter 64 which converts the signal to low to high signal which is applied to the reset (R) input of flip-flop 70 and thus a high signal is provided on lead 71 to AND 72. With AND 72 enabled by the high ON signal, it provides a high output signal via OR 74 to the driving amplifier 76 of motor 50 to rotate shaft 42 to feed web down the inclined surface 30. In order to stop feeding web, the signal on lead 71 must go low and so a low to high transition must be provided at the S input of flip-flop 70. Flip-flop 70 receives signals at its S input from an AND gate 68 which receives one of its two inputs from the output of an inverter 66. The output of inverter 66 is the opposite of the signal applied to the reset (R) input of flip-flop 70 so that AND 68 will be conditioned by a high signal from inverter 66 when the photoswitch 20 in FIG. 1 receives light and a predetermined low amount of web is in the vacuum chamber 8. Thus, AND 68 is conditioned to cause the signal on lead 71 to go low to stop feeding web when a predetermined low amount of web is in the buffer. The remainder of the circuit of FIG. 4 to be described below converts the pulses from amplifier 80 into an appropriate signal to activate AND 68 and thereby stop web feeding at the appropriate time; that is, to stop the web when the first fold pointing away from surface 30 is the distance S above the stack.

Referring to FIG. 4, transducer 78 and amplifier 80 provide a series of pulses whose frequency depend upon the rate of rotation of motor shaft 43 and, thus, the rate web is fed down the inclined surface 30 by the tractor drive shaft 42. The output of amplifier 80 is fed to an input of an OR 82 which provides a signal at the ADV input of a counter 86 in response to each pulse. The counter 86 is a conventional logic circuit and each pulse at its ADV input causes its contained count to advance by one toward the counter's maximum count. The counter's maximum count is selectively set by signals at its COUNT inputs. When the counter reaches its maximum count, it provides a positive output pulse at its output. The counter has another input designated R for reset and a positive signal at any time here resets the counter to zero. The output signal from counter 86 is fed via a delay 84 and an OR circuit 126 to the other input of AND 68 and also back to the counter's reset R input via an OR circuit 124. The delay circuit 84 is also conventional in that it merely generates an output level which follows its input level but changes state at some fixed period of time after the input signal changes state. The function of delay circuit 84 is to define the width of the counter output pulse. Thus, as pulses are generated from transducer 78, the counter is advanced by one for each pulse from zero to the maximum count loaded into it. When this count is reached, a high signal is provided at the counter's output which, via delay 84 and OR 126, is fed to an input of AND 68. The signal from delay 84 is also fed back to reset the counter.

The signals fed to the counter's COUNT inputs by which the maximum number to which the counter advances is set are applied by switches designated 100. There are three such switches and, as shown in FIG. 1, these three switches are controlled by a row of three push buttons 101 on the stacker's control box. By selectively closing the appropriate switches via the push buttons 101, the appropriate maximum count is set in the counter. The maximum count to which the counter advances is chosen in response to the form length S which as illustrated in FIG. 3*a* is the distance above the top of the stack to point D at which the first fold pointing away from the inclined surface 30 must be located. Thus, by operating buttons 101 to close switches 100, the appropriate maximum count may be placed in counter 86 to accommodate forms having different form lengths (different distances between adjacent folds).

When the motor 50 has rotated shaft 42 and thereby operated the paper feed tractors sufficiently so that the bottom of the loop of web in vacuum chamber 8 is above the photoswitch 20, the reset (R) input of flip-flop 70 goes low and the flip-flop 70 awaits a low to high transition at its set (S) input to provide a low signal on lead 71 to stop the motor. As previously noted, in this situation AND 68 already has an enabling input from the output of inverter 66. Each pulse from transducer 78 and amplifier 80 passes through OR 82 to advance the counter. The counter has been set to an appropriate value so that it provides a pulse at its output each time the first fold pointing away from the inclined surface is the predetermined distance above the top of the stack, i.e., the distance of one form length S. Since this occurs once for every other form, the count placed in the counter is obviously proportional to twice the form length. That is, buttons 101 are operated to close the appropriate switches 100 so that the maximum count placed in the counter is proportional to twice the form length of the web being utilized. The output pulse in the counter is fed to activate AND 68 to set flip-flop 70 and provide a low signal on lead 71 thereby stopping the motor.

As a specific example, assume that for each revolution of shaft 42, the paper feed tractors 24 and 26 operate to feed four inches of paper down the inclined surface 30. Assume also that strobe disk 52 connected to shaft 42 has 32 equally spaced marks so that one pulse is provided by the transducer 78 for every one-eighth inch of paper feed. If we assume a form length of twelve inches, two form lengths equals twenty-four inches. Thus, counter 86 must provide an output pulse in response to every 192 pulses at its ADV input (8 times 24). Thus, 192 will be loaded into counter 86 at its COUNT input. Of course, this assumes that in initially setting up the paper stacker the first fold pointing away from the inclined surface is initially located one form length above the platform by the operator utilizing the manual advance button.

As the web is stacked, the top of the stack on the platform 32 will rise and thus the location of the point D above the stack 36 as shown in FIG. 3*a* also rises. Obviously, the time at which AND 68 is activated to set flip-flop 70 must be modified periodically to accommodate this rise in the point at which the first fold pointing away from the inclined surface must be located when

the paper is stopped. To accomplish this, another counter 88 is provided in FIG. 4. Counter 88 is similar to counter 86 having ADV, COUNT and R inputs. A pulse is applied to its ADV input each time the other counter 86 provides an output pulse so that counter 88 advances one increment each time a distance of two form lengths of web is fed by the tractors. The output of counter 88 is fed via OR 82 to the ADV input of counter 86. Thus, each time counter 88 has an output, an additional pulse besides those pulses obtained from transducer 78 is applied to advance counter 86. This in effect shortens the time at which counter 86 indicates that the first fold pointing away from the surface 30 above the stack is one form length above the stack. This, thus, accommodates the rising stack. The output of counter 88 is fed back via delay 90 and OR 122 to reset itself. The function of delay 90 is similar to that of delay circuit 84.

Similar to counter 86, the signals applied to the COUNT inputs of counter 88 are derived from switches 98 which are activated by push buttons 99 on the control box of the stacker shown in FIG. 1. The stack 36 on the platform will rise at a rate proportional to the thickness of the web. Thus, the push buttons 99 on the control box are selectively regulated to accommodate different web thicknesses. As above noted, the web actually comprises selected numbers of interleaved paper and carbons. As a specific example, assume that the web is one sixty-fourth of an inch thick. Thus, for every two form lengths fed, the top of the stack rises one thirty-second of an inch and, of course, an output is provided from counter 86. Since a signal is provided at the ADV input of counter 86 for every one-eighth of an inch of paper being fed, to accommodate the rising stack at the rate of one thirty-second of an inch for each 24 inches fed, a pulse must be fed to the ADV input of counter 86 from counter 88 for every four of the counter's 86 output signals. Thus, the count loaded into counter 88 at its COUNT inputs is four so that the counter provides an output signal via OR 82 to the ADV input of counter 86 for every 4 times one thirty-second (or one-eighth) of an inch of paper fed. In this manner the fact that the stack of paper on platform 32 continually rises is accommodated.

To insure that the counters 86 and 88 and the flip-flop 70 are in the proper condition when operation of the system is initiated a single-shot multivibrator circuit 120 is provided with its input connected to the on side of switch 94 and its output connected to the inputs of OR circuits 122, 124 and 126. Single-shot 120 generates a single predetermined-width output signal whenever switch 94 is switched from off to on. This output signal acts to reset each of the counters to zero and, if the output from inverter 66 is high (indicating that the beam from photoswitch 20 is unblocked), also acts to set flip-flop 70.

To initiate operation of the stacker, the operator takes the web of forms extending from the output side of the printer, draws it across the top of vacuum chamber 8 and secures it in the tractors 26 and 28. Switch 94 (FIG. 4) must be in the off condition so that the manual advance button 96 is enabled and AND 72 is disabled. The latter condition is required at this point since there may be sufficient slack in the web to permit formation in chamber 8 of a loop large enough to block the beam from photoswitch 20. Such a condition would, without the degating of AND 72, prematurely initiate feeding of the forms.

The operator next depresses button 96 to advance the forms to the proper starting position (where a fold pointing outwardly from platform 30 is exactly the distance S above the top of the stack), giving manual assistance to the stacking action if such is required. When the stack is properly set up the operator places switch 94 into the on position. If the slack in the web is sufficient such that the beam from photoswitch 20 is blocked automatic operation of the stacker, as described below, will commence as soon as switch 94 is placed in the on position. If the slack is insufficient to block the beam nothing further will happen until the printer output supplies an additional length of the web sufficient to cut off the beam.

When the loop in the chamber 8 drops below the photoswitch the conditions depicted at the left of the waveform diagram of FIG. 5 are set up. The automatic operation of the preferred embodiment is hereinafter described with reference to FIGS. 4 and 5. With the web below the photoswitch, the low output of amplifier 62 causes a high output from inverter 64 which is applied to the reset input of flip-flop 70 and thus a high signal occurs on lead 71 which maintains the output of AND 72 high and drives the motor 50 to feed and stack the forms. With the motor 50 driven, shaft 42 rotates the strobe disk 52, transducer 78 and amplifier 80 operate to provide a train of pulses. These pulses are fed via OR 82 to advance counter 86 and at its maximum count (in the example above, 192) counter 86 provides an output which is fed to AND 68. However, since inverter 66 is low at this time (the loop still being below the beam) AND 68 is not enabled and cannot operate to set flip-flop 70.

Thereafter, the loop in vacuum chamber 8 goes above the photoswitch 20 and amplifier 62 provides a low to high signal so that inverter 66 also goes high and the output of inverter 64 goes low. At this time, flip-flop 70 no longer has a high signal at its reset (R) input and so its 1 output will go low in response to a low to high transition at its set (s) input. This low to high transition occurs the next time counter 86 provides an output signal which passes through AND 68 since AND 68 is enabled by a positive output from inverter 66 at this time. The signal on lead 71 goes negative to cause the output of AND 72 to be low and motor 50 is stopped. Of course, with motor 50 stopped, shaft 42 does not rotate and transducer 78 no longer provides a train of pulses.

This situation remains the same until the loop of the paper in vacuum chamber 8 again passes below the photoswitch 20 so that the output from amplifier 62 shifts low, the output from inverter 64 goes high and inverter 66 shifts low. The low signal from inverter 66 blocks AND 68 while the low to high transition applied at the reset (R) input of flip-flop 70 causes a high signal on lead 71, enabling of AND 72, operation of the motor and pulses from transducer 78. The motor is thus driven to stack paper whereupon the loop of paper in the chamber 8 is raised.

When the loop is raised above the beam of light from source 20 the signals from amplifier 62 and inverter 66 go high with that from inverter 64 going low. Thus, AND 68 is enabled and will pass a signal to set flip-flop 70 and terminate the high signal on lead 71 in response to the next output from counter 86. Of course, counter

86 responds to the output pulses from counter 88 as well as those from amplifier 80. As shown in FIG. 5, counter 86 was just initiating a new count when amplifier 62 initiated a high signal. During this count in counter 86, counter 88 provides an output signal to advance counter 86 along with those pulses from transducer 78. Thus, the next output of counter 86 will occur somewhat sooner than the previous output because the counter has been advanced by a pulse from counter 88 in addition to those from transducer 78. This accommodates the increased thickness of the stack of paper 36 on the platform 32. When the output signal from counter 86 occurs, the signal on lead 71 and the output of AND 72 go low to stop driving the motor 50.

FIG. 6 shows another embodiment of the invention which is a minor modification of the one already illustrated. In FIG. 6, a light source 104 is arranged to cooperate with a photocell 102. Light from source 104 is directed through the perforations occurring along one edge of the web. As the web is fed, for each perforation passing between the light source and photocell, a signal is provided by the photocell to an amplifier 80*a*. The amplifier 80*a* corresponds to the amplifier 80 in FIG. 4 and the photocell 102 and light source 104 take the place of strobe disk 52 and transducer 52 of FIG. 4. All the other elements of FIG. 4 remain the same. Of course, the maximum counts loaded into the counters will be different because the signals provided from photocell 102 would not necessarily be one pulse for every one-eighth of an inch of web fed as occurs with the circuit shown in FIG. 4 as previously described. Where the signals from the photocell of FIG. 6 are used, the maximum count loaded into counter 86 would be the number of perforations along one edge in two form lengths.

Referring again to FIG. 1 the paper stacker of the invention has several further minor features which enhance its usefulness. As illustrated, a static eliminating bar 110 is located on the vertically descending surface 30 at the front of the unit. The static eliminating bar is a conventional item used to discharge the static electricity generated as the web is fed through the printer.

As also shown in FIG. 1, the platform 32 is hinged at 114 at the bottom of the inclined surface 30. At each end of the platform connecting it to opposite sides of the inclined surface 30 are a pair of chains 34. The hinge 114 and chains 34 allow the platform to be pivoted to a position essentially parallel and adjacent to the inclined surface 30 for storage when the unit is not being utilized. A magnetic latch 112 is provided within the inclined surface 30 to maintain the platform in this stored position. When it is desired to use the unit, the platform is merely pulled away from the latch 112 and held in the proper location by chains 34. Preferably, the vertically inclined surface 30 is at an angle of approximately 15° with the vertical and the angle between the inclined surface 30 and platform 32 is approximately 85°.

It will be appreciated that various changes in the form and details of the above-described preferred embodiment may be effected by persons of ordinary skill without departing from the true spirit and scope of the invention.

We claim:

1. In an apparatus for stacking an elongated web having transversely extending folds which are longitudinally spaced with alternate folds pointing in opposite directions, the apparatus being of the type having a member with an inclined vertically descending surface, means for longitudinally feeding said web down said surface such that alternate folds point toward and away from said surface, and a platform adapted to receive said web from said surface and positioned at an angle to said surface so that as said web is received it is folded in a zigzag manner along the folds stacked on the platform, the improvement comprising:

means for conditioning said feeding means to discontinue stacking said web on said platform;

means for indicating when the first fold pointing away from said inclined surface above the top of the stack on said platform is a predetermined distance above the top of said stack; and

means, responsive to said indicating means, for stopping said feeding means when said feeding means is conditioned to discontinue stacking.

2. The apparatus as recited in claim 1 wherein said inclined vertically descending surface is approximately 15° from vertical.

3. The apparatus as recited in claim 2 wherein said platform is at approximately 90° with said inclined surface.

4. The apparatus as recited in claim 1 wherein the transverse folds are equally spaced along said web.

5. The apparatus as recited in claim 4 wherein the spacing between the transverse folds substantially equals said predetermined distance above the top of said stack indicated by said indicating means.

6. The apparatus as recited in claim 5 wherein said indicating means comprises first means for signaling each time a first predetermined length of said web is fed down said inclined-surface, said first predetermined length having a predetermined relationship with said predetermined distance.

7. The apparatus as recited in claim 6 wherein said first predetermined length is twice said predetermined distance.

8. The apparatus as recited in claim 6 wherein said web has equally spaced perforations longitudinally arranged along its length, and said indicating means further comprises means for sensing said perforations, means for counting said sensed perforations and indicating when a predetermined number of perforations have been sensed, said predetermined number being the number of perforations in said first predetermined length of web.

9. The apparatus as recited in claim 6 wherein said feeding means comprises a movable member adapted to engage said web, the movement of said member bearing a predetermined relationship to the length of web fed, and wherein said first signaling means is responsive to the movement of said member to indicate each time said first predetermined length of web is fed.

10. The apparatus as recited in class 6 wherein said feeding means comprises a rotatable shaft and means for engaging said web, said engaging means being rotatable with said shaft, the amount of rotation of said shaft bearing a predetermined relationship to the length of web fed, and wherein said first signaling means is responsive to the amount of rotation of said shaft to indi-

cate each time said first predetermined length of web is fed.

11. The apparatus as recited in claim **10** wherein said web has perforations arranged along its edges, said web engaging means comprises a pair of tractors having sprockets adapted to drivingly engage said edge perforation and said shaft is driven and drivingly engages said tractors.

12. The apparatus as recited in claim **6** further including means for selectively adjusting said first signaling means to indicate different first predetermined lengths so that the apparatus may stack different webs having different spacings between their folds.

13. The apparatus as recited in claim **6** wherein said indicating means further includes second means for signalling each time a second predetermined length of said web is fed down said surface, said second predetermined length having a predetermined relationship with the thickness of said web, and wherein, in response to said second signaling means, said first signal means signals each time a third predetermined length of web is fed, said third predetermined length being less than said first but greater than said second predetermined lengths.

14. The apparatus as recited in claim **13** further including means for selectively adjusting said second signalling means to indicate different second predetermined lengths corresponding to different web thicknesses so that the apparatus may stack webs of different thicknesses.

15. The apparatus as recited in claim **1** further including a first web buffer through which said web passes before being fed down said inclined surface and wherein said conditioning means comprises means for determining when a predetermined low amount of web is in said buffer and said feeding means is conditioned to discontinue stacking when said low amount occurs.

16. The apparatus as recited in claim **15** wherein said first web buffer comprises a vacuum chamber for containing a downwardly extending loop of web.

17. The apparatus as recited in claim **1** and further including means for resiliently supporting said web as an upwardly extending loop immediately before it is fed down said inclined surface.

18. The apparatus as recited in claim **17** wherein said supporting means comprises means for crating an air bearing within the top portion of said loop.

19. The apparatus as recited in claim **1** further including means, located on said vertically descending surface, for discharging static electrically from said web.

20. The apparatus as recited in claim **1** wherein said platform is hinged to said inclined surface and adapted to be placed adjacent and essentially parallel to said surface, and further including means for holding said platform adjacent and essentially parallel to said surface, whereby the platform may be placed and held in a storage position.

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