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(54) **GRAVITY FLUID DELIVERY SYSTEM WITH NON-INTRUSIVE CONTROLLER**

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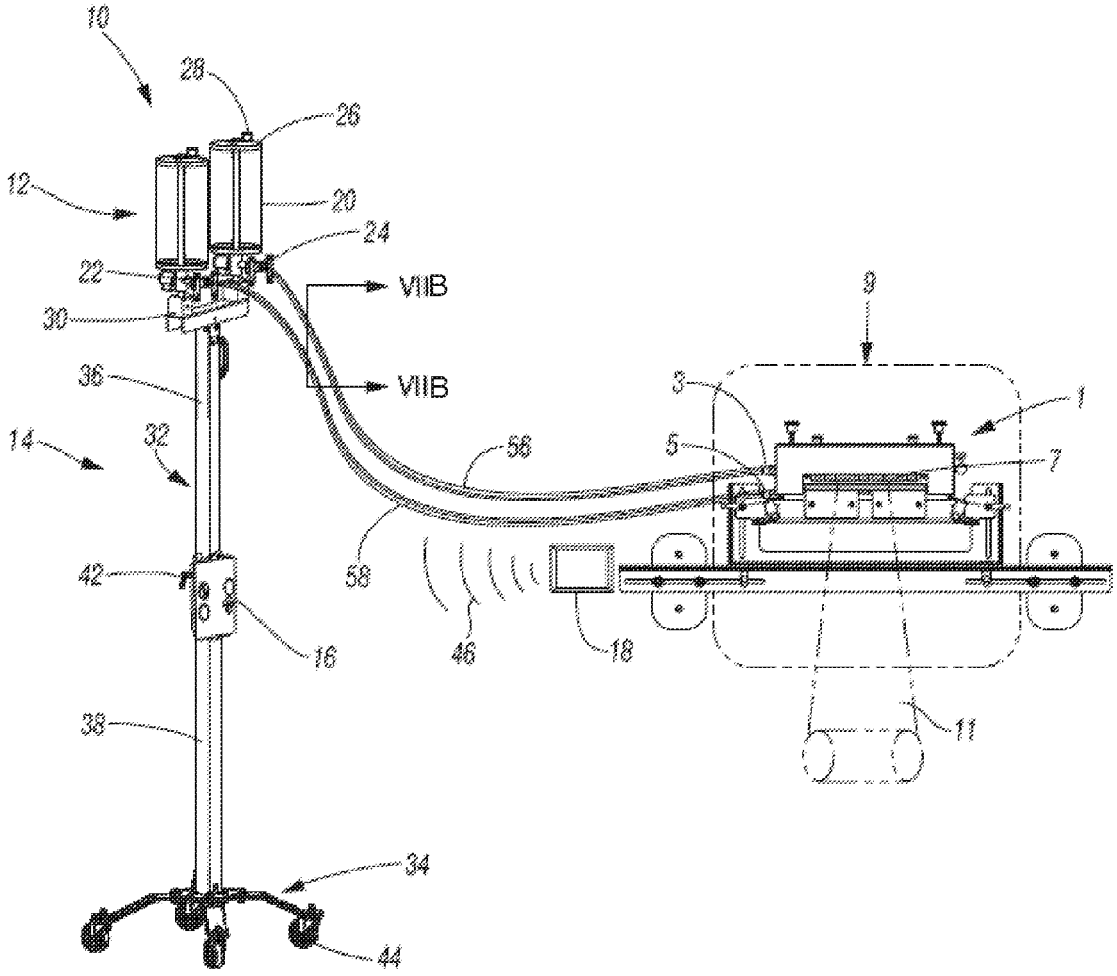
CPC ***F16K 17/36*** (2013.01)

(57) **ABSTRACT**

Systems and methods are provided for delivering fluid by gravity feed, the fluid feed being controlled by motion sensing.



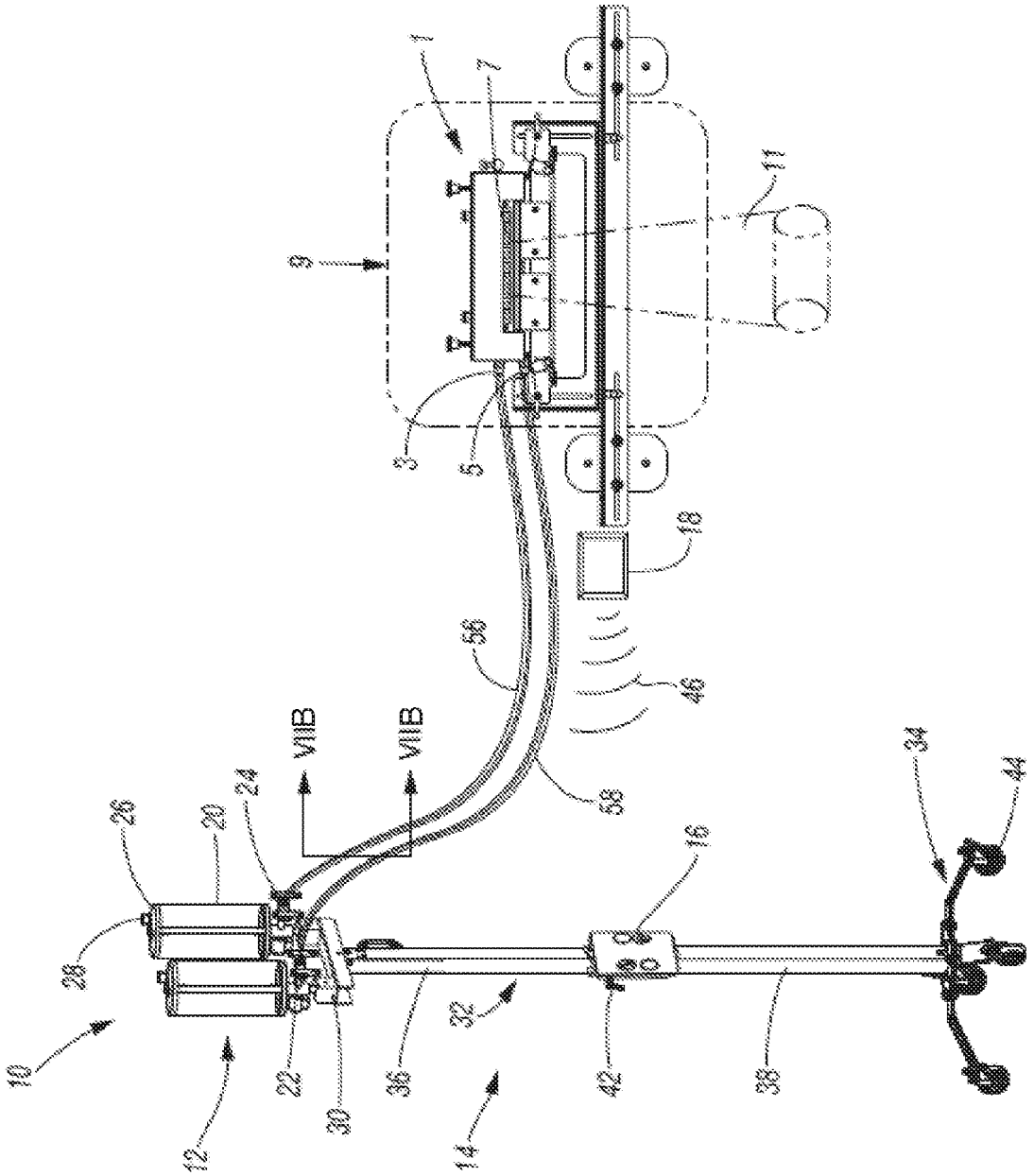

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FIG. 1

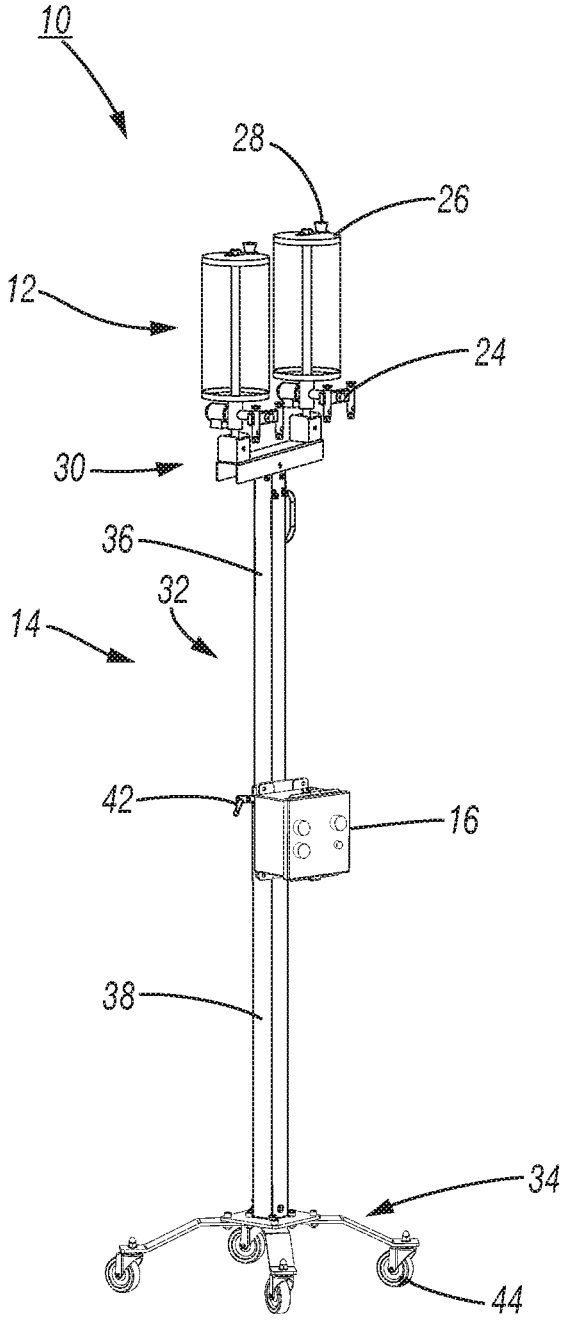

FIG. 2

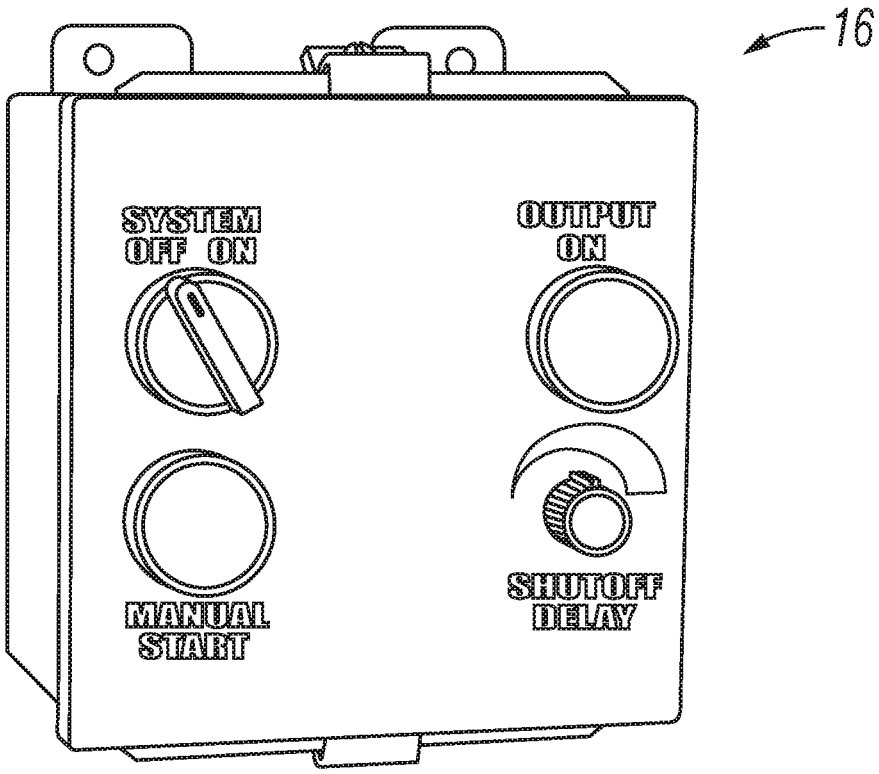

FIG. 3

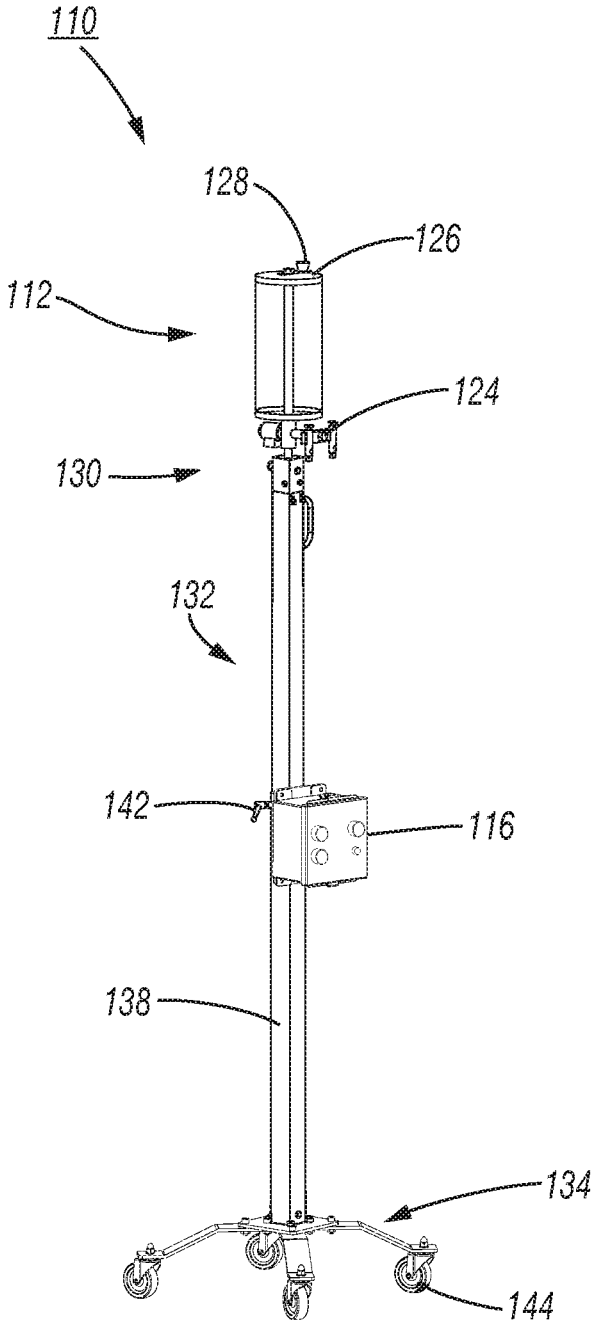

FIG. 4

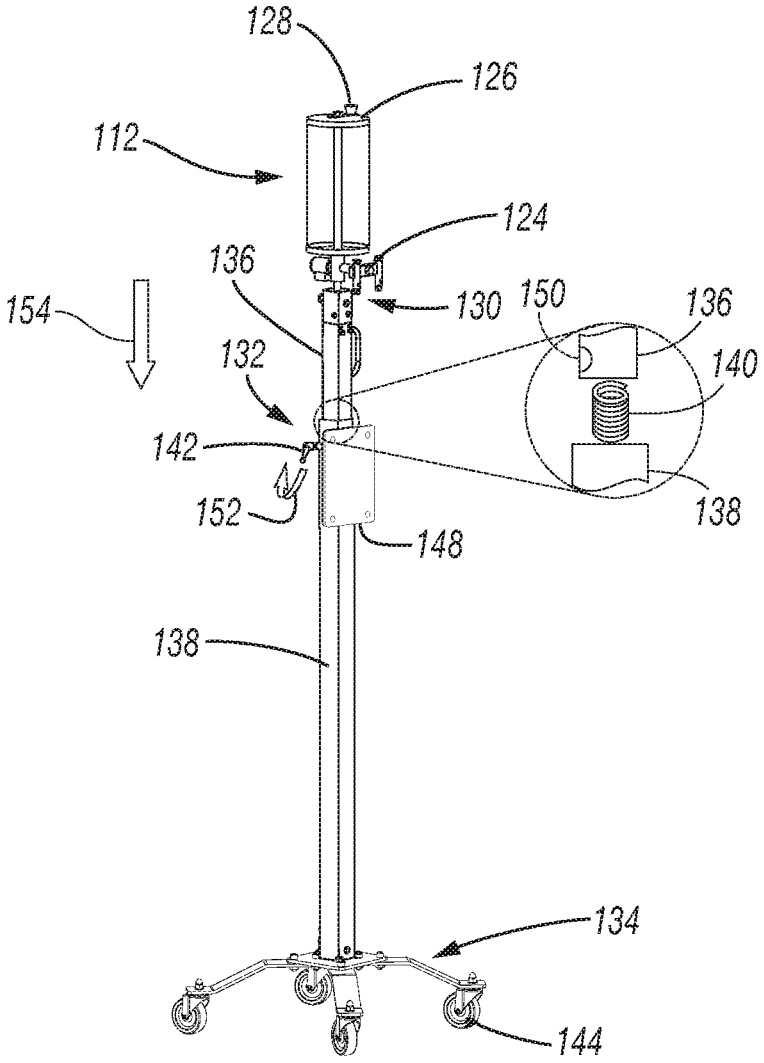
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FIG. 5

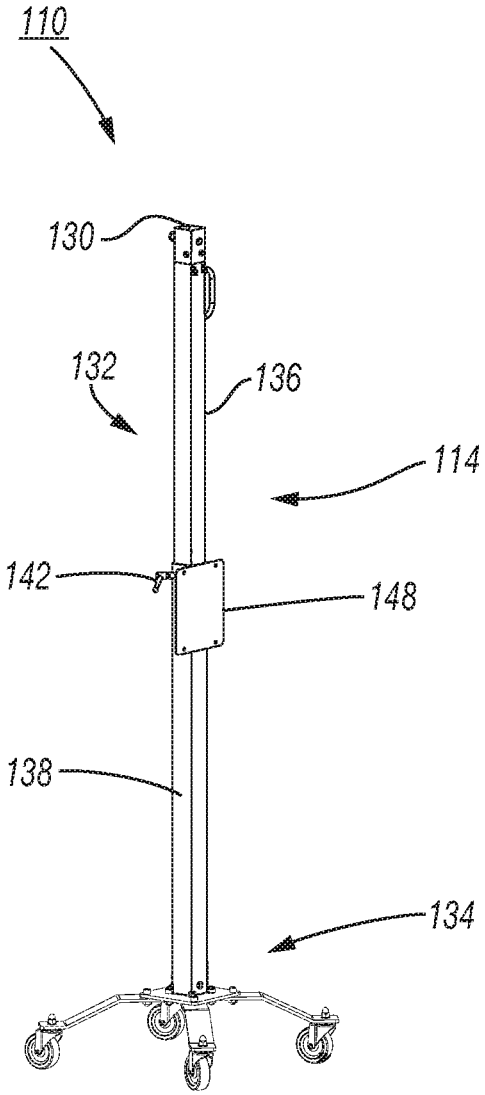

FIG. 6

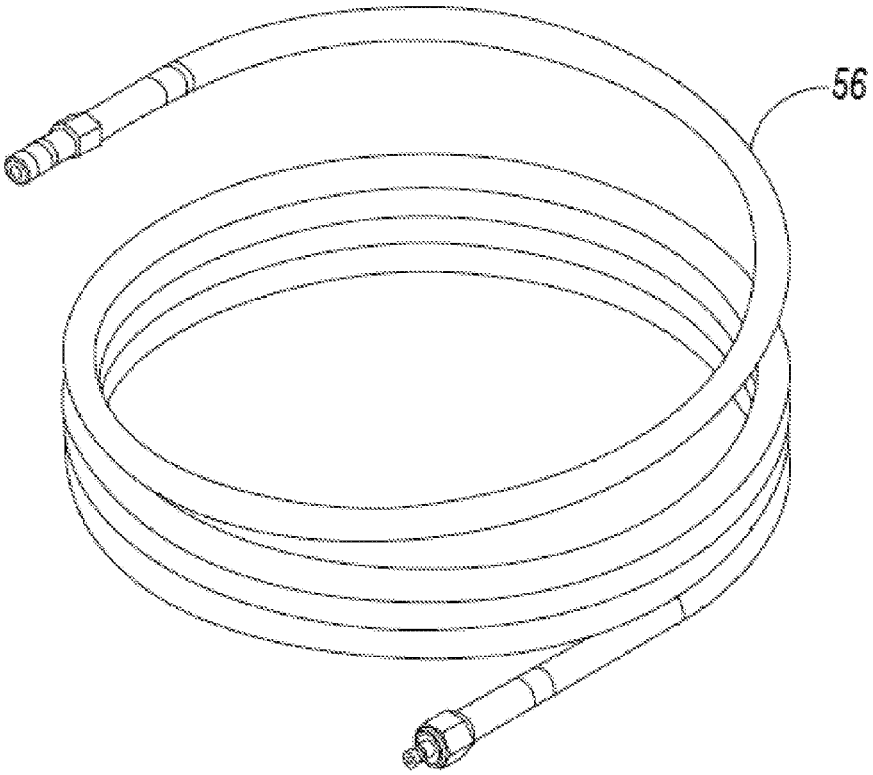

FIG. 7A

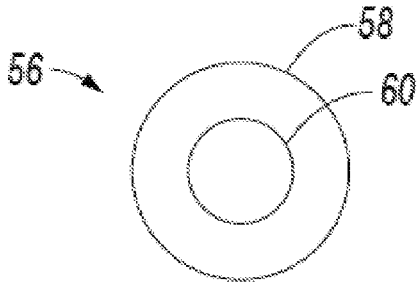

FIG. 7B

SECTION VIIB-VIIB

GRAVITY FLUID DELIVERY SYSTEM WITH NON-INTRUSIVE CONTROLLER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit of U.S. Provisional Patent Application Ser. No. 62/105,836, filed in the United States Patent and Trademark Office on Jan. 21, 2015, which is incorporated herein by reference in its entirety.

BACKGROUND OF THE DISCLOSURE

[0002] Fluid supply systems are used to deliver lubricants during infeeding of material, such as strip metals, to stamping presses and dies. Fluid applicators commonly used with gravity-fed fluid delivery systems are drip, wipers or rollers. Commercially available reservoirs with integral metering valves and solenoid activated shut-off valves are used widely.

[0003] The shut-off valve in a fluid supply system is provided to close a supply path from a fluid reservoir without losing an adjustment position of the metering valve(s), which might occur if the metering valve itself is used to shut-off fluid flow. The shut-off valve is operated manually in some primitive setups, which is labor-intensive and prone to error. For instance, if an operator fails to manually turn off the valve during periods of inactivity of a stamping machine, unintentional dispensing may occur. Accordingly, many companies opt for an electrically operated shut-off valve since an electrically operated shut-off valve is connected to the control wiring of the machine shut off occurs automatically when the press stops. However, the electrical shut-off valve option requires intrusion into a control system of the machine, requires a competent electrician to install, and often leads to a permanent installation of the delivery system, all of which increases costs. Moreover, permanent installation may be undesirable.

[0004] What is needed in the industry is a fast and easy method of changing lubrication type or concentration for a particular production run without the need for draining and flushing a reservoir and its lines. Additionally, a system is needed that is portable and can be used on multiple stamping machines without the need for maintenance personnel or permanent installation.

BRIEF SUMMARY OF THE DISCLOSURE

[0005] The present disclosure is directed in general to a fluid delivery system having a controller for automatic shut-off. The system detects motion of a ram or other reciprocating motion associated with a machine in operation. Detection is accomplished by a sensing or detection device such as an inductive proximity sensor affixed to a stationary face on a frame of the machine within range of the sensor. Alternatively, a mechanical limit switch may be used for the detection device.

[0006] In one aspect, the device is an applicator whereby lubricant is applied to the top and bottom surfaces of metal strips, typically from coil form, as it enters a stamping press or similar. Opposing rollers having a wicking surface, fibrous or otherwise, contact the named surfaces of the strip and roll on their axles by a motion created by the advancement of the strip being powered by its feeding system(s). The rollers are continuously replenished with lubricant, in this case internally, in graduated amounts to control the thickness of the coating.

[0007] A signal from the sensing device operates a "One Shot" timing relay to insure that a sustained signal cannot occur should the machine come to rest in a position where the sensor is on. A relay of this sort converts a sustained signal into a single pulse. From this "One Shot" relay, the output signal is fed to a "Delay On Break" timing relay. The operation of a relay of this sort is to "make" instantly once receiving a signal then "break" after an elapsed time period. If the next signal is received before the time expiration, the timer is reset and the relay effectively operates continuously. The output of this relay operates the solenoid valve on the reservoir.

[0008] According to another embodiment of the present disclosure, a roller assembly is configured for modular mounting and includes quick change features. The roller assembly may have a base affixable to stamping equipment. A roller applicator may be rapidly removed and replaced with another roller applicator without cleaning or contacting fluid application surfaces.

[0009] Another embodiment of the disclosure provides a gravity fluid delivery system, comprising a fluid reservoir; a portable fluid reservoir carrier; a controller; a motion sensor; and means for delivering fluid from the fluid reservoir to a fluid applicator. The fluid reservoir may be made of glass, plastic, metal or combinations of materials resistant to corrosive or abrasive distillates and chemicals. The controller may include a radiofrequency sensor in communication with the motion sensor. The motion sensor may be located near the fluid applicator. The means for delivering fluid from the fluid reservoir to the fluid applicator may be a hose or pipe having an inner tube disposed in an outer tube configured to reduce hose movement if the hose is pressurized.

[0010] In a particular embodiment, a gravity lubrication delivery system may include an automatic shut-off valve that is activated by motion of a machine in operation.

[0011] In another aspect, a non-intrusive control system that does not require hardwiring to the machine control or other programmable cam switches may be provided.

[0012] Additional objects and advantages of the present subject matter are set forth in, or will be apparent to, those of ordinary skill in the art from the description herein. Also, it should be further appreciated that modifications and variations to the specifically illustrated, referenced, and discussed features, processes, and elements hereof may be practiced in various embodiments and uses of the disclosure without departing from the spirit and scope of the subject matter. Variations may include, but are not limited to, substitution of equivalent means, features, or steps for those illustrated, referenced, or discussed, and the functional, operational, or positional reversal of various parts, features, steps, or the like. Those of ordinary skill in the art will better appreciate the features and aspects of the various embodiments, and others, upon review of the remainder of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] A full and enabling disclosure of the present subject matter, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures, in which:

[0014] FIG. **1** is a perspective view of a gravity fluid delivery system connected to a roller lubricator system (shown schematically) in an intended use environment according to an aspect of the present disclosure;

[0015] FIG. **2** is a perspective view of a gravity fluid delivery system as in FIG. **1**;

[0016] FIG. **3** is a perspective view of a controller used with the gravity fluid delivery system as in FIG. **1**;

[0017] FIG. **4** is a perspective view of a gravity fluid delivery system according to another aspect of the disclosure;

[0018] FIG. **5** is a perspective view of the gravity fluid delivery system as in FIG. **4** and a partial inset, exploded view showing preparations to remove an empty fluid cylinder from a carrier;

[0019] FIG. **6** is a perspective view of the gravity fluid delivery system as in FIG. **5**, particularly showing a fluid cylinder removed from the carrier; and

[0020] FIG. **7** includes perspective and cross-sectional views (taken along line VII-VII in FIG. **1**) of a fluid delivery hose that may be used in a fluid delivery system according to another aspect of the disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0021] In general, the present disclosure provides systems and methods for improving operations and functionality of applicator devices during treatment of stock metal strips before the stock enters a stamping press or similar production line. The systems are economical to make and use.

[0022] Detailed reference will now be made to the drawings in which examples embodying the present subject matter are shown. The drawings and detailed description provide a full and written description of the present subject matter, and of the manner and process of making and using various exemplary embodiments, so as to enable one skilled in the pertinent art to make and use them, as well as the best mode of carrying out the exemplary embodiments. However, the examples set forth in the drawings and detailed descriptions are provided by way of explanation only and are not meant as limitations of the disclosure. The present subject matter thus includes any modifications and variations of the following examples as come within the scope of the appended claims and their equivalents. The detailed description uses numerical and letter designations to refer to features of the drawings.

[0023] Turning now to the figures, FIGS. **1** and **2** show a gravity fluid delivery system, designated in general by the numeral **10**, arranged next to and connected or attached to a roller lubricator system **1**, which is operably connected to a press or stamping machine **9** (shown in phantom for clarity). A preferred roller lubricator system **1** is available from Automated Tool and Machine, Inc. of Brevard, N.C., USA. As shown, the exemplary gravity fluid delivery system **10** broadly includes one or more fluid containers or reservoirs **12**, a fluid reservoir carrier or portable stand **14**, a controller **16**, and a proximity or motion sensor and controller **18**. As shown, by way of brief introduction, a sheet of material such as stock metal **11** in coil form may be unrolled into the roller lubricator system **1**. In this example, two reservoirs **12** of the gravity fluid delivery system **10** deliver a fluid such as a lubricant to rollers **7** in the roller lubricator system **1**. The rollers **7** apply a lubrication fluid to a surface of the metal **11**, and the metal **11** proceeds downstream in a production line where the lubricated metal **11** is stamped, cut or the like.

[0024] With particular reference to the reservoirs **12** shown in FIGS. **1** and **2**, each reservoir **12** includes a container **20** that may be a clear material to facilitate visual inspection of fluid inside the container **20**. Preferably, the containers **20** are made of clear glass or a non-reactive, impermeable, clear plastic material such as acrylic to withstand various types of chemical lubricants use in metal stamping or pressing processes. Here, the containers **20** each have an attachment or base end **22** with a quick hose connector or discharge valve **24** located at or near the base **22** in this example. A top or filling end **26** of each container **20** may have a quick fill connector **28** to re-fill the container **20** when it becomes empty, as explained below. Moreover, the system **10** could be used on multiple stamping machines **9**. Due to the portability of the system **10**, it can be repurposed on another machine **9** in a matter of minutes. This procedure can be easily accomplished by a press setter without requiring maintenance personnel or an electrician to permanently install the system **10**. The fact that the delivery system **10** is not physically attached to the stamping equipment **9** significantly reduces fluid changeover time for short run productions.

[0025] Also shown in FIGS. **1** and **2**, the discharge valves **24** of each of the containers **20** is connected to respective fluid hoses **56**, **58**, such as lubricant hoses available from Automated Tool and Machine, Inc. of Brevard, N.C., USA. The fluid hoses **56**, **58** in turn are connected to respective quick connectors **3**, **5** of the roller lubricator system **1**. Thus, lubricating fluid from the reservoirs **12** is injected into, soaked up by, or permeates the rollers **7**, which in turn contact the metal **11** as it passes through the rollers **7**.

[0026] Also shown in the example in FIG. **1**, the fluid reservoir carrier **14** includes a reservoir end **30**, a telescoping body or frame **32**, and a roller base **34**. The reservoir end **30** is configured to receive and seat the base end **22** of the container **20** introduced above. Here, the telescoping body **32** has a first, top or distal end **36** and a second, bottom, or proximal end **38**, which has a generally larger inner circumference or perimeter than an outer circumference or perimeter of the top end **36**. A control latch or handle **42** is used to recess a portion of the top end **36** into a portion of the bottom end **38**, as explained in greater detail below. Also in this example, the roller base **34** may include a plurality of wheels **44** to move or maneuver the gravity fluid delivery system **10** to a desired position.

[0027] FIG. **1** further shows the motion sensor **18** arranged at or near the stamping machine **9**. The motion sensor **18** detects the motion of a ram or other reciprocating motion associated with the machine **9** while in operation. The motion sensing and detecting, indicated by electromagnetic waves or rays **46**, is accomplished by affixing or positioning the sensor **18** to a stationary face, for example, on a frame of the machine **9** within range of the sensor **18**. Here, the sensor **18** is an inductive proximity sensor but other sensors such as a mechanical limit switch may be used as the detection device **18**. As shown, the motion sensing and detecting **46** is relayed to the controller **16**.

[0028] FIGS. **2** and **3** more clearly show the controller **16**. Once the controller **16** is turned on, a signal from the sensing device **18** will automatically operate a "one shot" timing relay to insure that a sustained signal cannot occur should the machine **9** come to rest in a position where the sensor **18** is on. A relay of this sort converts a sustained signal into a single pulse. From this "one shot" relay, the output signal is fed to a "Delay On Break" timing relay. The operation of such a relay of this sort is to "make" instantly once receiving a signal then "break" after an elapsed time period. If the next signal is received before the time expiration, the timer is reset and the relay effectively operates continuously. The output of this relay operates the solenoid valve on the reservoir **18** to shut off the reservoir **18**.

[0029] FIG. **4** shows a gravity fluid delivery system designated in general by the numeral **110** according to another aspect of the disclosure. The gravity fluid delivery system **110** broadly includes a fluid container or reservoir **112**, a fluid reservoir carrier or portable stand **114**, a controller **116**, and a proximity or motion sensor and controller **118**. In this example, the reservoir **112** of the gravity fluid delivery system **110** is designed to hold and deliver a fluid such as a lubricant to a lubricator system to apply a lubrication fluid to a surface of a metal for stamping, cutting or the like.

[0030] The reservoir **112** shown in FIG. **4** includes a container **120** that may be a clear material to facilitate visual inspection of fluid inside the container **120**. Preferably, the container **120** is made of clear glass or a non-reactive, impermeable material to withstand various types of chemical lubricants use in metal stamping or pressing processes. As FIG. **4** further shows, the container **120** has an attachment or base end **122** with a quick hose connector or discharge valve **124** located at or near the base **122**. A top or filling end **126** of the container **120** may have a quick fill connector **128** to re-fill the container **120** when it becomes empty, as explained below. The discharge valve **124** of the container **120** is connected to a fluid hose such as a Kickless™ lubricant hose available from Automated Tool and Machine, Inc. of Brevard, N.C., USA, as shown for example in FIG. **7**. The fluid hose in turn will be connected to a lubricator system to prepare a material such as metal for stamping, cutting or pressing.

[0031] Also shown in the example in FIG. **4**, the fluid reservoir carrier **114** includes a reservoir end **130**, a telescoping body or frame **132**, and a roller base **134**. The reservoir end **130** is configured to receive and seat the base end **122** of the container **120** noted above. The telescoping body **132** has a first, top or distal end **136** and a second, bottom, or proximal end **138** having a generally larger inner circumference or perimeter than an outer circumference or perimeter of the top end **136**. A control latch or handle **142** is used to recess a portion of the top end **136** into a portion of the bottom end **138**, as explained in greater detail below. The roller base **134** may include a plurality of wheels **144** to move or maneuver the gravity fluid delivery system **110** to a required position.

[0032] FIG. **5** shows by way of example operation an empty reservoir **112** being readied for removal and replacement or refilling. Here, the release latch or control handle **142** is rotated in a release direction **152** to lower the first end **136** into the second end **138** as indicated by the direction arrow **154**. More particularly, as shown exploded in an inset view, a gas spring or conventional spring **140** is arranged within and between the first and second ends **136**, **138**. This arrangement permits the empty reservoir **112** to be lowered to a workable height, for instance, to avoid fluid spills by having to stand on a ladder to refill the container **120**. Once the desired refill height or first state is reached, the latch **142** can be returned to a locking position and lock into a notch or keyhole **150**, for instance, to hold the compressed assembly in the first state during refilling. Once the reservoir **112** is refilled or replaced, the control handle **142** is rotated by reversing the direction **152** urging the spring **140** to cause the first end **136** to return to an extended position or second state. Those skilled in the art will appreciate that other forms of unlocking and adjusting the telescoping parts **136**, **138** relative to each other can be practiced and are within the scope of equivalents of the disclosure.

[0033] Turning to FIG. **6**, the fluid reservoir carrier **114** with the reservoir end **130**, the frame **132**, and the roller base **134** is shown with the reservoir **112** and the controller **116** removed from an exemplary holding or attachment plate **148** (compare FIG. **4**). This may be desired when the lubrication type or concentration needs to be changed for a particular production run. Accordingly, the reservoir **112** can simply be removed without needing to drain and flush the reservoir **112** and associated fluid lines. Additionally, a user could simply disconnect fluid supply lines from a fluid applicator, roll the delivery system **110** aside and replace it with another having a reservoir **112** filled with the desired lubricant. Here, the handle **142** is shown returned to an unlocked, normal or relaxed position and the first arm **136** has extended from the second arm **138** of the frame **132**.

[0034] FIG. **7** shows an exemplary fluid delivery hose assembly **56**. Also shown in cross section from FIG. **1**, the hose assembly **56** includes an outer tube **58** and an inner composite tube **60** with rigid walls. In this example, the inner composite tube **60** is approximately ⅛ inch in diameter; however, such a tube alone would weigh relatively little and would move more if pressure were applied. Tube movement may damage a hose and cause leaks and increase the risk of harm to personnel if the tube moves into a walkway. Stated another way, as diameter decreases in order to achieve a better dispense, pressure rating increases, and there is more tube movement. Therefore, the outer tube **58** surrounds the necessarily smaller inner tube **60** to reduce movement or flopping and to achieve a better or more precise fluid dispense if a system is augmented by pressurization.

[0035] While the present subject matter has been described in detail with respect to specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing may readily produce alterations to, variations of, and equivalents to such embodiments. Accordingly, the scope of the present disclosure is by way of example rather than by way of limitation, and the subject disclosure does not preclude inclusion of such modifications, variations and/or additions to the present subject matter as would be readily apparent to one of ordinary skill in the art.

That which is claimed is:

1. A gravity fluid delivery system, comprising:

a fluid reservoir;

a portable fluid reservoir carrier;

a controller;

a motion sensor; and

means for delivering fluid from the fluid reservoir to a fluid applicator.

2. The gravity fluid delivery system as in claim **1**, wherein the fluid reservoir is made of a material selected from the group consisting of glass, plastic, metal and combinations thereof.

3. The gravity fluid delivery system as in claim **1**, wherein the portable fluid reservoir carrier includes wheels.

4. The gravity fluid delivery system as in claim **1**, wherein the controller includes a sensor in communication with the motion sensor.

5. The gravity fluid delivery system as in claim **1**, wherein the motion sensor is disposed proximate the fluid applicator.

6. The gravity fluid delivery system as in claim **1**, wherein the means for delivering fluid from the fluid reservoir to the fluid applicator is a hose having an inner tube disposed in an outer tube configured to reduce hose movement when the hose is pressurized.

7. A gravity fluid delivery system, comprising:

a fluid reservoir;

a fluid reservoir carrier;

a controller;

an inductive proximity or electromagnetic sensor disposed proximate a fluid applicator on a stamping line, the sensor being configured to sense motion in the stamping line; and

a pressure-responsive hose for delivering fluid from the fluid reservoir to a fluid applicator, the sensor in communication with the controller to deliver fluid from the fluid reservoir based on the sensed motion.

8. The gravity fluid delivery system as in claim **7**, wherein the fluid reservoir is made from a corrosive-resistant material.

9. The gravity fluid delivery system as in claim **7**, wherein the pressure-responsive hose includes a first tube disposed within a second tube and configured to reduce hose movement when the pressure-responsive hose is pressurized.

10. A gravity fluid delivery system, comprising:

a fluid reservoir;

a portable fluid reservoir carrier, the fluid reservoir attached thereto;

a controller in wireless communication with a stamping line;

a motion sensor disposed proximate the stamping line;

a shut-off valve; and

a pressure-sensitive conduit for delivering fluid from the fluid reservoir to a fluid applicator attached to the stamping line.

11. The gravity lubrication delivery system in claim **10**, wherein the shut-off valve is activated by motion of the stamping line.

* * * * *