

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
15 November 2007 (15.11.2007)

PCT

(10) International Publication Number
WO 2007/131125 A2

(51) International Patent Classification:
B65B 57/02 (2006.01)

(21) International Application Number:
PCT/US2007/068169

(22) International Filing Date: 3 May 2007 (03.05.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/417,702 4 May 2006 (04.05.2006) US

(71) Applicant (for all designated States except US): **ALTIVITY PACKAGING, LLC** [US/US]; 450 E. North Avenue, Carol Stream, IL 60188 (US).

(72) Inventor: **WADIUM, Christopher, Stephan**; 1348 East 5440 South, Salt Lake City, UT 84117 (US).

(74) Agents: **BEULICK, John, S.** et al.; Armstrong Teasdale Llp, One Metropolitan Square, Suite 2600, St. Louis, MO 63102 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

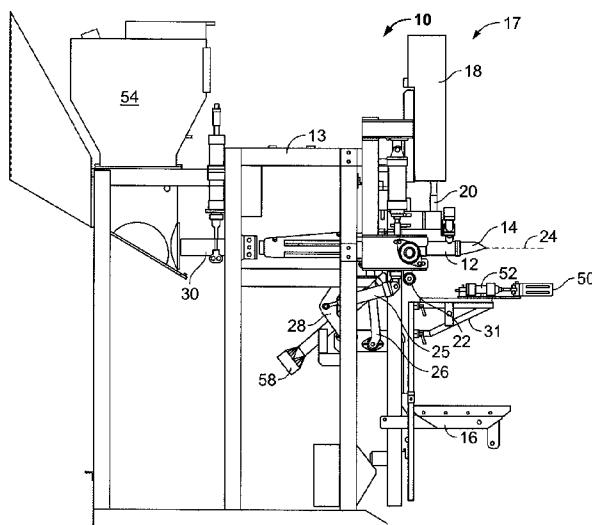
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: APPARATUS AND METHOD FOR SENSING A CONTAINER POSITIONED ABOUT A FILLING SPOUT



(57) Abstract: An apparatus for filling at least one container defining an opening is provided. The apparatus includes a filling spout in flow communication with a source of filling material. The filling spout is configured to enable the opening of the at least one container to fit about the filling spout. At least two stationary sensor assemblies are positioned about the filling spout. The at least two stationary sensor assemblies are configured to detect whether a container is positioned about the filling spout.

APPARATUS AND METHOD FOR SENSING A
CONTAINER POSITIONED ABOUT A FILLING
SPOUT

BACKGROUND OF THE INVENTION

[0001] This invention relates generally to an apparatus and method for filling and/or sealing containers and, more particularly, to an apparatus and method for accurately sensing whether a container has been properly positioned about a filling spout of a filling machine.

[0002] Conventional bag filling machines may include a mechanical device or component for detecting whether a bag is positioned on a filling tube. Some conventional filling machines include a wand or a paddle that extends over a bag support within the filling station. As the bag is positioned onto the filling tube, the bag urges the wand or paddle to move and activate a relay component, such as a contact or switch, to indicate that the bag is positioned on the filling tube.

[0003] Other conventional filling machines include a clamp that secures the bag to the filling tube. The clamp includes an air supply flow path configured to allow air to flow through the clamp. A corresponding hole is formed through a side wall of the filling tube and in initial flow communication with the air supply flow path. A supply of air indicates whether the bag is positioned on the filling tube. For example, if a bag is positioned on the filling tube, the hole formed through the side wall of the filling tube is covered and flow communication between the air supply flow path and the hole is prevented. An increase in pressure and/or a decrease in air flow are detected to indicate that the bag is positioned on the filling tube. If the bag does not cover the hole, the supply of air flows into the filling tube to indicate that no bag is positioned on the filling tube.

[0004] The conventional methods for determining whether the bag is positioned on the filling tube require physical manipulation of the bag. Further, the

conventional methods may result in false confirmation that the bag is positioned on the filling tube. For example, false confirmations may result from placing the bag adjacent to, but not about, the filling tube and moving the wand or paddle. Similarly, placing the bag adjacent to, but not about, the filling tube may also cover the hole to prevent flow communication between the air supply flow path and the hole formed within the filling tube. Such situations will result in a false confirmation that the bag is positioned on the filling tube.

BRIEF DESCRIPTION OF THE INVENTION

[0005] In one aspect, an apparatus is provided for filling at least one container defining an opening. The apparatus includes a filling spout in flow communication with a source of filling material. The filling spout is configured to enable the opening of the at least one container to fit about the filling spout. At least two stationary sensor assemblies are positioned about the filling spout. The at least two stationary sensor assemblies are configured to detect whether a container is positioned about the filling spout.

[0006] In another aspect, a detection system is provided for determining whether a container is positioned about a filling spout of an apparatus for filling at least one container. The filling spout is in flow communication with a source of filling material and configured to enable an opening defined by the container to fit about the filling spout. The detection system includes at least two stationary sensor assemblies positioned about the filling spout. Each stationary sensor assembly of the at least two stationary sensor assemblies includes a sensing component. The sensing component is configured to measure a first distance from a sensing component location to a first spatial location on an outer surface of the filling spout and a second distance from the sensing component location to a second spatial location on an outer surface of the container positioned about the filling spout.

[0007] In another aspect, a method is provided for filling at least one container defining an opening. An apparatus is positioned along a processing path.

The method includes placing a container on a support configured for receiving, in succession, a plurality of containers. The support is configured to maintain each successive container in an orientation, with the opening extending toward the apparatus. The method includes confirming that the container is positioned about a filling spout of the apparatus. The filling spout is in flow communication with a source of filling material and configured to enable the opening of a container to fit about the filling spout. The container is then filled with filling material.

[0008] In another aspect, a method is provided for determining whether a container is positioned about a filling spout of an apparatus for filling at least one container. The filling spout is in flow communication with a source of filling material and configured to enable an opening defined by the container to fit about the filling spout. The method includes providing at least two stationary sensor assemblies positioned with respect to the filling spout. Each stationary sensing assembly of the at least two stationary sensor assemblies includes a sensing component. Each sensing component is calibrated to measure a first distance from a sensing component position to a position on an outer surface of the filling spout. A second distance between each sensing component position and a position on an outer surface of the container positioned about the filling spout is then measured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 is a side elevation view of an exemplary filling and sealing apparatus, in which the rear bag flaps are open;

[0010] Figure 2 is a front end elevation view of the filling and sealing apparatus shown in Figure 1;

[0011] Figure 3 is a fragmentary top plan view of the filling and sealing apparatus shown in Figure 1, in which the rear bag flaps are shown in an open position and a closed position;

[0012] Figure 4 is an enlarged fragmentary side elevation view of the filling and sealing apparatus shown in Figure 1, showing the filling spout in an extended position and the rear bag flaps in the open position;

[0013] Figure 5 is an enlarged fragmentary side elevation view of the filling and sealing apparatus shown in Figure 1, showing the filling spout in a retracted position and the rear bag flaps in the open position;

[0014] Figure 6 is a fragmentary side elevation view of the filling and sealing apparatus shown in Figure 1, showing the filling spout in a retracted position and further showing a bag being sealed with the rear bag flaps in the closed position;

[0015] Figure 7 is a fragmentary front elevation view of an exemplary filling and sealing apparatus;

[0016] Figure 8 is a perspective view of the filling and sealing apparatus shown in Figure 7;

[0017] Figure 9 is a fragmentary front elevation view of the filling and sealing apparatus shown in Figure 7 with a scalable valve bag properly positioned about a filling spout;

[0018] Figure 10 is a front elevation view of an exemplary sensor assembly for the filling and sealing apparatus shown in Figure 7;

[0019] Figure 11 is a side elevation view of the exemplary sensor assembly shown in Figure 10 with a portion of a housing removed;

[0020] Figure 12 is a front elevation view of an exemplary array of sensor assemblies position about a filling spout of the filling and sealing apparatus shown in Figure 7; and

[0021] Figure 13 is a front elevation view of an alternative exemplary array of sensor assemblies position about a filling spout of the filling and sealing apparatus shown in Figure 7.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The present invention provides an apparatus and method for determining whether a container, such as a bag, including a sealable or non-sealable valve bag, is properly positioned about a filling spout of a filling apparatus. An array of sensor assemblies is positioned about the filling spout to sense or detect whether the container is properly positioned about the filling spout. Each sensor assembly is configured to transmit a confirmation signal to a controller in operational control communication with a filling system of the apparatus indicating that a container is properly positioned about the filling spout. Further, in one embodiment each sensor assembly is configured to transmit a container positioning error signal or no confirmation signal if the sensor assembly detects that a container is not properly positioned about the filling spout.

[0023] The present invention is described below in reference to its application in connection with and operation of a filling apparatus for filling sealable or non-sealable valve bags. However, it will be apparent to those skilled in the art and guided by the teachings herein provided that the present invention is likewise applicable to any apparatus including a filling system, with or without a sealing system, for use with any suitable bags including, without limitation, multiple wall bags, such as valve bags fillable through a generally horizontally positioned filling tube or spout and open-mouth bags fillable through a generally vertically positioned filling tube or spout. Further, the present invention may be applied to systems for filling and/or sealing any suitable container, including bags, boxes, cartons and/or display trays.

[0024] Figures 1-13 show an exemplary filling apparatus 10. Filling apparatus 10 includes a filling tube or spout 12, which is connected to a source of

filling material (not shown). In one embodiment, filling spout 12 is mounted to a frame assembly 13 of apparatus 10. Frame assembly 13 provides sufficient support for the various functional stationary and/or moving components of apparatus 10, as may be required or desired by the dictates of any particular installation. Filling spout 12 includes a nozzle 14 configured for insertion into an opening defined in a container, such as a valve structure of a valve bag. Such valve bags are known in the art and may include sealable valve bags such as disclosed in Kelley et al., U.S. Pat. No. 6,092,930. It is apparent to those skilled in the art and guided by the teachings herein provided that other suitable bags, as well as any suitable container, may be used with the apparatus and method of the present invention. As shown in Figure 1, in one embodiment the bag is vertically supported by a support 16, such as a bag chair. Support 16 may be a stationary support or representative of a conveyor belt, roller table, indexing conveyor structure or similar structure, such that support 16 is configured to repeatably position individual bags in alignment with filling spout 12.

[0025] In one embodiment, filling apparatus 10 includes a sealing system having a sealer 18 with a heating element or ultrasonic horn 20 that is suitably mounted for reciprocable vertical movement into and out of contact with an upper surface of a protruding valve structure of a sealable valve bag. Suitable controls and operating systems for actuating and generating heat and/or ultrasonic vibrations are provided.

[0026] A pivotable sealer anvil 22 is pivotably mounted for movement about an axis 23 (shown in Figure 2) that passes more or less perpendicularly relative to a longitudinal axis 24 (shown in Figure 1) of filling spout 12 with filling spout 12 in an extended position, as shown in Figure 1.

[0027] In an alternative embodiment, filling spout 12 is horizontally and pivotally reciprocally mounted to frame assembly 13. Suitable linkage elements, such as linkage cylinder 25, front linkage 26 and/or rear linkage 28, are provided for facilitating enabling selective coordinated combined longitudinal/pivotal reciprocation of filling spout 12. Figure 3 is a fragmentary top plan view of filling apparatus 10, in

particular showing filling spout 12 and a mechanism for moving filling spout 12 in and out of the valve structures of the bags. A flexible tube 30 is connected to an end portion of filling spout 12 distal to nozzle 14. Depending upon the material that is being put in the bags, flexible tube 30 may be fabricated from any suitable leak and sift proof flexible material, which may need to be a food-grade material, as requirements dictate. As shown and described herein, flexible tube 30 accommodates the horizontal and pivoting movement of filling spout 12.

[0028] In alternative embodiments, flexible tube 30 is replaced with a rigid tube having an end portion architecture configured to permit an adjacent end of filling spout 12 to be pivotably moved away from the rigid tube as filling spout 12 moves to a retracted position. Suitable gasketing is used to provide an adequate seal at the interface of the adjoining tube ends with filling spout 12 in the extended position. Alternatively, any suitable connecting tube constructions may be employed to permit or accommodate the pivoting movement of filling spout 12.

[0029] In one embodiment, at least one bag side support 31 is mounted to frame 13 for facilitating stabilizing the bag as the bag is filled and/or sealed. As shown in Figures 1-3, bag side supports 31 have any suitable configuration such that the lateral spacing of bag side support 31 is sufficiently close to the width of a bag as the bag is being filled and sealed such that the bag is prevented from shifting or moving to either side. Tipping of the bags may lead to spillage and/or incomplete or inaccurate sealing of the bag valves.

[0030] In one embodiment, apparatus 10 includes two rear bag flaps 50, which are located proximate the outer end of support 16. Rear bag flaps 50 are mounted for reciprocating pivoting movement about vertical axes 51. In this embodiment, each rear bag flap 50 includes an elongated rectangular paddle that is substantially longer in a transverse direction than a vertical height. It is apparent to those skilled in the art and guided by the teachings herein provided that rear bag flaps 50 may have any suitable or desired size and/or shape. Rear bag flaps 50 are moved between a closed position and an open position, as shown in Figure 3, by

corresponding rear bag flap actuators 52. In one embodiment, rear bag flap actuators 52 are pneumatic or hydraulic cylinder and piston arrangements, such as shown in Figure 3. In alternative embodiments, any suitable type of actuator that is controlled by a suitably programmed control system may be used to move rear bag flaps 50. When rear bag flaps 50 are in the closed position, rear bag flaps 50 are either close to or in actual contact with the back (the side opposite the valve tube) of a bag that is positioned on support 16. This prevents a bag being filled and/or sealed from being pushed away (e.g., by the rising sealer anvil prior to sealing) or falling away from filling spout 12 or the sealer mechanism. Rear bag flaps 50 thus facilitate ensuring a complete and cleaner fill of the bags and a more positively positioned seal of the bag valves.

[0031] While bag side supports 31 and rear bag flaps 50 are shown in particular configurations, other configurations for bag side supports 31 and/or rear bag flaps 50 may be used, as desired or required by a particular installation.

[0032] In one embodiment, apparatus 10 includes a dust collecting mechanism. A flexible shroud 56 is positioned to surround the end portion of filling spout 12 distal to nozzle 14. Shroud 56 is connected to a dust collection tube 58, which is connected to a vacuum source (not shown). Shroud 56 has any suitable shape and/or is made of any suitable flexible material generally known in the art of bag filling apparatus. As is typically done, filling spout 12 enters into shroud 56 through a substantially sealed aperture (not shown). In one embodiment wherein filling spout 12 is movable (whether pivoting or longitudinally reciprocating), the dust collection mechanism, including shroud 56 and dust collection tube 58, is substantially stationary, although those portions of shroud 58 that are directly coupled to filling spout 12 are sufficiently flexible to accommodate the movements of filling spout 12 and maintain a substantially sealed relationship to filling spout 12 throughout its movements.

[0033] Figure 4 is a slightly enlarged view of filling apparatus 10, showing filling spout 12 in an extended position. Figure 5 shows filling spout 12 in a

retracted position. Figure 6 is a fragmentary side elevation of filling apparatus 10 of Figures 1-5, showing the filling spout in the retracted position and further showing a bag being sealed.

[0034] In operation, containers, such as valve bags, including sealable or non-sealable valve bags, are placed at support 16 by any suitable mechanism including, without limitation, a conveyor belt, powered roller table, bag holding and/or indexing mechanism. At support 16, the bag is positioned in an upright position with the protruding valve structure pointing toward filling apparatus 10. Typically, in the process of raising the bags, a gripping mechanism, as known in the art, may squeeze the top of the bag slightly, so as to pop open the end of the valve structure for facilitating entry of nozzle 14 and/or filling spout 12. A pushing device (not shown) may be employed for slightly moving the bag toward nozzle 14 or, in an alternative embodiment, for simply holding the bag in place while nozzle 14 is inserted into the valve tube of a stationary bag.

[0035] In one embodiment, filling spout 12 is in an extended position and is stationary when a valve bag 40 is placed on support 16. As described above, valve bag 40 may include a sealable or non-sealable valve structure. Further, other suitable bags may be filled with filling apparatus 10, as described herein. Valve bag 40 is then pushed onto nozzle 14 to assume the position shown in phantom in Figure 4, such as by a piston actuated pusher or bag gripping device (not shown). In an alternative embodiment, nozzle 14 is inserted into the open valve tube of a stationary valve bag 40.

[0036] In either embodiment, the movement of nozzle 14 is the same or similar. To extend nozzle 14, cylinder(s) 25 is/are actuated to withdraw the pistons. Linkages 26 and 28 pivot forward and filling spout 12 moves in a complex arc from the position shown in Figure 5 to the position shown in Figure 1, 3 or 4. Once pivoting of filling spout 12 has been completed and valve 42 has been placed on nozzle 14 (or nozzle 14 inserted into valve structure 42), filling of valve bag 40 can commence. Using a pump or other suitable means, the material to fill valve bag 40 is

supplied from a source, such as a hopper 54 and flows in the direction indicated by arrow 55.

[0037] In one embodiment, linkage cylinder(s) 25 include a hydraulic or pneumatic piston and cylinder assembly. In order to accommodate the upward pivoting of filling spout 12, flexible tube 30 is collapsed and folded downward.

[0038] In the embodiments as described herein, suitable wiring, tubing and control mechanisms (suitably programmed or coupled to control actuators using known control techniques) are provided for the selective and/or automated actuation of cylinder(s) 25 between the retracted position and the extended position.

[0039] After filling is complete (based upon timing of flow, volumetric measurement upstream of filling spout 12, or measurement of weight at support 16, among other possible cut-off determination techniques), filling spout 12 is generally pivoted backward from, and nozzle 14 tilted upward with respect to, valve bag 40 such that nozzle 14 is removed from valve structure 42. Apparatus 10 thus returns to the configuration shown in Figure 5.

[0040] Whether valve bag 40 is pushed onto a stationary nozzle 14 or nozzle 14 is pushed into a stationary valve bag 40, the relative positions of the pivot points for the linkages and/or the lengths of the linkages are selected such that during the pivoting movement of filling spout 12 away from valve bag 40, the initial movement of the nozzle 14 is to actually initially dip downwardly relative to valve structure 42 before filling spout 12, as a whole, pivots backward away from and tilts upward relative to valve bag 40. Such a pivoting movement may be readily accomplished by one of ordinary skill in the art having the present disclosure before them.

[0041] As shown in Figures 1-6, in one embodiment the linkages coupled to filling spout 12 are coupled to the lower side of filling spout 12 and are

positioned generally below filling spout 12. The linkages are further configured such that filling spout 12 pivots up and away from valve bag 40 in the retracted position.

[0042] Referring to Figures 7-13, in one embodiment apparatus 10 includes a bag detection system 60 positioned with respect to filling spout 12 for facilitating detecting whether a bag, such as a valve bag 40, has been properly and accurately positioned about filling spout 12 and/or nozzle 14 prior to beginning the bag filling process.

[0043] In one embodiment, detection system 60 includes an array 62 of stationary sensor assemblies positioned about filling spout 12 and a controller 64 in operational communication with each sensor assembly of array 62. Figure 7 is a fragmentary end view of apparatus 10 including array 62 positioned with respect to filling spout 12. Figure 8 is a fragmentary perspective view of apparatus 10 including array 62 positioned about filling spout 12. Figure 9 is a fragmentary end view of apparatus 10 including array 62 and a valve bag 40 properly and accurately positioned about filling spout 12. In one embodiment, array 62 includes at least two sensor assemblies. As shown in Figures 7-9, in this embodiment array 62 includes three sensor assemblies 65, 66 and 67 positioned with respect to filling spout 12 and/or nozzle 14 and configured to detect or sense whether valve bag 40 is positioned about filling spout 12. In alternative embodiments, array 62 includes any suitable number of sensor assemblies, i.e., less than three sensor assemblies or more than three sensor assemblies. Each sensor assembly 65, 66, 67 is mounted to frame 13 using any suitable mounting component known to those skilled in the art.

[0044] Referring further to Figures 10-13, sensor assemblies 65, 66, 67 are positioned about filling spout 12 and configured to detect or sense whether valve bag 40 is properly and accurately positioned about filling spout 12. In one embodiment, each sensor assembly 65, 66, 67 is contained within a housing 68 to protect the internal sensor components from undesirable contact with and/or exposure to dust or debris introduced during the bag filling process. In this embodiment, housing 68 protects the sensor assembly components from being covered with product

or filling material being moved into the bags on filling apparatus 10. Such product or filling material may prevent or limit sensor assemblies 65, 66, 67 from working properly. Further, in a particular embodiment, housing 68 is air purged with a suitable amount of air to provide positive pressure within housing 68 and prevent the product or filling material from entering housing 68 as the purge air escapes from within housing 68. Purge air is supplied to each housing 68 through an efficient circuit of hoses, as shown in Figures 7-9.

[0045] As shown in Figure 10, in one embodiment housing 68 includes a transparent panel 69 fabricated from a suitable transparent material, such as a Lexan[®] material available from General Electric Company located in Schenectady, NY or any suitable transparent or semi-transparent material, for facilitating monitoring the operation of the sensor assembly components housed within housing 68. In alternative embodiments, housing 68 may include a solid, non-transparent panel in lieu of transparent panel 69.

[0046] Each sensor assembly 65, 66, 67 includes a laser sensing component 70 positioned within housing 68 that emits a light beam against an outer surface 72 of filling spout 12. As shown in Figure 10, laser sensing component 70 emits one light beam 71. However, in an alternative embodiment, laser sensing component 70 is configured to emit a plurality of light beams directed at varying directional angles against outer surface 72 of filling spout 12.

[0047] Housing 68 defines an aperture 73, as shown in Figure 11, through which light beam 71 travels. In alternative embodiments, each sensor assembly 65, 66, 67 includes an ultrasonic sensing component, a photoeye sensing component or any suitable sensing component known in the art and guided by the teachings herein provided in lieu of laser sensing component 70 for facilitating detecting or sensing whether valve bag 40 is properly and accurately positioned about filling spout 12. In this embodiment, each sensor assembly 65, 66, 67 including corresponding housing 68 is coupled to frame 13 using a suitable mechanical component, such as a bracket 74 shown in phantom lines in Figures 10 and 11.

Further, each sensor assembly 65, 66, 67 is in independent operational communication with controller 64 via a suitable wire or cable 76, as shown in Figures 12 and 13.

[0048] Referring further to Figures 12 and 13, laser sensing component 70 of each sensor assembly 65, 66, 67 is positioned such that laser sensing component 70 emits a light beam 71 directed at outer surface 72 at a spatial location on outer surface 72. Each spatial location is positioned with respect to adjacent spatial locations of directed light beams emitted from corresponding sensor assemblies. In a particular embodiment, laser sensing component 70 of each sensor assembly 65, 66, 67 is configured such that the corresponding light beam emitted from laser sensing component 70 is directed at a spatial location on outer surface 72 at a radial distance of about 120° with respect to a spatial location of adjacent emitted light beams. Further, each sensor assembly 65, 66, 67 is positioned with respect to filling spout 12 and/or calibrated to measure a first or initial distance between corresponding laser sensing component 70 and outer surface 72. In a particular embodiment, each sensor assembly 65, 66, 67 is positioned with respect to filling spout 12 and/or calibrated such that a first or initial distance between laser sensing component 70 of sensor assembly 65 and outer surface 72 is substantially equal to a first or initial distance between laser sensing component 70 of sensor assembly 66 and outer surface 72 and a first or initial distance between laser sensing component 70 of sensor assembly 67 and outer surface 72, as shown in Figures 12 and 13. Each sensor assembly 65, 66, 67 is configured to measure a corresponding first or initial distance between a location of laser sensing component 70 to the corresponding spatial location on outer surface 72 of filling spout 12 where the emitted light beam contacts outer surface 72.

[0049] In an alternative embodiment, each sensor assembly 65, 66, 67 is positioned such that corresponding laser sensing component 70 emits a light beam directed at outer surface 72 at a spatial location on outer surface 72, as desired, i.e., the corresponding light beam emitted from laser sensing component 70 is directed at a spatial location on outer surface 72 at a radial distance of less than or greater than

about 120° with respect to a spatial location of adjacent emitted light beams. In further alternative embodiments including less than three sensors or more than three sensors, the sensors are suitably positioned about filling spout 12 such that a corresponding laser sensing component emits a light beam directed at outer surface 72 at a spatial location on outer surface 72, as desired.

[0050] Further, in the embodiment shown in Figures 7-13, sensor assemblies 65, 66, 67 are positioned such that corresponding laser sensing component 70 emits a light beam directed at outer surface 72 at a spatial location on outer surface 72 substantially planar to the spatial locations of the other emitted light beams, e.g., each spatial location of the emitted light beams is positioned within a plane perpendicularly intersecting longitudinal axis 24 of filling spout 12. In an alternative embodiment, at least one sensor assembly of array 62 is positioned within a plane generally parallel to a plane in which at least one other sensor assembly is positioned. For example, in alternative embodiment, sensor assembly 65 is positioned with respect to a first location along a length of filling spout 12 such that corresponding laser sensing component 70 emits a light beam directed at outer surface 72 at a spatial location within a first plane intersecting filling spout 12 along the length of filling spout 12. Additionally, sensor assembly 66 and/or sensor assembly 67 is positioned with respect to a second location along the length of filling spout 12 different from the first location such that corresponding laser sensing component 70 emits a light beam directed at outer surface 72 at a spatial location within a second plane different from the first plane and intersecting filling spout 12 along the length of filling spout 12.

[0051] Each sensor assembly 65, 66, 67 is configured for facilitating determining whether valve bag 40 is properly positioned about filling spout 12. Further, each sensor assembly 65, 66, 67 is configured to transmit a confirmation signal to controller 64 indicating that valve bag 40 is properly positioned about filling spout 12 or, in one embodiment, a bag positioning error signal indicating that valve bag 40 is not properly positioned about filling spout 12. When each sensor assembly 65, 66, 67 transmits a confirmation signal to controller 64 indicating that valve bag 40

is properly positioned about filling spout 12, controller activates a filling mechanism of apparatus 10 to begin the bag filling process. In this embodiment, the bag filling process will not begin until each sensor assembly 65, 66, 67 transmits a confirmation signal indicating that valve bag 40 is properly positioned about filling spout 12.

[0052] With valve bag 40 properly positioned about filling spout 12, a portion of valve bag 40 interferes with the light beam emitted from each laser sensing component 70 such that a second distance shorter than the first distance is detected or sensed by each sensor assembly 65, 66, 67 resulting in a status change. The detected second distance represents a measurement between the location of laser sensing component 70 and a corresponding location on an outer surface 82 of valve bag 40 fit or positioned about filling spout 12. Upon detecting or sensing that the measured second distance is less than the measured first distance, each sensor assembly 65, 66, 67 transmits a confirmation signal to controller 64 indicating such and confirming that valve bag 40 is properly and accurately positioned about filling spout 12. In one embodiment, each laser sensing component 70 is configured to accurately measure a distance of about 0.001 inch; thus, allowing sensor assemblies 65, 66, 67 to accurately detect or sense valve bag 40 positioned about filling spout 12.

[0053] In a situation wherein valve bag 40 is not properly positioned about filling spout 12, at least one sensor assembly 65, 66, 67 does not sense or detect a second distance different than the first distance or senses or detects a measured second distance equal to the measured first distance resulting in no status change. The sensing of a measured second distance equal to the measured first distance or not sensing a second distance indicates that valve bag 40 is not interfering with the light beam emitted from corresponding laser sensing component 70 and, hence, valve bag 40 is not properly positioned about filling spout 12. If sensor assembly 65, 66 and/or 67 does not sense a second distance or senses the measured second distance equal to the measured first distance, sensor assembly 65, 66 and/or 67 does not transmit a confirmation signal and/or transmits a bag positioning error signal to controller 64 indicating that valve bag 40 is not properly positioned about filling spout 12. If

controller 64 receives the bag positioning error signal, controller 64 is configured to prevent the initiation of the bag filling process or discontinue the bag filling process until the bag positioning error is resolved.

[0054] Upon confirmation that valve bag 40 is properly positioned about filling spout 12, controller 64, in operational control communication with apparatus 10 and/or filling spout 12, transmits an initiation signal to activate the filling mechanism to fill valve bag 40 with the filling material. In one embodiment, upon detecting that the measured second distance is less than the measured first distance, each sensor assembly 65, 66, 67 transmits a confirmation signal to controller 64 indicating that a valve bag 40 is properly positioned about filling spout 12. However, when at least one sensor assembly 65, 66, 67 detects that the measured second distance is equal to the measured first distance (indicating that valve bag 40 has not interfered with at least one emitted light beam), sensor assembly 65, 66 and/or 67 detecting the measured second distance does not transmit a confirmation signal to controller 64. In a particular embodiment, sensor assembly 65, 66 and/or 67 detecting the measured second distance transmits a bag positioning error signal to controller 64 indicating that a valve bag 40 is not properly positioned about filling spout 12. Upon receiving no confirmation signal from sensor assembly 65, 66 and/or 67 or receiving the transmitted bag positioning error signal from sensor assembly 65, 66 and/or 67, controller 64 prevents a flow of filling material through filling spout 12 until each sensor assembly 65, 66, 67 confirms the detection of the measured second distance less than the measured first distance.

[0055] In one embodiment, a method is provided for determining whether a container, such as valve bag 40, is properly positioned about filling spout 12 for filling at least one container with filling material. Filling spout 12 is in flow communication with a source of filling material and configured to enable the structure of the container defining the opening to fit about filling spout 12. An array of sensor assemblies 62 is provided that includes a plurality of stationary sensor assemblies radially positioned about the filling spout. Each sensor assembly includes a sensing

component, such as a laser sensing component, that is calibrated to measure a first distance from a sensing component position or location to a spatial position or location on an outer surface of the filling spout. Each sensor assembly is configured to measure a second distance indicating that a container is positioned about filling spout 12. The measured second distance is equal to a distance between each sensing component position or location and a corresponding position or location on an outer surface of the container positioned about the filling spout.

[0056] Upon each sensing component detecting a measured second distance less than the measured first distance, the corresponding sensor assembly transmits a confirmation signal to a controller in operational control communication with the filling mechanism confirming that a container is positioned about the filling spout. In response to the confirmation signal received from each sensor assembly (indicating that the container is properly positioned about the filling spout), the controller initiates activation of the filling mechanism, which allows flow of the filling material through the filling spout to fill the container properly positioned about the filling spout. However, upon at least one sensing component not sensing a second distance or at least one sensing component sensing a measured second distance equal to the measured first distance, the corresponding sensor assembly sensing no second distance or sensing such measured second distance transmits a container positioning error signal to the controller indicating that a container is not properly positioned about the filling spout. In response to at least one sensor assembly transmitting a container positioning error signal (indicating that the container is not properly positioned about the filling spout), the controller prevents activation of or deactivates the filling mechanism to prevent flow of the filling material through the filling spout. Such flow of the filling material is prevented until each sensor assembly transmits a confirmation signal to the controller indicating that the container is properly positioned about the filling spout.

[0057] After the container, such as valve bag 40, is filled with the filling material, the container is sealed by a sealing apparatus including sealer 18 and

anvil 22. One possible mechanism that may be used may be identical or similar to that employed in Wadium et al., U.S. Pat. No. 5,244,532 (in which sealer 18 employs an ultrasonic vibration horn 20), except that the anvil (instead of the horn) is pivotably mounted. When a container is being filled, or moved in or out of the filling station, anvil 22 is in the position shown in solid lines in Figures 1, 4 and 5.

[0058] Once filling has been completed, anvil 22 is rotated outwardly and upwardly, in the direction indicated by arrow 90 in Figure 5, to the position indicated in Figure 6. Anvil 22 may be pivotably mounted and propelled by suitable linkages and propulsion mechanisms, similar to those employed moving filling spout 12, or by other mechanisms understood by those of ordinary skill in the art. More or less simultaneously, horn 20 is lowered, in the direction of arrow 92, as shown in Figure 5 (e.g., by a suitably controlled piston and cylinder system or other mechanism), until valve structure 42 is clamped between horn 20 and anvil 22, as shown in Figure 6. Ultrasonic vibrations and/or heat are then applied for a sufficient period of time and to a sufficient degree to activate the adhesive or sealable liner of valve structure 42.

[0059] Upon completion of the sealing step, horn 20 is raised and anvil 22 is pivoted downwardly and away from the container. The filled and sealed container is moved away from support 16 and replaced by a successive empty container with the opening structure ready to receive nozzle 14 or to be pushed onto nozzle 14.

[0060] The above-described apparatus and method for filling at least one container, such as a valve bag, allows containers to be accurately filled without spillage. More specifically, the apparatus and method facilitate sensing or detecting whether a container has been properly and accurately positioned about the filling spout prior to initiating the container filling process. As a result, containers are reliably and efficiently filled without false confirmations that a container is properly positioned about the filling spout.

[0061] Exemplary embodiments of an apparatus and method for filling at least one container are described above in detail. The apparatus and method are not limited to the specific embodiments described herein, but rather, components of the apparatus and/or steps of the method may be utilized independently and separately from other components and/or steps described herein. Further, the described apparatus components and/or method steps can also be defined in, or used in combination with, other apparatus and/or methods, and are not limited to practice with only the apparatus and method as described herein.

[0062] While the invention has been described in terms of various specific embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the claims.

WHAT IS CLAIMED IS:

1. An apparatus for filling at least one container, the at least one container defining an opening, the apparatus comprising:

a filling spout in flow communication with a source of filling material, the filling spout configured to enable the opening of the at least one container to fit about the filling spout; and

at least two stationary sensor assemblies positioned about the filling spout, the at least two stationary sensor assemblies configured to detect whether a container is positioned about the filling spout.

2. An apparatus in accordance with Claim 1 wherein the at least two stationary sensor assemblies are radially positioned about the filling spout, each stationary sensor assembly of the at least two stationary sensor assemblies comprising one of a laser sensing component, an ultrasonic sensing component and a photoeye sensing component.

3. An apparatus in accordance with Claim 1 wherein each stationary sensor assembly of the at least two sensor assemblies comprises a laser sensing component configured to emit a light beam directed at a spatial location on an outer surface of the filling spout.

4. An apparatus in accordance with Claim 3 wherein the laser sensing component is positioned within a housing.

5. An apparatus in accordance with Claim 3 wherein the spatial location is radially positioned about the outer surface of the filling spout at about 120° with respect to adjacent spatial locations.

6. An apparatus in accordance with Claim 5 wherein the spatial location is substantially planar with adjacent spatial locations.

7. An apparatus in accordance with Claim 5 wherein a first spatial location of a light beam emitted from a first stationary sensor assembly of the at least two stationary sensor assemblies is positioned at a first position along a length of the filling spout and a second spatial location of a light beam emitted from a second stationary sensor assembly of the at least two stationary sensor assemblies is positioned at a second position along the length of the filling spout different from the first position.

8. An apparatus in accordance with Claim 3 wherein each stationary sensor assembly is configured to measure a first distance between a laser sensing component position and a corresponding spatial position on the outer surface of the filling spout and a second distance between the laser sensing component position and a spatial location on an outer surface of the container positioned about the filling spout.

9. An apparatus in accordance with Claim 8 wherein each stationary sensor assembly is positioned about the filling spout to measure a substantially equal first distance.

10. An apparatus in accordance with Claim 8 further comprising a controller operatively coupled to each stationary sensor assembly and in operational control communication with the filling spout, wherein, upon each stationary sensor assembly detecting the second distance, each stationary sensor assembly transmits a confirmation signal to the controller indicating that a container is properly positioned about the filling spout.

11. An apparatus in accordance with Claim 8 wherein, upon at least one stationary sensor assembly detecting the first distance, the at least one stationary sensor assembly prevents a confirmation signal from being transmitted to the controller indicating that a container is properly positioned about the filling spout.

12. An apparatus in accordance with Claim 8 wherein, upon at least one stationary sensor assembly detecting the first distance, the at least one stationary

sensor assembly transmits a container positioning error signal to the controller indicating that a container is not properly positioned about the filling spout.

13. An apparatus in accordance with Claim 1 further comprising a support configured for receiving, in succession, a plurality of containers, the support configured to maintain each successive container in an upright, substantially erect orientation, with the opening extending toward the apparatus.

14. An apparatus in accordance with Claim 1 further comprising a sealing apparatus including at least one sealing member configured to be reciprocally moved between a sealing position in operable engagement with the opening and a standoff position substantially removed from the container.

15. A detection system for determining whether a container is positioned about a filling spout of an apparatus for filling at least one container, the filling spout in flow communication with a source of filling material, the filling spout configured to enable an opening defined by the container to fit about the filling spout, the detection system comprising:

at least two stationary sensor assemblies positioned about the filling spout, each stationary sensor assembly of the at least two stationary sensor assemblies including a sensing component, the sensing component configured to measure a first distance from a sensing component location to a first spatial location on an outer surface of the filling spout and a second distance from the sensing component location to a second spatial location on an outer surface of the container positioned about the filling spout.

16. A detection system in accordance with Claim 15 wherein the sensing component comprises one of a laser sensing component, an ultrasonic sensing component and a photoeye sensing component.

17. A detection system in accordance with Claim 15 wherein each sensing component comprises a laser sensing component configured to emit a light

beam directed at the first spatial location on an outer surface of the filling spout, the laser sensing component electrically coupled to a controller configured to measure a first distance from a laser sensing component location to the first spatial location and a second distance from the laser sensing component location to the second spatial location.

18. A detection system in accordance with Claim 17 wherein the first spatial location of the light beam emitted from each laser sensing component is positioned radially about the outer surface of the filling spout at about 120° with respect to adjacent first spatial locations.

19. A detection system in accordance with Claim 17 wherein each first spatial location is substantially planar with adjacent first spatial locations.

20. A detection system in accordance with Claim 17 wherein a first spatial location of a light beam emitted from a first laser sensing component is positioned at a first position along a length of the filling spout and a first spatial location of a light beam emitted from a second laser sensing component is positioned at a second position along the length of the filling spout different from the first position.

21. A detection system in accordance with Claim 17 wherein each laser sensing component is calibrated to measure a substantially equal first distance.

22. A detection system in accordance with Claim 17 wherein, upon each laser sensing component detecting the second distance, each laser sensing component transmits a confirmation signal to the controller indicating that a container is properly positioned about the filling spout.

23. A detection system in accordance with Claim 17 wherein, upon at least one laser sensing component detecting the first distance, the at least one laser sensing component transmits a container positioning error signal to the controller indicating that a container is not properly positioned about the filling spout.

24. A method for filling at least one container, the at least one container defining an opening, an apparatus being positioned along a processing path, the method comprising:

placing a container on a support configured for receiving, in succession, a plurality of containers, the support configured to maintain each successive container in an orientation, with the opening extending toward the apparatus;

confirming that the container is positioned about a filling spout of the apparatus, the filling spout in flow communication with a source of filling material, the filling spout configured to enable the opening of a container to fit about the filling spout; and

filling the container with filling material.

25. A method in accordance with Claim 24 wherein confirming that the container is positioned about a filling spout further comprises:

positioning at least two stationary sensor assemblies with respect to the filling spout, each sensor assembly of the at least two stationary sensor assemblies including a laser sensing component configured to emit a light beam directed at a spatial location on an outer surface of the filling spout;

calibrating each laser sensing component to measure a first distance from a sensing component location to a spatial location on an outer surface of the filling spout;

detecting a second distance between each sensing component location and a spatial location on an outer surface of the container positioned about the filling spout; and

confirming that the second distance is less than the first distance.

26. A method in accordance with Claim 25 wherein, upon each sensing component detecting the second distance, each sensing component transmitting a confirmation signal to a controller in operational control communication with the filling spout indicating that a container is properly positioned about the filling spout.

27. A method in accordance with Claim 25 wherein, upon at least one sensing component detecting the first distance, the at least one sensing component transmitting a container positioning error signal to a controller in operational control communication with the filling spout indicating that a container is not properly positioned about the filling spout.

28. A method in accordance with Claim 27 further comprising preventing flow of filling material through the filling spout until each sensing component detects the second distance.

29. A method in accordance with Claim 24 further comprising sealing the container with a sealing apparatus while maintaining the container in the upright position on the support.

30. A method in accordance with Claim 24 further comprising reciprocally pivoting and translating the filling spout between a horizontal filling position and a retracted position, in which the filling spout is tilted, filling nozzle upward, and moved backward from the horizontal filling position.

31. A method for determining whether a container is positioned about a filling spout of an apparatus for filling at least one container, the filling spout in flow communication with a source of filling material and configured to enable an opening defined by the container to fit about the filling spout, the method comprising:

providing at least two stationary sensor assemblies positioned with respect to the filling spout, each stationary sensing assembly of the at least two stationary sensor assemblies including a sensing component;

calibrating each sensing component to measure a first distance from a sensing component position to a position on an outer surface of the filling spout; and

measuring a second distance between each sensing component position and a position on an outer surface of the container positioned about the filling spout.

32. A method in accordance with Claim 31 wherein, upon each sensing component detecting the second distance less than the first distance, each corresponding sensor assembly transmits a signal to a controller in operational control communication with the filling spout indicting that a container is positioned about the filling spout.

33. A method in accordance with Claim 31 wherein, upon at least one sensing component detecting the second distance equal to the first distance, a corresponding sensor assembly transmits a signal to a controller in operational control communication with the filling spout that a container is not positioned about the filling spout.

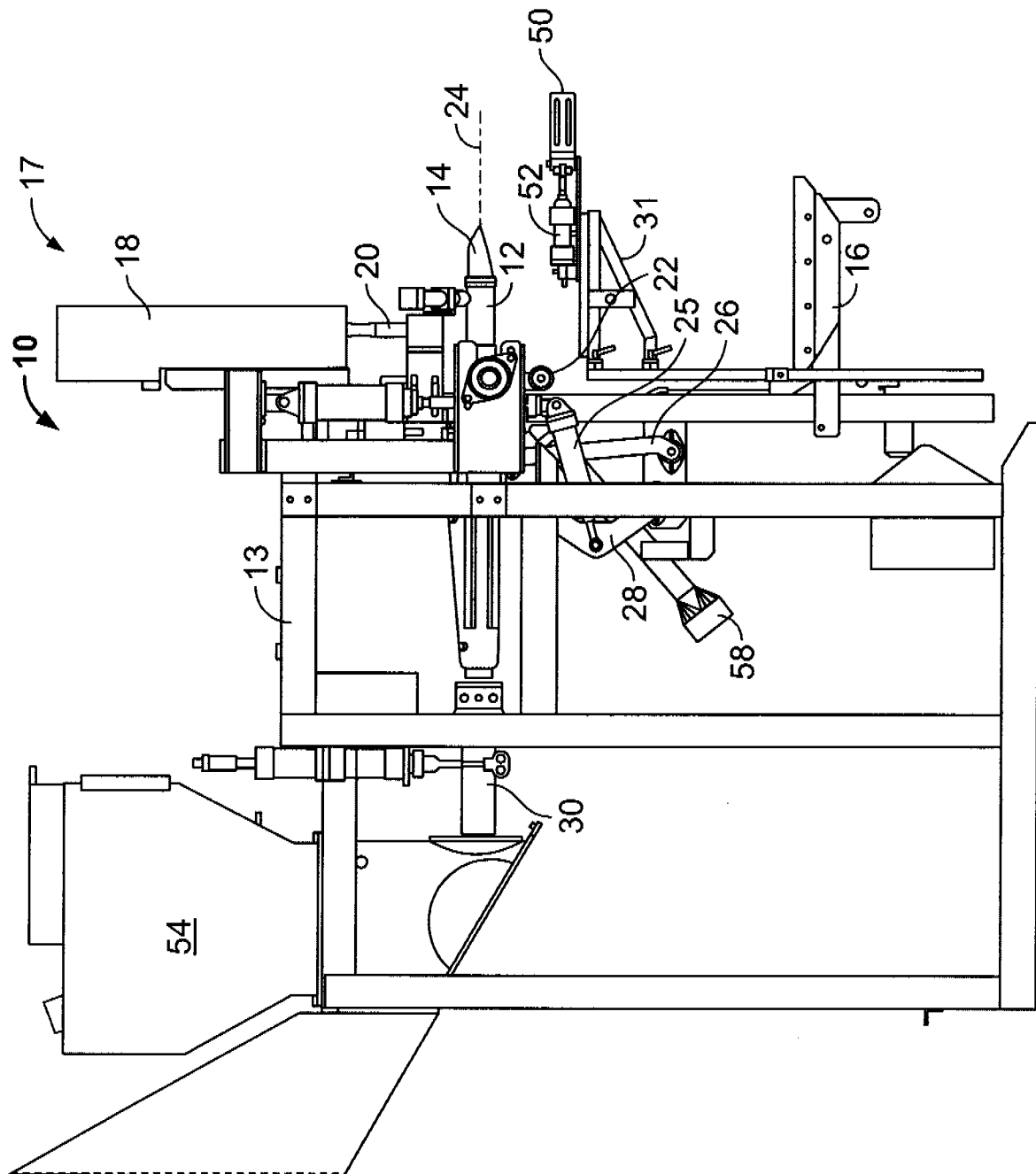


FIG. 1

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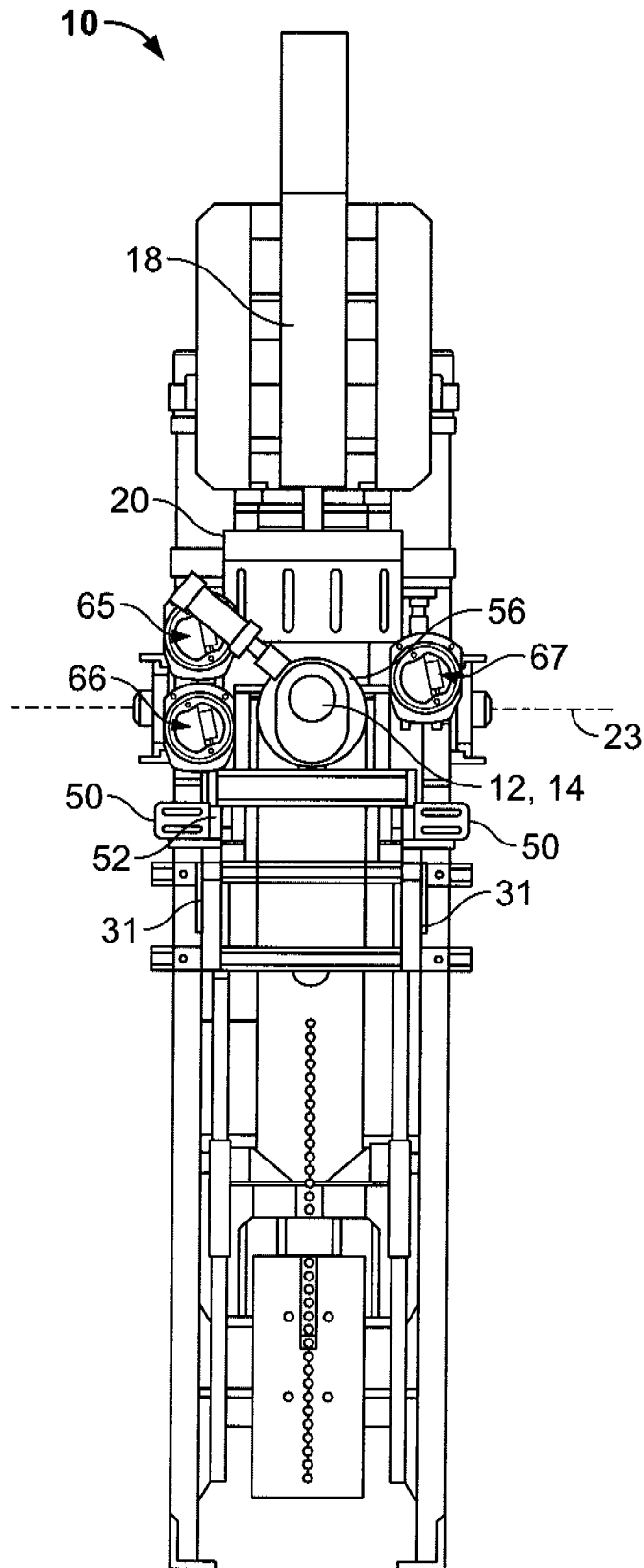


FIG. 2

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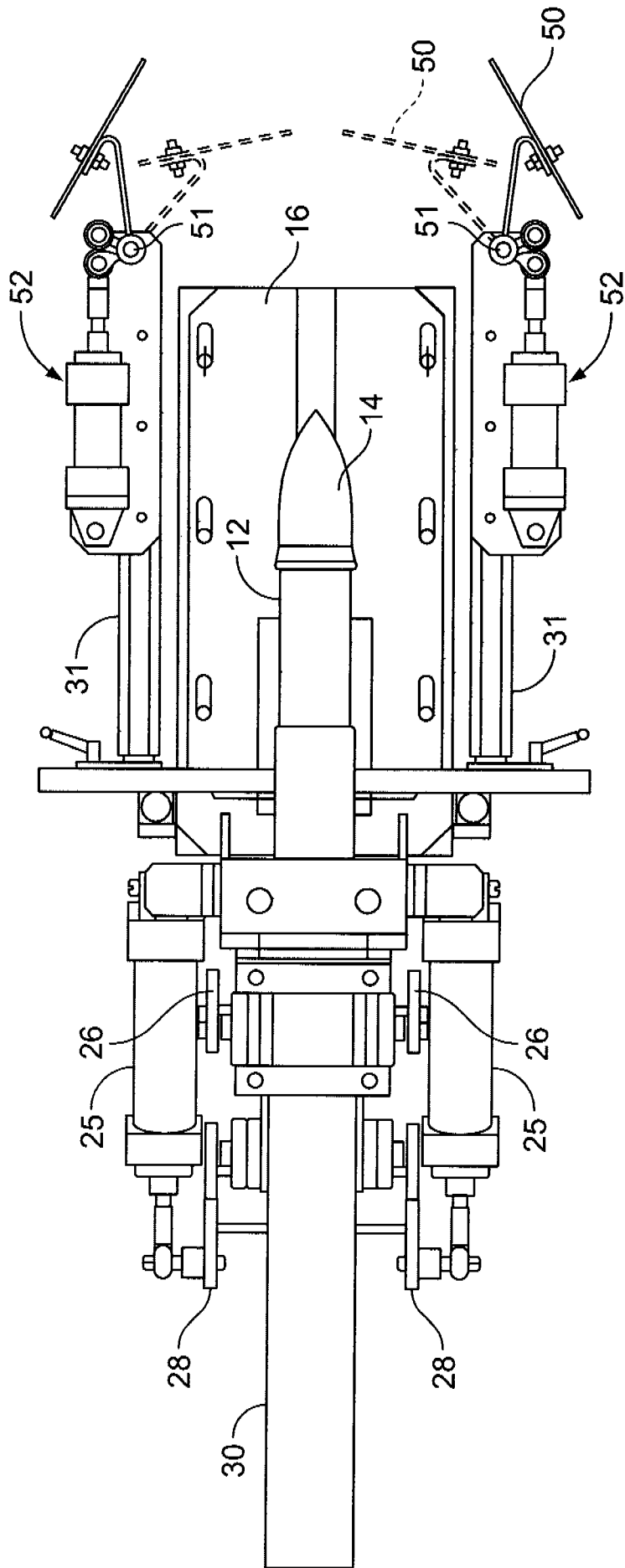


FIG. 3

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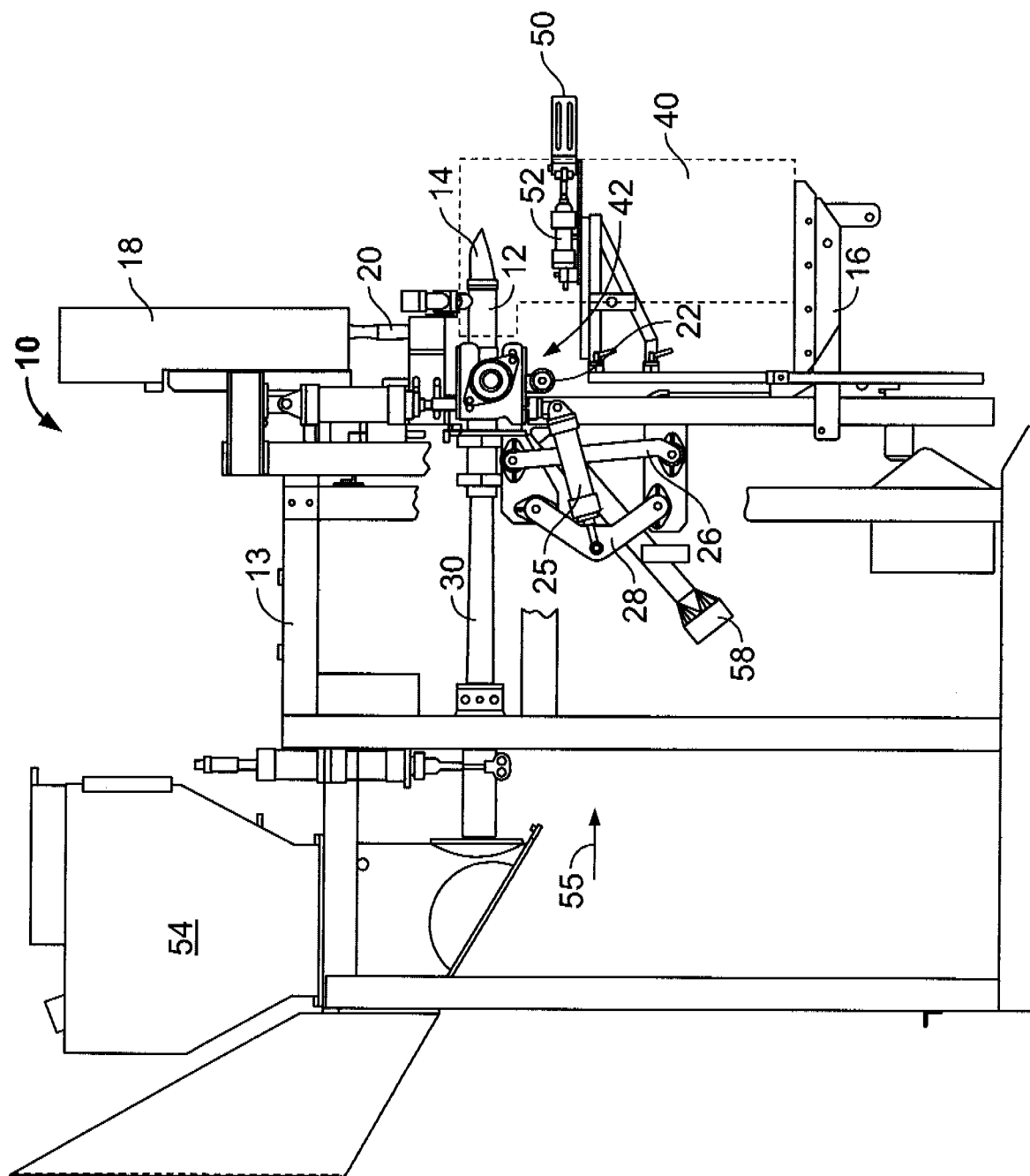


FIG. 4

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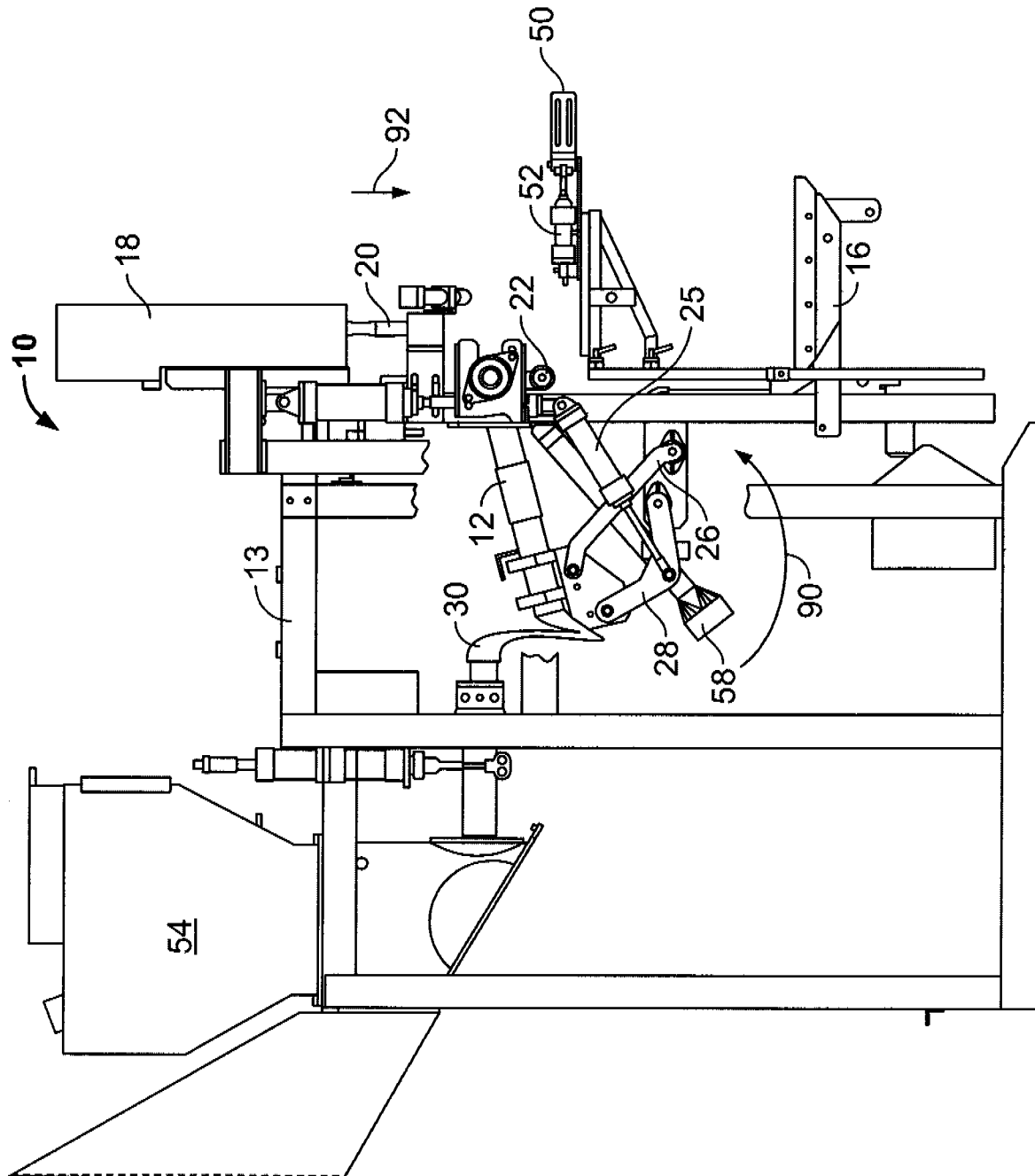


FIG. 5

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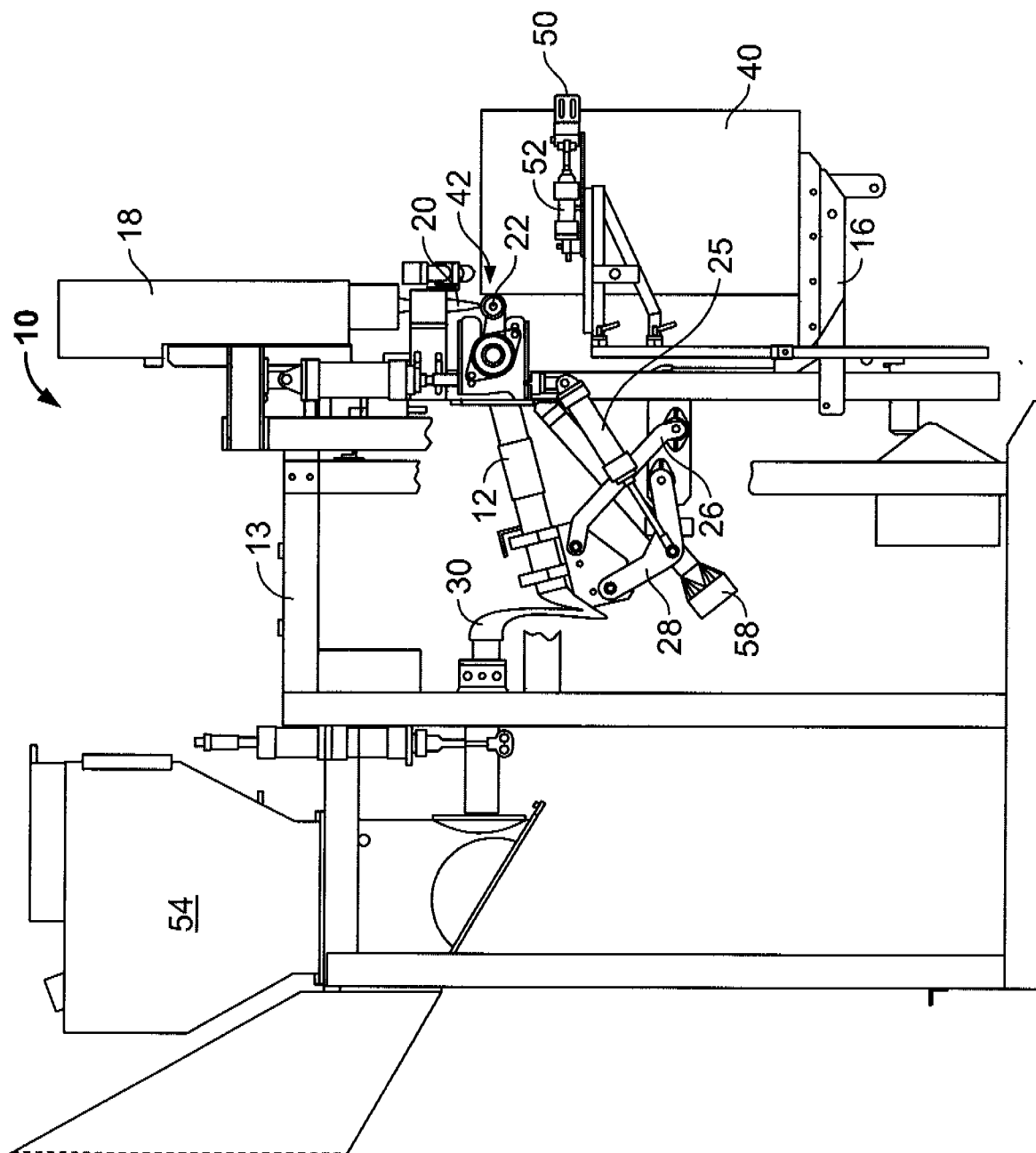


FIG. 6

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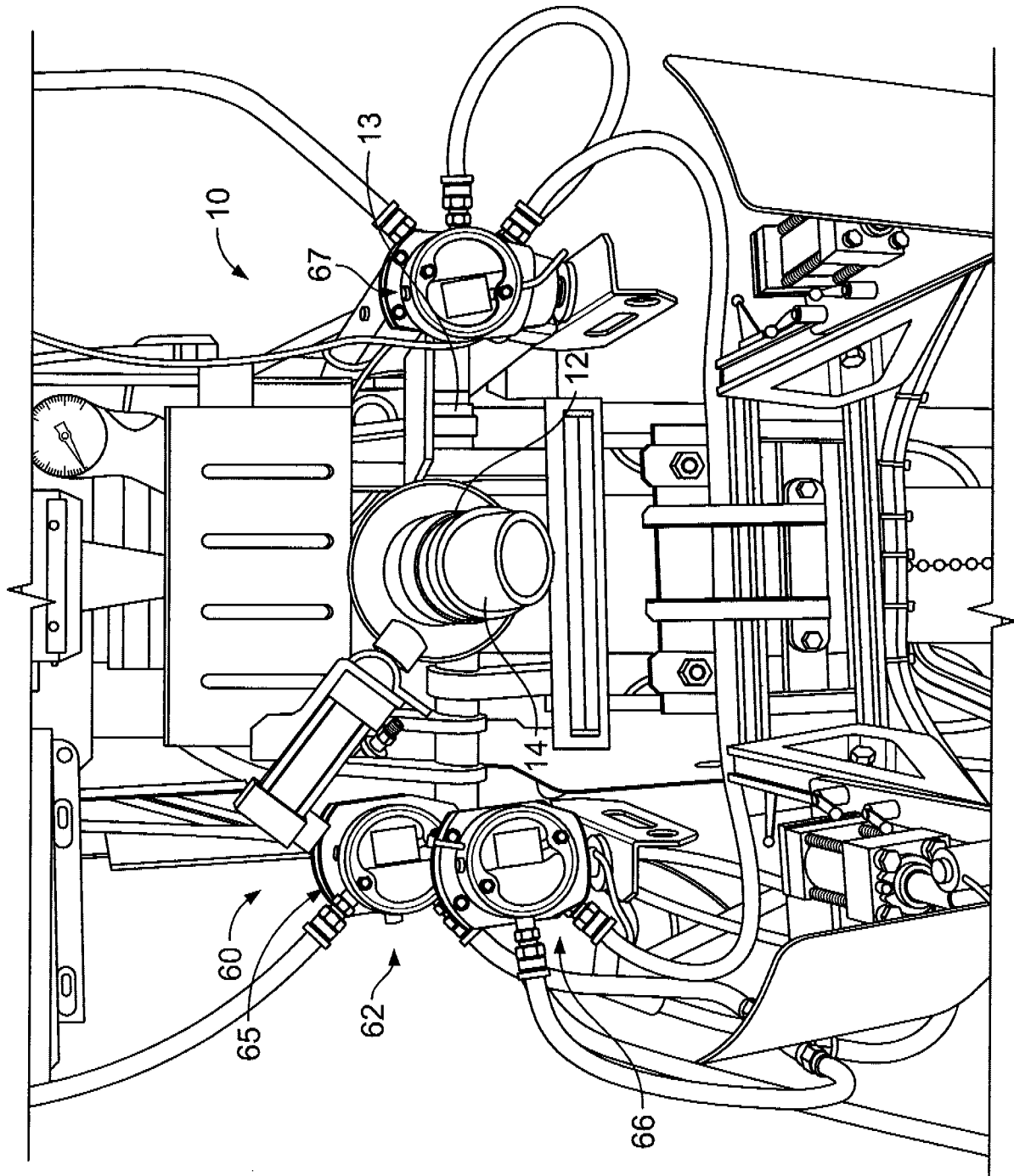


FIG. 7

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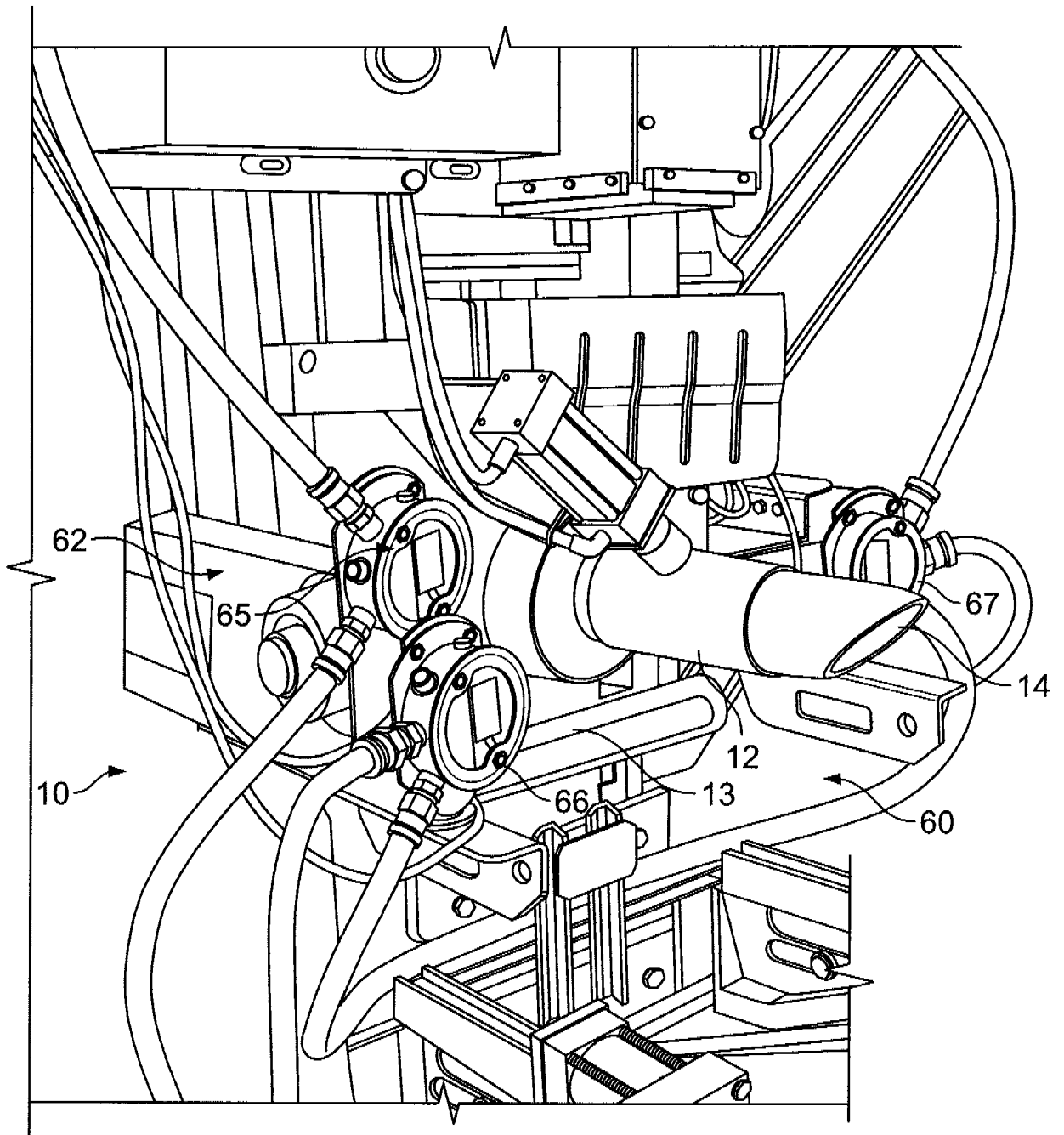


FIG. 8

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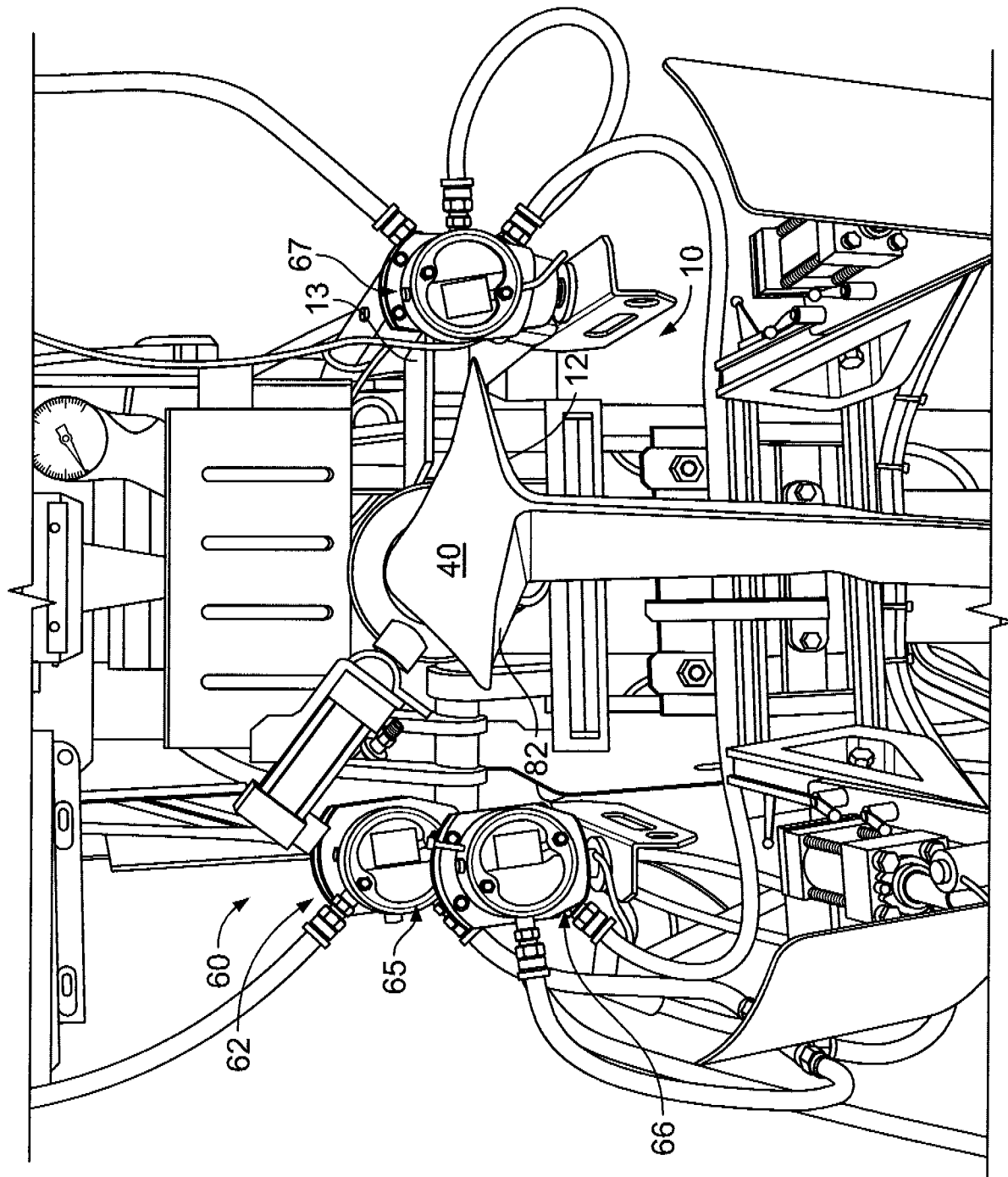


FIG. 9

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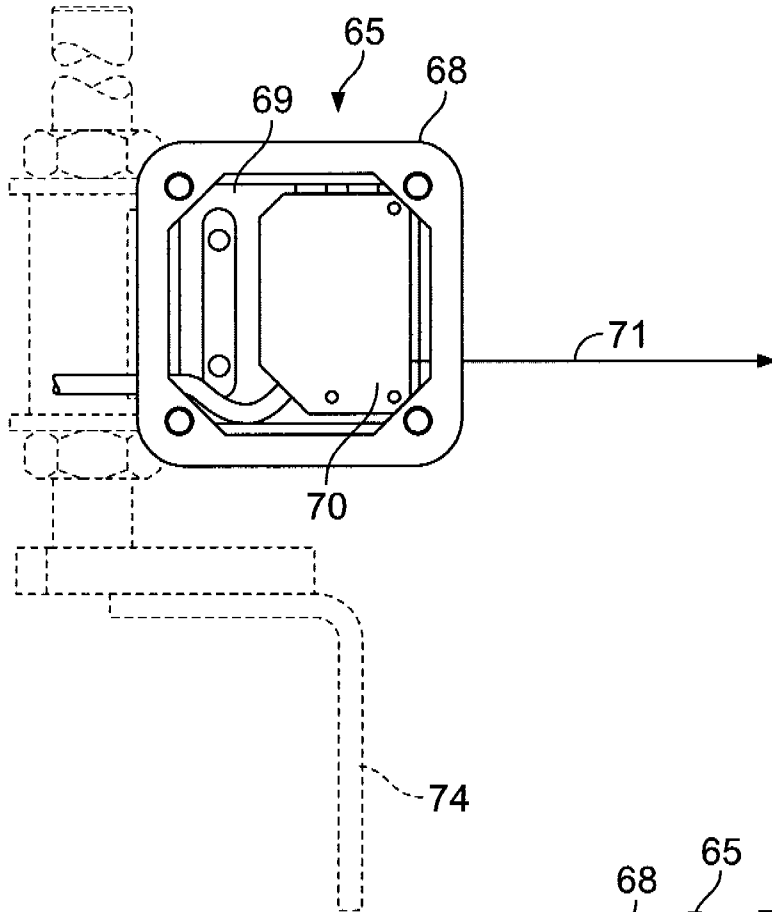


FIG. 10

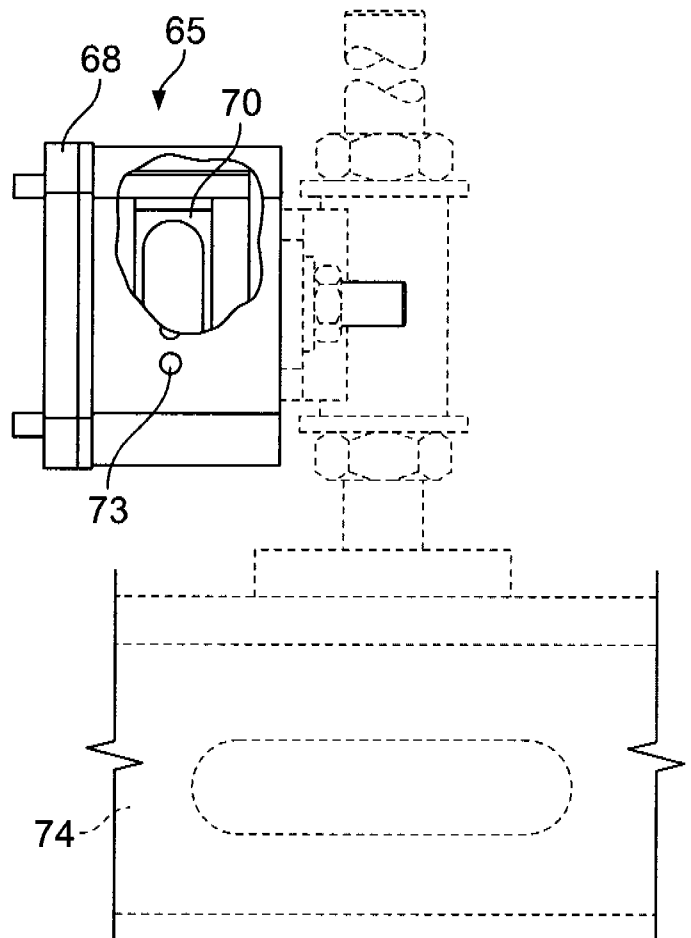


FIG. 11

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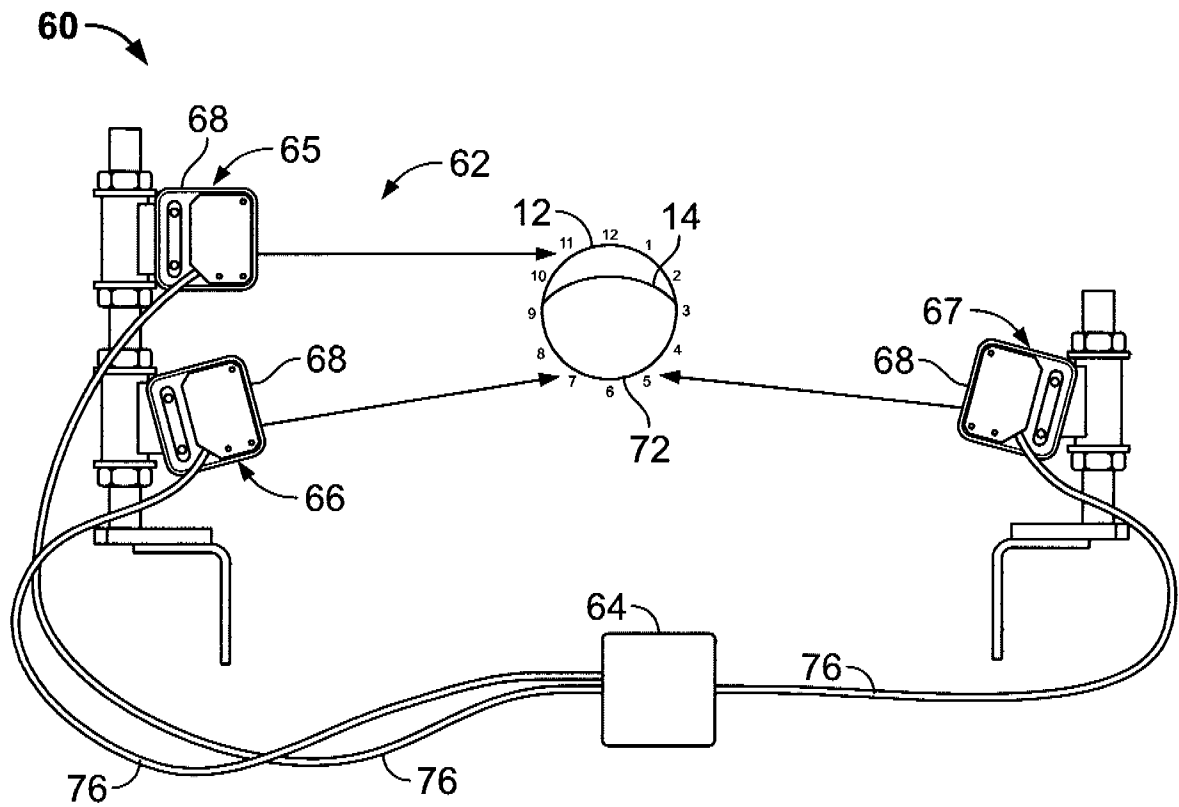


FIG. 12

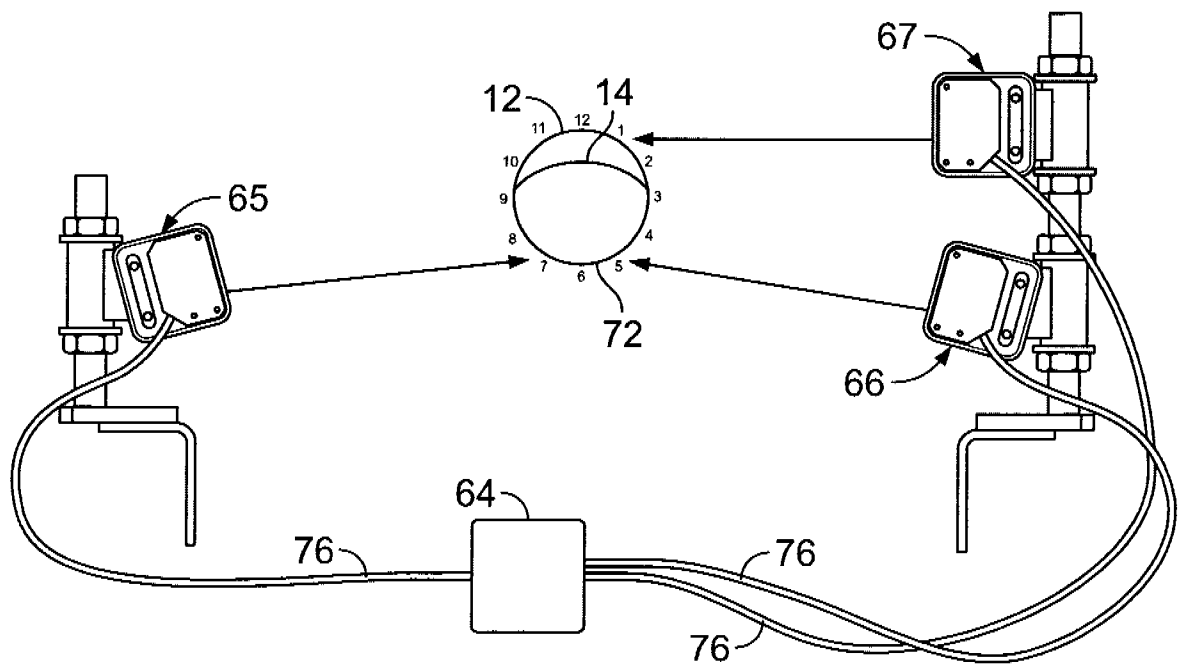


FIG. 13