United States Patent

Clark

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[54] ZERO ROTATION SENSOR FOR DRIVE ASSEMBLY IDLER

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[51] **Int. Cl.**.....**B65b 13/18**

[58] **Field of Search**.....226/143, 11; 242/36; 340/259; 192/126, 127, 128; 100/4

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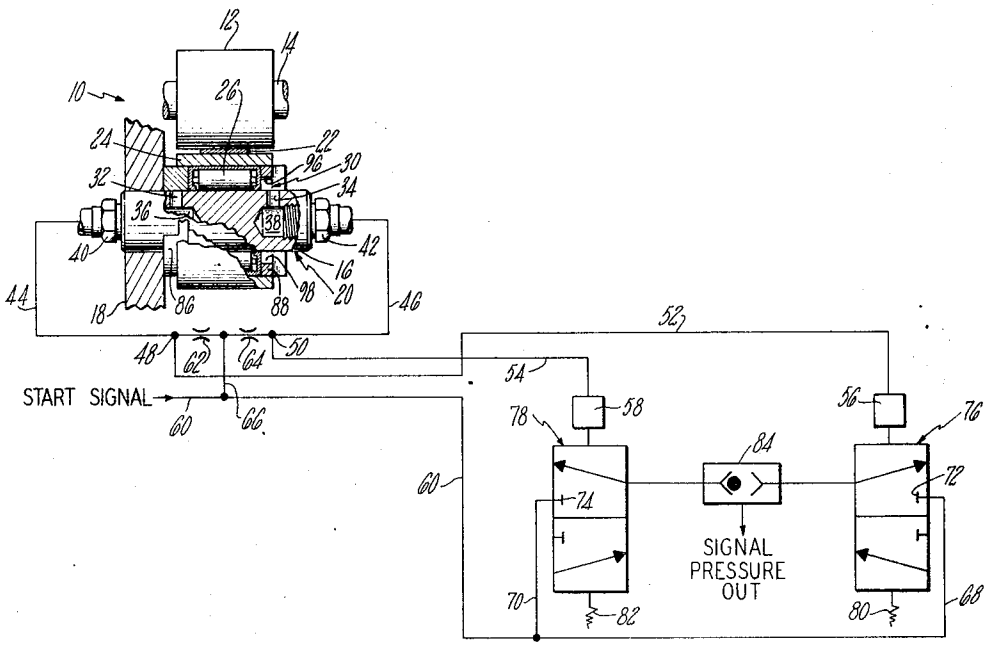
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[57] **ABSTRACT**

Apparatus for use in a material handling machine and including drive means and an idler for maintaining material being driven by the drive means in engagement therewith, the idler being rotatable responsive to movement of the material, and a zero rotation sensor in the idler for detecting when the idler stops rotating for indicating a motionless condition of the material.

8 Claims, 3 Drawing Figures



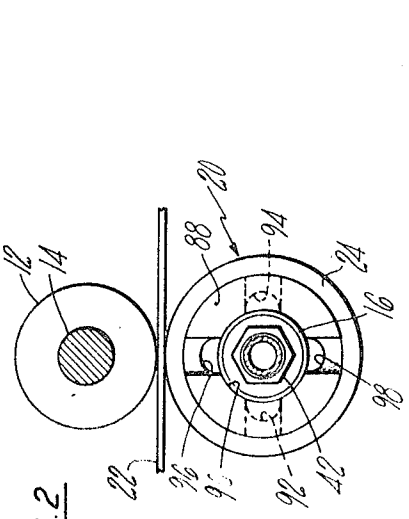


FIG. 2

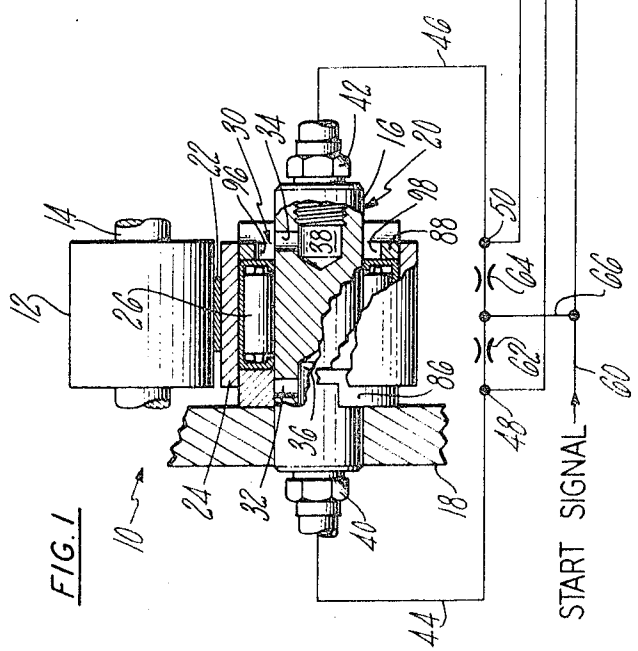
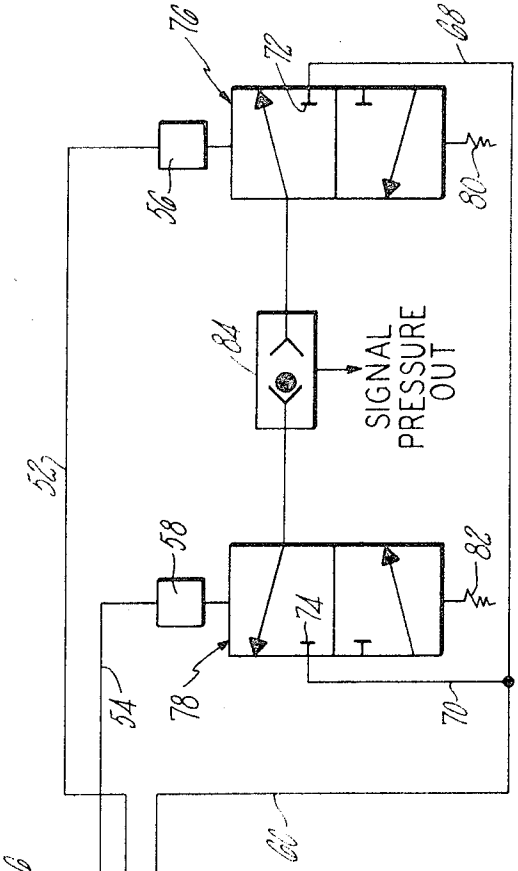


FIG. 1

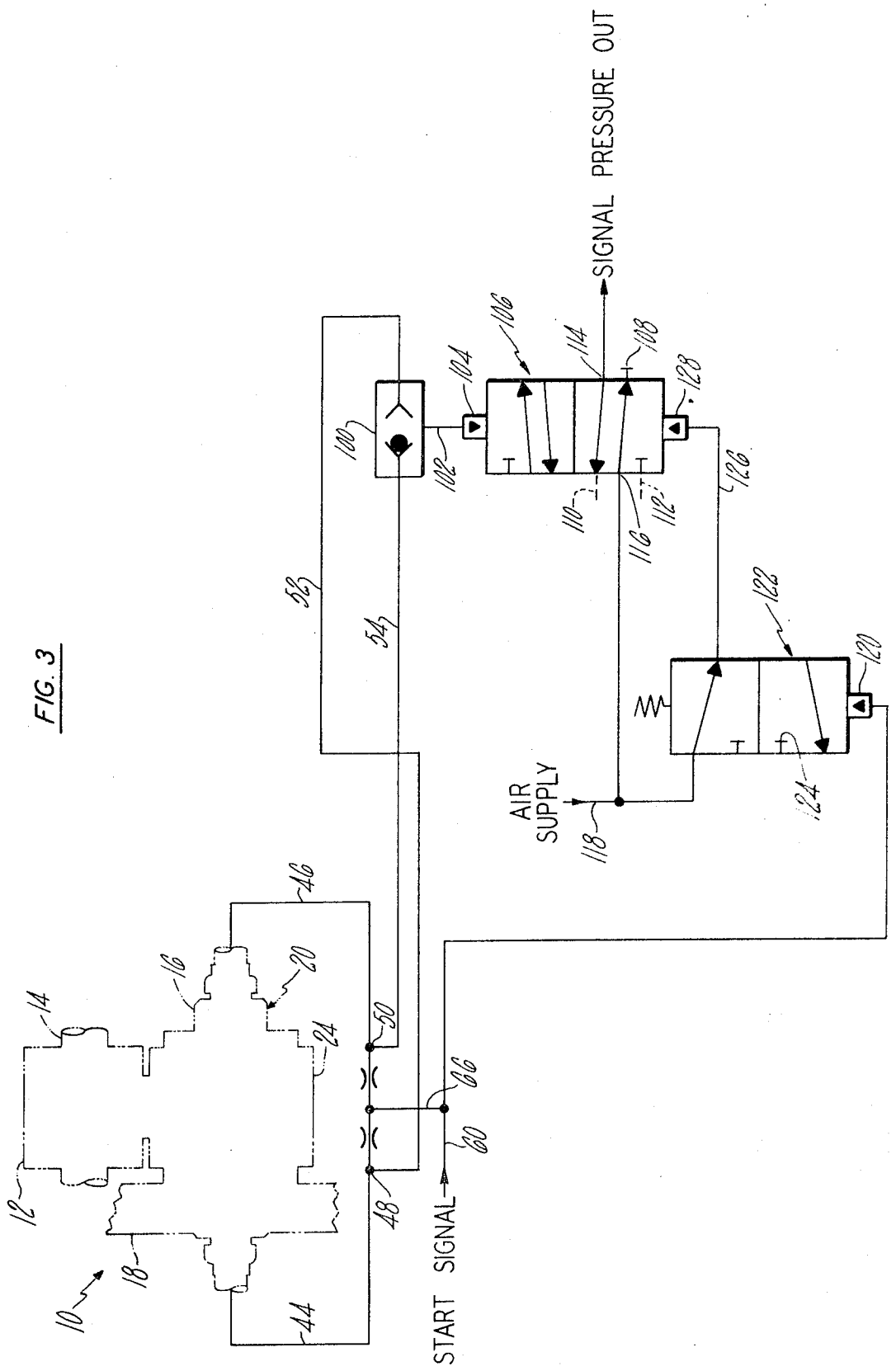


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FIG. 3


SIGNAL PRESSURE OUT
AIR SUPPLY
START SIGNAL
10
12
14
16
18
20
24
44
46
48
50
52
54
60
66
100
102
104
106
108
110
112
114
116
118
120
122
124
126
128

ZERO ROTATION SENSOR FOR DRIVE ASSEMBLY IDLER

FIELD OF THE INVENTION

This invention generally relates to machines for handling strap and the like and particularly concerns zero speed sensor devices usable in drive assemblies for such machines.

BACKGROUND OF THE INVENTION

While this invention is capable of being used in a wide variety of equipment for handling elongated flexible material such as wire and sheet material, for example, in different applications, this invention has particular utility in strapping machines for tying packages or articles.

Conventional strapping machines automatically provide a predetermined sequence of steps which include looping strap around an article, tensioning the strap, applying a seal to overlapping portions of strap and severing a supply end of the strap. Each of the foregoing functions are normally provided by a single machine, and it is frequently important to minimize the time required for completion of the entire strapping operation. A preset timer often has been used for signaling completion of strap tensioning, and the appropriate time base normally chosen is that time required to take-up all-slack strap from around the smallest article anticipated to be strapped which is frequently a considerably longer time than that required for larger size articles.

OBJECTS OF THE INVENTION

A primary object of this invention is to provide a zero speed sensor usable with a drive assembly of material handling equipment for detecting when the material being driven has stopped moving.

Another object of this invention is to provide a sensor particularly suited for use in a strapping machine for sensing a taut condition of strap about an article for significantly reducing the required time cycle without depending upon any timing means even though the machine is used for strapping articles of a wide range of sizes.

A further object os this invention is to provide a sensor of the above-described type which upon detecting proper tensioning of strap about an article may produce an output signal for automatically initiating a succeeding step in a strapping operation.

Other objects will be in part obvious and in part pointed out in more detail hereinafter.

A better understanding of the objects, advantages, features, properties and relationships of the invention will be obtained from the following detailed description and accompanying drawings which set forth an illustrative embodiment and are indicative of the various ways in which the principle of the invention is employed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view, partly broken away and partly in section, of a drive assembly incorporating this invention and shown connected to a fluid control circuit which is schematically illustrated;

FIG. 2 is a side view, partly broken away and partly in section, of the drive assembly of FIG. 1; and

FIG. 3 is a view similar to FIG. 1 wherein the drive assembly is in broken lines and shown connected to another type of fluid control circuit which is schematically illustrated.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to the drawings in detail wherein a preferred embodiment of this invention is shown, a drive assembly **10** is shown having a feed roll **12** supported for rotation about a fixed axis on a power operated drive shaft **14** in parallel aligned relation to a stationary shaft **16** suitably secured to a fixed frame **18** and rotatably supporting a back-up or idler subassembly **20**. As previously noted, while this invention is

capable of a wide variety of uses, it has particular utility with a strapping machine and will be described in connection with such an application. It will be understood that the drive shaft **14** may be power operated in a selected angular direction to rotate the feed roll **12** for withdrawing and tensioning strap, such as that shown at **22**, about an article, not shown. The strap **22** is maintained in engagement with the feed roll **12** by the idler subassembly **20** which includes a pressure sleeve **24** supported by conventional roller bearing assemblies **26** for rotation about the shaft **16** responsive to the transmission of motion by the moving strap **22** engaging the pressure sleeve **24**.

To immediately produce a signal when the strap **22** is withdrawn to an extent determined by termination of further strap movement responsive to the driving power of the feed roll **12**, and to significantly reduce the required time cycle for a strapping operation irrespective of the size of the articles about which the strap **22** is being applied, a zero rotation sensor **30** is incorporated in the idler subassembly **20** of this invention for immediately detecting when the pressure sleeve **24** stops rotating.

Referring more specifically to FIGS. **1** and **2**, the sensor **30** includes vent ports **32, 34** which are formed adjacent opposite ends of the stationary shaft **16**. The ports **32, 34** are shown for illustrative purposes as extending vertically upwardly from axial compartments **36, 38** in their respective ends of the shaft **16** to open in an upper bearing surface of the shaft **16**. The compartments **36, 38** in the shaft **16** are suitably connected through fluid couplings **40, 42** to vent lines **44, 46** extending to junctures **48, 50** which are respectively connected through fluid lines **52, 54** to valve actuators **56, 58** and to a supply line **60** which will be understood to be connected to a source of pressurized fluid such as air which is made available during a strap take-up or tensioning step of the strapping operation.

The junctures **48, 50** are also connected with the source of air through suitable line restrictions **62, 64** leading to a common inlet passage **66** from the supply line **60** which in turn is shown connected through valve supply lines **68, 70** to supply ports **72, 74** in control valves **76, 78**. The control valves **76, 78** are respectively operated by the valve actuators **56, 58** against the bias of springs **80, 82** and are shown (schematically with USA Standard fluid power graphic symbols) as being two-position, three-way pneumatic valves. Upon being operated, each valve **76** and **78** will act to apply supply line pressure to a suitable double-acting check valve **84** to produce an output signal pressure.

The pressure sleeve **24** carries a pair of end plates **86, 88** having inner annular surfaces such as at **90** in circumferentially surrounding relation to the shaft **16**. To maintain the fluid circuit in a nonsignaling condition during strap tensioning, the sensor **30** further includes a plurality of spaced apart ports or exhaust openings **92, 94** and **96, 98** formed in the annular surface of end plates **86** and **88** for confronting registration with their respective vent ports **32** and **34**. Upon rotation, the pressure sleeve **24** thus acts to exhaust the vent lines **44, 46** to atmosphere and prevent back pressure build-up in the fluid lines **52, 54** leading to the control valves **76, 78**. To ensure that one of the vent ports **32, 34** is always covered by one of the end plates **86, 88** to produce an output signal when the sleeve **24** stops rotating, the exhaust openings **92, 94** and **96, 98** in each of the end plates **86** and **88** are shown suitably dimensioned relative to the vent ports **32** and **34** and arranged in diametrically opposed relation to one another and in 90° offset angular relation to the openings in the other end plate.

When the strap **22** is sufficiently tightened about an article and the feed roll **12** is no longer capable of withdrawing further strap, the pressure sleeve **24** will stop rotating and the air pressure in the vent lines **44, 46** corresponding to that vent port **32, 34** covered by its end plate **86, 88** will increase to a sufficient level to activate the valve actuator **56, 58** of its respective control valve **76, 78**. The activated valve is then operated against its spring bias to connect its supply port (**72** or **74**) to the check valve **84** whereupon line pressure is ap-

plied to produce an output signal indicative of the tensioned condition of the strap.

In the specific illustrated embodiment, one or both vent ports **32, 34** may simultaneously be in nonaligned relation to its respective exhaust openings **92, 94** and **96, 98**, at any given time, it having been found that, with proper design and dimensioning of the flow passages and orifices, alternate intermittent venting of the fluid lines **52, 54** during rotation of the sleeve **24** will provide sufficient pressure relief to prevent inadvertent operation of the control valves **76, 78**. Should both control valves **76, 78** be simultaneously operated upon stopping rotation of the pressure sleeve **24**, sufficient air flow is assured through the check valve **84** to produce an effective signal pressure output.

The signal emitted by the above-described control circuit may be utilized in a variety of ways depending on the application with which this invention is intended to be utilized. In the above-described application, for example, the output signal may be applied to actuate a high torque motor (not shown) to apply even greater tensioning to the strap **22** or, if desired, to initiate a subsequent sealing and shearing step in the strapping operation.

In FIG. **3**, another control circuit is schematically illustrated, it being understood that the drive assembly **10** is identical to that described in FIGS. **1** and **2** and that identical reference numerals are used to identify like parts of the drive assembly and control circuit of FIG. **3**. The vent lines **44, 46** are connected via lines **60, 66** to a source of air providing a start signal available during the take-up portion of the cycle and to opposite sides of a double-acting check valve **100** having an outlet passage **102** connected to a pilot actuator **104** for a two-position, four-way, five-ported pneumatic signal control valve **106**. The valve **106** includes one blocked port **108**, two exhaust ports **110, 112**, and a service port **114** which, upon operation of the valve **106**, communicates with a supply port **116** connected to a constant air supply line **118** for emitting output signal pressures.

During strap take-up, start signal pressure is applied through supply line **60** to the opposite ends of the shaft **16** supporting the pressure sleeve **24**, as described in connection with FIGS. **1** and **2**, and also to a pilot operator **120** of a spring-returned, two-position, three-way, ON/OFF reset valve **122** for disconnecting its supply port **124** to the constant air supply line **118** for relieving an air pressure bias applied to valve **106** via line **126**. It will be understood that air pressure is normally supplied to pilot actuator **128** to reset the valve **106** to an inoperative position, and that valve **106** is biased by any suitable means such as a spring detent, not shown, to nonsignaling ready condition during strap take-up.

With the pressure sleeve **24** continuously rotating to permit air to be discharged to atmosphere through the vent ports **32, 34** and exhaust openings in the idler subassembly **20**, it will be understood that any air pressure transmitted through the check valve **100** is insufficient to overcome the bias imposed on the valve **106**. Once the strap stops moving, causing the pressure sleeve **24** to stop rotating, the end plates **86, 88** of the pressure sleeve **24** will cover one of the vent ports **32, 34** in the shaft **16** to obstruct discharge of the air through its vent line **44, 46** whereupon back pressure will increase to a sufficiently high level in its respective valve supply line **52, 54** leading to the check valve **100** to actuate the pilot operator **104** and overcome the opposing bias to operate the signal control valve **106**. Upon being operated, the signal control valve **106** immediately connects the air supply line **118** to the output service port **114** to signal completion of the strap tensioning.

As in the previously described embodiment, a subsequent step in the automatic operation of the strapping machine may be actuated by means of the output signal pressure from port **114** to complete the strapping operation.

A zero rotation sensor constructed in accordance with this invention may be utilized in a variety of applications to provide a significant reduction in the required time cycle to minimize interruption of a material handling operation. The use of this invention in a strapping machine application not only immediately detects completion of strap tensioning regardless of the size of the article being tied, but also produces an output signal which may be desirably used to actuate another component of the machine in a continued automatic sequence of steps.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I CLAIM:

1. Driving and sensing apparatus for detecting a motionless condition of strap material and the like being driven thereby and comprising drive means for driving the material along a path, a rotary idler engageable with the material for maintaining it in driving engagement with the drive means, the idler being rotatable responsive to the transmission of motion thereto by the material being driven by the drive means, a fluid circuit, and a pressure actuated sensor including means for selectively venting the fluid circuit operable in response to the idler being stopped when the movement of the material is terminated for varying the fluid pressure in the fluid circuit and actuating the sensor to produce a signal indicative of the motionless condition of the material.

2. Driving and sensing apparatus for detecting a motionless condition of strap material and the like being driven thereby and comprising drive means for driving the material along a path, a rotary idler engageable with the material for maintaining it in driving engagement with the drive means, the idler being rotatable responsive to the transmission of motion thereto by the material being driven by the drive means, a sensor operable in response to the idler being stopped when the movement of the material is terminated for producing a signal indicative of the motionless condition of the material, the sensor including fluid porting means carried by the idler, and a fluid circuit including fluid operated signal control means and passage means for supplying fluid under pressure, the passage means being connected between the signal control means and the idler porting means, the idler porting means being registrable with the fluid passage means and automatically assuming a predetermined flow control position in relation to the fluid passage means when the idler is stopped to cause a change in fluid pressure in the passage means for activating the signal control means.

3. The apparatus of claim **2** wherein a stationary shaft is provided for supporting the idler for rotation, wherein the fluid passage means includes vent porting means formed in he stationary idler shaft, and wherein the idler porting means includes a plurality of exhaust openings circumferentially arranged about the idler shaft for communication with the vent porting means during rotation of the idler, the idler being in obstructing relation to the vent porting means upon termination of idler movement, causing pressure build-up in the fluid passage means for activating the signal control means.

4. The apparatus of claim **2** wherein said predetermined flow control position of the idler porting means is in at least partially blocked relation to the passage means to effect pressure build-up therein for activating the signal control means when the idler is stopped.

5. Driving and sensing apparatus for detecting a motionless condition of strap material and the like being driven thereby and comprising drive means for driving the material along a path, a rotary idler engageable with the material for maintaining it in driving engagement with the drive means, a stationary shaft for rotatably supporting the idler, the idler being rotatable responsive to the transmission of motion thereto by the material being driven by the drive means, a sensor operable in response to the idler being stopped when the movement of the material is terminated for producing a signal indicative of the motionless condition of the material, the sensor including first and second fluid porting means respectively formed in the stationary shaft and the idler, fluid passage means for supplying fluid under pressure to the first fluid porting means in the

shaft, and fluid operated signal control means communicating with the first fluid porting means in the shaft, said first and second fluid porting means being registrable for exhausting fluid from the first fluid porting means during rotation of the idler and being in nonaligned relation when the idler stops rotating for effecting an increase in fluid pressure to operate the signal control means.

6. The apparatus of claim 5 wherein the idler includes an annular surface surrounding the stationary shaft, wherein said first fluid porting means formed in the stationary shaft is in confronting relation to the annular surface of the idler, and wherein the annular surface includes a plurality of spaced apart exhaust openings constituting said second fluid porting means.

7. Driving and sensing apparatus for detecting a motionless condition of flexible strap of binding an article and comprising a powered feed roll rotatable about a fixed axis for driving the strap along a path and tensioning the strap about the article, a rotary idler engageable with the strap for maintaining it in driving engagement with the feed roll, a stationary shaft, the idler being rotatable on the stationary shaft responsive to the transmission of motion to the idler by the strap being driven by the feed roll, a sensor operable in response to the idler being stopped when the movement of the strap is terminated for producing a signal indicative of the motionless condition of the strap, the sensor including vent porting means formed in one of the shaft and idler members and exhaust openings formed in the other of the shaft and idler members for registering with the vent porting means, and a pneumatic circuit including signal control means and passage means for supplying air under pressure, the passage means being connected between the signal control means and the vent porting means, the venting porting means in said one member communicating with the exhaust openings in the other member during rotation of the idler to prevent air pressure build-up in the passage means during strap tensioning, the vent porting means being at least partially blocked by said other member when the idler stops rotating to cause pressure build-up in the passage means for activating the signal control means--.

8. Apparatus usable in a strapping machine for tightening flexible strap about an article and comprising powered drive means for tensioning strap about the article, a freely rotatable idler engageable with the strap for maintaining it in engagement with the drive means and rotatable responsive to movement of the strap during tensioning, and a fluid circuit including fluid operated signal control means, a source of pressurized fluid and passage means in communication therewith, the passage means having vent porting means mounted adjacent the idler and connected to the signal control means, the idler having exhaust porting means carried thereon registrable with the vent porting means, and the exhaust porting means automatically assuming a predetermined flow control position in relation to the vent porting means when the idler stops rotating to cause a change in fluid pressure in the passage means for activating the signal control means for indicating a predetermined tensioning of the strap.

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