United States Patent [19]

Behrens et al.

[11] **3,834,289**

[45] **Sept. 10, 1974**

[54] **PHOTOELECTRIC COUNTER FOR PAPER CONVEYOR**

[75] Inventors: **Roy E. Behrens; Leo O. Donahue,** both of Highland, Calif.

[73] Assignee: **Graphic Engineers, Inc.,** Highland, Calif.

[22] Filed: **Apr. 2, 1973**

[21] Appl. No.: **347,191**

[52] **U.S. Cl.** ..... **93/93 C,** 93/93 R, 271/57

[51] **Int. Cl.** **B31b 1/96**

[58] **Field of Search** ..... 271/46, 47, 57; 93/93 C, 93/93 R, 93 DP

[56] **References Cited**

UNITED STATES PATENTS

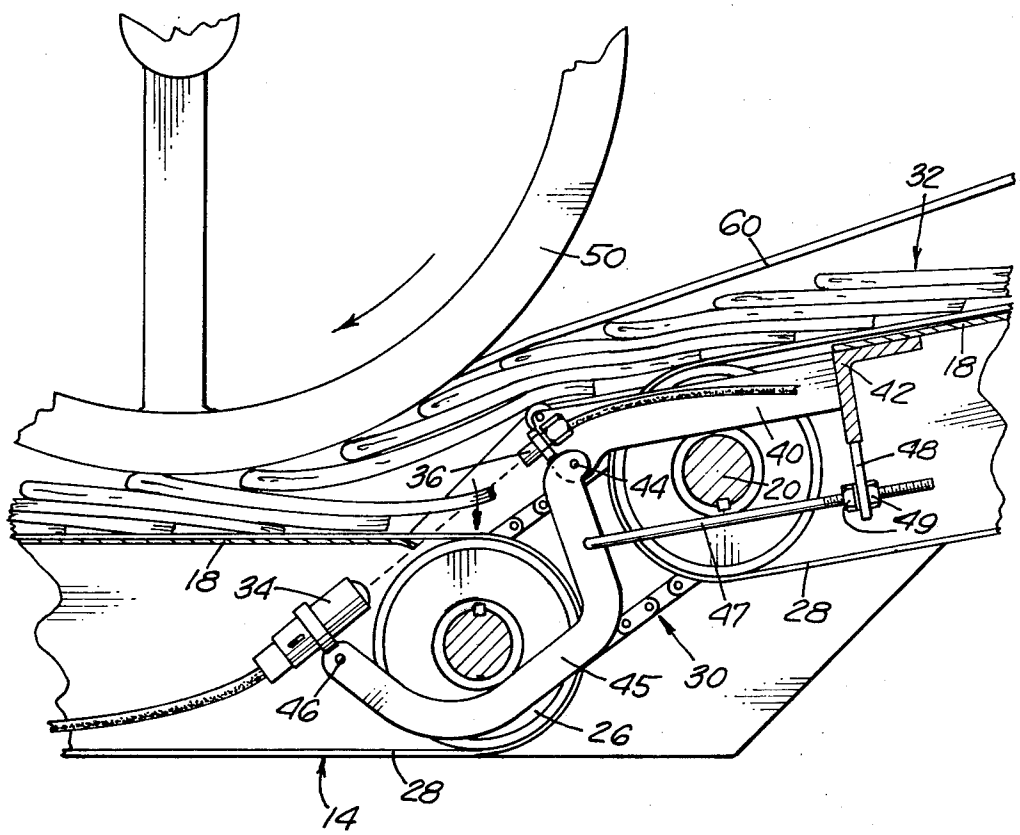
3,683,758	8/1972	Feldkamper	271/46 X
2,787,363	4/1957	Howdle	93/93 C
2,834,450	5/1958	Govin	93/93 C
3,239,676	3/1966	Pali	93/93 C
3,604,321	9/1971	Snellman	93/93 C
3,738,644	9/1973	Kluge	93/93 C X

Primary Examiner—Roy Lake
Assistant Examiner—James F. Coan
Attorney, Agent, or Firm—Herbert E. Kidder

[57] **ABSTRACT**

A photoelectric counter for a belt conveyor system that transports a continuous stream of shingled papers, said conveyor system comprising first and second conveyor sections, the first section delivering the papers to the second section, and the discharge end of the first section being elevated above the receiving end of the second section, so that the trailing edges of the papers flip downwardly as they leave the first section. A photoelectric cell and lamp are mounted under the conveyor sections at the point where the papers transfer from one to the other, with the light beam from the lamp positioned where it is interrupted by the downward flipping of the trailing edges of the papers. A wheel resting on the top surface of the papers presses the papers downwardly and bends them into an arcuate curve of relatively short radius, causing the trailing edges to flip smartly downwardly in a brisk and positive movement, to interrupt the light beam and actuate the photoelectric cell.

7 Claims, 5 Drawing Figures



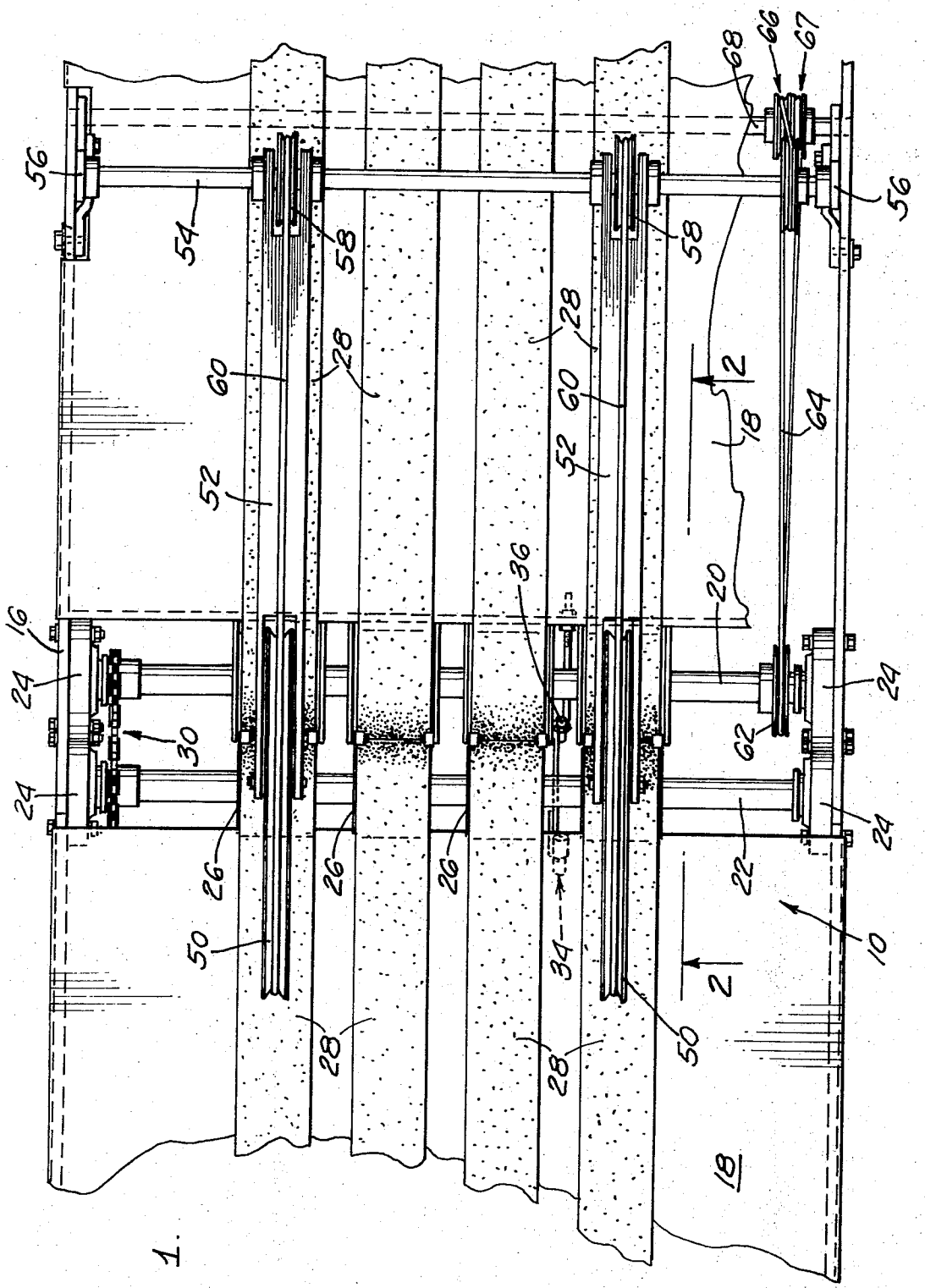


FIG. 1.

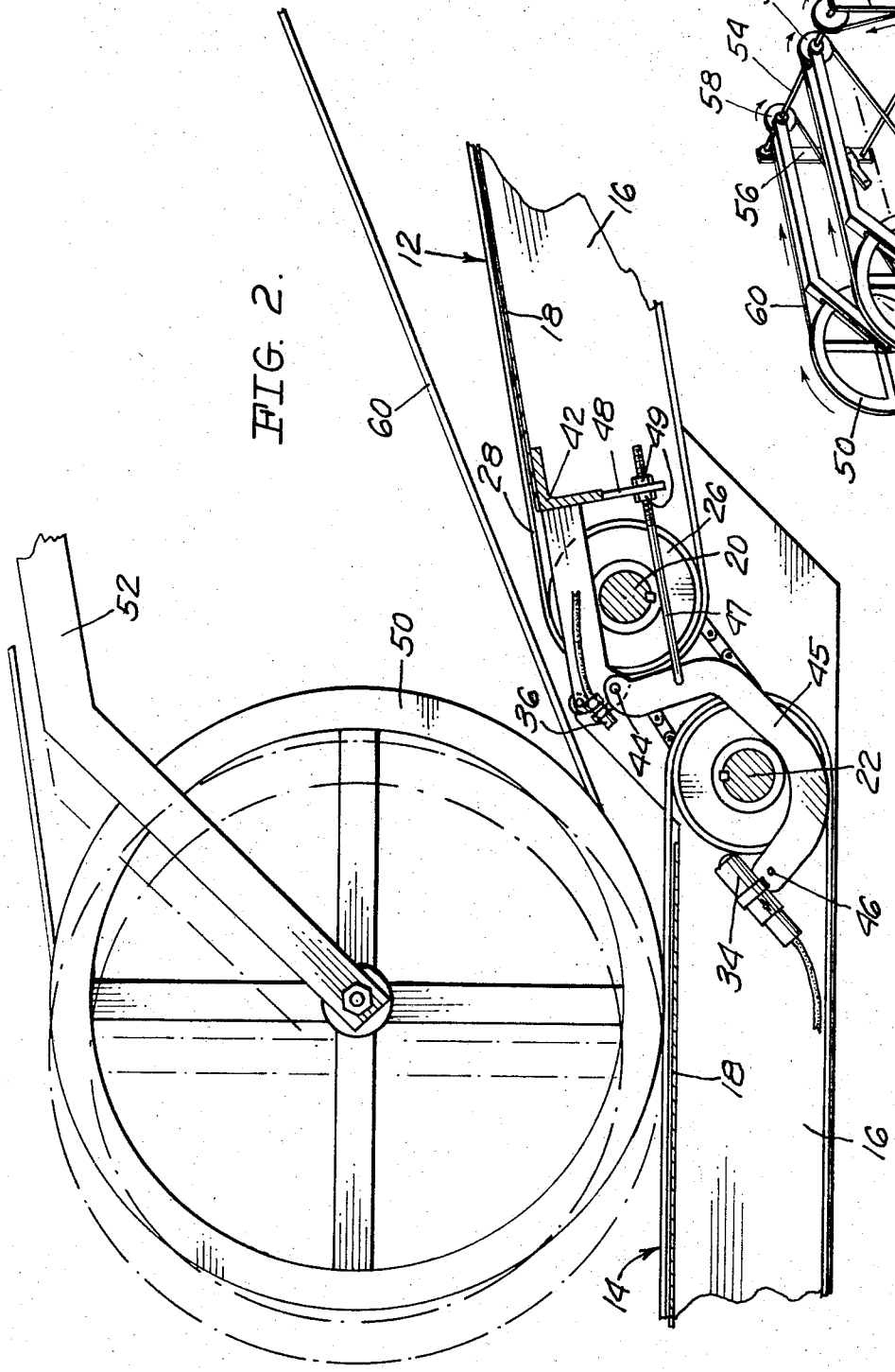

12
16
18
60
28
42
48
49
26
20
47
52
50
36
44
45
22
46
34
18
16
14

FIG. 2.

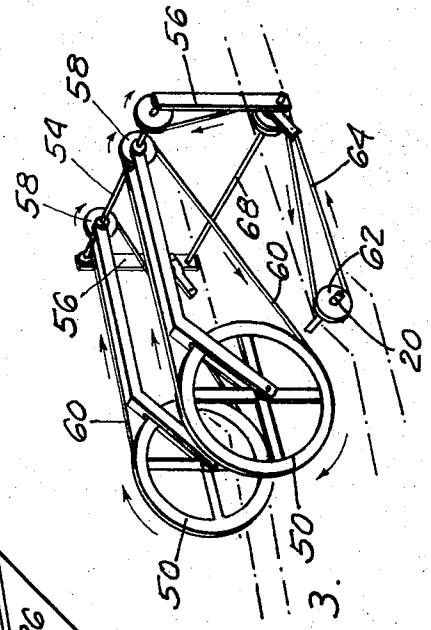

56
58
54
58
64
68
60
62
56
20
60
50
50

FIG. 3.

FIG. 4.

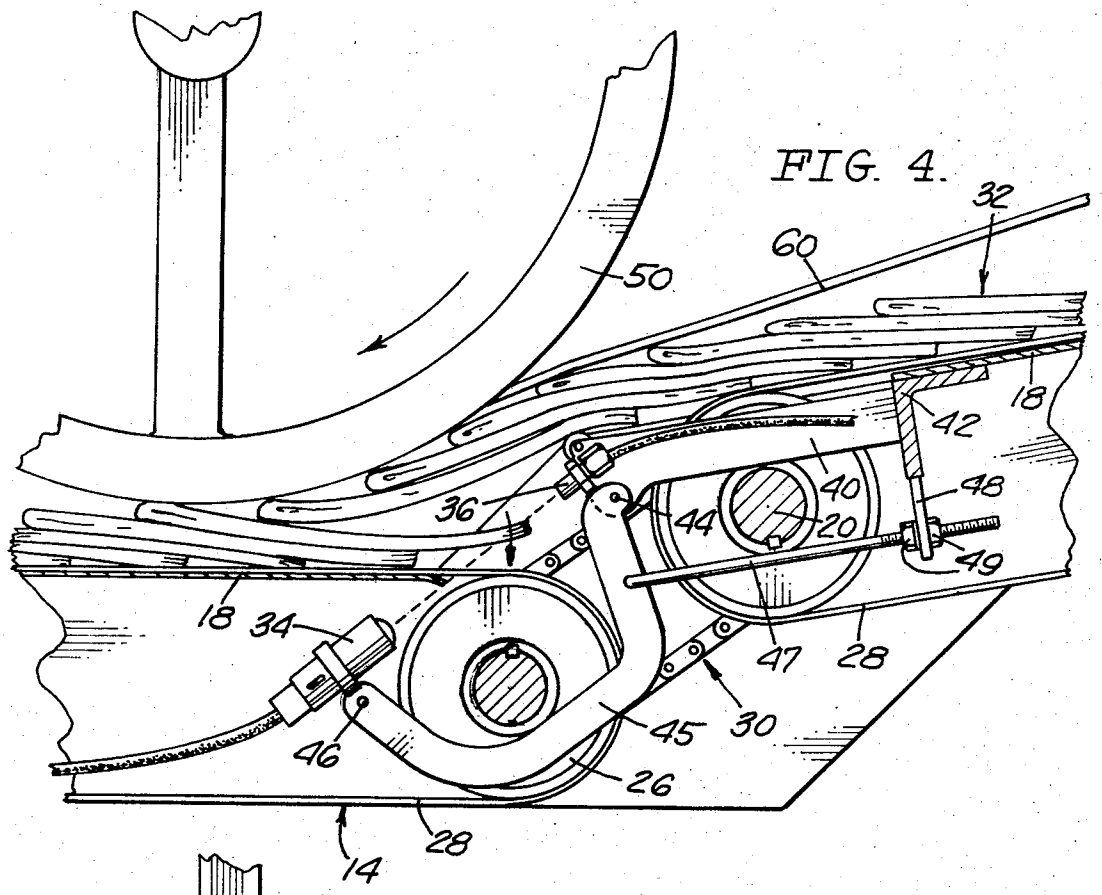
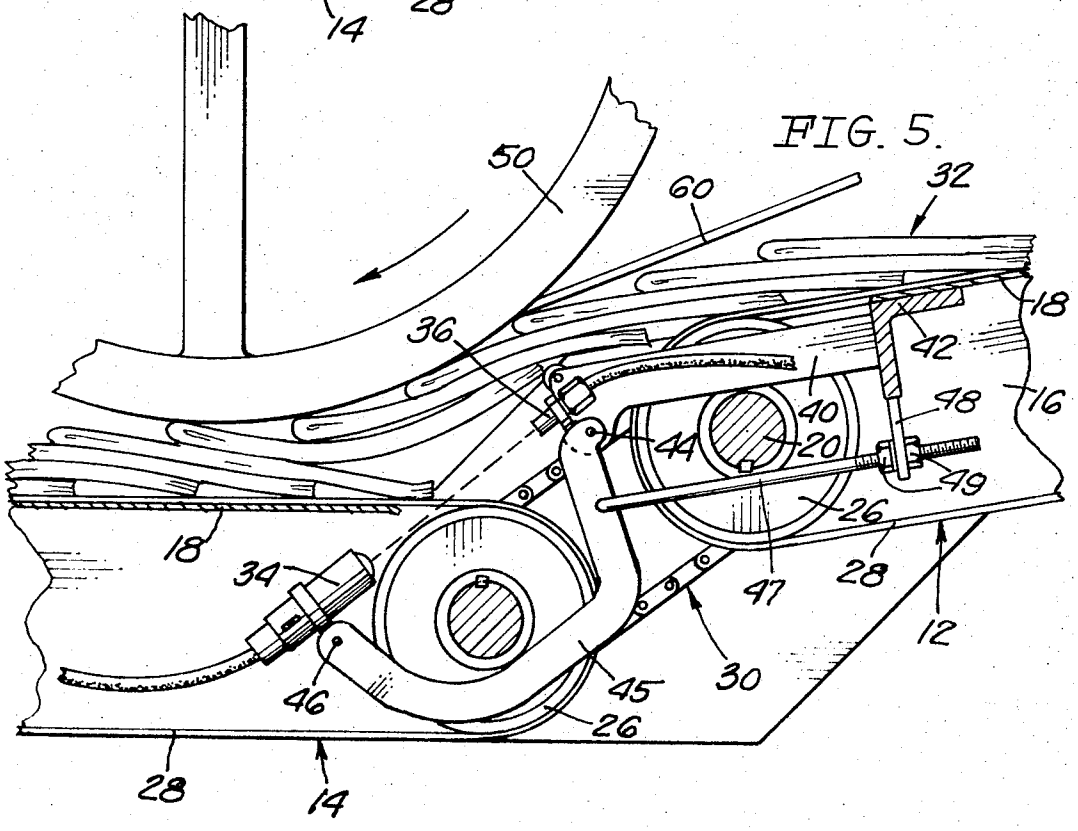

50
60
32
18
42
40
48
36
44
20
49
18
34
47
28
45
30
46
26
28
14

FIG. 5.


50
60
32
18
36
42
40
48
16
44
20
49
26
18
34
47
28
12
45
30
46
26
28
14

PHOTOELECTRIC COUNTER FOR PAPER CONVEYOR

BACKGROUND OF THE INVENTION

The present invention pertains generally to photoelectric counters for papers carried on belt conveyors, and is an improvement on the photoelectric counter embodied in the counting and stacking machine shown and described in our U.S. Pat. No. 3,543,651. In the said patent, a stream of overlapping, shingled papers is transported along a belt conveyor to a stacking station, where the papers are stopped by a limit stop, causing the papers to build up into stacks of a predetermined count. Means is provided ahead of the stacking station for intercepting the papers periodically so as to open up a gap in the line at intervals such that the number of papers going into each stack is included between gaps. Other means is provided for retracting the limit stop just as the last paper is inserted into each stack, thereby releasing the stack and allowing it to move on. As the stack clears the retracted limit stop, the latter rises up through the gap that follows the last paper, and a new stack is started. The mechanism for actuating the interceptor which opens up the gaps in the line of papers is actuated by a photoelectric counter that counts the papers as they pass a certain point on the conveyor. It is with this photoelectric counter that the present invention is primarily concerned.

In the machine of the patent, the lamp and photoelectric cell are mounted on opposite sides of the conveyor at a point where the papers transfer from one conveyor section to the other that is slightly lower, and in making the transfer, the trailing edges of the papers flip downwardly to interrupt the beam of light from the lamp, which passes horizontally across the width of the conveyor. While this arrangement works well at times, there are other times when the counter becomes erratic and inaccurate. This is due to the fact that when thicker papers are being counted, the trailing edges sometimes do not flip down as one single entity, but may fan out, or all of the papers on the bottom side of the fold may drop first, and the remainder of the pages drop an instant later, causing the photoelectric cell to count two or more papers, where in fact there was only one.

Another problem encountered with the photoelectric counter of the aforesaid patent is that its accuracy depends upon a uniform shingle of the papers on the conveyor. If the shingle becomes non-uniform, the counter will register an inaccurate count.

SUMMARY OF THE INVENTION

The primary object of the invention is to provide a photoelectric counter that is extremely accurate at all speeds and with all thicknesses of paper, and that does not depend upon a uniform shingle for its accuracy. The only requirement is that the papers be spaced apart a certain minimum distance, which may be as little as ¾ inch for thin papers, up to about 2½ inches for relatively thick papers. This one requirement is no problem, since all high speed presses deliver papers with shingles within the specified range. One advantage of the invention is that it is accurate and produces good results over a wide range of shingle spacing. Another advantage is that it will count with equal accuracy whether the papers have the fold at the leading edge or trailing edge, whereas prior counters all require that the fold be on the leading edge.

The foregoing objects and advantages are achieved in the present invention by providing a first conveyor section having its delivery end elevated slightly above the receiving end of a second conveyor section, and mounting the photoelectric cell and lamp on the conveyor beneath the papers, with the light beam from the lamp directed in the same general direction as the flow of papers, at the point where the papers transfer from the first section to the second. The light beam is interrupted by the downwardly flipping trailing edges of the papers, said trailing edges being caused to flip downwardly smartly, with a positive, vigorous action, by pressing downwardly on the top surface of the papers with a wheel, which bends the papers into an arcuate curve of relatively short radius. This downward bending of the papers causes the trailing edge of each paper, when released, to slap downwardly against the second conveyor section with a smart flip, producing a sudden, positive, and sharply defined interruption in the light beam.

Other objects and advantages of the invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiment thereof, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a fragmentary top plan view of a conveyor system embodying the photoelectric cell counter of the invention;

FIG. **2** is an enlarged sectional view, taken at **2—2** in FIG. **1**;

FIG. **3** is a schematic perspective view of the driving arrangement for driving the two large wheels that ride on top of the papers;

FIG. **4** is a further enlarged view of the mechanism in FIG. **2**, showing the stream of shingled papers carried on the conveyor, with the trailing edge of one paper flipping downwardly to interrupt the beam of light from the lamp to the photoelectric cell; and

FIG. **5** is a view similar to FIG. **4**, showing how the paper whose trailing edge is interrupting the light beam in FIG. **4** has now moved on to uncover the light beam.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the photoelectric counter of this invention is designated in its entirety by the reference numeral **10**, and is integrally associated with a conveyor system comprising a first conveyor section **12** and a second conveyor section **14**, which are connected together, end-to-end. The conveyor sections **12, 14** may be a part of a counting and stacking machine, such as that shown and described in our U.S. Pat. No. 3,543,651, or they may be a part of any conveyor system transporting a continuous stream of overlapping, shingled papers delivered by a sheet or web-fed perfecting press, or other paper handling machine.

Each of the conveyor sections **12, 14** includes an elongated supporting framework made up of two laterally spaced, parallel side bars **16**, which are connected together across their top edges by a top plate **18**. Transverse shafts **20** and **22** are journaled at the ends of the conveyor frame in bearings **24**, and mounted on the

shafts are four laterally spaced pulley wheels **26,** around which conveyor belts **28** are trained. Shaft **22** of conveyor **14** is driven from conveyor shaft **20** by a sprocket and chain drive **30.**

Papers **32** move along the conveyor on belts **28** from right to left, as viewed in the drawings, and conveyor section **12** discharges the stream of papers onto section **14.** As shown in the side elevational views, first conveyor section **12** is inclined downwardly at an angle of about 10°, and its delivery end is elevated above the receiving end of the horizontal second conveyor section **14.** As a result of this difference in elevation, the papers drop down to the lower level as they transfer from the first section to the second. The leading edge of each paper overlies the paper ahead, and therefore the leading edges are supported and bridge over from the first conveyor section to the second section in a more-or-less smooth curve. However, the trailing edges of the papers are not so supported, and tend to flip downwardly as each trailing edge clears the end of the conveyor **12.** As the trailing edge of the paper flips downwardly, it momentarily interrupts the beam of light from a lamp **34** to a photoelectric cell **36,** causing the latter to put out a signal in the form of a pulse of electrical current, which actuates an electrical counter (not shown).

In order to provide a sharp-edged drop-off for the papers as they leave the end of conveyor section **12,** and to allow the maximum distance for the trailing edges of the papers to fall as they flip downwardly from section **12** to conveyor section **14,** a shelf-like extension is provided at the delivery end of section **12.** The said shelf-like extension comprises a plurality of laterally spaced, small-diameter rollers **38,** journaled on the ends of extension arms **40,** which are fixed to the left-hand side of a transverse angle iron **42** mounted on the underside of top plate **18.** Extension arms **40** are arranged on opposite sides of each of the pulleys **26,** and extend to the left beyond the outermost peripheral surface of the pulley, as shown in FIGS. **2, 4** and **5.** The top sides of the rollers **38** are substantially tangent to the plane of the top surface of conveyor section **12,** and the line of papers passes first over the top of pulley **26** and then over rollers **38** before dropping down onto the conveyor belts of section **14.** The rollers **38** thus serve to hold the trailing edges of the papers until the last instant, and then release these trailing edges abruptly. Otherwise, if the papers were to leave the first conveyor section over the relatively large diameter pulley **46,** the papers would tend to follow down along the curvature of the pulley, and the total drop distance would be reduced by that amount. The shelf-like support provided by the rollers **38** gives the papers an abrupt release, which results in a smart, sharply defined interruption of the light beam.

The photoelectric cell **36** is mounted on the side of one of the extension arms **40,** and its aperture is aimed downwardly and to the left, as shown in FIGS. **4** and **5.** The attachment for the photoelectric cell to the arm **40** permits angular adjustment in the vertical plane, so that the aperture of the cell can be aimed in any direction within a limited angular range.

Pivotally mounted at **44** on the end of the extension arm **40** supporting the photoelectric cell **36** is a U-shaped yoke **45,** which passes under the conveyor shaft **22** of section **14,** and its other end supports lamp **34.** The housing of lamp **34** is pivoted at **46** on the yoke **45,** and can be tilted so that it can be aimed accurately at the aperture of the photoelectric cell. Lamp **34** focuses through a bullseye lens, so that its light beam is narrow and sharply defined. Yoke **45** is swingable about pivot **44** to aim the lamp **34,** and adjustment of the position of the yoke is provided by means of a link **47** which has one end hooked through the yoke, while the other end passes through a tab **48** projecting downwardly from angle iron **42** and is threaded to receive two adjustment nuts **49** on opposite sides of the tab.

To make the trailing edges of the papers flip downwardly with a smart, positive, sharply-defined action, the papers are bent downwardly into an arcuate curve of relatively small radius at the point where they transfer from section **12** to section **14.** This is accomplished by means of two laterally spaced wheels **50,** mounted side-by-side above the conveyor belts of section **14,** and resting on top of the papers. Each of the wheels **50** is journaled at one end of a downwardly bent support arm **52,** the other end of which is pivotally supported on a transverse shaft **54** extending across the width of conveyor section **12** above the papers. Shaft **54** is rotatably supported at its ends by two vertical posts **56** extending upwardly from the side plates **16.** Posts **56** are swingable in the vertical plane, so that their upper ends, carrying shaft **54,** can be moved in one direction or the other, parallel to the line of travel of the conveyor belts. This permits shifting of the position of the wheels **50** to the optimum position with respect to the delivery end of conveyor section **12;** the optimum distance being the point at which the radial distance from the center of wheel **50** to the rollers **38** is the same as the radial distance from the wheel center to the top of conveyor section **14,** the said distance in both cases including the thickness of the papers **32.**

While the wheels **50** may be driven by frictional contact with the papers, the preferred arrangement is to drive the wheels so that their peripheral speed is the same as the linear speed of the papers on the conveyors. This is accomplished by means of a driving arrangement shown in FIG. **3,** wherein the wheels **50** are driven from a second set of smaller-diameter wheels **58,** on shaft **54,** by means of wire coil spring belts **60.** Wheels **58** are fixed to shaft **54** and turn therewith. Shaft **54** is driven from the conveyor **12** by means of a drive pulley **62** mounted on shaft **20,** and passing around pulley **62** is a round drive belt **64,** which passes under two free-wheeling idler pulleys **66** and **67,** journaled side-by-side on a transverse shaft **68,** which serves as the pivot axis for posts **56.** After passing under pulleys **66, 67,** the belt **64** is trained around driven pulley **70** fixed to shaft **54,** to drive the latter. Passing both runs of the belt **64** under the two pulleys **66, 67** causes driven pulley **70,** shaft **54,** and wheels **50,** to turn in the clockwise direction, whereas the pulley shaft **20** turns in the counterclockwise direction. The diameters of the pulleys **62, 70** and wheels **58** are such that the coil spring belt **60** is driven at the same speed as the linear speed of the papers **32** traveling on the conveyor belts. This, in turn, drives wheels **50** at the same speed, so that the papers **32** are driven from both top and bottom as they transfer from the first conveyor section **12** to the second section **14.**

The mode of operation of the invention is believed to be more-or-less self-evident from the foregoing description. As the papers reach the delivery end of section **12** the trailing edges thereof are supported by

small-diameter rollers **38** until the last instant, and then are abruptly released. Wheels **50** bend the papers down into an arc of relatively small radius, and this causes the trailing edges to flip downwardly with a smart, sharply defined action, interrupting the beam of light from lamp **34** to photoelectric cell **36.** Almost immediately after the trailing edge of the paper strikes the conveyor belts of lower section **14,** the paper is carried along so that its trailing edge uncovers the light beam, as shown in FIG. **5.**

While we have shown and described in considerable detail what we believe to be the preferred embodiment of our invention, it will be understood by those skilled in the art that the invention is not limited to such details, but might take various other forms within the scope of the following claims.

The term "papers" as used in the claims includes any other material of generally similar characteristics.

What we claim is:

1. In a belt conveyor system for transporting a stream of shingled papers, including a first conveyor section and a second conveyor section arranged end-to-end, said first conveyor section delivering said papers to said second conveyor section, and the discharge end of said first conveyor section being elevated above the receiving end of said second conveyor section, whereby the papers are caused to flip their trailing edges downwardly as they leave said first conveyor section, a photoelectric counter comprising:

a photoelectric cell mounted on the end of one of said conveyor sections below the stream of papers;

a light source mounted on the adjacent end of the other conveyor section below said papers, the beam of light from said light source extending generally parallel to the line of travel of the papers, and said light beam being positioned where it is interrupted by the downward flipping of the trailing edges of the papers; and

a wheel riding on the top surface of the papers and bearing downwardly thereon as the papers pass from said first conveyor section to said second conveyor section, for bending the papers downwardly into an arc of relatively short radius, whereby the trailing edges of the papers are caused to flip smartly downward in a brisk and positive movement to interrupt the light beam and actuate said photoelectric cell, said wheel being journaled on a vertically movable support, and the radius of said wheel being approximately the radius of said arc.

2. The apparatus of claim **1,** wherein said wheel support is movable along the line of travel of the papers on said conveyor, so that said wheel can be shifted to the optimum distance from the discharge end of said first conveyor section, as determined by the thickness of the papers on the conveyor, said optimum distance being the point where the radial distance from the axis of said wheel to the point on said first conveyor section where the trailing edge of the papers drops, is the same as the radial distance from the wheel axis to the top of said second conveyor section, the distance in each case including the thickness of the papers on the conveyor.

3. The apparatus of claim **1,** wherein said wheel is journaled at the end of an arm, the other end of said arm being pivoted for vertical swinging movement about an axis located above said papers, transverse to the line of travel thereof.

4. The apparatus of claim **1,** wherein said photoelectric cell is mounted on said first conveyor section, with its aperture aimed downwardly and in the direction of travel of the papers, and said light source comprises a lamp mounted on a yoke that is pivoted on said first conveyor section for vertical swinging movement, said lamp being positioned under said second conveyor section, with its beam of light aimed at said photoelectric cell.

5. The apparatus of claim **1,** wherein means is provided for driving said wheel so that its peripheral speed is substantially the same as the linear speed of the papers on the conveyor.

6. The apparatus of claim **3,** which further includes a coil spring drive belt passing around said wheel and around a second wheel rotatable about said pivot axis of said support arm, and means operatively connected to said conveyor for driving said second wheel at a speed such that the peripheral speed of said first wheel is always substantially the same as the linear speed of the belt conveyor.

7. The apparatus of claim **6,** wherein said conveyor belts are driven by pulleys at opposite ends of the conveyor sections, and said second wheel is driven by a second drive belt passing around a drive pulley on said conveyor pulley and a driven pulley connected to said second wheel.

* * * * *