May 26, 1970 L. A. NELSON 3,513,689

METHOD AND APPARATUS FOR DETECTING DUD CONTAINERS

Filed Dec. 29, 1967 2 Sheets-Sheet 1

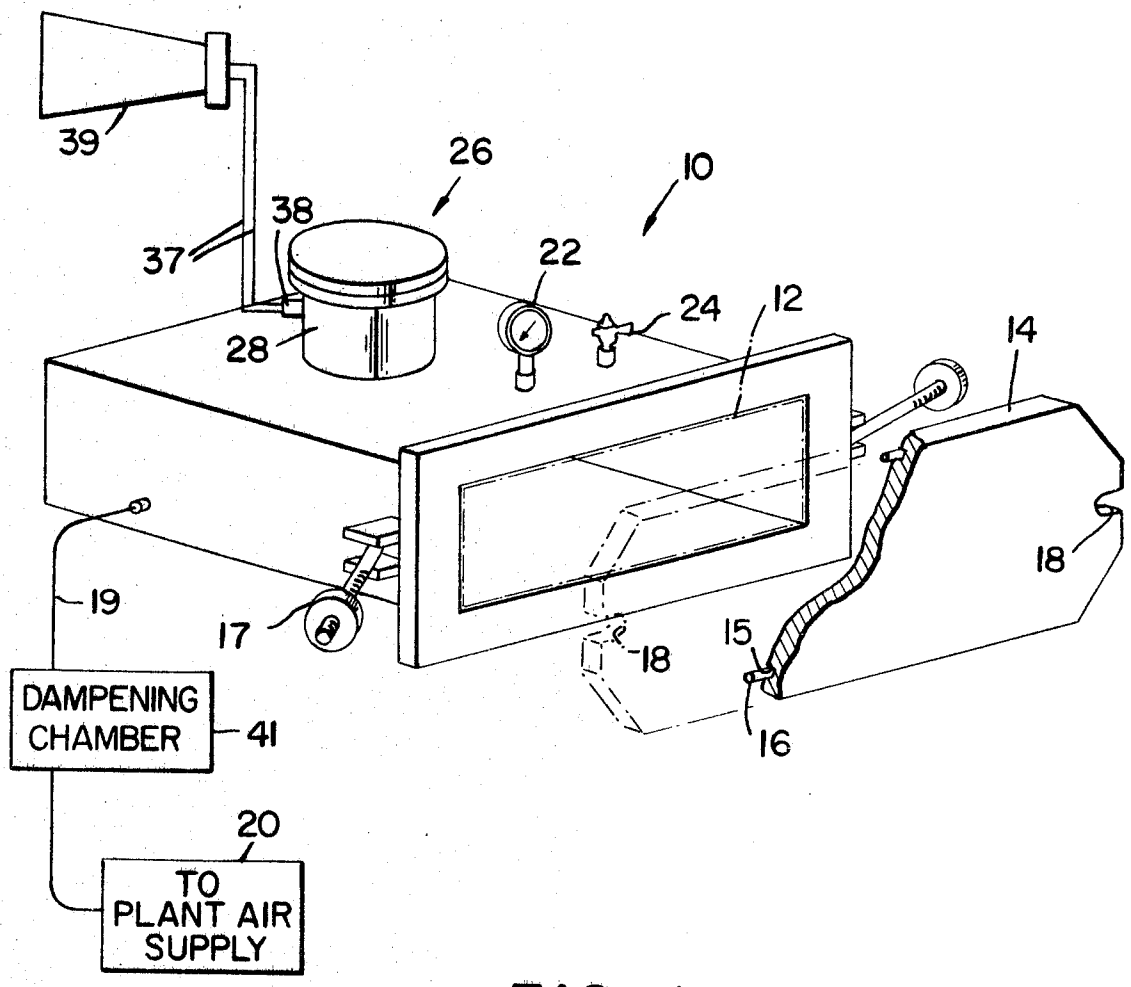


FIG_1

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METHOD AND APPARATUS FOR DETECTING DUD CONTAINERS

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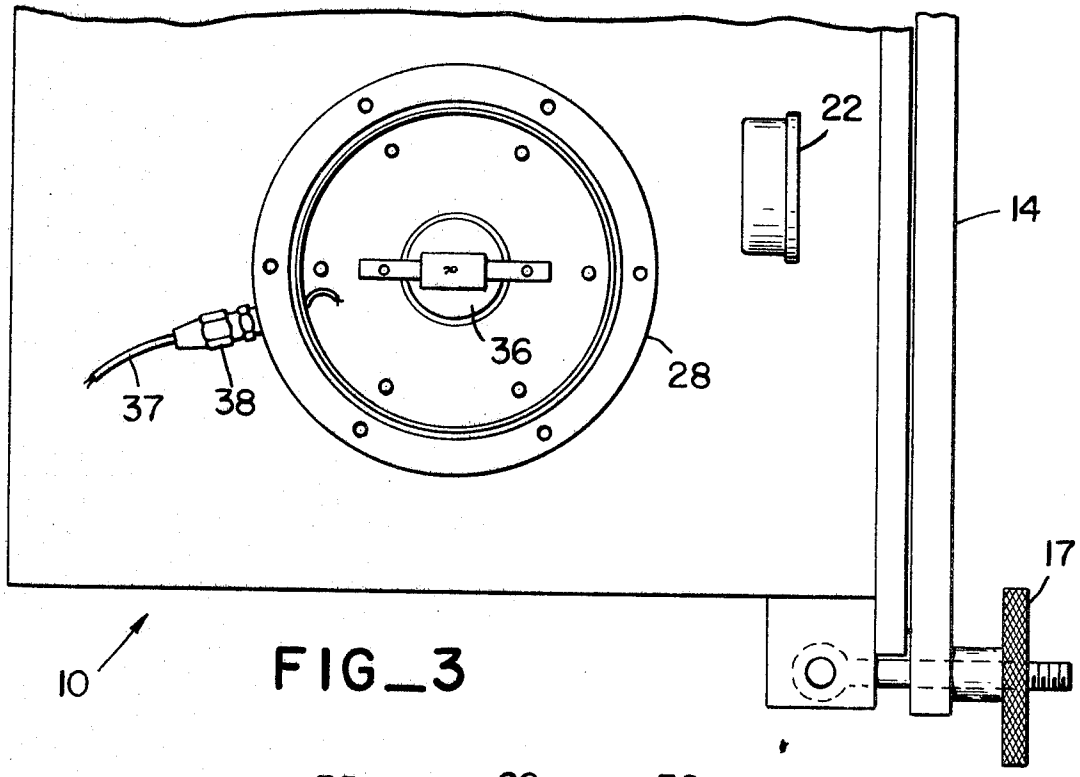


FIG_3

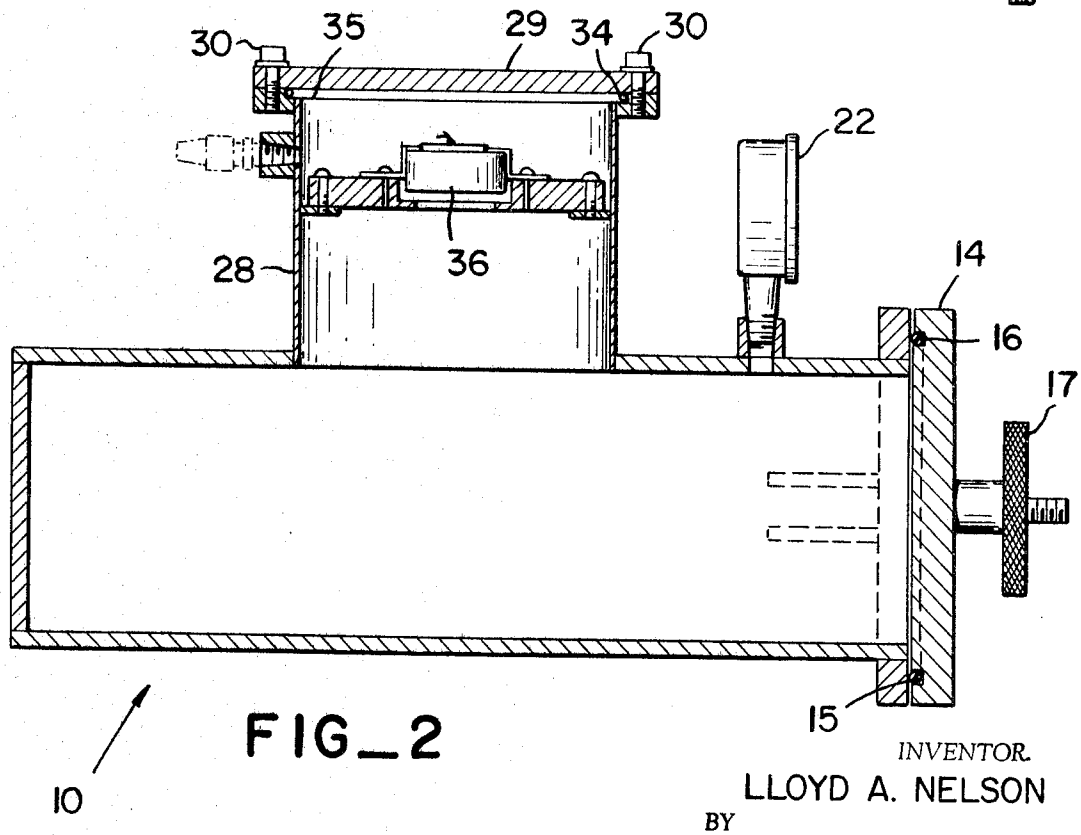


FIG_2

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METHOD AND APPARATUS FOR DETECTING DUD CONTAINERS

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U.S. Cl. 73—37 10 Claims

ABSTRACT OF THE DISCLOSURE

A non-destructive method and apparatus for testing hermetically-sealed containers that include a thin flexible diaphragm. When the container includes a predetermined amount of vacuum, the diaphragm is concave with respect to the container contents. When the internal vacuum is less than the predetermined amount, the diaphragm is convex. The present method is accomplished by subjecting the container to sufficient gaseous external pressure to create the concave deflection of the diaphragm even in the absence of any vacuum within the container. As a result, any container having an internal vacuum that is insufficient to retain the diaphragm in a concave position, at atmospheric pressure, will emit a detectable impulse as the diaphragm deflects from a convex to a concave position during application of sufficient external pressure. In this manner, containers having insufficient vacuum can be separated from those having sufficient vacuum.

This invention relates to a method for the nondestructive examination of hermetically-sealed containers to ascertain the existence of a satisfactory vacuum condition within the containers and apparatus for accomplishing the same.

It is common in the baby food industry to heat sterilize and store perishable foods under vacuum in hermetically-sealed containers to retain the contents in an aseptic condition to prevent microbial spoilage. To ensure a continuous hermetically-sealed environment during periods of long shelf-storage, a metal cover has been developed that is applied to the container while the contents thereof are being processed at a high temperature suitable for complete sterilization. This metal cover, including a sealing member, is also provided with a die-drawn or stretched center panel (diaphragm) that is normally biased outwardly so that the panel is convex with respect to the interior of the container. The panel is fabricated to deflect inwardly when the pressure within the container is less than the external pressure by a predetermined amount. When the contents of the container cool down to about room temperature, the internal pressure within the container is reduced, thereby creating the pressure drop within the container necessary to cause deflection of the panel. As a result, the center panel is distorted (or deflected) inwardly so as to occupy a concave position.

Employment of this type of closure member has proved to be advantageous for indicating the effectiveness of the hermetic seal. For example, the absence of an inward distortion of the center diaphragm of a filled container after processing is a visually-observable indication of an unsatisfactory hermetic seal within the container. Such containers are commonly referred to as "duds." Conversely, the continued presence of the inwardly distorted center diaphragm also provided a visually-observable indication of a satisfactory asceptic condition within the container. This visual aspect is especially useful to the ultimate consumer who can readily determine the aseptic condition of the container immediately prior to utilizing the contents thereof.

However, individual visual observation is not suitable for the testing of containers on the high-speed assembly lines presently utilized for processing and packaging perishable commodities. This is particularly significant where assembly line procedures provide containers enclosed in opaque, sealed fiber shipping cartons. Present quality control methods involve the opening of a representative sampling of the closed shipping cartons to determine the presence of a satisfactory hermetic seal within individual containers. As a result, total control of product quality is not presently conveniently and economically obtained.

In the past, devices have been developed for the nondestructive determination of air pressure conditions within a sealed metal container, such as a "tin can," having a flexible end closure. For example, a device disclosed by the Landrum, U.S. Pat. No. 1,825,744 employs reduced external air pressure to deflect a flexible end closure. Because this particular type of end closure is normally inverted (concave) even when the internal and external air pressures are equal, reduction in external air pressure can be employed to cause the flexible end closure to audibly "flip" to the convex position. Thus, Landrum isolates defective tin cans by subjecting the cans to an external partial vacuum up to but less than that desired within the container. Under proper conditions, the end closure of the defective tin can will be forced outwardly by the relatively greater pressure within the can. In this manner, one employing the Landrum device is able to determine those tin cans that have excessive internal air pressure, i.e., insufficient internal vacuum.

As previously stated, the center diaphragm of the twist-off cover presently employed with containers in the baby food industry is normally biased outwardly (convex). Only when at least a predetermined pressure differential exists, does the diaphragm deflect inwardly to the concave position. Thus, artificial reduction of the air pressure surrounding a hermetically-sealed container employing the aforementioned cover would only produce diaphragm movement among satisfactorily-sealed containers, leaving unsatisfactorily-sealed containers (having initially convex cover panels) completely undetected.

Broadly stated, the present invention is accomplished by increasing the gaseous pressure surrounding a hermetically-sealed container having a normally outwardly-biased flexible center diaphragm so that the pressure differential is that required to cause the flexible center diaphragm to invert, i.e., occupy a concave position. When a container having insufficient vacuum or even a positive internal pressure is treated in this manner, a detectable impulse will be produced as the flexible center diaphragm is inverted from a convex to a concave position. Conversely, those hermetically-sealed containers that have sufficient internal vacuum to retain the center diaphragm thereof in the desired inverted (concave) position prior to application of the external pressure, will not emit a detectable impulse as no diaphragm movement between the convex and concave position will occur. Thus, those hermetically-sealed containers having insufficient internal vacuum (negative pressure), and hereinafter preferred to as duds, can be readily distinguished from satisfactory containers having sufficient internal vacuum and quickly separated therefrom. Throughout this disclosure, the container will be referred to as being a glass baby food jar with a twist-off reclosable cover. However, this is for illustrative purposes only and it is not intended that the process or apparatus of this invention be limited to only this container, cover or type of product.

As a feature and advantage of this invention, a plurality of the aforementioned containers, that have been filled with a product, hermetically sealed, processed, labeled and

placed in a gas-pervious shipping carton that is glued or stabled closed, can be simultaneously tested by providing a chamber of at least sufficient size to receive the closed, ready-to-ship carton. Then by sealing the chamber and subjecting the contents to a predetermined elevated pressure sufficient to cause the aforementioned deflection, the flexible diaphragm of any containers having unsatisfactory internal vacuum will deflect and provide a detectable impulse. When "duds" are infrequent, i.e., when high quality control conditions are present, a chamber can be employed that is of sufficient dimensions to receive a plurality of cartons such as would be stored, for example, on a shipping pallet. Thus a rapid means is provided for simultaneously testing a large number of containers to ensure high quality product control.

In still another aspect, increasing the air pressure within the chamber during testing produces a corresponding increase in the density of the air therein and enhances the transmission of sound waves. Thus the detectable impulse particularly when it results from the audible characteristics of sound emitted by inversion of the flexible panel, will be more readily observable.

Other features and advantages of the invention as well as further objects thereof will be apparent when reference is made to the specific embodiment described in the attached drawing wherein:

FIG. 1 is an exploded, partially cutaway, perspective view of a specific embodiment of this invention;

FIG. 2 is a sectional view of the embodiment of FIG. 1; and

FIG. 3 is a partial top plan view of the embodiment of FIG. 1.

Referring now to the drawings wherein similar characters of reference represent corresponding parts in each of the several views, there is shown a generally rectangular chamber **10** of a suitable metal such as cast iron and having internal dimensions at least sufficient to receive a standard cardboard shipping carton **12**. In this embodiment, carton **12** is depicted as containing 24 5 oz. glass baby food jars having screw-on metallic covers each including a flexible metallic diaphragm. However, it will be apparent to those skilled in this art that chamber **10** can be of a suitable size to receive any number of cartons **10** of various conventional sizes.

Chamber **10** is equipped with a removable closure member (door) **14** for sealing chamber **10** to maintain a pressure of up to at least 25 p.s.i.g. therein. Closure member **14** includes an annular recess **15** in which is fitted a sealing O-ring or gasket **16** of rubber or the like, that is adapted to engage the corresponding end of chamber **10** and effect a fluid-tight seal when door **14** is secured to chamber **10** with threaded releasable fasteners **17**. Threaded fasteners **17** are pivotally attached to the sides of chamber **10** and adapted for positioning in apertures **18** in closure member **14** to draw member **14** into fluid-tight contact with chamber **10**. Chamber **10** is in fluid communication with inlet line **19** attached to high pressure air supply **20**. Also in fluid communication with chamber **10** are air pressure gauge **22**, bleeder valve **24** and amplifying system **26**.

Referring now to FIGS. 2 and 3 wherein amplifying system **26** is shown in more specific detail as including a microphone chamber **28** integral with chamber **10** and disposed above and near about the center thereof. Microphone chamber **28** includes a cover member **29** removably secured thereto through a series of threaded bolts **30**. O-ring **34** is provided in recess **35** to ensure an airtight seal between cover **29** and the walls of chamber **28**. Disposed within chamber **28** and preferably in rigid attachment thereto is a conventional microphone **36**. Wires **37** extend from microphone **36** through an airtight coupling **38** to microphone **39**. Amplifying means (not shown) may be included to increase the sound emitted from speaker **39**. It is further advantageous to employ sound dampening chamber **41** to assist in minimizing extraneous background noises such as may occur during the introduction of gas from high-pressure supply **20**. Chamber **10** may also be equipped with a safety valve to prevent excessive pressure therein.

In operation, a glued carton **12** containing 24 5 oz. baby food containers is placed in chamber **10**. Closure member **14** is positioned across the opening and secured in airtight relationship thereto by threaded fasteners **17**. Air pressure is admitted to chamber **10** from air supply **20** through line **19**. As the pressure increases, a distinct audible click is produced by any jars having insufficient internal vacuum. The sound of any deflection is received by microphone **36** and emitted by speaker **39**. After the pressure within the chamber is increased by a predetermined amount known to be sufficient to produce deflection, the source of air pressure is turned off and the air released through bleeder valve **24**. As the pressure falls, any flexible diaphragm that may have been deflected from a convex to concave position during the air pressure increase will again return to the position it originally occupied under atmospheric pressure. A second audible sound or click will then be transmitted.

Where the particular group of containers being tested contains more than one unsatisfactorily sealed container a corresponding number of separate audible clicks will usually be heard. By experiment, it has been found that as the air pressure within the sealed chamber is raised, the diaphragm of those containers devoid of an internal vacuum, i.e., having internal atmospheric pressure, will be deflected when subjected to an elevated pressure of about 6–7 p.s.i.g., and thereby emit the distinct audible click. Containers having some negative internal pressure will deflect more easily thus producing the audible click at even less elevated pressures. However, to ensure that containers having spoiled contents (and high internal pressures) will be detected, it has been found to be advantageous to employ chamber pressures of up to about 25 p.s.i.g. or higher.

In actual practice, the absence of an audible sound will ensure that the carton contains no defectively sealed containers and is ready for shipping. Thus, it is only necessary to re-examine those cartons from which an audible sound is emitted.

Although the specific embodiment illustrated in the drawings utilizes an audible detection system, one skilled in this art will appreciate that the physical deflection of a flexible diaphragm can be also translated to provide other detectable impulses that may be useful for automatically actuating a case-rejecting mechanism.

In still another aspect, the audible click has been found to occur at a frequency in the range of 300–450 cycles per second. Thus a monitoring or rejection device can be programmed to respond to audible emissions only in about this frequency range. In addition, other devices as exemplified by dampening chamber **41** may be utilized to eliminate the effect of background noise. In this manner, other audible processing noises will not interfere with detection of the audible impulse.

Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it will be appreciated that certain changes and modifications may be practiced within the spirit of the invention as limited only by the scope of the appended claims.

What is claimed is:

1. In the packaging of perishable products in a hermetically-sealed container having a sealing member of the type including a flexible, normally convex-biased diaphragm adapted to occupy a concave position when the positive gaseous pressure difference between the outside of the container and the inside of the container exceeds a predetermined amount and to occupy said convex position when said pressure difference is up to said predetermined amount, the movement of said flexible diaphragm between said convex and concave positions

producing a detectable impulse, the improvement comprising determining the absence of a pressure difference in excess of said predetermined amount through the steps of: placing the entire container within an airtight chamber, increasing the pressure within said chamber to provide at least said predetermined amount of pressure difference between the inside and the outside of said container; and monitoring said container to determine the presence or absence of said detectable impulse.

2. A process in accordance with claim 1 wherein said monitoring is followed by the step of releasing the pressure from said chamber.

3. A process in accordance with claim 1 wherein said monitoring is accomplished while simultaneously filtering out extraneous background impulses.

4. A process in accordance with claim 3 wherein said detectable impulse provides an audible indication of the movement of said flexible diaphragm.

5. A process in accordance with claim 1 wherein said determination is accomplished simultaneously upon a plurality of said containers, said process being further characterized by separating any container having a flexible diaphragm that emits said detectable impulse from other containers having flexible diaphragms that do not emit such a detectable impulse.

6. A process in accordance with claim 5 wherein said plurality of containers are enclosed in an gas-pervious shipping carton.

7. Apparatus for determining the absence of a desired amount of pressure differential between the inside and outside of a hermetically-sealed container having a flexible diaphragm adapted to occupy a concave position when at least the desired amount of pressure differential is present and to occupy a convex position when the desired amount of pressure differential is absent, the movement of said diaphragm between said convex and said concave positions producing a detectable impulse, comprising: an airtight chamber of a size sufficient to receive at least one of said containers; means for increasing the air pressure in said chamber by up to at least the equivalent of said desired amount of said pressure differential; and means for sensing the occurrence of a detectable impulse from said container produced if said diaphragm is deflected between said convex to said concave position.

8. Apparatus in accordance with claim 7 and further characterized by means for filtering extraneous background impulses.

9. Apparatus in accordance with claim 7 wherein said chamber is of a size sufficient to receive a plurality of said containers.

10. Apparatus in accordance with claim 7 wherein said sensing means provides an audible indication when said diaphragm deflection occurs, said apparatus being further characterized by means for releasing said increased air pressure.

References Cited

UNITED STATES PATENTS

1,447,701	3/1923	White.	
1,825,744	10/1931	Landrum	73—49.3
2,383,936	9/1945	Hohl	73—49.3

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