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(54) Title: CAN SEAMER APPARATUS HAVING ON-LINE MONITORING OF SEAMER HEAD CONDITION

(57) Abstract

Can seamer apparatus including on-line monitoring of seamer head condition wherein can seal integrity is indicated by monitoring the position of the rocker arm (46) carrying the seaming rolls (26, 28) in such a manner as to provide data from which the condition of the top rotary chuck (25) and various other parts of each seamer station on the rotary turret (16) may be determined. For this purpose, a single sensor (74) is used to determine the position of each rocker arm as it passes a given location during the rotation of a turret, which position information is then accumulated and analyzed to provide the required information.
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CAN SEAMER APPARATUS HAVING ON-LINE MONITORING OF SEAMER HEAD CONDITION

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates to can seamer apparatus having on-line monitoring of seamer condition to determine whether covers have likely been properly sealed to the can rims. More particularly, the invention relates to apparatus for monitoring each seamer head, particularly the top chuck of each seamer head, on an on-line basis as covers are sealed to the cans to determine whether the covers have likely been properly sealed to the cans. The apparatus of this invention provides fault information after the improper sealing of a minimal number of cans due to a defective top chuck, and can indicate defective conditions in various other components of each seamer head.

2. PRIOR ART:

Apparatus now exists for filling cans with different materials while the cans are being moved through a filling machine or passed along a conveyor line. For example, the cans may be filled with different liquids such as soft drinks,
or with edibles such as soup, during this filling operation. Such filling apparatus is now so advanced that thousands of cans may be filled per minute. In the present day filling operations, the cans that are passed through the filling machines have a bottom and continuous side portion, with an opening on the top side. The cans are generally filled from a position above the cans, so the can openings are pointed upward during this operation.

After the filling operation, the cans are generally transferred by a conveyor line to a machine that applies the covers to the top rim of the filled cans. These machines are generally called seaming machines or seamers in the packaging trade, and the sealing area or junction between the cover and can is called the seam. The filled cans are transferred from the filler discharge conveyor by means of an infeed starwheel into the seamer. The seamers are usually rotary devices where the main rotary turret is comprised of a plurality of top and bottom rotary chuck holding devices spaced around its periphery for properly positioning the cans and their covers for the seaming operation. Each of these holding stations is called a seaming head. During one rotation of the seamer turret a cover is inserted onto the top of each can and the cover and the rim of the can are sealed in a two step successive seaming operation. The first step is called the first seam operation and the second step is called the second seam operation. In the first seam operation, the cover is formed around the can rim preparing it for the second
operation, but at this point the seam is not airtight. In the second seam operation, the cover is fully sealed to the can rim resulting in an airtight junction that preserves the freshness and integrity of the packaged product.

When the can is transferred from the infeed starwheel to the rotary turret of the seamer, it is placed on a rotating bottom chuck that carries it past the position where the cover is applied. At that point, the top rotating chuck is engaged on top of the cover, thus forming a uniformly rotating assembly consisting of the top chuck, cover, can and bottom chuck rotating about an axis radially displaced from the axis about which the entire seamer turret rotates. This rotating assembly is passed through the first and second seam operations as the seamer turret rotates, where seam rollers, called seam rolls in the trade, are disposed against the junction of the cover and can rim. The pressure of each seam roll against the respective top chuck in the first seam operation forms the can/cover junction into the proper configuration for a reliable sealed seam, and the pressure of the each seam roll against the respective top chuck in the second seam operation provides the final sealing of the can/cover junction that was formed in the first seam operation.

Because of the speed at which seamers operate, any significant down time of a seamer represents a substantial loss of valuable production time. On the other hand,
operation of a seamer with one or more faulty seaming stations thereon for any significant period of time will create substantial waste and cause a very expensive manual inspection to separate the improperly sealed cans from the properly sealed cans. Also, while it is expensive to replace the rotating chucks, particularly the top rotating chucks when the same do not need replacement, it is even more costly to not replace the same or selected ones of the same when the same are, or are likely to be, unserviceable in the very near future. Accordingly, it would be highly desirable to be able to monitor the performance of each seaming station of a seamer to detect catastrophic failure for immediate shutdown of the seamer, and to track the performance of each seamer station so as to identify the stations on the seamer turret which need servicing and to indicate whether the need for such servicing is immediate, or can be delayed, perhaps to the next scheduled shutdown.
BRIEF SUMMARY OF THE INVENTION

Can seamer apparatus including on-line monitoring of seamer head condition wherein can seal integrity is indicated by monitoring the position of the rocker arm carrying the seaming rolls in such a manner as to provide data from which the condition of the top rotary chuck and various other parts of each seamer station on the rotary turret may be determined. For this purpose, a single sensor is used to determine the position of each rocker arm as it passes a given location during the rotation of a turret, which position information is then accumulated and analyzed to provide the required information.
BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a top view of a preferred embodiment of the present invention as added to an exemplary conventional seamer.

Figure 2 shows a side view of a portion of the rotating assembly consisting of the top chuck, cover, can and bottom chuck plus the first and second seam rolls.

Figures 3A and 3B illustrate the rolling of the cover onto the top of the can, where Figure 3A shows the can/cover combination after the first seaming operation and Figure 3B shows the can/cover combination after the second seaming operation.

Figure 4 presents a top view of the mechanical arrangement for the first and second seaming operations with their respective locations relative to the sensing means for measuring the integrity of the seaming chucks, seam rolls or other pertinent parts of the seamer.

Figure 5 presents a detailed top view of the mechanical arrangement that holds the first and second seam rolls with respect to the can/cover combination and the sensing means that measures the integrity of the seaming chucks, seam rolls or other pertinent parts of the seamer.
Figure 6 presents a side view of the can/cover combination positioned at the end of the second seam roll operation and the sensing means.

Figure 7 shows the details of the magnetic pick-up means that is mounted to the seam roll rocker mechanism to allow accurate detection of the position of the second seam roll at the end of the second seam roll operation.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

First referring to Figures 1 and 2, filled (open top) cans 10 without covers travel along transfer conveyor 12 from the filler to the infeed starwheel 17 of the seamer. The filled cans are each synchronized with one of the multiple seamer heads on the seamer turret 16 by the infeed starwheel 17 and placed onto the rotating lower chuck 24 of the respective seamer head. At position 15, covers 18 are placed over the top of the filled cans and the rotating top chuck 25 is lowered to secure the covers in position for the seaming operation. At this point, the top chucks, covers, cans and lower chucks are uniformly rotating together on the centerline of the cans while at the same time being transported around the main seamer turret axis to the position where the first and second seaming operations take place. As illustrated in Figure 1, the first seaming operation takes as the cans pass through region 22, and the second seaming operation takes place as the cans pass through region 23.

Figures 2 and 3 show the first and second seam rolls 26 and 28 and the mechanical deformation of the can/cover combination that gives an air tight seam between the cover and can. This method is called "double seaming" in the trade, due to the double wrap of the cover around the can top rim.

Referring now to Figures 1, 2 and 4, the rotating assembly of the top chuck 25, cover 18, can 10 and bottom
chuck 24 as this assembly enters the first seaming operation region 22 may be seen. The first seam roll 26 and the second seam roll 28 are mounted on a rocker arm arrangement 46 that pivots on a torque rod 44. This torque rod is driven by a cam arrangement located in the top of the seamer turret so that the rod and hence the rocker assembly 46 rotates counterclockwise for the first seaming operation in region 22 and then clockwise during the second seaming operation in region 23.

The first seaming operation engages the cam driven first seam roll 26, which is a free wheeling device, against the rotating assembly of the can/cover combination 10 and 18 and the top chuck 25. The shape of the cam gives a progressively increasing force to drive the first seam roll against the top chuck. This process forms the first stage of the can/cover seam as shown in Figure 3A. During the second seaming operation the rocker arm is rotated in the opposite direction and engages the second seam roll 28 against the semi-finished seam and gives the final seam as shown in Figure 3B. It will be noted that the shapes of the first and second seam rolls are carefully designed to give the desired results.

The force of the first and second seam rolls against the top chuck is controlled by the cam arrangement located in the seamer top turret and the torsion in the torque rod 44. Proper seaming action is dependent upon very precise alignment and forces between the first and second seam rolls and the
rotation top chuck, as well as the condition of the top chuck and other components of each seamer head.

A pick-up magnet assembly 68 is mounted to each rocker arm assembly 46 so that each is extended to its utmost limit when the rocker arm is in the second seaming position. This pick-up magnet 68 may be held in position by mounting it (threaded into) in the adjustment bolt 62 that sets the running position, and thus the force, for the second seam roll 28. Lock nut 64 secures the adjustment bolt 62 in place and lock nut 70 secures the pick-up magnet assembly 68 in position.

Near the end of the second seaming operation region 23, a seam sensor 74 is mounted to the non-rotating frame of the seamer 16 by bracket 75. The seam sensor 74 is a very sensitive linear magnetic field detector that accurately measures the distance from its front surface to the pick-up magnet assembly 68. This distance measurement should be a constant if the seamer is functioning properly. Any deviation in position translates into some type of seaming malfunction.

When a pick-up magnet assembly 68 passes by the seam sensor 74, a signal is generated that is passed on to a microprocessor 80. Two other sensors are used for timing the seam monitoring process. Sensor 92 provides one pulse for each revolution of the seamer turret and sensor 94 provides one pulse for each seaming head on the seamer turret. By
logically combining the signals of the two sensors 92 and 94, the microprocessor can calculate which seaming head and pick-up magnet assembly 68 thereon is then passing in front of the seam sensor 74.

As each seaming head passes the seam sensor near the end of the second seaming operation, a signal is generated that precisely indicates the distance from the pick-up magnet to the seam sensor. The microprocessor stores this signal and assigns it to a particular respective rotation position for a designated seaming head. A single signal for any given seaming head tells the condition of only one point on the top seaming chuck. The seamers are made so that after one 360° rotation of the seamer turret, a seaming chuck will be angularly displaced from its original position, but after some given number of full 360° rotations of the seamer turret, the cumulative total of each such angular displacement of the seaming chuck will be some multiple of 360°, thus returning the seaming chuck to its original angular position with respect to the seam sensor. For example, a seamer manufactured by one of the leading suppliers uses a gear drive for the seamer turret and the seamer head chucks which is designed so that after 156 rotations of the seamer turret, the top seaming chuck has returned to its original position. Thus, accumulating successive 156 signals for each seaming head (156 rotations of the seamer turret) gives information about 156 points uniformly distributed around the periphery of each top seaming chuck. By precise data collection and
analysis, noise may be averaged or filtered out, the trend of
each seaming head can be recorded, and very small changes in
the seam parameters can be detected. This will allow
detection of seam imperfections located anywhere on the
periphery of the can/cover combination in a minimum number of
seamer turret rotations. For example, on a twelve head
seamer, proper data collection and statistical analysis can
detect top chuck defects in several, say three, rotations of
the top chuck, or 3 \times 156 = 468 \text{ rotations of the seamer}
turret. During this period, a total of 12 \times 468 = 5,616 \text{ cans}
have been seamed. On high speed filling lines, this equates
to several minutes. Until this invention was implemented, it
took hours to find top chuck or seam roll defects which
resulted in bad seams, and required the manual examination of
many thousands of filled and seamed cans. Also, a
catastrophic failure of a top chuck, such as having a piece
broken therefrom, will give a major and repetitive disturbance
in the sensor output for that angular position of the top
chuck of the respective sensor head, allowing the computer to
output a substantially immediate shutdown signal for shutdown
of the seamer. In addition, the data obtained by the present
invention can also be analyzed under computer control to
recognize amplitudes and frequencies therein characteristic of
the top chuck bearings, drive gears and other mechanical parts
of each seamer head to indicate the condition thereof.

Figure 7 is a partial cross section showing the details
of the pick-up magnet assembly 68. A magnet 69 is pressed
into a mounting bolt 67, which then is screwed into an already properly adjusted adjustment bolt 62 (see Figure 5) and itself adjusted and locked in position by lock nut 64 so as to establish a predetermined minimum spacing at the time of closest proximity between each pick-up magnet assembly 68 and the seam sensor 74.

The signal provided by the sensor assembly 74 is of course an analog signal, the same being sampled as strobed by the output of sensor 94, with the sample being converted to a digital signal by an analog to digital convertor for input to the microprocessor 80 (see Figure 1). While the preferred embodiment uses a linear magnetic field detector in the sensor assembly 74, other types of sensors could be used if desired, including optical sensors and the like.

While a preferred embodiment of the present invention has been disclosed and described herein, it will be obvious to those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.
1. A rotary seamer having an on-line can seal inspection capability comprising:

   a rotary turret having a plurality of seaming heads, each having a spinning bottom chuck for receiving an open top can, a spinning top chuck for holding a cover in position over the open top of an open top can resting on the bottom chuck, and a seam roller assembly for forming the top of the open top can and the outer edge of the cover for sealing, and for sealing the same together by squeezing the formed top of an open top can and outer edge of a cover between a seam roller and the top chuck of the seaming head;

   sensing means for sensing a characteristic of each seam roller assembly at a predetermined stage of the squeezing of the formed top of an open top can and outer edge of a cover between a seam roller and the top chuck of the seaming head to seal a can, and for providing a sensing means output in response thereto; and,

   means responsive to the sensing means output for accumulating successive sensing means outputs for each seaming head and for maintaining a time history thereof, and for detecting differences in the sensing means output for each seaming head over time and for different top chuck orientations.
2. The rotary seamer of claim 1 wherein the sensing means is responsive to changes in the spacing between the axis of the seam roller and the axis about which the top chuck rotates.

3. The rotary seamer of claim 2 wherein the sensing means comprises a magnetic field sensor having a single stationary sensor assembly, and a magnet mounted on the seam roller assembly of each seaming head so as to pass in close proximity to the stationary sensor assembly when the respective seam roller assembly is at the predetermined stage of the squeezing of the formed top of an open top can and outer edge of a cover between a seam roller and the top chuck of the seaming head to seal a can.

4. The rotary seamer of claim 3 wherein the magnetic field sensor senses the magnitude of a magnetic field.

5. The rotary seamer of claim 1 wherein the means responsive to the sensing means output is a computer.

6. A rotary seaming device having a real time inspection system that monitors the seaming process, comprising:

   a plurality of seaming heads, each having a rotating bottom chuck for receiving and positioning a can with an open top rim, a rotating top chuck for holding a cover in position
over the open top rim of said can, and first and second seam roll assemblies for forming an air tight seam between the top rim of said can and periphery of the cover by squeezing them together between the top chuck and seam roll assemblies in a predetermined manner;

sensing means for sensing the absolute position of the second seam roll assembly with respect to the top chuck at a predetermined stage of the squeezing process that forms said seam, and for providing an output in response thereto, and

means responsive to the sensing means output for accumulating successive said outputs for each seaming head and for maintaining a time history thereof, and for detecting particular variations in the sensing means output for each seaming head over time and for different top chuck rotational positions such that the entire periphery of said top chuck is monitored.

7. A rotary seamer having a real time inspection system that monitors the seaming process comprising:

a rotary turret having a plurality of seaming heads, each having a spinning bottom chuck for receiving and positioning an open top can, a spinning top chuck for holding a cover in position over the open top rim of said can, and first and second seam roll assemblies for forming an air tight seam between the top rim of said can and periphery of the cover by squeezing them together between the top chuck and seam roll assemblies in a predetermined manner;
sensing means for sensing the absolute position of the second seam roll assembly with respect to the top chuck at a predetermined stage of the squeezing process that forms said seam, and for providing an output in response thereto, and means responsive to the sensing means output for accumulating successive said outputs for each seaming head and for maintaining a time history thereof, and for detecting particular variations in the sensing means output for each seaming head over time and for different top chuck rotational positions such that the entire periphery of said top chuck is monitored.

8. A rotary seaming device having a real time inspection system that monitors the seaming process, comprising:

a plurality of seaming heads, each having a rotating bottom chuck for receiving and positioning a can with an open top rim, a rotating top chuck for holding a cover in position over the open top rim of said can, and a first and second seam roll assemblies for forming an air tight seam between the top rim of said can and periphery of the cover by squeezing them together between the top chuck and seam roll assemblies in a predetermined manner;

sensing means for sensing the absolute position of the second seam roll assembly with respect to the top chuck at a predetermined stage of the squeezing process that forms said seam, and for providing an output in response thereto, and
means responsive to the sensing means output for accumulating successive said outputs for each seaming head and for maintaining a time and angular position history for this data.

9. The rotary seaming device of claim 8 wherein the time and position history data contains particular variations in the sensing means output for each seaming head over time and for different top chuck rotational positions such that the entire periphery of the top seaming chuck is monitored.

10. The rotary seaming device of claim 9 wherein the time and position history data also includes discrete data about the seam roll assemblies, the top chuck bearings and gears and other mechanical parts utilized in the seaming process.
A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) : B65B 7/16
US CL. : 53/75, 334; 413/31, 41

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 53/52, 335,336,337,485,486,487,488; 72/1, 3, 31; 413,5,6,40; 493/33,32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

Date of the actual completion of the international search: 28 SEPTEMBER 1992

Date of mailing of the international search report: 21 NOVEMBER 1992

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