US 20080098783A1

(19) United States

(12) Patent Application Publication

Gillest

(10) Pub. No.: US 2008/0098783 A1

(43) Pub. Date: May 1, 2008

(54) NON-CONTACT SPRAY LUBRICATOR

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(21) Appl. No.: **11/866,236**

(22) Filed: **Oct. 2, 2007**

Related U.S. Application Data

(60) Provisional application No. 60/827,897, filed on Oct. 3, 2006.

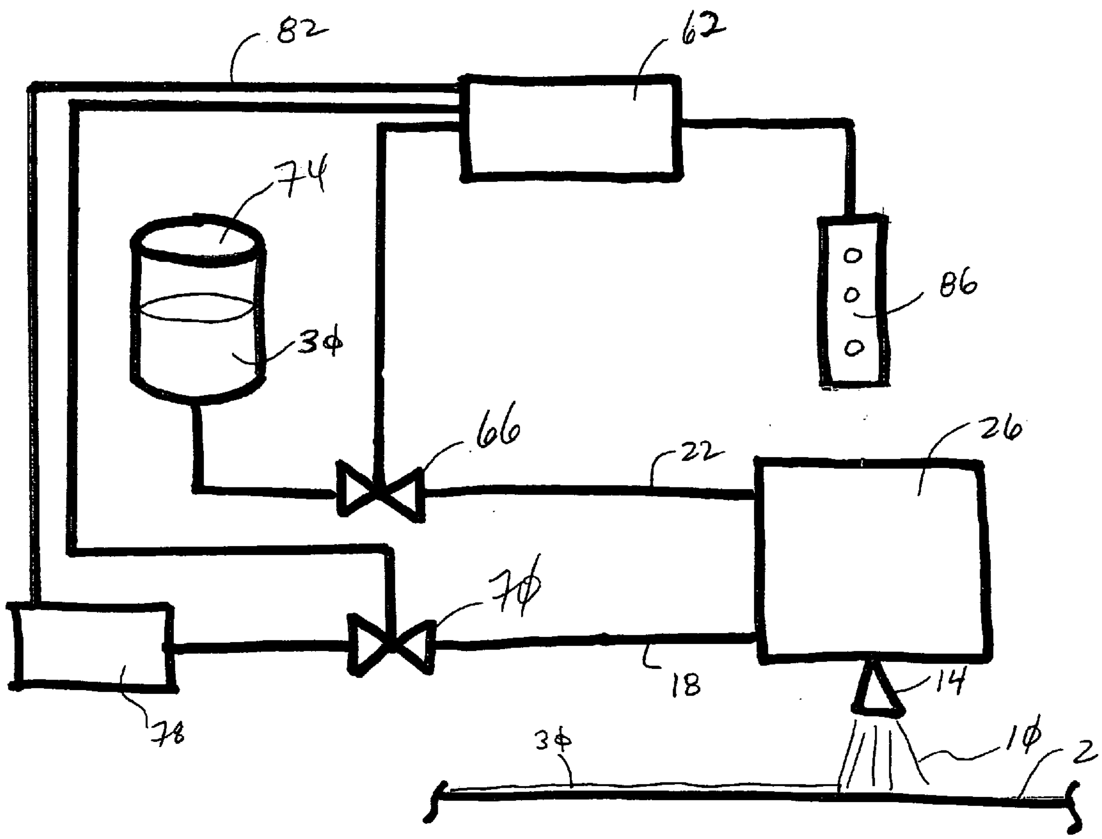
Publication Classification

(51) **Int. Cl.**
B21B 45/02 (2006.01)
B21B 45/00 (2006.01)

(52) **U.S. Cl.** **72/44**; 72/362; 72/43

(57) **ABSTRACT**

A non-contact spray lubrication device is provided that applies a thin layer of lubrication to a sheet of metal emanating from a coil. The amount of lubrication is important for metal forming and thus the speed of which the coil is being placed near nozzles of the non-contact spray lubricator is monitored by a plurality of proximity sensors that dictate the amount of spray being dispensed out of a nozzle and/or the speed of the coil.



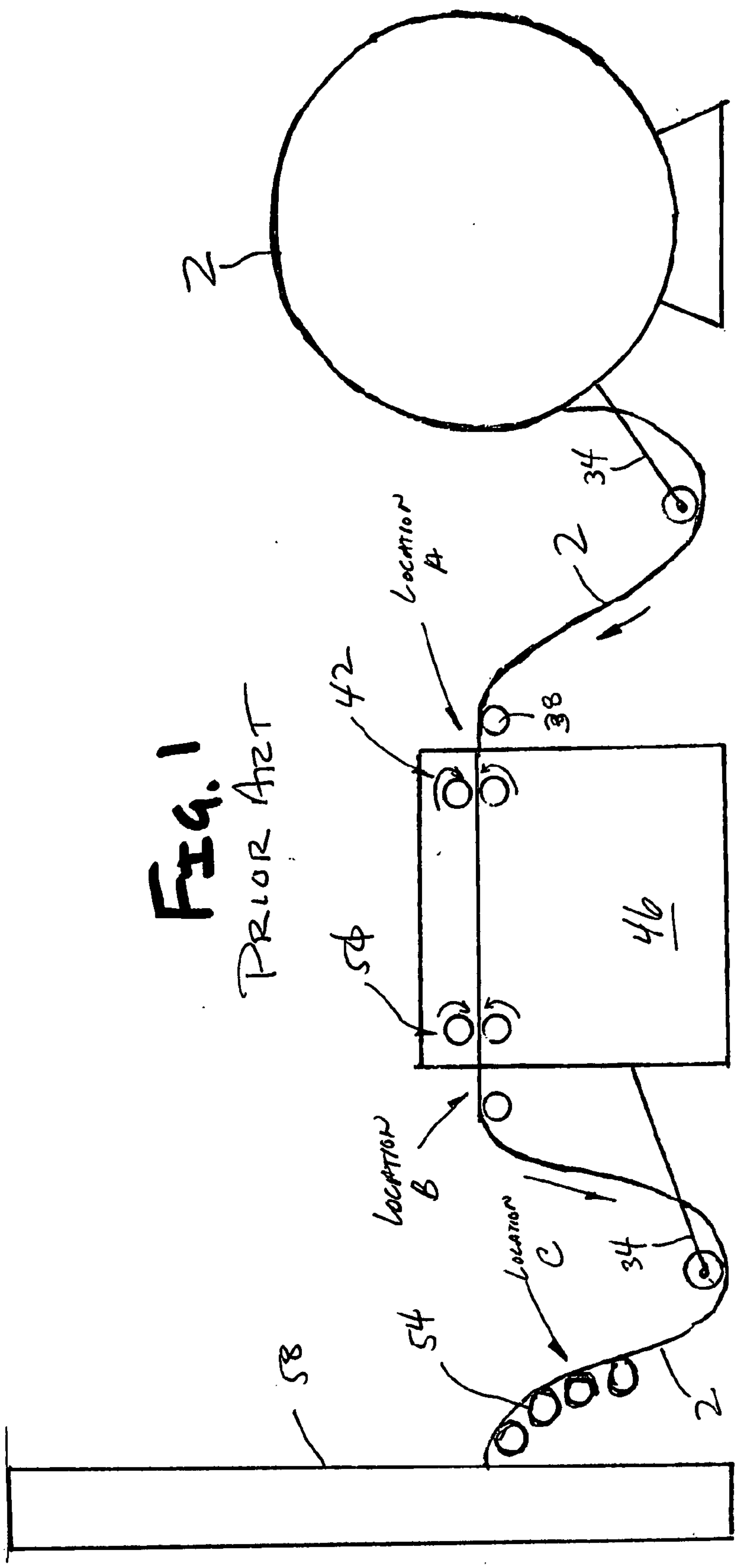


FIG. 1
PRIOR ART

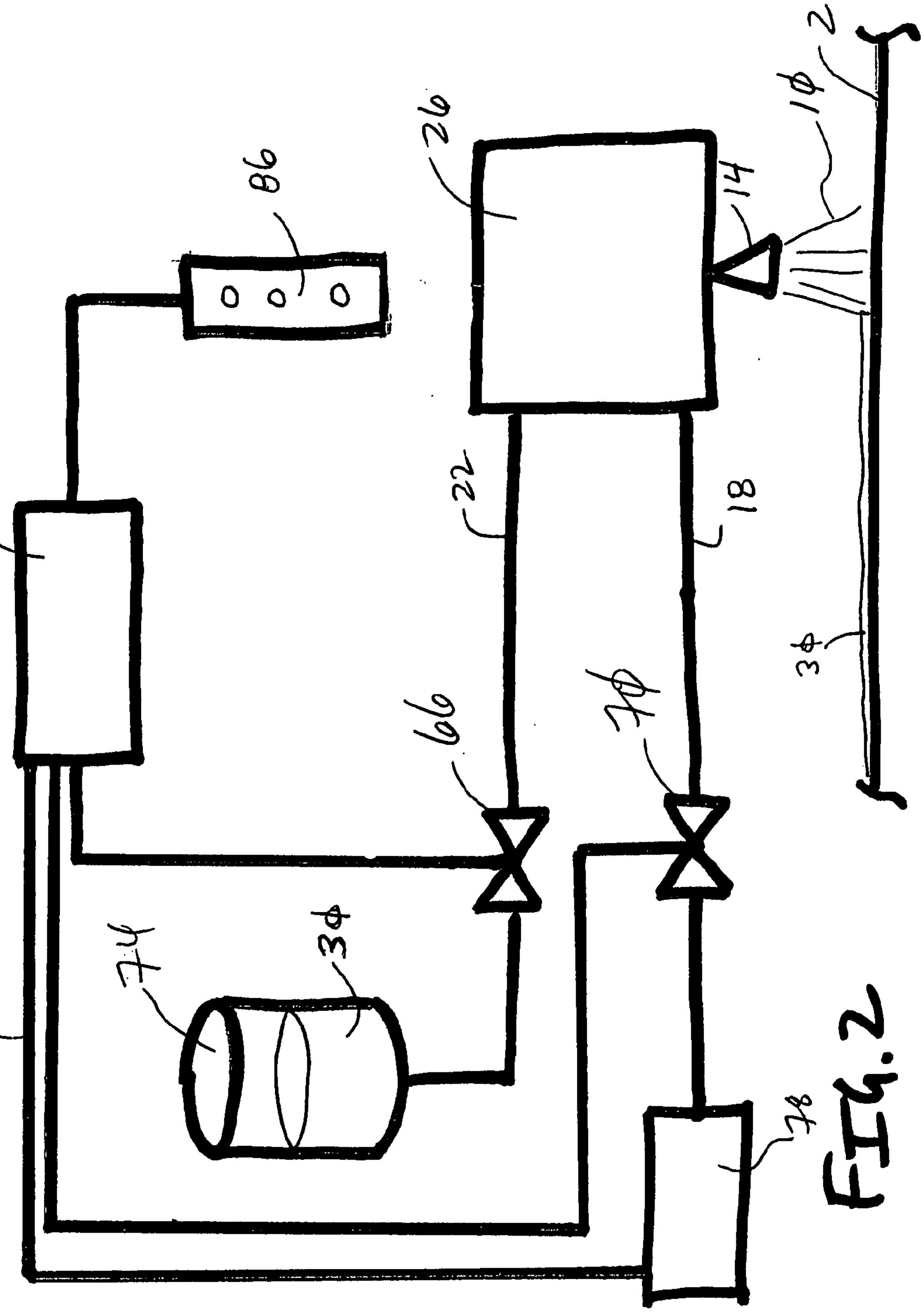


FIG. 2

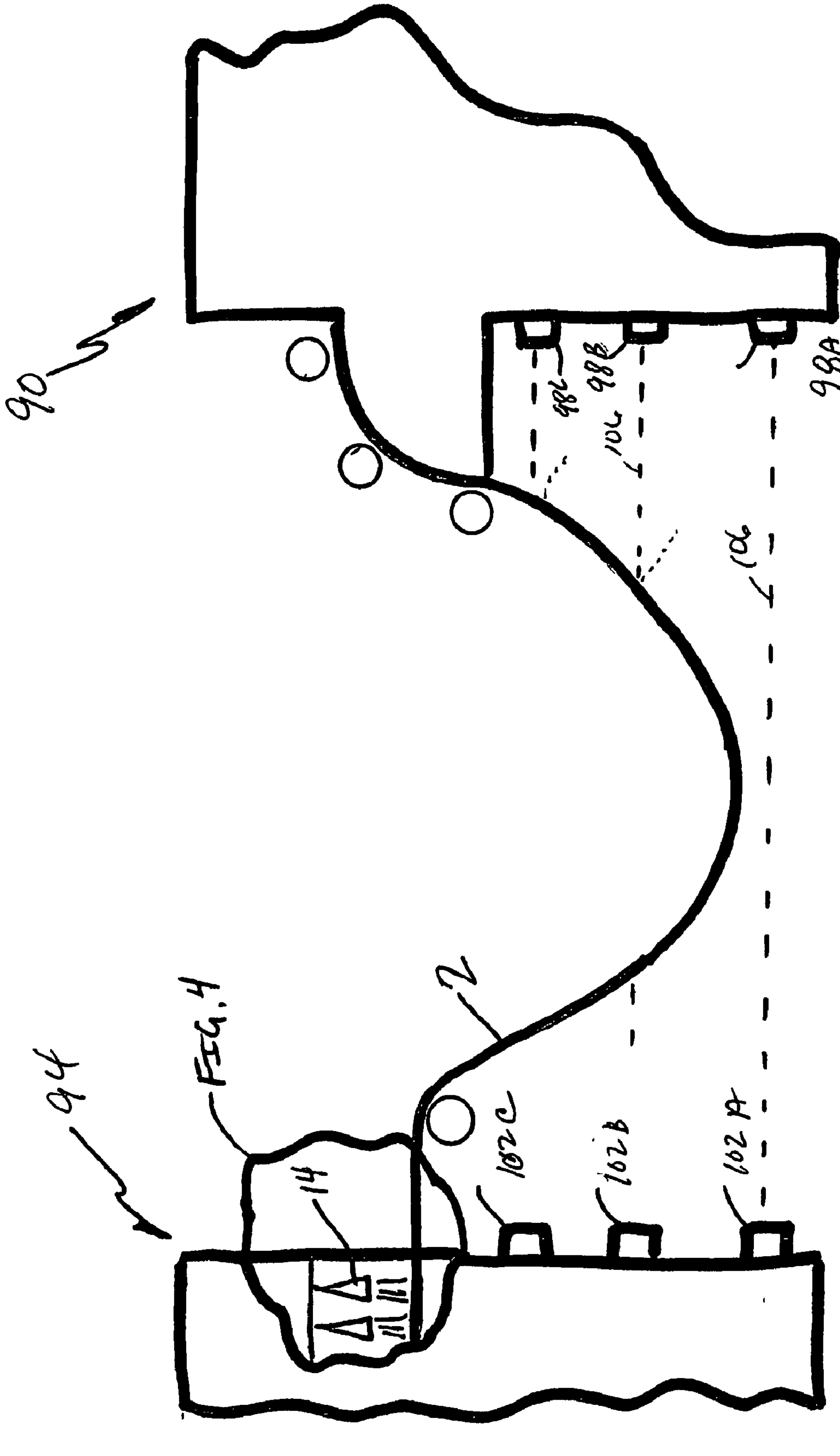


FIG. 3

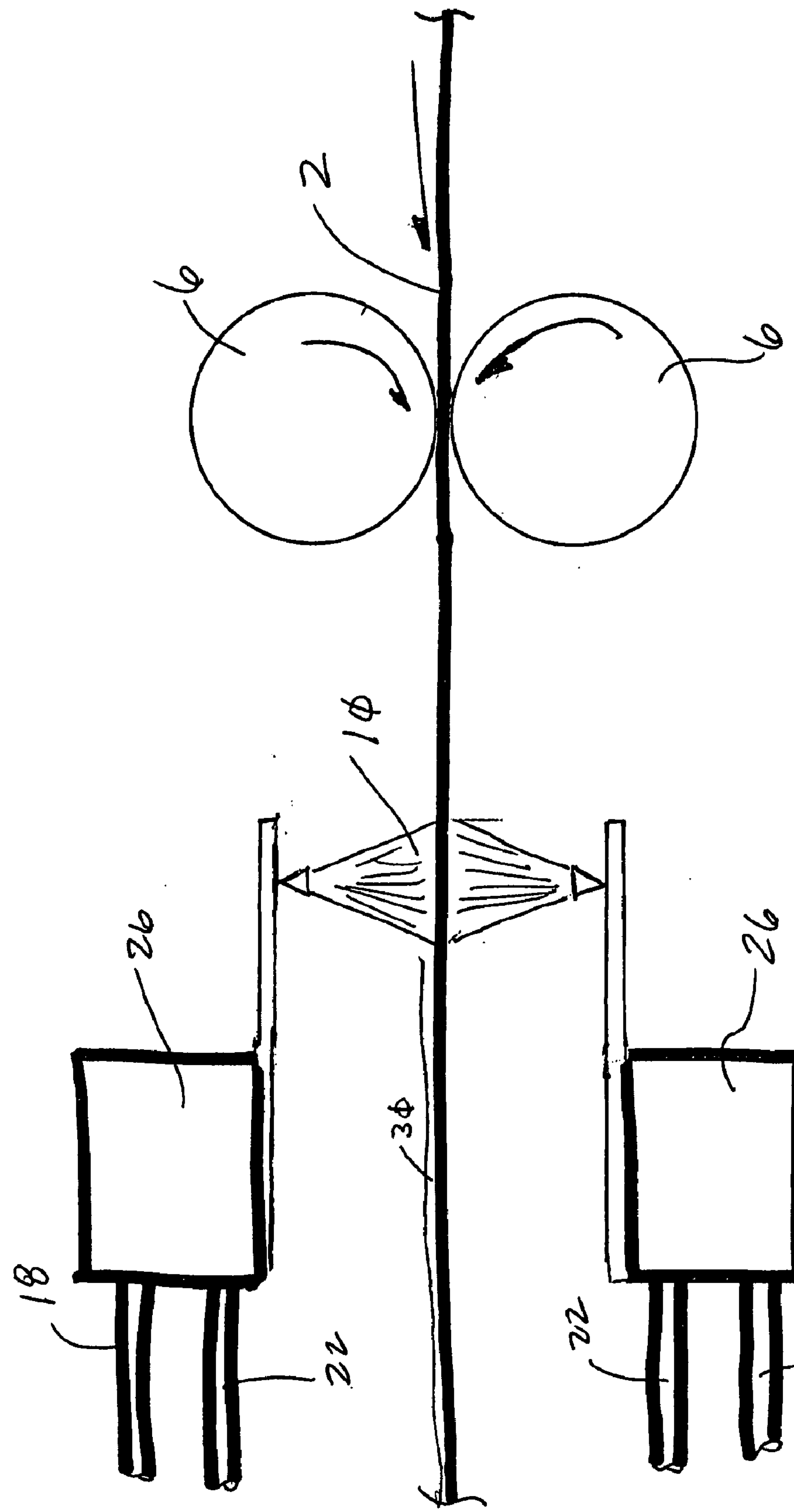


FIG. 4

NON-CONTACT SPRAY LUBRICATOR

[0001] This application claims the benefit of U.S. Patent Application Ser. No. 60/827,897, filed Oct. 3, 2006, the entire disclosure of which is incorporated by reference herein.

FIELD OF THE INVENTION

[0002] The present invention is related generally to sheet metal lubrication. More specifically, an apparatus and method is provided that monitors and regulates the intake speed of a sheet metal coil and applies a predetermined thickness of lubricant thereto.

BACKGROUND OF THE INVENTION

[0003] A drawn and ironed container generally comprises two pieces, i.e., the container body and the container end closure. In order to form the container body, a portion of aluminum or metallic sheet from a coil is formed to a predetermined shape. Each coil typically weighs about 15,000 to 25,000 pounds and when rolled out flat can be anywhere from 20,000 ft. to 30,000 ft. long and 6 ft. wide. The sheet metal coil is positioned in an uncoiler machine at the beginning of the beverage can assembly. The uncoiler provides the function of unrolling the metal sheet that is fed into a lubricator prior to the forming operation. The lubricator deposits a thin film of lubricant on both sides of the metal sheet that allows the metal to flow smoothly during the subsequent forming processes. The forming process of a drawn and ironed container begins in a large machine called a cupping press that cuts circular disks from the sheet and forms them into cups that drop from the press onto a conveyor for further forming. These two metal forming operations are generally called blank and draw, respectively, and are performed at speeds ranging from 1,500 to 3,000 cups per minute.

[0004] It is important to ensure that the proper amount of lubrication is applied to the raw sheet coming from the coil. That is, metal lubrication has been referred to as an art as well as a science, wherein subtle differences in forming processes and workpiece metallurgy can greatly affect the performance of lubrication. For example, having the incorrect amount or type of lubrication can adversely affect the metal forming process causing tool seizure, excess heat generation, tool wear, etc. The importance of correct lubrication of the metallic sheet prior to metal forming during the cupper operation is thus critical to an efficient container manufacturing operation.

[0005] Traditional lubricating machines employ rollers to apply the lubrication on the metallic sheet. The prior art has many drawbacks, such as inconsistent lubrication weights, i.e. thicknesses of lubrication on the metal, and an increase in moving parts. As appreciated by one skilled in the art, all of these drawbacks can result in equipment failure, increased maintenance and downtime in the manufacturing process which results in additional costs.

[0006] Thus it is a long felt need in the field of beverage container manufacturing to provide a lubrication system that reduces moving parts while providing a method of applying a predetermined metered amount of lubrication on the coil of sheet metal. The following disclosure describes an improved lubrication system that utilizes a non-contact spraying mechanism and that monitors and controls the speed at which the coil is fed into the lubrication machine, thus ensuring that the correct amount and thickness of lubricant is deposited on the metallic sheet prior to the cupper operation.

SUMMARY OF THE INVENTION

[0007] It is thus one aspect of the present invention to provide a non-contact spray lubrication system for use in drawn and ironed container manufacturing. More specifically, one embodiment of the present invention includes a plurality of guide rollers that direct a dry coil of metal, preferably aluminum or steel, adjacent to nozzles positioned above and below the coil. The nozzles receive lubricant and air from a reservoir and an air supply via a compressed air source. The nozzles apply a predetermined thickness of lubricant on the metallic coil surface, thereby preparing it for further forming operations.

[0008] It is another aspect of the present invention to provide a method for monitoring and controlling the speed of the coil being fed into the non-contact spray lubricator. More specifically, various embodiments of the present invention employ a plurality of proximity sensors positioned at various locations adjacent to the coil as it follows its path from an uncoiler machine to the non-contact spray lubricator. Generally, the coil follows a downward sloping arcuate path that begins at the uncoiler and ends at the non-contact spray lubricator. The proximity sensors generally include a signal transmitter and a signal receiver wherein depending on the radius of curvature of the coil between the uncoiler, signals emitted by the transmitters will be received by their respective receivers. For example, when all receivers are not receiving a signal the uncoiler will decrease in speed thereby ensuring that the coil does not touch the ground. In addition, it is contemplated that the amount of lubrication being injected from the nozzles and related thickness of lubricant on the metal sheet may be selectively altered depending on the speed that the coil is entering the lubricator. Although optical proximity sensors are described as being used in one embodiment of the present invention, one skilled in the art will appreciate that other types of proximity sensors may be utilized to monitor the coil path and/or speed of travel of the coil without departing from the scope of the invention.

[0009] As appreciated by one skilled in the art, the present invention has many advantages including reduced maintenance due to a reduction in moving parts, more consistent lubrication thickness and reduced maintenance since rollers do not need to be replaced, cleaned, etc. Other advantages will be apparent to those skilled in the art upon review of the following.

[0010] The Summary of the Invention is neither intended nor should it be construed as being representative of the full extent and scope of the present invention. The present invention is set forth in various levels of detail in the Summary of the Invention as well as in the attached drawings and the Detailed Description of the Invention and no limitation as to the scope of the present invention is intended by either the inclusion or non-inclusion of elements, components, etc. in this Summary of the Invention. Additional aspects of the present invention will become more readily apparent from the Detail Description, particularly when taken together with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and together with the general description of the invention given above and the detailed description of the drawings given below, serve to explain the principles of these inventions.

[0012] FIG. **1** is a layout of machines employed in blank and draw operations;

[0013] FIG. **2** is a schematic of one embodiment of the present invention;

[0014] FIG. **3** is a front elevation view of one embodiment of the present invention; and

[0015] FIG. **4** is a detailed view of FIG. **3**.

[0016] To assist in the understanding of the present invention the following list of components and associated numbering found in the drawings is provided herein:

COMPONENT

[0017] **2** Coil

[0018] **6** Guide roll

[0019] **10** oil spray

[0020] **14** Nozzle

[0021] **18** Air line

[0022] **22** Oil line

[0023] **26** Injector

[0024] **30** Lubricant

[0025] **34** Dancer arm

[0026] **38** Roller

[0027] **42** Drive rollers

[0028] **46** Emulsion lubricator

[0029] **50** Metering roller

[0030] **54** Catenary

[0031] **58** Blank & draw machine

[0032] **62** Control unit

[0033] **66** Oil valve

[0034] **70** Air valve

[0035] **74** Reservoir

[0036] **78** Air supply

[0037] **82** Air pressure control line

[0038] **86** Proximity switch

[0039] **90** Un-coiler

[0040] **94** Non-contact spray lubricator

[0041] **98**A Low speed coil proximity switch transmitter

[0042] **98**B High speed coil proximity switch transmitter

[0043] **98**C Tight coil proximity switch transmitter

[0044] **102**A Low speed coil proximity switch receiver

[0045] **102**B High speed coil proximity switch receiver

[0046] **102**C Tight coil proximity switch receiver

[0047] **106** Signal

[0048] It should be understood that the drawings are not necessarily to scale. In certain instances, details that are not necessary for an understanding of the invention or that render other details difficult to perceive may have been omitted. It should be further understood that the invention is not necessarily limited to the particular embodiments illustrated herein.

DETAILED DESCRIPTION

[0049] Referring now to FIGS. **1**-**4**, embodiments of the present invention that apply lubricant to a section of sheet metal from a coil loop **2** as provided herein. More specifically, the present invention generally relates to applying lubricant to one or more surfaces of the metallic coil **2** that is to be blanked and drawn in a cupping/forming operation. One embodiment of the present invention employs a plurality of guide rollers **6** that direct the coil **2** adjacent to an oil spray **10** emanating from one or more nozzles **14**. The oil spray **10** is driven by an air line **18** and an oil supply line **22** that feed an injector **26** that is interconnected to the nozzle **14**. As a predetermined amount of lubricant **30** is applied to the coil **2**, the metallic coil **2** is subsequently conveyed down the assembly line to be cut and drawn into cups. As referred to herein, the term "coil"**2** generally refers to a sheet of metal such as aluminum or steel emanating from a cylindrical coil of thin sheet stock.

[0050] Referring now to FIG. **1**, a depiction of the prior art process of coil lubrication is shown. More specifically, the coil **2** is directed from the uncoiler and engages a roller interconnected to a dancer arm **34**. The dancer arm **34** provides tension to the coil **2** thereby ensuring that the coil **2** correctly contacts rollers **38** and does not become too slack or too tight. Next, the coil **2** is driven by a plurality of steel drive rollers **42** of an emulsion lubricator **46**. "Emulsion lubricator"**46** generally refers to a device that applies lubricant, such as an oil/water mixture onto at least one surface of the coil **2**. The coil **2** is then directed adjacent to a pair of rubber metering rollers **50** that alter the thickness of the applied lubrication. More specifically, depending on the forming process occurring downstream in the assembly line, the amount and thickness of lubricant applied to the coil **2** will vary. The rubber metering rolls **50** thus provide a mechanism to control the amount of lubricant being applied to the coil. If, for example, the coil **2** is to be vigorously formed or stamped the amount of lubrication required will be greater than if only simple metal manipulation is required. The selection of lubricant thickness is well known to those skilled in the art. After the coil **2** exits the emulsion lubricator **46** it is directed to another dancer arm **34** that maintains the tension of the coil **2**. Thereafter, the coil **2** is directed via a catenary **54** to a blank and draw machine **58** or other forming device.

[0051] Various embodiments of the present invention that have been briefly described above and that will be described in detail below, may be located prior to the emulsion lubricator **46** (location A), after the emulsion lubricator **46** (location B), or prior to entry into the blank and draw machine **58** (location C). Embodiments of the present invention have been tested at location B wherein no actual lubrication is applied by the emulsion lubricator **46**. The emulsion lubricator **46** in the experiments was used to provide a drive mechanism that directs the coil to the lubricating mechanism of embodiments of the present invention, thereby illustrating how embodiments of the present invention can be easily integrated into existing processes.

[**0052**] Referring now to FIG. **2**, a schematic of one embodiment of the present invention is shown. More specifically, a control unit **62** is employed that selectively operates an oil valve **66** and an air valve **70**. The oil valve **66** supplies lubricant **30** from a reservoir **74** to the oil line **22** that feeds the injector **26**. Similarly, the air valve **70** provides compressed air from an air supply **78** via an air line **18** to the injector **26**. The air supply **78** is controlled via an air compressor control line **82** that is interconnected to the control unit **62** that directs the air supply to engage and disengage. During normal operations lubricant **30**, via the oil line **22**, and air, via the air line **18**, are directed into the injector **26** and then through the nozzle **14** which generates a spray **10** that coats the coil **2** with a predetermined amount of lubricant **30**.

[**0053**] In order to control the amount of lubricant **30** and/or air being directed into the injector **26**, a proximity switch **86** may be employed in one embodiment. The proximity switch **86** simply lets the control unit **62** ascertain the speed of which the coil **2** is being directed into the non-contact lubricator **90**. The amount of spray **10** being injected from the nozzle **14** depends on the intake speed of the coil **2**. The slower the coil **2** is moving, a reduced flow rate of spray **10** is injected out of the nozzle **14**, thereby ensuring that the thickness of the lubricant **30** applied to the coil **2** does not exceed a predetermined level. If the coil **2** is moving too slow, i.e. a "tight roll condition, the uncoiler may be shut down. In addition, if the coil **2** is moving at a high rate, the control unit **62** will direct additional lubricant **30** and air into the injector **26** to ensure that the layer of lubricant **30** is not below a predetermined level. Finally, the proximity switch **86** will speed up the movement of the coil **2** and spray **10** from the nozzle **14** if the coil **2** becomes too slack wherein it may contact the floor and damage or contaminate the coil **2**. Alternatively, the injector **26** may be operated at a constant flow rate, and the thickness of lubricant **30** applied to the coil **2** controlled specifically by the speed of the coil **2**.

[**0054**] Referring now to FIGS. **3** and **4**, one embodiment of the present invention is shown. As depicted, the coil **2** is directed from an uncoiler **90** in a generally arcuate path into the non-contact spray lubricator **94**. The non-contact spray lubricator **94** includes a plurality of guide rollers **6**, preferably positioned above and below the coil **2** that direct the coil **2** from the uncoiler **90** into the non-contact spray lubricator **94**. A plurality of proximity sensors are provided, that are comprised of a transmitter **98** and a receiver **102**. In the illustrated embodiment, a signal **106** is sent, for example, from a low speed transmitter **98**A to a low speed receiver **102**A. As long as the signal **106** is received by the low speed receiver **102**A, the control unit of the non-contact spray lubricator **94** assesses that the coil **2** has not dipped too close to the ground. Once the low speed signal **106** is broken, the control unit will increase the coil speed or increase the amount of lubricant **30** deposited on the coil **2**. During normal operations, a high speed transmitter **98**B and receiver **102**B are not in line of sight, such that any signal sent from the high speed transmitter **98**B is reflected by the coil **2**. This condition indicates that the system is running properly and at the correct coil speed. If the high speed receiver **102**B is receiving a signal from the high speed transmitter **98**B the uncoiler is sending coil at a decreased rate. When a tight coil transmitter **98**C successfully sends a signal to a tight coil receiver **102**C, the tight coil is apparent wherein the uncoiler and lubricator are shut down.

[**0055**] One skilled in the art will appreciate that the proximity sensors may not be required wherein other methods known in the art were used to control the amount of lubrication applied to the coil. For example, the uncoiler may feed coil directly to the non-contact spray lubricator in a non-accurate manner. Alternatively, the non-contact lubricator may include a mechanism that pulls the coil directly from the uncoiler in a generally straight path.

[**0056**] Referring again to FIGS. **1**-**4**, a process of using one embodiment of the present invention is described. In operation, a traditional drawing and blanking process, as shown in FIG. **1** is employed, or alternatively an uncoiler **90** may be spaced a predetermined distance from the non-contact lubricator **94**. Once the coil **2** is successfully integrated into the uncoiler **90** and the coil **2** is placed between the guide rollers **6**, the non-contact spray lubrication process is then initiated, wherein the coil **2** is directed beneath and above nozzles **14** that are interconnected to a plurality of air/oil fed injectors **26**. When the non-contact spray lubricator **94** is initiated, the proximity sensors are also activated wherein the signal **106** is received by the low speed receiver **102**A from the low speed transmitter **98**A. The signals from the high speed transmitter **98**B and a tight coil transmitter **98**C are blocked from their respective receivers initially. As lubrication of the coil continues, variations in the coil path between the uncoiler **90** and the non-contact spray lubricator **94** will necessarily occur. Thus, the proximity sensors are continuously monitored thereby dictating the speed of the uncoiler and/or the flow rate of the nozzles **14**. In a situation where the tight roll receiver **102**C is receiving an adverse signal from the tight roll transmitter **98**C, the system preferably shuts down. As further appreciated by one skilled in the art, it is feasible that any number of control mechanisms may be implemented to feed the coil **2** into the non-contact spray lubricator **94**. More specifically, it may be unnecessary to utilize a loop configuration as shown in FIG. **3**, and wherein the coil **2** may be fed directly into the non-contact spray lubricator **94**.

[**0057**] While various embodiments of the present invention have been described in detail, it is apparent that modifications and alterations of those embodiments will occur to those skilled in the art. However, it is to be expressly understood that such modifications and alterations are within the scope and spirit of the present invention, as set forth in the following claims.

What is claimed is:

1. An apparatus for applying a lubricant to a metallic material received from an uncoiling mechanism, comprising:

a reservoir for holding the lubricant;

an air supply;

an injector in communication with said reservoir and said air supply;

a nozzle interconnected to said injector;

a control unit in operable communication with a valve that controls the flow of lubricant from said reservoir to said nozzle;

a first proximity switch comprised of a first transmitter and a first receiver, said first proximity switch interconnected to said control unit;

a second proximity switch comprised of a second transmitter and a second receiver, said second proximity switch interconnected to said control unit;

a third proximity switch comprised of a third transmitter and a third receiver, said third proximity switch interconnected to said control unit; and

wherein the coil travels from the uncoiling mechanism to said apparatus for applying lubrication, such that the receipt of a signal by at least one of said first receiver, said second receiver and said third receiver from at least one of said first transmitter, said second transmitter and said third transmitter, respectively, represents the position of the coil that allows said controller to dictate at least one of the speed in which the coil is positioned approximate to said nozzle and the flow rate of the lubricant, wherein the thickness of the lubricant applied to the metallic material is selectively altered.

2. The apparatus of claim 1, wherein said nozzle is positioned above the coil and further comprising a second nozzle positioned beneath the metallic material.

3. The apparatus of claim 1, wherein air from said air supply is selectively directed to said injector with a valve.

4. The apparatus of claim 1, wherein the lubricant is selectively directed to said injector with a valve.

5. The apparatus of claim 1, further comprising an un-coiler that is adapted to receive the coil, the un-coiler being spaced from a lubricator device, which includes said nozzle, wherein said first transmitter, said second transmitter and said third transmitter are associated with said un-coiler and said first receiver, said second receiver, and said third receiver are associated with said lubricator device to regulate the speed by which the metallic material travels from the un-coiler.

6. An apparatus for applying a lubricant to a metallic material which is positioned on an uncoiling mechanism, comprising:

a non-contact spray lubrication device that includes a lubricant reservoir, an air supply, a means for injecting associated with said lubricant reservoir and air supply, a means for dispersing associated with said means for injecting and a means for controlling the flow of lubricant from said lubricant reservoir to said means for dispersing;

an un-coiler device that dispenses the metallic material at a predetermined distance from said non-contact spray lubrication device, wherein the metallic material dispersed from the coil is adapted to be positioned proximate to said non-contact spray lubrication device;

at least one transmitter associated with at least one of said non-contact spray lubrication device and said un-coiler device; and

at least one receiver associated with at least one of said non-contact spray lubrication device and said un-coiler device, wherein the thickness of the lubricant applied to the metallic material can be selectively regulated.

7. The apparatus of claim 6, wherein said means for injecting mixes air from said air supply and the lubricant from said lubrication reservoir and directs said mixture to said means for dispersing.

8. The apparatus of claim 6, wherein said means for dispersing is at least one of a nozzle, a spout, a discharge pipe, and a discharge aperture.

9. The apparatus of claim 6 wherein said at least one transmitter is comprised of a first transmitter, a second transmitter and a third transmitter and said at least one receiver is a first receiver, a second receiver, and a third receiver; and

wherein when the metallic material travels from the uncoiling mechanism to said non-contact spray lubrication device, such that the receipt of a signal by at least one of said first receiver, said second receiver and said third receiver from at least one of said first transmitter, said second transmitter and said third transmitter, respectively, represents the position of the metallic material between said non-contact spray lubrication device and said uncoiler device that allows said means for controlling to dictate at least one of the speed in which the metallic material is positioned approximate to said means for dispersing and the flow rate of the lubricant is selectively altered.

10. The apparatus of claim 6, wherein said means for dispersing is positioned above the metallic material and further comprising a second means for dispersing positioned beneath the metallic material.

11. The apparatus of claim 6, wherein air from said air supply is selectively directed to said means for injecting with a valve.

12. The apparatus of claim 6, wherein the lubricant is selectively directed to said means for injecting with a valve.

13. A method of continuously applying a film of lubricant to a surface of metallic material stored on a coil, comprising:

providing an uncoiling mechanism for rotatably unwinding a coil of rolled metal material to be formed;

providing a lubricating mechanism with a nozzle for depositing lubricant at a predetermined flow rate on said metallic material;

providing a first proximity switch comprised of a transmitter and a receiver, said first proximity switch positioned a first distance from the ground;

providing a second proximity switch comprised of a transmitter and a receiver, said second proximity switch positioned a second distance from the ground;

providing a third proximity switch comprised of a transmitter and a receiver, said third proximity switch positioned a third distance from the ground;

providing a control unit in communication with said first proximity switch, said second proximity switch and said third proximity switch;

feeding said metallic material from said uncoiling mechanism to said lubricating mechanism in an arcuate path having a first radius of curvature wherein the lowest portion of the coil is located between said second distance and said third distance thereby defining a high speed coil feed condition wherein said coil is positioned under said nozzle at a predetermined speed and said nozzle deposits lubricant at a predetermined flow rate;

increasing with said control unit said flow rate if said first radius of curvature is increased such that said lowest portion of the coil is located between said first distance and said second distance thereby defining a tight roll condition;

at least reducing or terminating said flow rate with said control unit if said first radius of curvature is reduced such that said lowest portion of the coil is located between said third distance and the ground thereby defining a low speed condition.

14. The method of claim 13, further comprising a second nozzle positioned beneath the metallic material that deposits the lubricant at a predetermined flow rate.

15. The apparatus of claim 13, wherein said nozzle is interconnected to an injector that receives air from an air supply and lubricant from a lubricant supply.

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