United States Patent

Palmer

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[45] **Aug. 15, 1972**

[54] **ARTICLE COUNTING SENSOR APPARATUS**

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[52] **U.S. Cl.**.....**200/61.41,** 200/61.42, 200/153 T

[51] **Int. Cl.**.....**H01h 3/16**

[58] **Field of Search** .200/18, 33 B, 37 A, 38 R, 38 B, 200/38 BA, 38 C, 38 CA, 153 L, 153 LA, 153 LB, 153 T, 33 C, 61.13, 61.16, 61.42, 52

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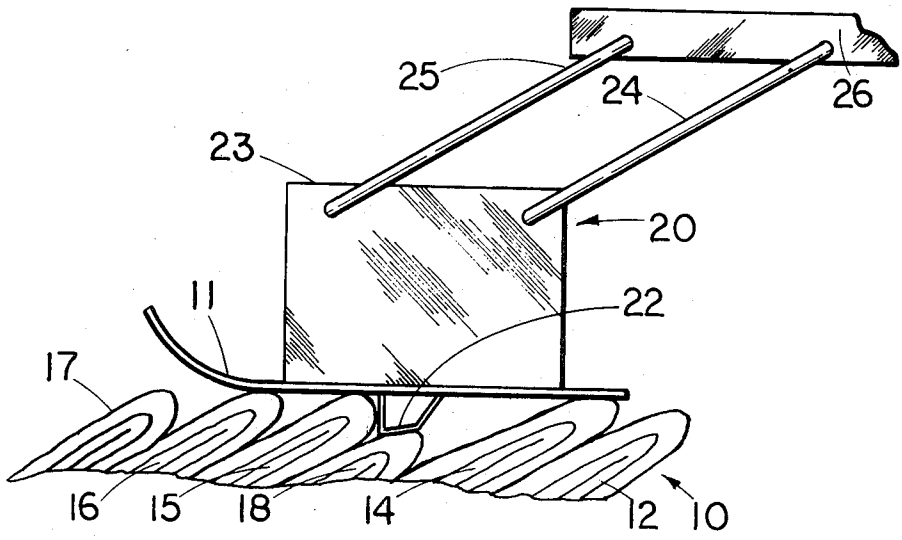
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[57] **ABSTRACT**

A sensor of articles and discontinuities in general but particularly suited for counting newspapers arranged in overlapping fashion and flowing past the counter in a stream. A trip is engaged by the leading edge of a paper, or other article, and is moved in the direction of stream movement to actuate a switch enabling the use of an external power source to effect a count. The count having been made, the trip lifts out of the paper stream, is reset to an initial position, and is returned to the stream. The switch action which accomplishes the count is used to initiate forcible removal of the trip from the stream followed, after a time delay, by forcible return to the stream.

8 Claims, 6 Drawing Figures

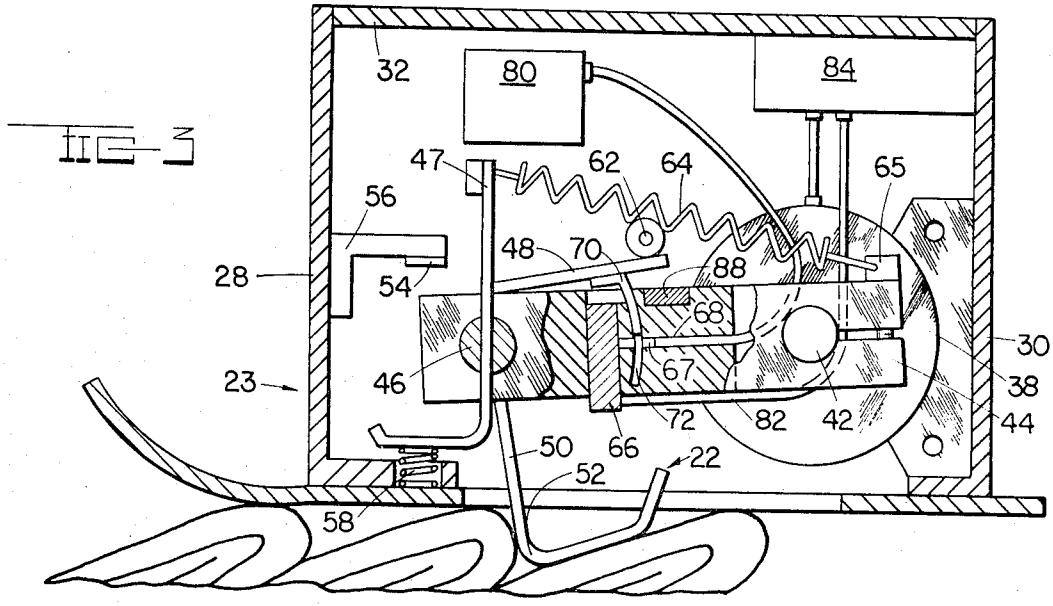


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SHEET 1 OF 2

FIG-3



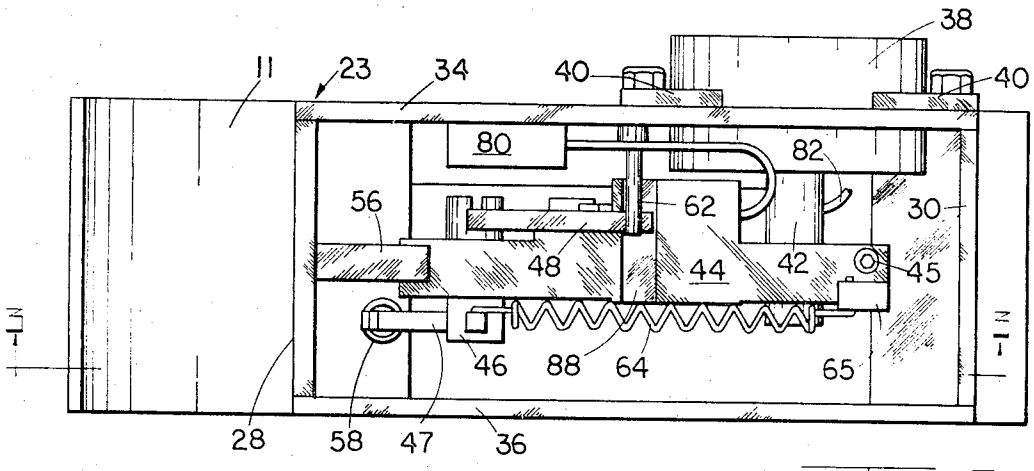
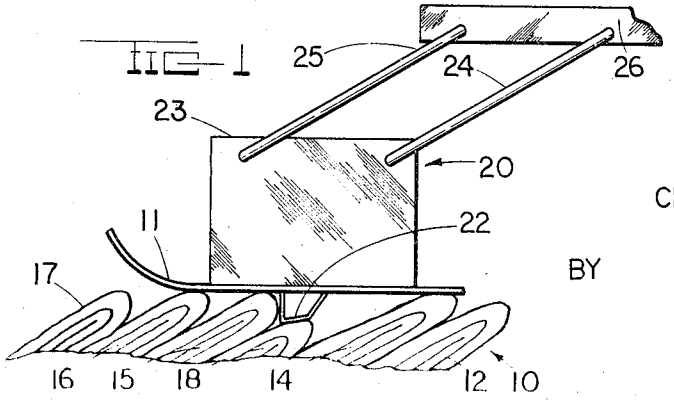


FIG-2

FIG-1



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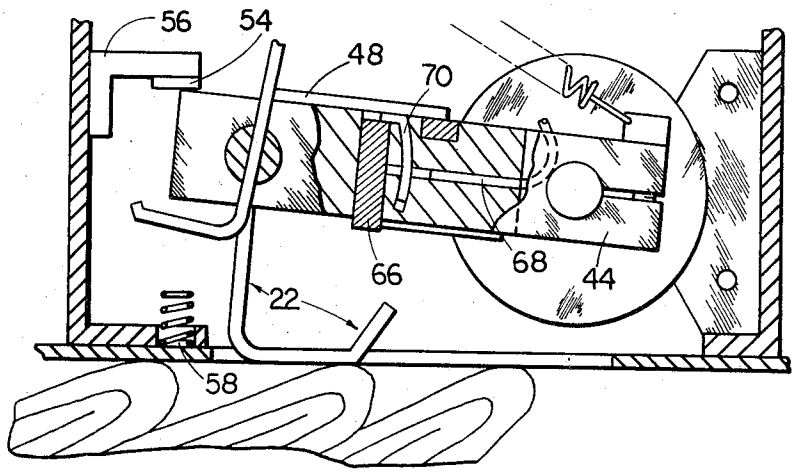


FIG 4

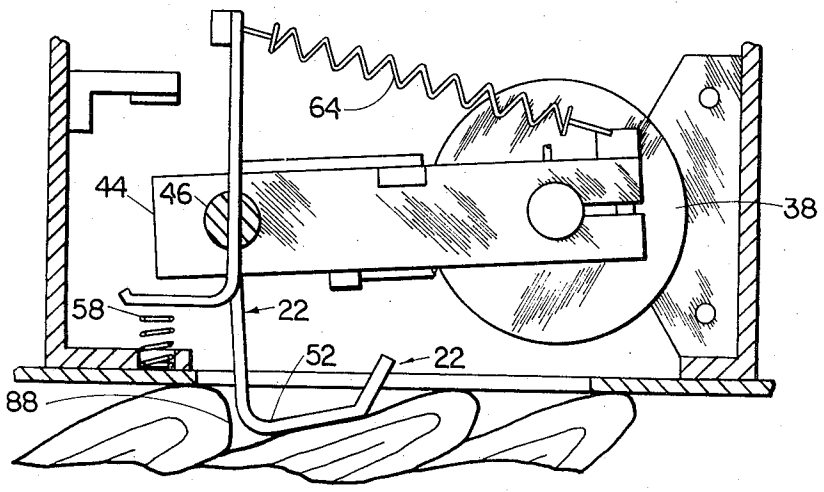


FIG 5

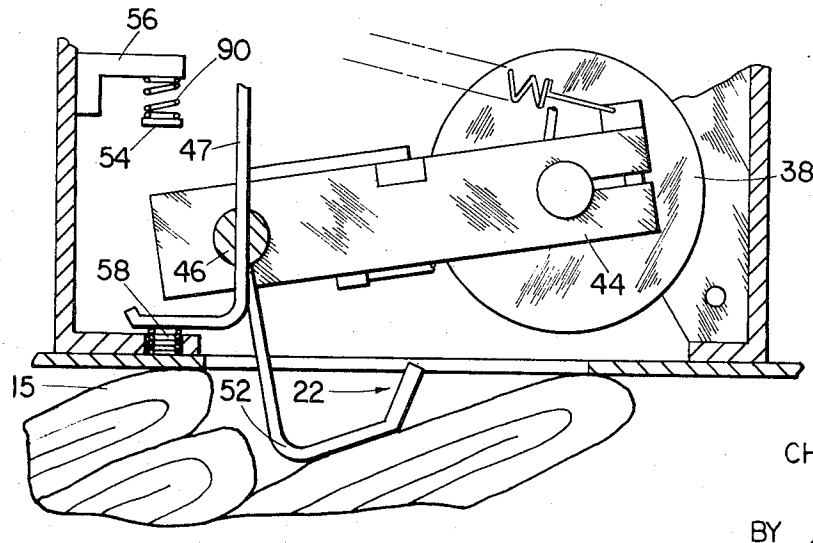


FIG 6

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ARTICLE COUNTING SENSOR APPARATUS

This invention relates to improvements in discontinuity sensors and it relates particularly to apparatus for counting articles, such for example as newspapers, as they flow along in a stream.

It is an object of the invention to provide an improved sensing structure capable of sensing or counting the discontinuities along a line. In a broad sense, the invention is useful for sensing and counting irregularities and discontinuities of various kinds. It is not limited to detecting or counting articles although the invention is particularly well suited to this application. Accordingly, it is another object of the invention to provide an apparatus for detecting or counting the relative movement of articles past a counter. A particularly difficult article counting application is the counting of newspapers as they are conveyed in a stream away from a printing press. An embodiment especially suited for this application has been selected for illustration in the accompanying drawing and for detailed description herein. One of the objects of the invention is to provide an improved newspaper counter although it is to be understood that neither the utility nor the objects of the invention are limited to this application.

The counting of newspapers is made difficult by the fact that the thickness of the paper may change from issue to issue and also because the counting speed is high and because the paper spacing is often non-uniform. An object is to provide a counter which will perform satisfactorily without need for adjustment or calibration over a wide range of paper thicknesses, of counting speeds, of paper spacing, and of paper spacing variations.

A further object is to provide a sensor which is rugged, accurate and reliable. In this connection it is an object to provide a sensor having a mechanical trip which is interposed in the path of article movement and is tripped by being forced to move in a direction along the path whereby to insure that an adequate quantity of energy is transferred from the article to the trip to provide a positive, unambiguous sensing signal. A further object is to provide a sensor whose mechanical trip is free to move out of the stream after it has provided its output signal. In the preferred form of the invention the signal is made the occasion for forcibly retracting the trip.

These and other objects and advantages of the invention which will hereinafter appear are realized in part by the provision of a trip movable in the direction of the discontinuity path as an incident to engagement with a discontinuity and by the provision of means for permitting the trip to move out of the stream as an incident to its displacement in the direction of the stream. Further, certain of the objects and advantages of the invention are realized by the provision in a discontinuity counter of a trip movable between a position in the path of discontinuity movement and a position out of that path together with trip moving means sensitive to engagement of said trip with a discontinuity for moving the trip to a position out of the path.

Also, certain of the objects and advantages of the invention result from inclusion of the elements more particularly defined in connection with the description of the structures shown in the accompanying drawing in which:

FIG. 1 is a view in side elevation of a newspaper counter embodying the invention and mounted upon a fragment of a newspaper conveyor structure which structure carries a stream of newspapers such that the counter rests on the folded edges of the newspapers of the stream;

FIG. 2 is a top plan view of the newspaper counter of FIG. 1 with its top cover removed;

FIG. 3 is a cross-sectional view of the newspaper counter taken on line 3—3 of FIG. 2, a portion of the arm structure being broken away to expose its interior elements;

FIGS. 4 and 5 are cross-sectional views of a fragment of the newspaper counter all taken on line 3—3 of FIG. 2 and each showing the movable elements of the counter in different operating conditions; and

FIG. 6 is a cross-sectional view of a newspaper counter showing the movable elements of a counter which is like that shown in the other figures except for the addition of a compression spring to the stop structure.

In many conveying systems the articles to be conveyed are arranged side by side and are moved along by a conveyor belt so that each article is easily available for engagement with a trip or other sensing element of a counting mechanism. Newspapers, on the other hand, are commonly conveyed in a stream with their folded edges leading and arranged in overlying, overlapped fashion so that the folded edge of each paper lies at a point in the stream ahead of the folded edge of the paper immediately above and behind it. Most often the papers are held in a stream by a number of narrow belts arranged in parallel and running over pulleys whose axes are mounted transversely to the flowpath. Two sets of belts are used. One set is mounted on each side of the stream and the stream is pressed between them so that the leading edge of the papers cannot be lifted in the wind and so that the stream can be moved vertically as well as horizontally as the papers are moved rapidly from the press. The means by which papers are placed in the stream at the point of its beginning is usually arranged so that the degree of overlap of successive papers is uniform. The amount of overlap is variable from press to press run as relative press speed and conveyor speed change usually because of changes in the number of pages printed. Although it is normal for the degree of overlap between successive newspapers to be uniform in any press run, there are a variety of reasons why the degree of overlap between successive papers may be substantially different from time to time and varied spacing occurs frequently.

One effect of difference in the amount of overlap is illustrated in FIG. 1. The conveyor belts have been omitted from this and the other figures of the drawing for the sake of clarity. It is enough to state that those belts confine the flow of papers to a stream **10** which moves toward the right in FIG. 1 along a path parallel to the lower plate **11** of the counter structure. Newspaper **12** has passed beyond the counter. Newspaper **14** overlies paper **12**. The distance between the leading edges of the two papers is called "overlap" despite the fact that it is the paper below, rather than the paper above, that leads. In this example it is assumed that the mechanism that introduces successive newspapers into the conveyor system produces the

degree of spacing or overlap shown to exist between papers 12 and 14 when the system is operating normally. In FIG. 1 the downstream papers 15, 16 and 17 are spaced to overlap in this same amount. However, one paper, numbered 18, is positioned so that its leading edge overlaps paper 14 by much more than the standard amount and so that it is overlapped by paper 15 by far less than the standard amount. The counter 20 includes a sensing finger 22 which projects down into the stream of papers so that it is engaged in turn by each of the papers of the stream and a count made of the number of such engagements. The stream 10 moves past the counter 20 at uniform velocity and it is apparent that the time interval between counting of papers 18 and 15 is substantially less than the time available for counting successive papers 12 and 14 or any other "normally overlapped" pair of papers. Moreover, the position that the finger 22 must occupy to count paper 18 is different from the position it may occupy in counting the other papers. The invention provides an apparatus capable of accurate counting despite such overlap variation.

The moving papers could be used to push a sensor out of the stream or to translate it downstream. In the invention, the sensor trip is arranged so that at least part of its movement is in the downstream direction. Maximum force is imparted to the trip when it is placed in the path of the paper so that it is forced downstream thereby providing the most positive counting action available. The cost of realizing this advantage is that the trip must be raised after each count to clear the stream. In addition, of course, it must be moved forward to overcome the rearward displacement imparted to it during the counting procedure. Means are included to accomplish such movements in the sensing mechanism.

The sensing mechanism is enclosed in a housing 23 to which the lower plate or ski 11 is attached. The housing is mounted on a pair of arms 24 and 25 by pivotal connection. The other ends of the two arms 24 and 25 are pivotally mounted upon a structural element 26 of the conveyor system whereby the housing 23 forms one side of a parallelogram. This mounting arrangement is not essential but is preferred. The housing 23 is free to move downwardly by its own weight until the plate 11 engages the upper edges of the papers of the stream. When the overall thickness of the stream is increased, as it is when the number of pages of the individual papers is increased, the stream simply pushes the housing 23 upwardly so that the plate 11 rides atop the stream at increased height.

The housing 23 and its internal mechanism are illustrated in FIGS. 2 and 3. The housing includes an upstream end wall 28, a downstream end wall 30, a cover 32, a rear wall 34 and a forward wall 36. The rear wall 34 is provided with a circular opening which accommodates the cylindrical case of a stepping motor 38. As best illustrated in FIG. 2, the motor is held in place by a pair of bracket assemblies 40 and 41 which hold the motor so that its output shaft 42 extends to the interior of the housing 23. An arm 44 is carried on that shaft. The rightmost end of the arm is slotted and bifurcated from the end to the cylindrical hole in which the shaft 42 is disposed. A cap screw 45 extends through the upper portion of the arm to a threaded connection in the lower portion thus enabling the two portions to be drawn together to clamp the arm 44 securely on the shaft 42 as illustrated.

The arm 44 extends generally leftward from the motor shaft 42. Near its left end it carries a pivot pin 46 which extends through the arm 44 on an axis parallel to the axis of shaft 42. The pivot pin 46 is free to rotate about its axis. The ends of the pivot pin are slotted. A finger is press fitted into each one of these slots. One finger is generally J-shaped. This finger, which is designated by the reference numeral 47, is press fitted into the slot in the end of the pivot pin 46 which is closest to the front wall 36 of the housing. The rear finger is press fitted into the slot at the other end of the pivot pin 46. As best shown in FIG. 3, that rear finger comprises an upper portion 48 which extends generally along the upper surface of the arm 44. In addition, the rear finger includes a lower portion 50 which extends downwardly from the upper portion 48 at approximately a right angle and terminates at its lower end in the hook 52. The rear finger is the trip 22 of FIG. 1 where only the hook portion 52 is visible.

Both fingers are rotated when either is rotated because they are both fixed to the pivot pin 46. The pin is rotatable on its axis relative to arm 44 and arm 44 is rotatable about the axis of motor shaft 42. In both cases rotational displacement is limited to an arc which is only a small fraction of a circle. Clockwise rotation of arm 44 is limited, as illustrated in FIG. 4, by a stop 54 carried on a bracket 56 fixed to the upstream end wall 28. Counterclockwise rotation of the arm is limited, as shown in FIG. 5, by engagement of the hook 52 with the surface of a newspaper in the stream below the sensor. In the absence of a newspaper to engage the hook, counterclockwise rotation of the arm is limited by compression spring 58 which is engaged by the lower portion 60 of the J-shaped finger 47. Clockwise rotation of the pivot pin 46 is limited by the upper face of arm 44 against which the upper portion 48 of the rear finger comes to rest. Counterclockwise rotation of pin 46 is limited by stop 62 when the arm 44 is in a clockwise position and by compression spring 58 when arm 44 is in a counterclockwise position. The pin 46 and its fingers 47 and 22 are urged to clockwise rotation by a means for returning the sensing finger or trip to initial position after a count. In this embodiment that means comprises a tension spring 64 stretched between a connection at the upper end of the J-shaped finger 47 and a bracket 65 carried at the upper rear of arm 44. This spring pulls on the upper end of the J-shaped finger attending to rotate the pivot pin 46 clockwise, in FIG. 3, until the upper portion 48 of the trip 22 lies flat against the upper surface of the arm 44.

An insertion means is included in the structure for rotating arm 44 to carry the trip 22 into the paper stream where it will be engaged and moved downstream by successive papers. The fact that the arm 44 is pivoted at the right of its center of gravity results in a tendency of the arm to rotate to carry the trip down and this structural arrangement constitutes that means at least in part. However, the preferred embodiment does not rely on gravity. The arm's mass is held to a low value to insure minimum inertial effect for faster response. The stepping motor is employed to force the sensing trip down into the stream.

The invention also includes a retraction means for lifting the trip out of the stream after it has been displaced downstream by the paper to be counted. This means may have several forms. In the preferred embodiment the trip is lifted by the stepping motor. In an alternative form of this means, the sensing finger is shaped so that its upstream surface serves as a cam follower which utilizes the article counted as a cam to lift the finger. The preferred embodiment combines this structural feature with lifting by the motor. The lower end of the trip is formed into hook **52** with a rounded forward portion so that it will serve as a cam follower in combination with the folded edge of the papers to be counted.

The invention includes a switch means or bistable element by which trip finger movement is counted. That means may have a variety of forms and the invention does not depend upon the specific form employed except that one form is found to be particularly advantageous and is incorporated in the preferred embodiment.

A light cell assembly **66** is mounted in a recess within the arm **44**. A longitudinal opening **67** through a portion of the arm serves as a passageway for light which emerges from an end of an optical fiber light pipe **68**. Light from the end of the pipe passes through the opening **67** and impinges upon the light cell of assembly **66** except when the vane **70** is moved downwardly in the slot **72** to interfere with that light flow. The vane **70** is fixed to the upper portion **48** of the trip **22** so that it moves up and down in the slot **72** as the trip **22** is pivoted by rotation of the pivot pin **46**.

When the hooked portion **52** of the trip **22** is engaged by a newspaper moving toward the right in FIG. 3, the trip will be rotated counterclockwise against the bias of spring **64** lifting the upper portion **48** of the trip and the vane **70** so that eventually the vane clears the opening **67** and permits the flow of light from the light pipe **68** to the light cell assembly **66**. The degree of this motion is limited by the stop **62** carried by the rear wall **34**.

A lamp contained in a lamp housing **80** is the source for light that travels through the light pipe **68**. When the light is permitted to impinge upon the light cell assembly **66**, an electrical output is produced which is conducted by conductor **82** to the electronic controller **84**. The electronic controller is not visible in FIG. **2** because it is carried by the cover which has been removed from FIG. **2**.

When the vane **70** is lowered so that it interferes with the passage of light to the light cell assembly, then the electronic controller **84** energizes the motor **38** in a direction such that the arm **44** is rotated counterclockwise. Counterclockwise rotation of the arm carries the pivot pin **46** downwardly whereby the trip **22** is carried downwardly so that the hook **52** is lowered into the stream of newspapers. The hook is engaged by the folded edge of the next newspaper to pass under the counter into contact with the hook. Continued energization of the stepping motor holds the trip in the stream. Motion of the newspaper forces the trip **22** and the pivot pin **46** to counterclockwise rotation lifting the upper portion **48** of the trip away from the upper surface of the arm. As the upper portion **48** is rotated counterclockwise it carries vane **70** with it until the vane is lifted above the opening **67** and light is permitted to pass from the light pipe **68** to the light cell **66**. This condition is sensed in the light cell assembly and a signal is conveyed by conductor **82** to the electronic controller **84**. That controller immediately reverses connection to the stepping motor **38** and reenergizes the motor in a direction to rotate the arm **44** clockwise. Clockwise rotation of the arm carries the pivot pin **46** upwardly. The trip **22** is carried with the arm out of the stream of papers. As soon as the trip has cleared the newspaper that pushed it counterclockwise, the trip is released to the action of the tension spring **64** which acts to rotate the pivot pin **46** in a clockwise direction whereby the hook portion of the trip is moved to its extreme forward position. This condition is illustrated in FIG. **4** where the arm **44** is shown to be rotated to its full clockwise position in which its upper surface engages the stop **62**. The upper portion **48** of the trip **22** is shown to lie flat against the upper surface of the arm. The vane **70** has returned to a position in which it blocks the passage of light from the light pipe **68** to the light cell assembly **66**.

Very shortly after arm **44** is lifted the stepping motor energization is reversed to move the arm counterclockwise and return the trip **22** to the paper stream. FIG. **5** illustrates the circumstance in which the trip is returned to a paper stream at a point where the papers have a normal degree of overlapping. In FIG. **5** the lower surface of the hook **52** comes to rest upon one of the newspapers of the stream.

The electronic controller **84** is arranged so that it will reverse the torque of the stepping motor **38** after a count has been made and the sensor is lifted from the stream. In this case the signal for reversing the motor torque and driving the sensor back into the stream is occasioned by breaking of the light beam by return of the vane **70** after having been lifted. A short time interval is permitted to elapse before the motor torque is reversed. A very rapid return is desirable. FIG. **6** illustrates, in one of several possible forms, a means for storing the energy imparted to the arm as it is lifted from the stream. That energy may be stored in a spring such, for example, as compression spring **90** which is disposed between stop **54** and bracket **56**.

Advantageously, means are incorporated for opposing any tendency of the trip to be rotated by frictional forces arising out of the contact between the lower surface of the trip and the upper face of the newspaper upon which it rides. That means may comprise a tension spring **64** which applies a force tending to oppose those frictional forces whereby the spring serves this purpose as well as the primary purpose of returning the trip to initial position after having effected a count. In the preferred embodiment, this means has an additional form. A detent is employed to insure that a relatively strong force, such as the force of a newspaper bearing upon the trip structure, is required to make the trip rotate. A magnetic detent is incorporated in the embodiment selected for illustration in the drawings. The upper portion **48** of the trip finger is made of a magnetizable material. The arm **44** is not magnetizable except that it has a magnet **88** embedded in its upper surface in position to act upon the magnetizable trip portion **48**. When the trip finger is rotated clockwise in full degree, the portion **48** seals against the upper sur-

face of the magnet **88** so that a substantial force acting against the hook **52** is required to break the seal. Once broken, the magnetic attractive effect is greatly diminished.

The compression spring **58** has been described as a means for limiting counterclockwise rotation of the arm **44** when the hook portion of the trip finger does not come to bear on a surface that limits its downward travel. When the arm comes to rest in the position it is shown to occupy in FIG. **5**, it need be rotated only a small distance to lift it out of the stream. Only a short time is required for the stepping motor to accomplish the lifting action. However, the time interval available for returning the sensing finger to be tripped by newspaper **15** after having been tripped by newspaper **18** (see FIG. **6**) is much shorter than the standard period. Because of this problem, the invention advantageously incorporates a means for augmenting action of the means that lifts the counting mechanism after a count, which means is operable when the finger is inserted deeply into the stream. In the embodiment illustrated, the spring **58** serves as that means. Comparison of FIGS. **5** and **6** will show that the spring **58** is compressed when the arm **44** is rotated counterclockwise in extraordinary degree. That rotation forces the lower portion of the J-shaped finger **47** down to compress the spring **58** and store in it energy that is available to push the arm up when the stepping motor energization is interrupted. The location of the compression spring relative to the pivot pin **46** is selected so that spring **58** helps to rotate the pivot and fingers in a clockwise direction when the motor releases downward pressure on the arm whereby to shorten the time that the trip **22** is returned to initial position.

Each time vane **70** is lifted to clear the light path from light pipe **68** to the sensing unit **66**, an electrical signal is conducted by conductor **82** to the controller **84**. That controller comprises means for counting the incidents of trip movement; it includes means for reversing stepping motor direction, and it includes means which is operable at a selected time after initial motor reversal to again reverse the motor in a direction to carry the sensor back down into the stream. In the preferred embodiment, the electric controller is made responsive to passage of light from the source to the light cell. It will be apparent to those skilled in the art that a signal could be derived, and the control and counting functions accomplished, on the occasion of light interruption rather than opening of the light path. Also, a number of the elements within the structure are moved as an incident to engagement of the trip by an article to be counted and it will be apparent that the motion of any of these elements may be employed to provide the signal by which operation of the unit is controlled and the articles counted.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art.

I claim:

1. In a counter for use in counting articles moving relative to the counter along a path, comprising in combination:

a trip movable between a position in the path of article movement and a position out of the path of article movement;

trip retraction means, other than the article being sensed, sensitive to engagement of said trip with an article for forcibly moving the trip to a position out of said path; and

means for returning said trip to a position in said path after having been retracted therefrom comprising a resilient stop; and

in which the trip is mounted upon a pivoted arm, and in which said retraction means comprises an electromagnetic device for rotating the arm on its pivot against said resilient stop.

2. In a counter for use in counting articles moving relative to the counter along a path, comprising in combination:

a trip movable between a position in the path of article movement and a position out of the path of article movement;

trip retraction means, other than the article being sensed, sensitive to engagement of said trip with an article for forcibly moving the trip to a position out of said path; and

said trip being mounted upon an arm;

which further comprises the electromagnetically operated means for returning the trip to said path of article movement after having been retracted therefrom; and

said trip retraction means comprising a spring in which energy is stored when said trip is forced into said path of article movement.

3. In a counter for use in counting articles moving relative to the counter along a path, comprising in combination:

a trip movable between a position in the path of article movement and a position out of the path of article movement;

trip retraction means, other than the article being sensed, sensitive to engagement of said trip with an article for forcibly moving the trip to a position out of said path; and

a switch actuated by movement of said trip along said path said retraction means comprising means for moving the trip out of said path of article movement in response to actuation of said switch.

4. The invention defined in claim **3** in which said switch includes a light source and a light sensitive receiver and a shutter between them, said shutter being operated by movement of said trip.

5. In a counter for use in counting articles moving relative to the counter along a path, comprising in combination:

a trip movable between a position in the path of article movement and a position out of the path of article movement;

trip retraction means, other than the article being sensed, sensitive to engagement of said trip with an article for forcibly moving the trip to a position out of said path; and

said retraction means comprising a retraction member and means for moving the retraction member from a first position to a retracted position in response to an actuating signal;

said trip being carried on said retraction member and movable relative thereto to spaced positions in the direction of said path of article movement; and further comprising a switch carried by the retraction member and operated by said trip to provide said actuating signal.

6. The invention defined in claim 5 which further comprises means responsive to displacement of said trip along said path in greater than selected degree for moving said retraction member toward retracted position independently of switch operation.

7. The invention defined in claim 6 which further comprises leveling means for moving the retraction member as an incident to displacement of the path of article movement whereby the penetration of said trip within the path of article movement remains relatively uniform.

8. The invention defined in claim 7 in which said leveling means comprises a pivoted arm mounting the retraction member at a point spaced from the pivot of the arm; in which said trip is pivoted on the retraction member at a trip pivot and said retraction member is carried on a pivot spaced from the trip pivot; in which the retraction member is moved to carry said trip into and out of said path of article movement by operation of a stepping motor; and in which said stepping motor is stepped by operation of said switch to retract the retraction member and, after a time delay, to return said retraction member to said first position.

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