June 27, 1950 W. D. BELL 2,512,910

METHOD AND MEANS FOR DETECTING IMPERFECTLY SEALED CONTAINERS OF VACUUM-HOLDING TYPE

Filed Feb. 14, 1947 3 Sheets-Sheet 1

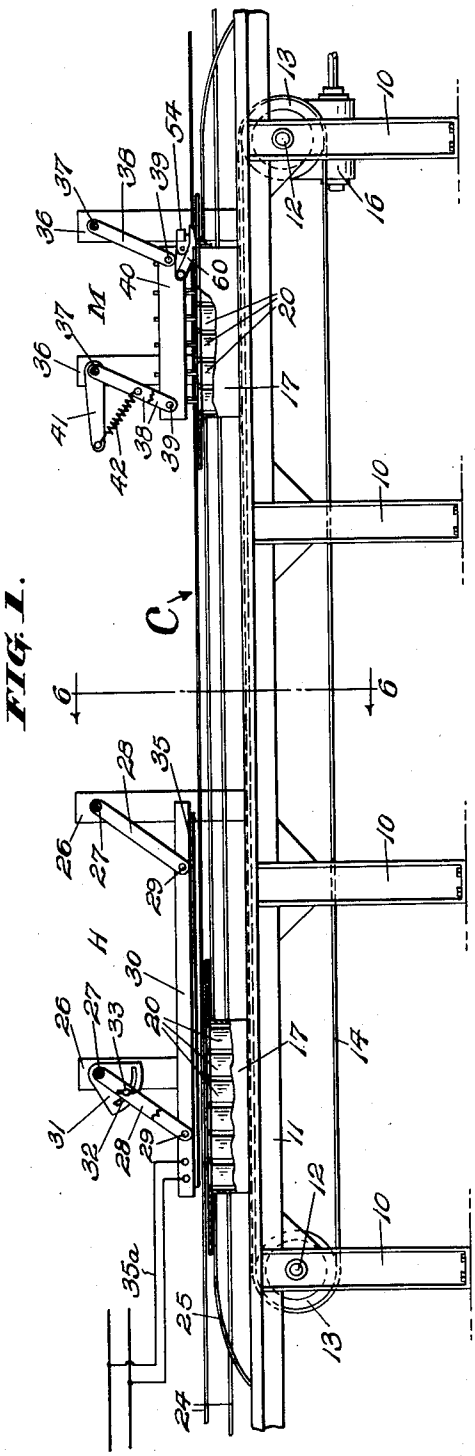


FIG. 1.

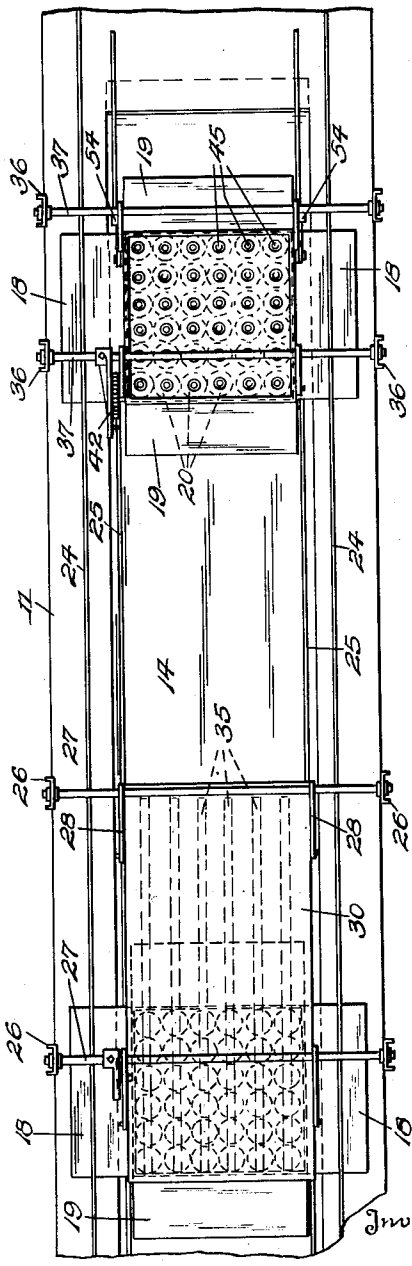


FIG. 2.

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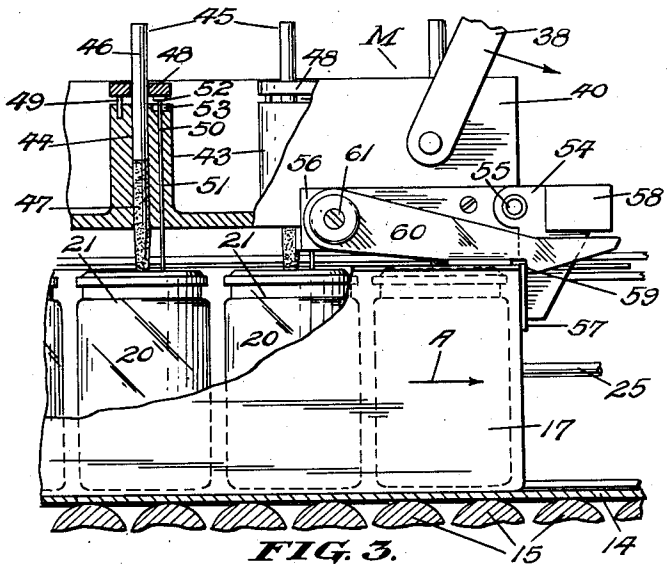


FIG. 3.

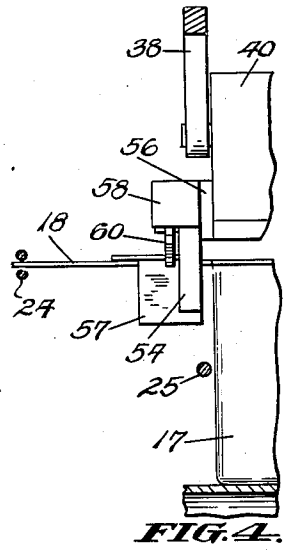


FIG. 4.

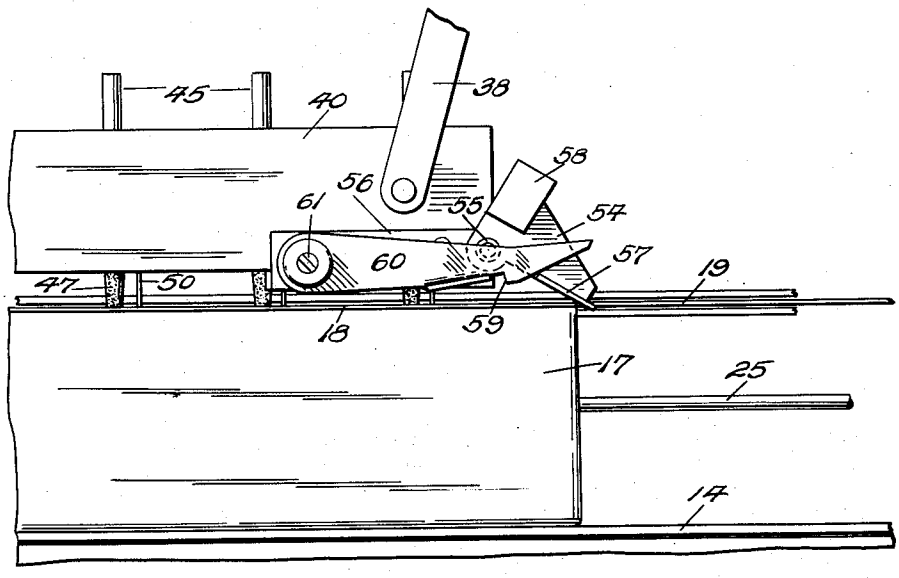


FIG. 5.

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METHOD AND MEANS FOR DETECTING IMPERFECTLY SEALED CONTAINERS OF VACUUM-HOLDING TYPE

Filed Feb. 14, 1947 3 Sheets-Sheet 3

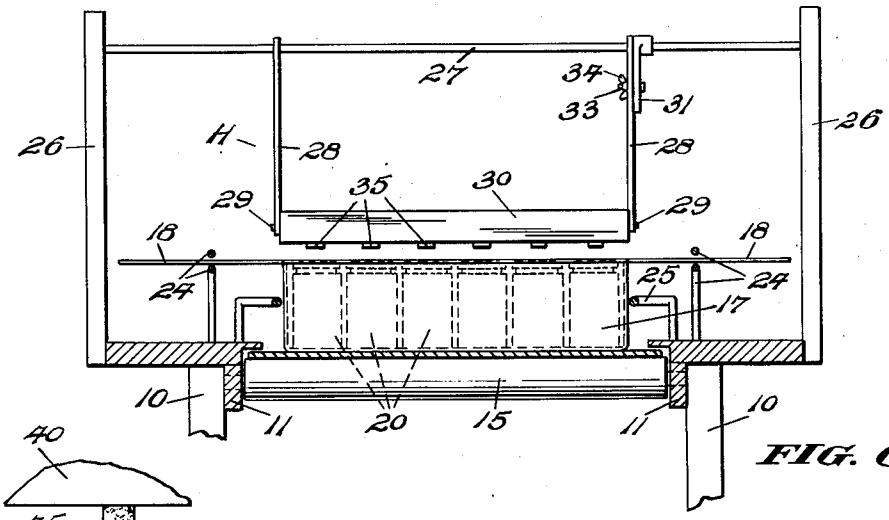


FIG. 6.

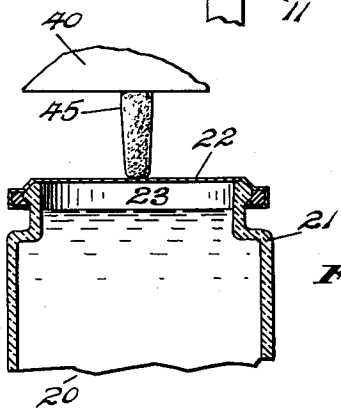


FIG. 7.

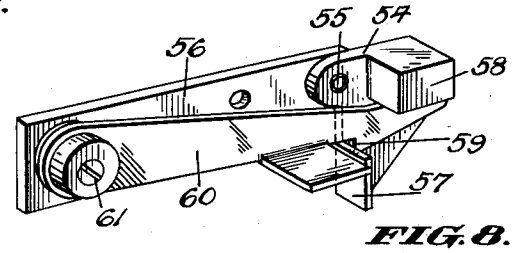


FIG. 8.

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Patented June 27, 1950 2,512,910

UNITED STATES PATENT OFFICE

2,512,910

METHOD AND MEANS FOR DETECTING IMPERFECTLY SEALED CONTAINERS OF VACUUM-HOLDING TYPE

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Application February 14, 1947, Serial No. 728,612

5 Claims. (Cl. 73—15)

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This invention relates to method and apparatus for determining the presence of vacuum in sealed containers. It has to do, more particularly, with a method and apparatus for marking sealed containers in an automatic manner when such containers do not possess an internal vacuum of required degree.

Many food stuffs are subject to deterioration when exposed to oxygen of the atmosphere. For this reason, it is a current practice on the part of many food processors and packers to place food stuffs in sealed containers in which a commercial vacuum is present, this being done for the purpose of excluding atmospheric oxygen and preserve the food stuffs indefinitely while they are retained in the containers during shipment and storage and prior to the opening of the containers by their ultimate users.

In producing such vacuum conditions in sealed containers, it is customary to introduce regulable quantities of steam into the head spaces of such containers prior to the final capping thereof, or in another process, as set forth in my prior Patent No. 2,284,631 granted June 2, 1942, to produce combustion of combustible gases in confined regions around the head spaces of such containers, and when combustion conditions reach a peak to seal the containers by applying the closure caps thereto.

While these methods are in the main effective in the vast majority of operations, it sometimes happens that imperfections in the glass bodies of the containers, or in the construction of the metallic closure caps and their gaskets, or in the sealing operation itself, will result in leakage of air into the containers, thereby eliminating the desired vacuum in the head spaces of such containers, or impairing the vacuum to such a degree that food spoilage may result. The presence or absence of a vacuum (by which is meant a "commercial" or partial vacuum) in the head space of a container may be manifest in several ways, such as noting the depression of the metallic cap or closure, or the audible sound given off when the closure of such an imperfectly sealed container is tapped. None of the methods heretofore available, however, has been entirely satisfactory, either by reason of their fallibility or the time and labor involved in marking the same.

In the method and apparatus herein disclosed, I make use of the fact that the thermal properties or thermal response of the head spaces of containers of the type under consideration vary with the amount of air or gases contained therein, and I employ such variance to determine the degree of vacuum by noting the rate at which the head space will absorb and/or reject heat.

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It is, therefore, an object of this invention to provide a method and means of making this determination and to mark the defectively sealed containers unmistakably so that they may be removed from a group of containers prior to final packaging and shipment thereof.

It is another object of the invention to provide a novel method and means for marking sealed containers which may be readily adapted to production methods of packaging a number of such containers in boxes or cartons, and wherein the containers, while positioned in such boxes or cartons, and moving along a conveyor line, are marked individually and automatically when improper vacuum conditions obtain therein, or when vacuum is entirely absent.

A further object of the invention is to provide a method and means for marking defective vacuum sealed containers having removable caps formed from heat-conducting materials, and wherein the caps are subjected successively to determined intervals of heating and cooling, and to which caps there is applied indicators of a composition which, when heated to a predetermined temperature, will apply a mark, or other graphic designation to the caps of containers which are imperfectly sealed.

In the accompanying drawings, I have illustrated apparatus which may be used in carrying out the present invention. However, it is to be understood that this apparatus may take various forms as long as it embodies the basic features of my invention. In the drawings similar characters of reference designate corresponding parts, and:

Fig. 1 is a side elevational view of apparatus employed by the present invention in the marking of improperly or defectively sealed vacuum-type containers;

Fig. 2 is a top plan view of the apparatus;

Fig. 3 is a detail side elevational view, partly in vertical section, of the container-marking mechanism utilized by my present invention;

Fig. 4 is a detail end elevational view of the apparatus disclosed in Fig. 3, with associated parts in transverse cross section;

Fig. 5 is a side elevational view of the marking mechanism and disclosing the latch elements thereof in their released positions;

Fig. 6 is a vertical transverse sectional view on the line 6—6 of Fig. 1;

Fig. 7 is an enlarged vertical transverse sec-

tional view taken through a vacuum sealed container of the type to which the present invention is particularly applicable;

Fig. 8 is a detail perspective view of one of the latch devices carried by the marking mechanism;

The apparatus illustrated comprises a frame structure composed of a plurality of longitudinally spaced and vertically extending legs 10, the latter at their upper ends being united with a pair of transversely spaced and longitudinally extending horizontal rails 11. Journaled in the ends of this frame structure are shafts 12 carrying pulley wheels 13, around which passes an endless belt or apron conveyor 14. Preferably, the rails 11 also act to support a plurality of transversely extending idler rolls 15, which are placed immediately beneath the upper run of the belt 14 for the purpose of supporting the latter and the products arranged thereon and advanced thereby. One of the shafts 12 may be driven by a motor 16, or other driving element.

Adapted to be positioned on the upper run of the conveyor belt for longitudinal advance along the machine in a guided course or way are paperboard boxes or cartons 17, the latter being of the usual commercial variety having open tops which are adapted to be closed by foldable side and end flaps 18 and 19, respectively. Each of these boxes or cartons is adapted to receive a group of closely packed sealable containers 20. While my invention is not so restricted, each of these containers may be of the type comprising a glass jar or body 21, formed with an open top for the reception of food stuffs or other perishable substances. Such a glass jar, for example, may hold approximately 4½ ounces of a food product when filled to within one-fourth of an inch of the open top thereof. This top is then closed and sealed by means of a thin metal cap, indicated at 22, which may be approximately 43 mm. in diameter. During the sealing operation, a vacuum of 20 to 24 inches Hg or more is produced in the head space 23 of each container, that is, the space between the food products packed in the container and the under surface of the metal cap.

With the entire package at approximately room temperature, application of heat to the metal caps will result in thermal changes in the head spaces of the containers, depending upon the degree of vacuum present in such head spaces. The lower the pressure in the head spaces, the lower the vaporizing point of the moisture in liquid form on the inner surface of the closing cap; also, the rate of heat transfer from the cap to the contents of the container will be correspondingly reduced. Accordingly, the metal cap or closure will, with a relatively high vacuum in the head space, respond more rapidly to applied heat since more heat is retained in the cap itself and less loss by radiation and conduction to the atmosphere of the head space and to the contents of the contained than would occur if a conducting atmosphere were present in the head space and the vaporizing temperature higher. The same conditions, acting in reverse, cause the cap to cool more rapidly, when the under side thereof is exposed to a desired vacuum, after the source of heat is removed.

If the cap and head space of such a container is exposed to a source of radiant or convected heat, the rate at which the cap will heat, or the amount of heat which the cap will absorb, will be determined by the conductivity and thermal

capacity of the atmosphere within the head space of the container. In like manner, the rate at which the cap will cool after being heated as above, will be determined by the amount of heat that has been absorbed by the cap and the atmosphere of the head space during the heating period. Therefore, by carefully controlling the rate and time of heating, and by determining by one means or another the temperature of the cap after a definite cooling interval, the density of the atmosphere of the head space can be determined.

In the operation of a typical production line, as employed in food-packing establishments, the jars or containers 20 are filled with raw or partially cooked food stuffs. The metallic lids, caps or closures, shown at 22, are applied and vacuum created in the head space. The containers may then be processed under appropriate conditions of heat and pressure to sterilize the contents. After cooling, labels are applied and the containers are placed in the shipping boxes or cartons 17 in which they are ultimately shipped. In acordance with the present invention, just prior to the final closing and sealing of the cartons for shipment, the individual containers are checked to make sure that a proper vacuum exists in the head space of each container. Usually the containers are closely packed in the boxes or cartons in rows of six, making thirty-six containers within each box or carton. Such a box or carton is then placed on the conveyor 14, with its side and end flaps held in outward horizontal positions, so that the top of the box or carton is completely open to expose the metal caps of the containers 20. The side flaps of the boxes or containers are positioned between stationary guide rods 24, so that they will be positively retained in approximately horizontal positions while the boxes or cartons are moving with the conveyor belt in the direction indicated by the arrow A in Fig. 3. Corresponding guide rods 25 may be suitably supported by the frame structure of the conveyor for the guidance of the boxes or cartons.

Arising from the framework of the conveyor are stationary standards 26, four in number. These standards effect the support of transversely extending rods 27, on which are pivotally mounted for swinging movement the upper ends of a plurality of parallel links 28, the lower ends of said links being pivotally connected as at 29 with a horizontally disposed frame 30 of a heating mechanism H. One of the rods 27 may be provided with a fixed quadrant 31 having formed therein an arcuate slot 32, this slot being adapted for the reception of a threaded bolt 33, carrying a wing nut 34. By this construction, the frame 30 of the heating mechanism may be raised or lowered with respect to the top of the container-filled boxes or cartons moving therebeneath on the conveyor.

While the heating mechanism may take one of several forms, I preferably provide the frame 30 with a plurality of electrically energized resistor strips 35, which may be wired in parallel in an electrical circuit 35*a*, and which register with the metallic caps of the containers 20. These strips are of sufficient length and emit sufficient heat so that without interrupting the sustained longitudinal advance of the boxes or cartons 17, the cap of each container will be heated to the required degree for vacuum-testing purposes. Optimum conditions in this regard can be obtained readily when different sizes and types of

containers are used by slight experimentation and adjustments, such as by determining the proper distance between the resistor strips and the tops of the containers, the rate of linear advance of the conveyor, and the length of each of the resistor strips. These, of course, are practical factors which may be readily determined to best advantage by a skilled worker in the art.

The conveyor belt is driven continuously at a constant rate of speed, so that after a given box holding the containers travels past the heating mechanism H, the box will enter a cooling zone C, in which a reduction in temperature on the part of the containers and their heated metallic caps takes place, this cooling period being of a definite or determined duration, so that the properly sealed containers, in which a desired degree of vacuum is present, will attain a somewhat lower temperature than in containers which are improperly sealed, that is, in which a lower degree of vacuum or atmospheric pressures are present.

At the end of this cooling zone, the framework of the machine supports a marking mechanism, which is designated in its entirety by the reference character M. Advantageously, this mechanism may consist of a plurality of vertical standards 36, which are secured to the sides and form a part of the machine framework. The upper ends of registering pairs of these standards carry cross rods 37, upon which are pivotally mounted the upper ends of sets of parallel links 38, the lower ends of these links being pivotally joined as as 39 to the rectangular frame 40 of the marking mechanism. This frame occupies a substantially horizontal position above the boxed containers moving with the upper run of the conveyor belt, but the mounting of the frame is such that the same may be moved vertically toward and away from the tops of the boxed containers. Normally the frame is maintained in a relatively elevated position by providing one of the cross rods 37 with a fixed arm 41, and securing to the outer end thereof a spring 42, the opposite end of the spring being connected with one of the links 38. Unless otherwise influenced, as will be hereinafter explained, the spring 42 serves to maintain the frame in its relatively elevated position.

The frame 40 is formed with a plurality of upstanding bosses 43, each of the latter being formed with an axially disposed opening or bore 44 which, when the frame is lowered, is adapted for vertical and axial registration with one of the containers 20. Slidably positioned in each of the openings 44 is an indicator pencil 45. Each pencil advantageously may comprise a solid rod-like body 46 which carries at the lower end thereof a fusible crayon-like marking portion 47. The lower ends of the marking portions of these indicating pencils are adapted to contact the center of each container lid or cover, and the material from which the marking portion is formed is carefully selected so that it will soften, fuse or melt in very close temperature limits. This range is such that the hotter container lids or caps, present on imperfectly sealed containers, will possess a temperature sufficient upon momentary contact of the pencils therewith to soften the lower ends of the marking portions of the pencil and cause the same to produce a mark or spot in the center of the lids or caps possessing abnormally high temperatures. The perfectly sealed cans or containers, having lids or caps at lower temperatures, will not soften or fuse the pencil ends and, therefore, will not be marked thereby. After the boxed containers pass out of registration with the marking mechanism, a marked container or containers may be readily noted by an attendant, removed from the box and a perfectly sealed container or containers substituted therefor.

To compensate for pencil wear, the rod-like bodies 46 thereof are received in clamping rings 48. These rings have their under surfaces engaged with the upper ends of fulcrum pins 49 carried by and projecting upwardly from the bosses 43. Opposite to the pins 49, the under surfaces of the rings 48 engage with the upper ends of vertically movable stems 50. These stems are slidably mounted in vertical openings 51 provided therefor in the bosses, and the lower ends of the stems positioned to engage with the caps or lids of the containers 20, as shown in Fig. 3. Normally, the headed upper ends 52 of the stems 50 are positioned in sockets 53 provided therefor at the upper ends of the openings 51, so that the clamping rings 48 are somewhat angularly positioned with relation to the horizontal for the purpose of gripping the rods of the marking pencils and holding the same against vertical movement. However, as the pencils wear down as a result of use, this condition is compensated for by the presence of the stems 50 which, as stated, when the frame 40 is lowered, will contact the container lids, causing the clamping rings to be rocked on their fulcrum pins 49 and releasing the marking pencils so that their lower ends will contact the container lids. When the frame 40 moves upwardly, the stems drop downwardly, releasing the clamping rings and enabling the same to grip the rod-like bodies of the marking pencils, thereby retaining the latter against descent in the opening 44 of the bosses 43.

To effect the swinging movement of the frame of the marking mechanism, so that the marking pencils brought into and out of engagement with the container lids or caps, the rear end of the frame 40 carries a dog 54 at each side thereof. Each of these dogs is pivotally mounted as at 55 on a base plate 56 secured to the frame 40. Each dog is further formed with a laterally directed rectangular plate extension 57 and an offset weight 58, the tendency of the latter being to so rock each of the dogs that the plate extension 57 thereof will be vertically positioned and disposed in the path of movement of the side flaps 18 of the boxes 17, as illustrated in Fig. 4. The dogs are held in this normal position by means of the shoulders 59 of a pair of latches 60, the latter being pivoted as at 61 on the base plates 56 and formed with laterally offset foot extensions 61*a*.

Thus, as the boxed containers advance with the upper run of the conveyor belt 14, and are brought beneath and in vertical registration with the marking mechanism, the forward end of the box or carton, as shown in Fig. 3, engages with the plate extensions 57 of the dogs 54, thereby swinging the frame 40 of the marking mechanism about the pivotal axes of the links 38, and against the resistance of the spring 42, until the lower ends of the marking pencils are brought into contact with the container lids. Following this operation, the continued descent of the marking frame causes the foot extensions to contact the box flaps and operate the latches 60 to release their shouldered engagement with the plate extensions 57, so that the dogs 54 may rotate to the positions illustrated in Fig. 5, thus releasing the carton or box from engagement with the

marking mechanism and allowing the latter to return to its normal elevated position in response to the action of the spring 42, the dogs 54 returning to their normal positions. After the conveyor moves past the marking mechanism, it may be viewed by an attendant who, by noting the marked caps on the product containers, may remove the containers of such marked caps from the box or carton and substitute therefor properly sealed and previously inspected containers. The flaps 18 and 19 may then be folded and sealed in the usual manner and the inspected package is then ready for shipment.

It will be apparent from the foregoing description that I have provided simple and economical methods and means for facilitating the inspection of vacuum-packed containers. The invention readily lends itself to production systems for packaging a plurality of food containers or the like, and is reliable, effective and positive in operation. Many advantages of the invention have been discussed herein and others will be apparent.

I claim:

1. The method of determining the degree of vacuum in the head space of a container of the type having a removable lid formed from a material possessing high heat conductivity, comprising heating the lid end of the container at a given temperature for a predetermined time, allowing the container and its lid to cool for a definite interval of time, and thereafter bringing into contact with the lid a marking compound which softens at a predetermined temperature as indicative of a defective seal.

2. The method of determining the degree of vacuum in the head space of a container adapted to receive food stuffs which are subject to deterioration through oxidation and wherein the container is of the type having at its top a removable cap formed from a material possessing good heat conductivity, the steps which comprise: advancing a plurality of such containers while the same are positioned in closely grouped vertical order in a carton beneath a heating means capable of applying heat to the caps of the containers to cause the same to attain a predetermined temperature, discontinuing the application of heat to the caps and allowing the same to cool for a determined interval, and thereafter applying to each of the caps a graphic indicator which is fusible at a predetermined temperature, whereby to cause said indicator to mark caps having a temperature in excess of that of other similarly heated caps positioned in said container and in which desired conditions of vacuum are present, the temperature of the last-named caps being insufficient to soften said indicators to mark-producing temperatures.

3. The method of detecting imperfectly sealed containers of the type adapted for the reception of perishable foods and in which vacuum conditions are maintained in head spaced provided in the containers between the foods received therein and removable caps covering the tops of the containers, the steps which comprise: advancing such containers longitudinally in a guided course

of travel, during such advance of the containers subjecting the caps thereof to a heating instrumentality whereby to impart a given temperature to the caps in a predetermined period of time, thereafter advancing the containers through a cooling zone and allowing the containers to cool in said zone for a period of definite duration, and at the end of said cooling zone, bringing the caps of said containers into engagement with a fusible marking compound having a predetermined softening point, whereby to cause said compounds to produce a marking deposit on caps possessing a temperature in excess of a given or predetermined temperature.

4. Apparatus for detecting the presence and absence of vacuum in sealed containers of the type having removable caps, comprising a frame structure, a conveyor for advancing such containers along a longitudinal course, means for supplying heat to the caps of said containers during advance thereof in unison with said conveyor, and means for applying a fusible compound to the caps of said containers following predetermined heating and cooling thereof, the softening point of said compound being such as to produce a deposit of the compound on container caps possessing a temperature in excess of that of a predetermined temperature, the latter temperature being below the softening point of said compound.

5. Apparatus for determining the degree of vacuum in the head space of a container sealed by a removable cap, comprising a conveyor adapted to receive a carton in which a plurality of such containers are arranged in closely adjacent rows, said cartons being of the type having foldable side flaps, guide means arranged adjacent to said conveyor for maintaining said side flaps in open substantially horizontal positions, electrically energized heating means mounted adjacent to said conveyor immediately above the tops of the containers positioned in said cartons, whereby during advance of the cartons in unison with the conveyor, the said heating means will serve to impart a predetermined temperature to the upper ends of said containers, a vertically movable frame mounted above and adjacent to said conveyor, means carried by said frame and actuated by the side flaps of said cartons to lower said frame, and fusible means carried by said frame and engageable with the caps of said containers when the frame is in its lower position to impart an indicating marker to the caps of said containers possessing a temperature in excess of a predetermined temperature.

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