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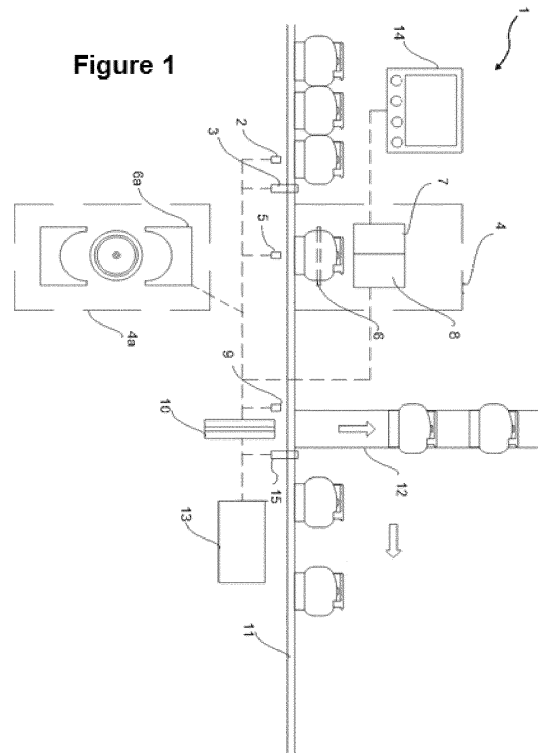
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(54) **A cylinder recognition system**

(57) This invention relates to a cylinder recognition system, identifying the type of a cylinder prior to a filling process by means of a camera using artificial vision technology and allowing conveying a single type of cylinder to a filling line. It comprises at least one illuminator (8) providing the illumination of cylinders conveyed on a conveyor line to a filling unit in a storage cabin (4); at least one camera (7) generating an image providing the classification of cylinders conveyed to a filling unit; at least one storage cabin (4) in which cylinders conveyed to a filling unit are stopped, their images taken by the camera (7) and the type of cylinder is determined accordingly; at least one control unit (13) in which electric signals from photocells (2, 5, 9) and camera (7) are processed, and accordingly, electronic signals are transmitted to the deflecting piston (10) to classify the cylinders; and at least one operator display (14) by which the type of cylinder is selected and the number of cylinders deflected or conveyed to a filling unit is monitored by the user.



Description

Field of Invention:

[0001] This invention relates to a cylinder recognition system, identifying the type of a cylinder prior to a filling process by means of a camera using artificial vision technology and allowing conveying a single type of cylinder to a filling line.

Prior Art:

[0002] A cylinder filling process in LPG filling stations is performed by authorized personnel by manually adjusting a filling balance according to the tare of a cylinder to be filled. Cylinders designed in various shapes, e.g. with narrow or wide grips, with long or short collars, with wide or narrow lower circles, according to the need of clients, are identified visually by authorized personnel and the tare of the respective type of cylinder is determined accordingly.

[0003] As a result of the similarities emerging between the designs of cylinder, the differentiation of cylinders prior to filling has become difficult and susceptible to operator faults. Thus, when a different type of cylinder is mistakenly entered to a filling line during a filling process of cylinders, a problem emerges in that the filling is made either over or below the required level. Another point increasing the importance of the problem is the lack of a safety valve in some cylinders, such that serious hazards may occur when an LPG cylinder is overfilled.

[0004] On the other hand, since the method of identifying the tare by an operator in a visual manner is susceptible to errors, a system was developed which identifies the type of a cylinder prior to a filling process by means of a camera using artificial vision technology and allows conveying a single type of cylinder to a filling line. This system is designed to recognize at least four different types of cylinders prior to filling and to allow only the type of cylinder which is planned for filling to proceed on a line, and thus to deflect the remaining 3 types of cylinders from the line. In order to differentiate the cylinders from each other, the diameter differences in the upper ring (grip) and the collar size are used. Thus, depending on the type of cylinder of which the filling is intended, only that type of cylinder is conveyed to the filling process and other types of cylinders are prevented from entering the filling process.

[0005] The German patent document DE19816881 discloses classifying materials on a line by scanning the materials using a line laser light source. Said invention primarily analyses the light returned from objects on a line by means of spectroscopy (different wavelengths in returned light are detected) and differentiates the objects accordingly. The cylinder recognition system according to the present invention, in turn, operates by analysing a 2 dimensional image of objects, as a result of capturing an image of a field, in place of scanning a one dimensional

line. Additionally, by making use of the differences in contrast and color in the image captured by a camera, the sizes of figures in the image are defined based on pixels, so that the cylinders (objects) are identified by comparing the areas of the figures in the image to the size of previously determined figures. By virtue of this method, devices such as a multi-anode photon multiplier and a toroidal mirror in said patent are not required.

[0006] The UK patent document GB 1354993 refers to an invention used for identifying certain figures, i.e. numbers or letters, by means of a photoelectric converter. Even if there is a general similarity between that document and the aim of the cylinder recognition system according to the present invention, e.g. identifying some figures, the technique used by these two methods to achieve this object is quite different. In a cylinder recognition system, the image of a cylinder is captured by a camera in an entirely digital medium, and then the process is proceeded through this image to determine the compliance of a cylinder of which the image is captured. In the determination process, the image captured by the camera is subjected to digital image processing, the contrast difference in the image is determined, the pixel areas occupied by the physical shape of the cylinder in the captured image is established and finally the type of the cylinder is identified. In said patent document, on the other hand, no method is used for capturing images in a digital medium and for processing the same; said invention is based completely on analog signals. The photoelectric converter, electron beam, focusing coils used to enlarge the image, electrical analog logic circuits etc. used in that patent are not used in the cylinder recognition system according to the present invention. Additionally, the operation logic of said patent comprises the scanning of a field, enlarging any figures detected during the scanning process and focusing on these points, and then identifying these figures by means of electrical signals. In the logic of the cylinder recognition system according to the present invention, in turn, in place of a sequential operation as specified above, an image on a fixed plane is captured, the image is digitally processed, the figures in the image are differentiated based on contrast differences, and accordingly the figures are identified; no point on an image captured is examined upon being enlarged and focused, but the image is processed as a whole.

Brief Description of Invention:

[0007] The object of this invention is to provide a cylinder recognition system capable of preventing in advance any operator faults in the classification of cylinders to be filled.

[0008] Another object of this invention is to provide a cylinder recognition system capable of identifying a cylinder type using a pixel area on a camera image.

Detailed Description of Invention:

[0009] A cylinder recognition system developed to achieve the object of the present invention is illustrated in an accompanying figure, briefly described hereunder.

[0010] Figure 1 is a schematic illustration of a cylinder recognition system.

[0011] The parts in the figure are individually enumerated as following.

1. Cylinder recognition system
2. Primary photocell
3. Primary stopper
4. Storage cabin
- 4a. Storage cabin (top view)
5. Secondary photocell
6. Cylinder centering stopper
- 6a. Cylinder centering stopper (top view)
7. Camera
8. Illuminator
9. Tertiary photocell
10. Cylinder deflecting piston
11. Filling line
12. Deflected cylinder line
13. Control unit
14. Operator display
15. Secondary stopper

[0012] A cylinder recognition system (1) according to the present invention comprises

- at least one illuminator (8) providing the illumination of cylinders conveyed on a line to a filling unit in a storage cabin (4),
- at least one camera (7) generating an image providing the classification of cylinders conveyed to a filling unit,
- at least one storage cabin (4) in which cylinders conveyed to a filling unit are stopped, their images are taken by a camera (7) and the type of cylinder is determined accordingly,
- at least one primary photocell (2) detecting a cylinder conveyed to a filling unit and enabling it to enter to the storage cabin (4),
- at least one primary stopper (3) which, when there is a cylinder present in the storage cabin (4), keeps the next cylinder on the line until the cabin is emptied,
- at least one secondary photocell (5) detecting the entrance of a cylinder conveyed to a filling unit into the cabin (4),
- at least one cylinder centering stopper (6) which stops a cylinder entered into the storage cabin (4) when it just comes to the center of the cabin,
- at least one cylinder deflecting piston (10) differentiating the type of cylinders which are to be conveyed to a filling unit from those which are not to be conveyed, based on a warning received from a control unit (13),

- at least one secondary stopper (15) stopping those cylinders which are intended to be guided by the cylinder deflecting piston (10) for some time,
- at least one third photocell (9) detecting the cylinders leaving the storage cabin (4) and activating the cylinder deflecting piston (10) to guide a cylinder leaving the cabin (4),
- at least one filling line (11) by which the type of cylinders classified by the control unit (13) and intended to be filled are conveyed to a filling unit,
- at least one deflected cylinder line (12) by which the type of cylinders classified by the control unit (13) and not intended to be filled are deflected from the filling line (11) and proceeded thereon,
- at least one control unit (13) in which electric signals from the photocells (2, 5, 9) and the camera (7) are processed, and accordingly, electronic signals are transmitted to the deflecting piston (10) to classify the cylinders, and at least one operator display (14)

through which the number of cylinders deflected or filled can be visually monitored and through which the type of cylinders is selected by an operator.

[0013] All cylinders to be filled are checked by the operator and classified according to their types prior to filling. If an operator fault is made during this check made around every 2 seconds as the line is proceeding, overfilled or underfilled LPG cylinders are delivered to the clients, this in turn leads to additional labor and product costs, customer dissatisfaction, and most significantly, the problems associated with the delivery of overfilled cylinders.

[0014] The system (1) is designed to be assembled on a conveyor line and is adapted to the conditions of explosive-inflammable environments. Cylinders which are successively conveyed on the conveyor line are first stopped by the primary stopper (3). The stopper (3), is kept open by means of the primary photocell (2) placed in front of the stopper (3) during a time interval in which only a single cylinder can be passed, such that the cylinders are entered into the recognition cabin one by one. A cylinder entering into the storage cabin (4) illuminated by an illuminator (8) is detected by means of a secondary photocell (5) when it comes below the camera (7), and is stopped by means of a specifically-designed cylinder centering stopper (6) just below the camera (7).

[0015] The image of the cylinder is captured by the camera (7); and the upper ring diameter and the collar size of the cylinder are determined by the control unit (13). If the cylinder conveyed to filling is not of the type determined by the operator, the control unit (13) does not allow the cylinder to be conveyed to filling and deflects the cylinder from the line by means of the deflecting piston (10). The operator display (14) allows both to select the type of cylinder and displays the whole process, the number of cylinders deflected and conveyed to filling.

[0016] The image of cylinders captured by the camera (7) is necessary to identify the type of cylinders, so when

the camera is absent, the cylinder recognition system (1) will not work. The numbers of cylinders deflected and conveyed to filling and the selection of the type of cylinder intended for filling by the user is checked on the operator display (14). If this display is removed from the system (1), another method must be used to select the type of cylinders.

[0017] Since the camera (7) may capture an incorrect image when a cylinder does not come below the center of the camera, the cylinder centering stopper (6) is essential for the system. The control unit (13) comprises a PLC control system which enables to deflect the cylinders which are not intended for filling from the filling line. When the control unit (13) is lacking, these cylinders cannot be deflected from the line.

[0018] The cylinder deflecting piston (10) enables to deflect a cylinder not to be filled from the line with a command received from the control unit. If it is lacking, the cylinders cannot be deflected from the line.

Since the stoppers (3, 6) and photocells (2, 5, 9) control the flow and order of the cylinders on the line, their absence will cause an error in the system.

[0019] Firstly, the identification of cylinders is entirely performed by the camera (7), and it is not dependent on a data to be received from a human or from a barcode or label applied to the cylinder. Thus, all types of cylinders, of which the sizes are entered to the control unit (13), can be detected, such that only those cylinders intended for filling are filled. Additionally, extra costs and labor of a label or barcode applied to cylinders will be avoided. Since the system (1) is PLC controlled, it allows to monitor the deflected cylinders and to keep statistical data electronically on the filling process. The system (1) is designed to identify cylinders of differing designs.

[0020] A cylinder to be filled is first selected by the operator on the operator display (14). The operator display (14) is taken into a panel with keypads in order to comply with the conditions of inflammable and explosive environments.

[0021] Cylinders proceeded successively to filling on the conveyor line are detected by photocells (2, 5, 9). The control unit (13), warned by the photocells (2, 5, 9) - that a cylinder is conveyed to a filling unit, opens the primary stopper (3) and lets one cylinder to pass. When the primary photocell (2) detects another cylinder, the control unit (13) closes the stopper (3) so that the cylinders are entered to the storage cabin (4) one by one.

[0022] The entrance of cylinder to the storage cabin (4) which is aimed to isolate the camera (7) therein from external lights is detected by the secondary photocell (5). When the photocell (5) detects the cylinder which is moved below the camera (7), the control unit (13) transmits an electrical signal to close the centering stopper (6) which normally is open. On the centering stopper (6) disposed on both sides of the conveyor are provided semilunar metal plates specifically produced according to the form of cylinders. When the centering stopper (6) is closed, the respective cylinder is stopped just below the

camera (7) for a short time.

[0023] When the control unit (13) detects that the cylinder is below the camera (7), it signalizes the camera (7) and illuminator (8) so that the image of the cylinder is captured. Meanwhile, the centering stopper (6) plates surrounding the cylinder make up a fixed background for the image to be taken by the camera (7).

[0024] The control unit (13) makes use of color and contrast differences within the image captured by the camera (7) and calculates the cylinder diameter, the collar size, and the pixel area occupied by the upper ring (grip). This area is compared to the pixel area occupied by different type of cylinders previously introduced to the control unit (13). The type of cylinders is determined as a result of this comparison.

[0025] The control unit (13) compares the type of the cylinder previously entered by the operator to the operator display (14) and the type identified by the camera (7), and according to the result of this comparison, the cylinder is conveyed either to the filling line (11) or to the deflected cylinder line (12).

When a cylinder decided to be deflected by the control unit (13) is detected by the photocell (9), a warning is transmitted to the deflecting piston (10) so that the cylinder is guided to the deflected cylinder line (12).

[0026] The number of cylinders conveyed to filling or deflected is monitored on the operator display (14).

The control unit (13) incorporates a PLC unit managing the cylinder identifying process, solenoid valves used for controlling the piston movements, pressure switches, and photocell amplifiers.

[0027] According to this basic principle, it is possible to develop many different embodiments of the cylinder recognition system (1) according to the present invention; therefore, the present invention is not to be restricted to the examples disclosed above and is basically defined in the claims.

40 Claims

1. A cylinder recognition system (1), comprising

- at least one illuminator (8) providing the illumination of cylinders conveyed on a conveyor line to a filling unit in a storage cabin (4),
- at least one camera (7) generating an image providing the classification of cylinders conveyed to a filling unit,
- at least one primary photocell (2) detecting a cylinder conveyed to a filling unit and enabling it to enter into the storage cabin (4),
- at least one primary stopper (3), which, when there is a cylinder present in the storage cabin (4), keeps the next cylinder on the line until the cabin is emptied,
- at least one secondary photocell (5) detecting the entrance of a cylinder conveyed to a filling

- unit into the cabin (4),
- at least one operator display (14) by which the number of cylinders conveyed to a filling unit and the number of cylinders deflected are monitored and the type of cylinder is selected, 5
 - at least one cylinder centering stopper (6) which stops a cylinder entered into the storage cabin (4) when it just comes to the center of the cabin,
 - at least one cylinder deflecting piston (10) differentiating the type of cylinders which are to be conveyed for filling from those which are not, 10
 - at least one secondary stopper (15) stopping those cylinders which are to be guided by the cylinder deflecting piston (10) for some time, 15
 - at least one third photocell (9) detecting the cylinders leaving the storage cabin (4) and activating the cylinder deflecting piston (10) to guide a cylinder leaving the cabin (4),
 - at least one filling line (11) by which the type of cylinders classified by the control unit (13) so as to be filled are conveyed for filling, 20
 - at least one deflected cylinder line (12) by which the type of cylinders classified by the control unit (13) and not to be filled are deflected from the filling line (11) and proceeded thereon, **characterized by** 25
 - at least one storage cabin (4) in which cylinders conveyed to a filling unit are stopped, their images are taken by a camera (7) and the type of cylinder is determined accordingly, 30
 - at least one control unit (13) making use of the color and contrast differences within the image captured by the camera (7) and calculating the cylinder diameter, the collar size, and the pixel area occupied by the upper ring (grip). 35
2. A cylinder recognition system (1) according to Claim 1, **characterized by** at least one control unit (13) in which electric signals from the photocells (2, 5, 9) and the camera (7) are processed, and accordingly, electronic signals are transmitted to the deflecting piston (10) to provide the classification of cylinders. 40
 3. A cylinder recognition system (1) according to claim 1 or 2, **characterized by** at least one storage cabin (4) in which cylinders conveyed to a filling unit are stopped, their images are taken by the camera (7) and the type of cylinder is determined accordingly. 45
 4. A cylinder recognition system (1) according to any of the preceding claims, **characterized by** at least one control unit (13) providing the classification of cylinders by comparing the pixel areas occupied by defined cylinders of various types. 50
 5. A cylinder recognition system (1) according to any of the preceding claims, **characterized by** at least one control unit (13) comparing the type of the cylinder entered by the operator to the operator display (14) and the type of cylinder identified by the camera (7), and according to the result of this comparison, conveying the cylinder either to the filling line (11) or to the deflected cylinder line (12). 55
 6. A cylinder recognition system (1) according to any of the preceding claims, **characterized by** at least one operator display (14) both allowing to select the type of cylinder and showing the number of cylinders deflected from the line and conveyed for filling.
 7. A cylinder recognition system (1) according to any of the preceding claims, **characterized by** a centering stopper (6) stopping a cylinder on the conveyor line for a short time, when it just comes below the camera (7).
 8. A cylinder recognition system (1) according to any of the preceding claims, **characterized by** a control unit (13) closing the primary stopper (3) when the primary photocell (2) detects another cylinder on the conveyor line.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 19816881 [0005]
- GB 1354993 A [0006]