United States Patent

[11] 3,603,441

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[54] **APPARATUS FOR SENSING THE ORIENTATION OF FLAT ARTICLE HAVING A RAISED PORTION ONE SIDE THEREOF**
4 Claims, 4 Drawing Figs.

[52] U.S. Cl. ..... 193/43 A, 198/33 AC, 302/2
[51] Int. Cl. B65g 47/24
[50] Field of Search ..... 193/43 R, 43 A; 198/33 AC, 43; 221/298; 19/37; 219/7.5; 302/2

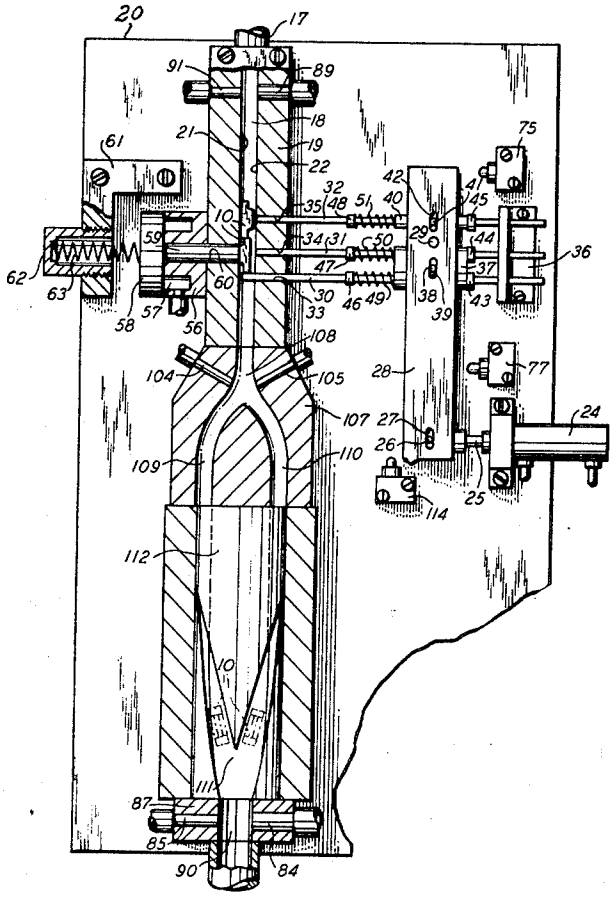
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ABSTRACT: An apparatus senses the orientation of a flat article having a raised portion on one side thereof by forcing the article against a wall where a valve stem is depressed if the raised portion faces the wall. A valve enclosing a chamber is opened by the depression of the valve stem to release fluid pressure from within the chamber. Pressure-sensing facilities operated by the fluid pressure in the chamber control an orientating mechanism to insure that all articles are placed into a predetermined orientation.



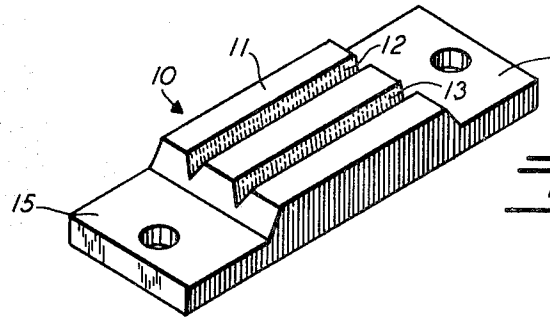


FIG-1

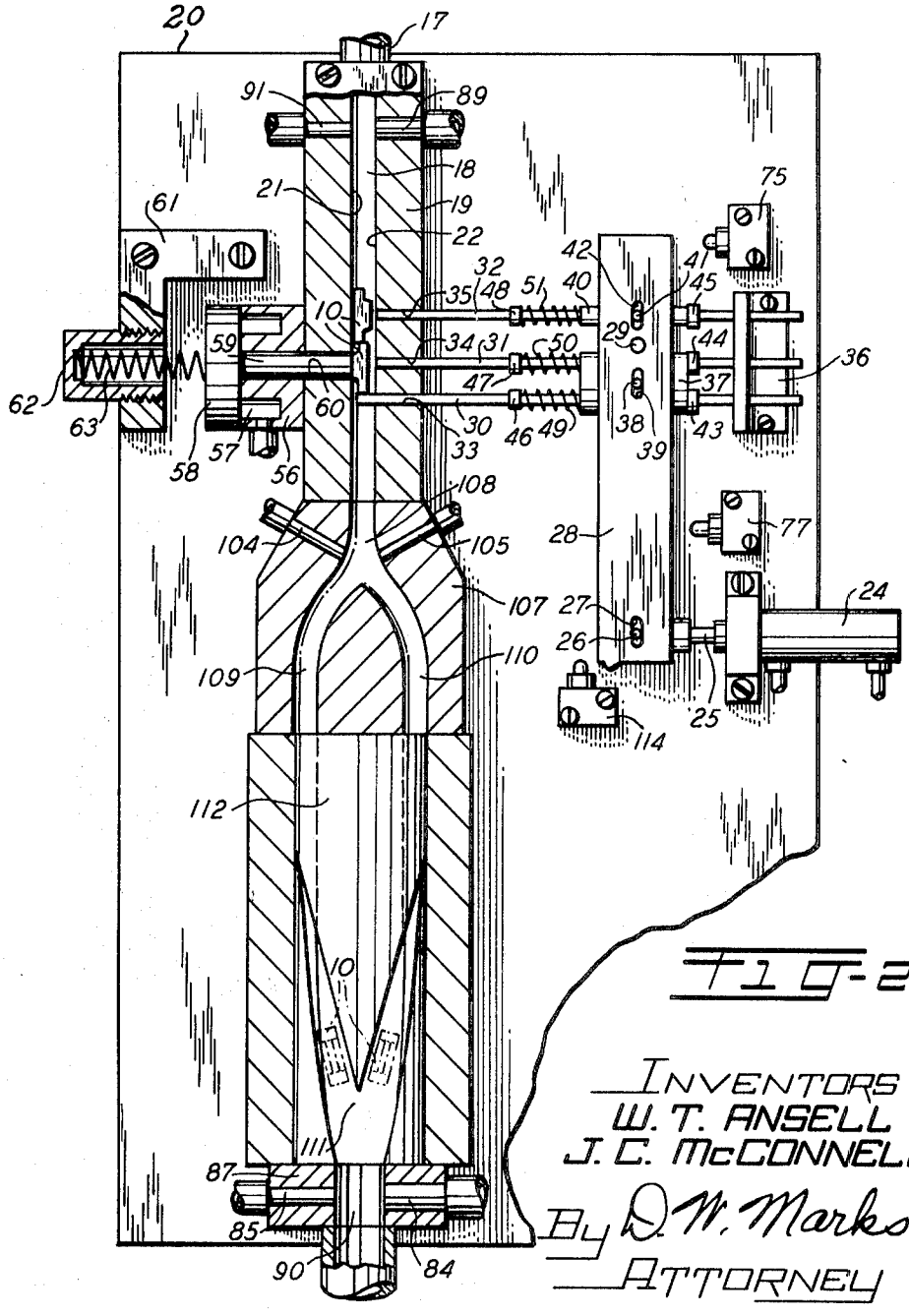


FIG-2

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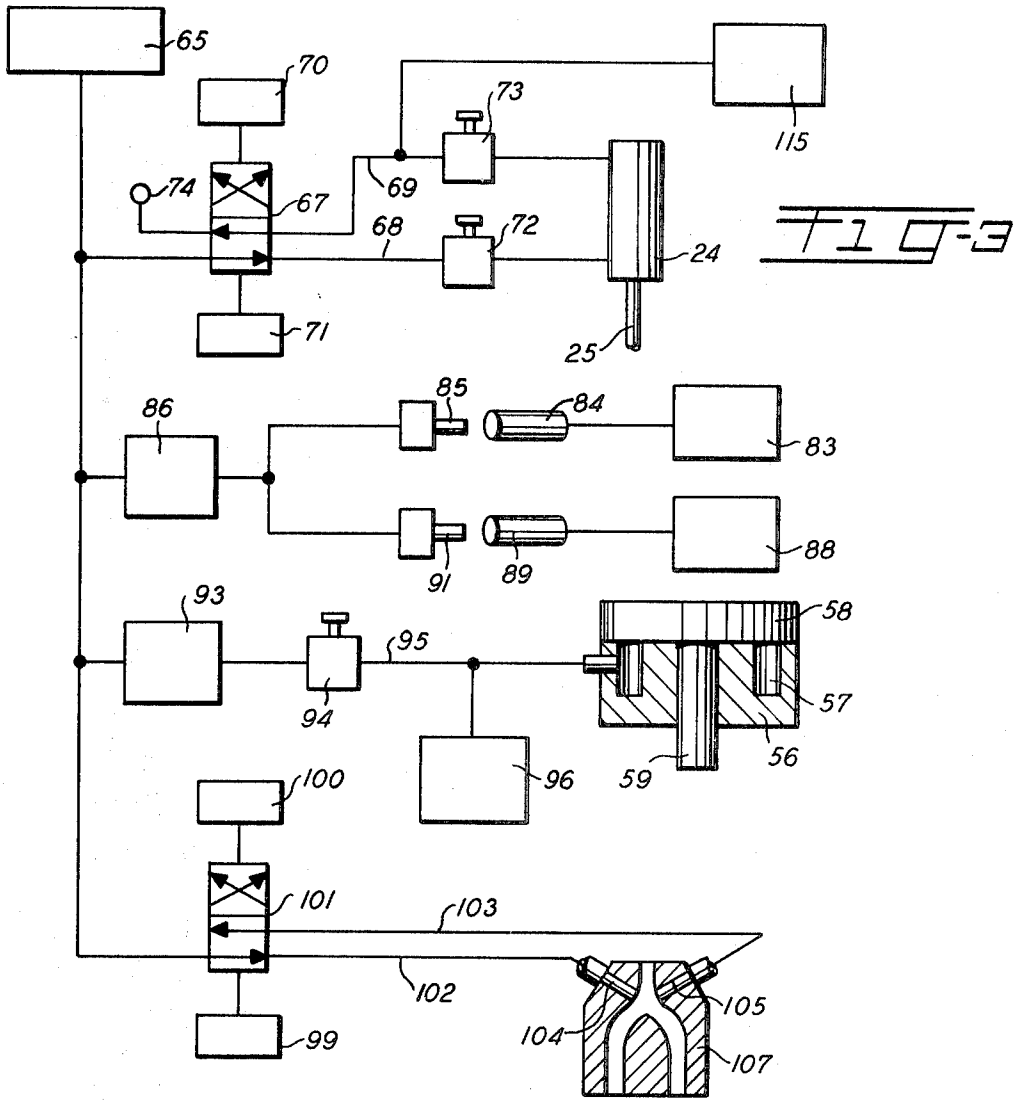

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FIG-3

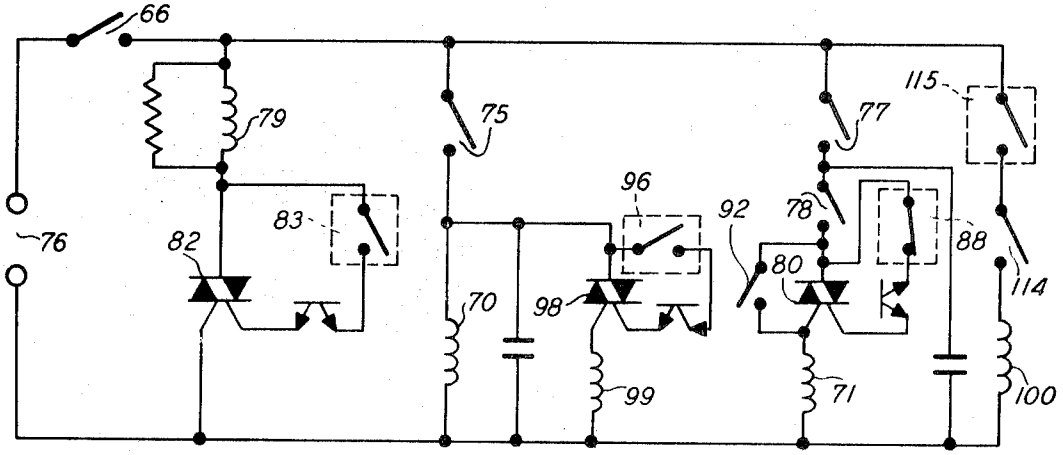

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FIG-4

APPARATUS FOR SENSING THE ORIENTATION OF FLAT ARTICLE HAVING A RAISED PORTION ONE SIDE THEREOF

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to apparatus for sensing the orientation of articles and particularly to apparatus for sensing the orientation of generally flat articles having raised portions thereon. One example of such a flat article with a raised portion is a ceramic resistor substrate wherein the side with the raised portion is coated with resistive material and then the raised portion abraded to produce a resistor of the desired resistance. It is necessary that the substrate be properly orientated so that various automatic processing machines may properly handle the substrates.

2. Prior Art

There are many apparatus in the prior art for sensing the orientation of articles. Generally, they are characterized by being subject to failure or being unable to sense slight raised portions on small generally flat articles.

One prior orientation-sensing apparatus utilized a wall with a rod end flush with the wall and against which one side of a flat article was forced such that the rod was depressed when a raised portion on the article was on the side facing the wall. A mechanical linkage mechanism was moved by depression of the rod end to operate a switch to sense the orientation of the article. The mechanical linkage mechanism was subject to wear and failure when operated a large number of times. Also dust, especially ceramic dust, from the articles would interfere with operation of this prior art orientation-sensing apparatus.

SUMMARY OF THE INVENTION

An object of the present invention is a new and improved apparatus for sensing the orientation of an article and, in particular, for sensing the orientation of a generally flat article having a raised portion on one side thereof.

Another object of the present invention is a new and improved orientation-sensing apparatus which is not subject to failure caused by dust associated with the articles.

Still a further object of the invention is a new and improved apparatus for sensing the orientation of generally flat ceramic substrates having raised portions on one side thereof.

In accordance with these and other objects, an embodiment of the invention utilizes a wall with an end of a valve stem substantially flush with the wall against which the substrate is forced to depress the valve stem when the raised portion of the substrate faces the wall. A valve member on the valve stem, normally biased to close a chamber, is opened by depressing the valve stem to release fluid pressure in the chamber. Pressure-sensing facilities connected to the chamber indicate the orientation of the article.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of a generally flat article having a raised portion on one side thereof;

FIG. 2 is a front view, partially in cross section, of the mechanical details of an apparatus suitable for sensing the orientation of the article shown in FIG. 1;

FIG. 3 is a diagram of the pneumatic details for operating the apparatus shown in FIG. 2; and

FIG. 4 is a diagram of the electrical details to control the operation of the apparatus shown in FIGS. 2 and 3.

DETAILED DESCRIPTION

Referring first to FIG. 1, there is shown a resistor substrate or article 10 having a generally flat configuration with a central raised portion 11 on the top surface thereof. The raised portion 11 has grooves 12 and 13 extending between end portions 14 and 15. The substrate is made by pressing finely ground ceramic material and a binder into the shape shown in FIG. 1 and then firing in a kiln. A resistive film, such as tantalum nitride, is sputtered on all the upper surfaces and terminations, such as chromium-palladium-gold terminations, are evaporated on top of the resistive film layer on the upper surfaces of the end portions 14 and 15. Finally, the upper surface of the raised portion is abraded leaving the desired value of resistive material in the grooves 12 and 13. The various manufacturing steps are performed by automatic machines and it is necessary that the substrate be properly oriented in all machines.

While the herein described apparatus for sensing the orientation of and for orienting flat articles with raised portions on one side thereof is particularly useful for orienting resistors similar to the resistor 10, the apparatus may be modified to orient other similar articles having generally flat surfaces with raised portions thereon.

Referring now to FIG. 2, a plurality of articles 10—10 are gravity fed from a conventional vibratory feeder (not shown) down a tube 17 into a passageway 18 in a guide member 19 which is mounted on a vertical plate 20. The internal cross section of the tube 17 is oblong and the cross section of the passageway 18 is rectangular such that the articles 10—10 are fed into the passageway 18 with the raised portion of each article 10 facing either the wall 21 or the wall 22 of the guide member 19.

An air cylinder 24 mounted on the plate 20 has a piston rod 25 with a pin 26 extending through a slot 27 of an arm 28 pivotally mounted on a pin 29 attached to the plate 20. Three rods 30, 31 and 32 are slidably mounted in holes 33, 34 and 35 in the guide member 19 and holes (not shown) in a guide bracket 36 mounted on the plate 20. The rods 30 and 31 extend through holes (not shown) in a driving block 37 which has a pin 38 extending through a slot 39 in the arm 28 so that the driving block 37 is moved horizontally by pivotal movement of the arm 28. Similarly, the rod 32 extends through a hole (not shown) in a driving block 40 which has a pin 41 extending through a slot 42 in the arm 28 such that the block 40 is moved horizontal to pivotal movement of the arm 28. Collars 43 and 44 mounted on the respective rods 30 and 31 to the right of the block 37 as shown in FIG. 2 cause the rods 30 and 31 to move to the right with the block 37. Similarly, a collar 45 on the rod 32 abuts the block 40 to move the rod 32 to the right with the block 40. Collars 46 and 47 on the rods 30 and 31 with respective springs 49 and 50 interposed between the collars 46 and 47 and the block 37 urges the rods 30 and 31 to the left with the leftward movement of the block 37. Similarly, a collar 48 with a spring 51 interposed between the collar 48 and the block 40 urge the rod 32 to the left with the leftward movement of the block 40. The collars 42 and 46 on the rod 30 are positioned such that the left end of the rod 30 extends into the passageway 18 to support the articles 10—10 during most of a cycle of operation when the arm is alternately pivoted clockwise to engage a switch 75 and then counterclockwise to engage a switch 77. The collars 45 and 48 are positioned on the rod 32 such that the left end of the rod 32 engages the holds and second from the lowermost article 10 when the arm 28 is near its most counterclockwise position. While the second from the lowermost article 10 is held by the rod 32, the rod 30 is withdrawn from the passageway 18 by continued counterclockwise movement of the arm 28 to release the lowermost article 10. Clockwise movement of the arm 28 urges the left end of the rod 30 back into the passageway 18 and moves the rod 32 to the right so that the article 10 held by the rod 32 falls against the rod 30. Continued clockwise movement of the arm 28 urges the left end of the rod 31 against the lowermost article 10 above the rod 30 to force the article 10 against the the wall 21.

A housing 56 mounted on the plate 20 has an annular-shaped chamber 57 which is closed at one end by a valve 58. The value 58 has a valve stem 59 slidably mounted in a bore 60 through the wall 21 of the guide member 19 at a sensing station. The valve stem 59 terminates a flat end which is

generally flush or very slightly recessed from the wall of the passageway **18**. The bore **60** has a cross section large enough to receive the raised portion **11** of an article **10** but small enough to prevent the whole article **10** from being pushed therein. The bore **60** is positioned relative to the hole **33** such that the raised portion **11** of the lowermost article **10** is horizontally aligned with the bore **60**. A bracket **61** mounted on the plate **20** has a cap **62** threaded therein with a spring **63** interposed between the inner surface of the cap **62** and the valve **58** to bias the valve **58** in a closed position. The cap **62** may be screwed in or out to adjust the compression of the spring **63**. The spring **63** is set to exert a lesser compression force than the spring **50** interposed between the collar **47** and the block **37** on the rod **31**. When the arm **28** is rotated clockwise and the rod **31** forces the article **10** against the wall **21**, the raised portion **11** of the article **10** depresses the valve stem **59** opening the valve **58** if the raised portion faces the wall **21**. If the raised portion **11** faces the wall **22**, the valve **58** remains closed when the rod **31** forces the article **10** against the wall **21**.

Referring now to FIG. **3**, pressurized air from a source **65** passes through a four way valve **67** to one of the lines **68** or **69** connected to the air cylinder **24** driving the arm **28** in FIG. **2**. The valve **67** has a solenoid **71** which excited moves the valve to connect the line **69** to the source **65** and the line **68** to an exhaust opening **74**. A solenoid **70** of the valve **67**, upon excitation, switches the valve back to connect line **68** to the source **65** and line **69** to the exhaust **74**. A flow control valve **72** is interposed in the line **68** and a flow control valve **73** is interposed in the line **69** to control the rate of advance and retraction of the air cylinder **24**.

Referring to FIG. **4**, the solenoid **70** is shown connected in series with a normally opened contacts of the switch **75** and an on-off switch **66** across an AC voltage source **76**. As shown in FIG. **2**, the switch **75** is mounted on the plate **20** such that when the arm **28** reaches its extreme clockwise position the switch **75** is closed to excite the solenoid **70** and operate the valve **67** (FIG. **3**) to retract the piston rod **25** of the air cylinder **24** and move the arm **28** in a counterclockwise direction. Similarly, the solenoid **71** is in series with normally opened contacts of the switch **77** mounted on the plate **20** (FIG. **2**), contacts **78** of a relay **79**, and a TRIAC **80** across the voltage source **76**. The relay **79** is actuated to close the contacts **78** by current passing through a TRIAC **82** which is excited by the normally opened contacts of a pneumatic switch **83**. As shown in FIG. **3**, the pneumatic switch **83** is connected to an opening **84** in an exit member **87** (FIG. **2**) and into which a nozzle **85** in the member **87** directs air from a pressure regulator **86** connected to the source **65** to close the switch **83**. As shown in FIG. **2**, when articles **10—10** are backed up in a passageway **90** in the exit member **87**, the flow of air from the nozzle **85** is interrupted to open the switch **83** to discontinue the cycling of the apparatus. When the articles **10—10** no longer block the flow of air from the nozzle **85** to the opening **84**, the switch **83** is closed to allow the apparatus to continue operation. The TRIAC **80** is actuated by voltage through normally closed contacts of a pneumatic switch **88**. As shown in FIG. **3**, the pneumatic switch **88** is operated by air from a nozzle **91** into an opening **89**, as shown in FIG. **2**. The nozzle **91** is in the wall **21** and the opening **89** is in the wall **22** such that a sufficient number of articles **10—10** fed from the tube **17** into the passageway **18** interrupt the flow of air from the nozzle **91** to keep the switch **88** closed and to allow the apparatus to continue operation. If there are insufficient articles **10—10** stacked in the passageway **18** to interrupt the airflow from the nozzle **91** into the opening **89**, the switch **88** is opened to deactuate the TRIAC **80** to prevent excitation of the solenoid **71**. The TRIAC **80** may be bypassed by an operator closing a manual switch **92** allowing the remaining articles in the passageway **18** to be sensed and properly oriented.

Referring back to FIG. **3**, air from the source **65** is applied through a pressure regulator **93**, a needle valve **94** and a line **95** to the chamber **57** of the housing **56**. A pneumatic switch **96** connected to the line **95** senses the pressure within the chamber **57**. Referring to FIG. **4**, normally open contacts of the pneumatic switch **96** are connected to the control electrode of a TRIAC **98** to energize a solenoid **99** when the microswitch **75** is closed. As shown in FIG. **3**, the solenoid **99** together with a solenoid **100** operates a four-way valve **101** to selectively connect air from the source **65** to lines **102** and **103** which are connected to respective nozzles **104** and **105** in an orienting block **107** mounted on the plate **20** (FIG. **2**) at the lower end of the guide member **19**.

Referring to FIG. **2**, the orienting block **107** has an upper passageway **108** which branches into two passageways **109** and **110**. Air from the nozzle **104** blows a falling article **10** from the passageway **18** into the passageway **110** while air blowing from the nozzle **105** directs the falling article **10** into the passageway **109**. The passageways **109** and **110** are continued in the surface of a cylindrical insert **112** in the block **107** where the passageways **109** and **110** are rotated 90° in opposite directions and joined in the passageway **111**. The passageway **109** rotates an article 90° in a counterclockwise direction, as viewed from above, while the passageway **110** rotates an article **10** 90° in a clockwise direction. By selective application of air to the nozzle **104** and **105**, all articles **10** in the passageway **111** are oriented with the raised portion **11** facing the same direction.

Referring now back to FIG. **4**, the solenoid **100** is connected in series with normally open contacts of a switch **114** mounted on the plate **20** (FIG. **2**) and normally open contacts of a pneumatic switch **115** connected to the line **69** (FIG. **3**). As shown in FIG. **2**, the switch **114** is positioned such that it is operated by the arm **28** when the arm **28** is approximately 10° from engagement with the switch **75**. The switch **114** is positioned such that an article **10** sensed in a previous cycle has had sufficient time to fall through the passageway **108** and the switch **114** opens prior to the arm **28** engaging the switch **75**. As shown in FIG. **3**, the pneumatic switch **115** is connected to line **69** and is operated when air is applied to line **69** to advance the piston rod **25** and move the arm **28** (FIG. **2**) clockwise. The solenoid **100** is energized every time the arm **28** approaches its most clockwise position.

Referring to FIG. **3**, the solenoid **100**, when energized, operates the valve **101** to connect the source **65** to the line **102**. The solenoid **99**, when energized upon closing of switch **75** (FIGS. **2** and **4**) and the valve **58** (FIG. **2**) being closed to close the switch **96** (FIG. **4**), operates the valve **101** to connect the source **65** to the line **103**. Thus, as shown in FIG. **2**, all the articles **10—10** passing through the passageway **111** are oriented with the raised portions **11—11** facing into the drawing.

OPERATION

Referring first to FIG. **2**, initially the arm **28** is in its most counterclockwise position wherein the arm **28** engages the switch **77**. First a vibrator feeder (not shown) is turned on to feed articles **10—10** through the tube **17** into the passageway **18** until a sufficient number of the articles **10—10** are stacked in the passageway **18** to interrupt the airflow from the nozzle **91** into the opening **89**.

Referring now to FIG. **4**, the switch **66** is closed to initiate the operation of the orientation sensing and orienting apparatus. As shown in FIG. **3**, with the airflow from the nozzle **91** interrupted, the pneumatic switch **88** is closed to actuate a TRIAC **80** in series with the switch **77**. With the passageway **90** (FIG. **2**) empty, air from the nozzle **85** enters the opening **84** to operate the pneumatic switch **83** to actuate the TRIAC **82** and the relay **79** to close the contacts **78** in series with the switch **77**. The closed switch **77** energizes the solenoid **71** to connect the air source **65** to the line **69** to initiate advancement of the piston rod **25** and clockwise rotation of arm **28**. As shown in FIG. **2**, the rod **32** withdraws from the passageway **18** allowing the lowermost article **10** to fall down against the rod **30**. Continued clockwise rotation of the arm **28** engages the

left end of the rod 31 against the lowermost article 10 to force the article 10 against the wall 21. If the raised portion 11 of the article 10 faces the wall 21, the valve stem 59 is depressed opening the valve 58 which opens the chamber 57.

Referring to FIG. 2, previous to the arm 28 reaching its most clockwise position, the switch 114 is closed to energize a solenoid 100 (FIGS. 3 and 4) through normally opened contacts of the pneumatic switch 115 which have been closed by the application of pressurized air to the line 69. The solenoid 100 operates the valve 101 to connect the source 65 to the line 102 and the nozzle 104. The switch 114 opens and the solenoid is deenergized prior to the arm 28 reaching its most clockwise position and its engagement with the switch 75.

Referring to FIG. 3, opening the chamber 57 reduces the pressure on the line 95 which allows the normally open contacts of the pneumatic switch 96 to open. As shown in FIG. 4, opening the contacts of the switch 96 deactuates the TRIAC 98 such that when the arm 28 reaches its most clockwise position and closes the switch 75, the solenoid 99 is not energized. Therefore, valve 101 remains operated to connect the source 65 to the line 102 and the nozzle 104.

Referring back to FIG. 2, if the raised portion 11 of the lowermost article 10 faces the wall 22, the valve stem 59 is not depressed and the pneumatic switch 96 (FIGS. 3 and 4) remains closed and the TRIAC 98 is actuated so that the solenoid 99 is energized and the source 65 is connected to the line 103 when the arm 28 engages the switch 75.

Referring to FIG. 4, closing the switch 75 also energizes the solenoid 70 to operate the valve 67 (FIG. 3) to connect the source 65 to the line 68 to retract the piston rod 25 and rotate the arm 28 in a counterclockwise direction. Referring back to FIG. 2, the left end of the rod 32 engages the second from the lowermost article 10 to hold the second article 10 and all articles 10—10 thereabove, and not allow them to fall. The rod 30 then withdraws from the passageway 18 to release the lowermost article 10 into the passageway 108. If the raised portion 11 of the falling lowermost article 10 faced the wall 21, air from the nozzle 104 directs the article 10 into the passageway 110 where it is rotated 90° such that the raised portion faces inwardly when it falls into the passageway 111. Conversely, if the raised portion 11 of the article 10 faced the wall 22, air from the nozzle 105 directs the article 10 into the passageway 109 where it is rotated 90° in the opposite direction such that the raised portion 11 of the article 10 faces inwardly when it falls into the passageway 111.

The arm 28 then engages the switch 77 to start a new cycle of operation.

It is to be understood that the above-described embodiment is simply illustrative of the principles of the invention and that many other embodiments may be devised without departing from the scope and spirit of the invention. For example, the passageway 109 may be horizontally aligned with the passageways 108 and 18 so that an article 10 falls by gravity into the passageway 109 unless air is applied to the nozzle 104. Thus, the nozzle 105 may be eliminated and the line 103 plugged.

What is claimed is:

1. An apparatus for sensing the orientation of a flat article having a raised portion on one side comprising:
- a guiding and indexing means for feeding the articles, one at a time, through a passageway past a substantially flat wall at a sensing station;
- a chamber;
- a valve member forming one wall of the chamber;
- means for biasing the valve member to close the chamber;
- a valve stem extending from the valve member with the end of the valve stem being substantially flush with the wall at the sensing station when the valve is closed;
- means for injecting fluid from a pressurized source into the chamber;
- means cooperating with the guiding and indexing means for forcing an article against the wall to depress the valve stem and to open the valve member when the raised portion of the article faces the wall; and
- means cooperating the article forcing means for sensing the fluid pressure in the chamber to indicate the orientation of the article.

2. An apparatus as defined in claim 1, including:
- means controlled by the sensing means for orienting all articles into a predetermined orientation.

3. An apparatus as defined in claim 1, including:
- a first twisted passageway extending from the sensing station for rotating articles with a first orientation into a predetermined orientation;
- a second twisted passageway extending from the sensing station for rotating articles with a second orientation into the predetermined orientation; and
- means operated by the sensing means for selectively directing the articles into the first and second twisted passageways.

4. An apparatus as defined in claim 3, wherein the selectively directing means includes:
- a nozzle for emitting a fluid at an article to urge the article into the first twisted passageway; and
- a valve means controlled by the sensing means for selectively applying fluid from a pressurized fluid source through the nozzle.