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ARRANGEMENT FOR VACUUM PACKAGING OF BRITTLE MATERIAL

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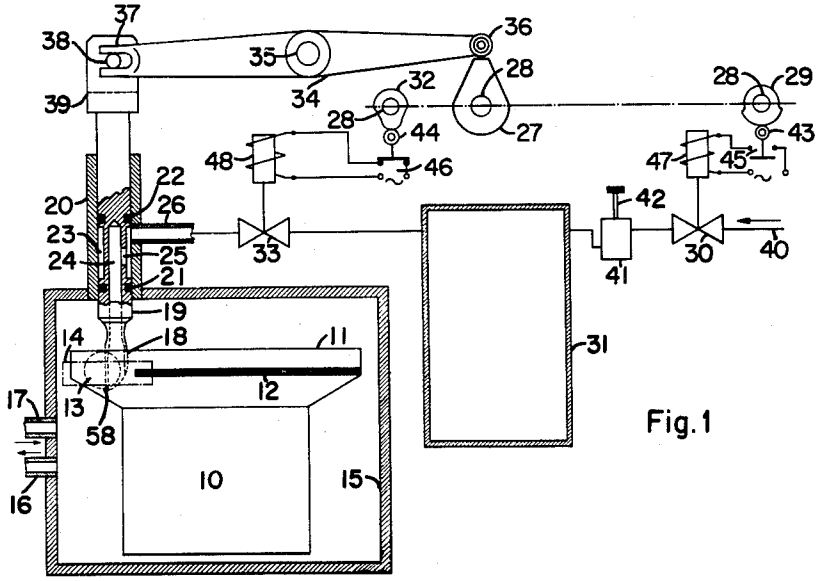


Fig.1

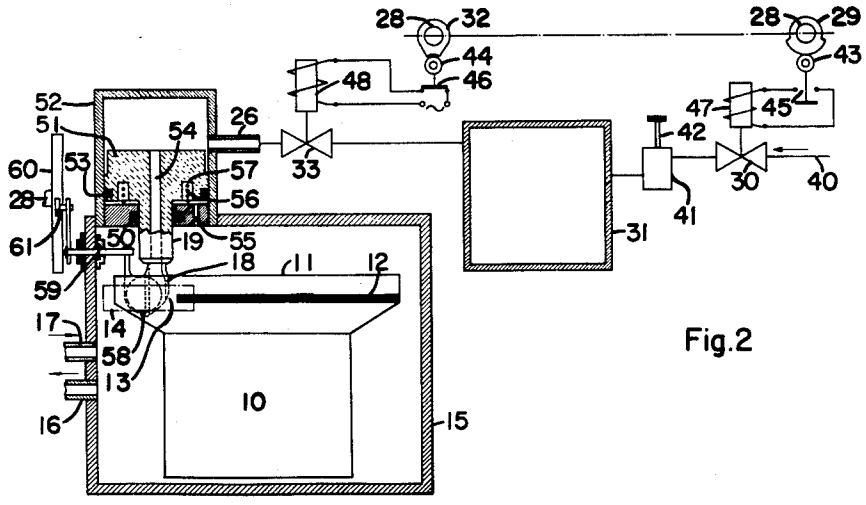


Fig.2

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ARRANGEMENT FOR VACUUM PACKAGING OF BRITTLE MATERIAL

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This invention relates to an apparatus for packaging dry material such as ground coffee or other products, wherein the product must be protected from the outer atmosphere which can cause oxidation, moistening, demoistening or the like.

In the past two principal methods for packaging such material have been employed. According to the first method the package, which must be of a type that can be vacuum sealed, has been filled with the material to be packed, and then subjected to a high degree of evacuation and then sealed. The vacuum has been in the order of magnitude of 10 mb. or even lower which has caused a difference in air pressure between the interior of the package and the surrounding atmosphere of about 990 mb. It has proved impossible to maintain the low air pressure in the interior of the package when the evacuation has taken place while the package itself has still been located in the outer atmosphere. It has been attempted to evacuate the package by means of a hollow lancet introduced through an opening in the package, but this method has proved unsatisfactory for obtaining a high degree of vacuum in the package because once a certain level pressure is reached in the interior of the package further evacuation has proved impossible since the atmosphere surrounding the package then leaks into the package around the lancet from the outer atmosphere in an amount equal to that which can be sucked out of the package through the lancet. Thus, by this first method it has not been possible to create the desired low interior air pressure in the order of 10 mb. or lower unless the package itself is placed in a vacuum chamber so that the atmosphere inside of the package and the atmosphere surrounding the outside of the package are of the same pressure. By this method the air is drawn out of both the interior of the package and the interior of the vacuum chamber (surrounding the package) after which the package is sealed and the outer atmospheric pressure is then let into the vacuum chamber. This method is particularly disadvantageous however since readmission of atmospheric pressure into the vacuum chamber surrounding the package then causes a shock-like pressure-wave all around the package and thereby subjects the package to a strong compression force.

According to a second method for evacuating air from a package the pressure in the interior of the package is reduced to 200 to 300 mb., that is, a much lower vacuum (or higher sub-atmospheric pressure) than is attained in the first method. The package is then brought back to atmosphere pressure of 1000 mb. by inserting some inert gas such as CO_2, N_2, Ar_2. The purpose of this method is to replace the air originally in the package with an inert gas rather than to simply remove the air and vacuum seal the package. This method is referred to as the vacuum-gas-method. However, this method suffers from two essential disadvantages. First there will always be a given quantity of air remaining in the interior of the package which could damage the product, for example by the oxidation of aromatic oils existing in the packed material (rancidity). Secondly, since the package is not compressed, that is, since there is not a pressure differential between the outside and the inside of the package, the package processed by this method cannot be tested

for leaks by known pressure differential package testing machine.

The vacuum-gas-method cannot be used with some especially sensitive materials such as dried vegetable products, rich in vitamins. Thus one would suspect that these products should be packed by the vacuum packaging method. However for the sensitive materials the vacuum packaging method has also proved unsuitable. These sensitive materials such as dried vegetable products are utterly brittle in their dry state. Packaging them according to the gas-vacuum-method will allow the separate particles to be loose in their package as a result of which they may be subjected to physical damage caused by shaking during transportation. As a result the product will be broken in parts and in some instances will be broken into a fine meal, which would definitely be unsuitable for many food preparation purposes. On the other hand it would be equally unsuitable to pack these sensitive materials according to the pure vacuum method. By the lancet method for evacuation a high enough vacuum could not be reached so that the packed material would be damaged by the air remaining in the pack. On the other hand if the vacuum chamber were used with the pure vacuum method, compression resulting from the shock-like pressure-wave upon the restoration of atmospheric pressure would break and crumble the pieces of material within the package.

According to the present invention a method and apparatus is provided for evacuating and vacuum packaging brittle materials by eliminating the disadvantages of the previous methods. According to the present invention a compromise is formed between the pure vacuum packaging method and the vacuum-gas-packaging method.

According to the method of this invention, a very high vacuum is formed in the package which is positioned in a vacuum chamber. At a suitable moment a lancet is introduced into the mouth of the package and an inert gas is fed through the lancet into the package so that thereafter the pressure in the interior of the package will rise to an amount which is essentially higher than the interior gas pressure existing earlier but also essentially below the outer atmospheric pressure.

In the apparatus according to the present invention a vacuum chamber is provided together with means for introducing a lancet into the vacuum chamber and into the mouth of the package being evacuated for feeding to the package an inert gas while the package is still in the vacuum chamber and under the highest vacuum attainable in the vacuum chamber.

The objects and advantages of the present invention will be apparent during the following detailed description given with relation to the accompanying drawings of which:

FIGURE 1 is a partially schematic drawing of a first apparatus for carrying out the method of this invention.

FIGURE 2 is a partially schematic drawing illustrating a second apparatus for carrying out the method of this invention.

In both the apparatus of FIGURE 1 and that of FIGURE 2 a brittle material is first placed in a pack of the type known per se, having an outer package of cardboard or other stiff material and provided with a liner of a heat sealable material such as a plastic. Further, the package has previously been provided with a vacuum tight seal at its bottom as well as at the mouth of the liner, for instance by a welding method, except for a small opening in the mouth of the liner which is left open for the evacuation of air. The closing of the mouth, except for the small opening, takes place after the material has been inserted into the package. In both FIGURE 1 and FIGURE 2 a package of the type discussed above is shown at 10 and its

liner is indicated in its closed state at 11. The welding joint in the mouth of the liner 12 provides a seal over the edge of the liner leaving only an unwelded portion 13 in the liner mouth for evacuation of air. A welding block, shown schematically as a rectangular piece 14 is provided within the vacuum chamber for closing off the mouth of the liner after the evacuation of air and other gas transfer procedures have taken place.

In the operation of the invention the package 10 is first placed into the vacuum chamber 15 after which the vacuum chamber is closed. In a manner known per se in the art the vacuum chamber 15 would be placed on a rotating turret (not shown), so that packages could be moved by means of the rotating turret to different vacuum chambers for different treatments each chamber located around the axis of the turret. The air is evacuated from the chamber 15 by means of a conduit 16, and air is readmitted to the chamber 15 by means of a conduit 17.

Referring now in particular to the apparatus shown in FIGURE 1 a lancet 18 is positioned at the lower end of a piston 19 which slides in a cylinder 20. The piston 19 is provided with two packing seals 21 and 22. A recessed portion 23 is provided on the surface of the piston 19, and a hollow bore 24 is provided in the center of the piston 19 extending from the lower end of the piston upwardly. A second bore 25 perpendicular to the bore 24 connects the circular recessed channel 23 with the central bore 24. A pipe 26 extending through the wall of the cylinder 20 connects the recess portion 23 to a source of inert gas. The piston 19 together with the lancet 18 is under the influence of a control device consisting of a cam 27 on the shaft 28. The shaft 28 also controls the movement of several other cams as will be discussed in more detail below. The shaft 28 carries cam discs (not shown) for the control of the valves in conduits 16 and 17. The shaft 28 further controls a cam disc 29 which controls a first valve 30 which allows the inert gas to pass from a source to a measuring vessel 31. Finally, the shaft 28 carries cam disc 32 for controlling a second valve 33 which controls transfer of inert gas from the measuring vessel 31 to the conduit 26 and then to the package 10.

A double armed lever 34, which oscillates about a shaft 35, is controlled by cam disc 27 at one end which controls the movement of the other end of lever 34, which other end is provided with a claw 37 which slidably engages a bolt 38 on the head 39 which is rigidly connected to the upward end of the piston 19. While the cam disc 27 acts to urge the first end of the lever 34 upwardly a spring bias means (not shown) is employed for forcing the lever 34 to turn in the clockwise direction when such movement is allowed by the cam disc 27. In this manner the movement of lever 34 is provided in a positive manner both upwardly and downwardly.

The source of inert gas under pressure (now shown) is connected by an inlet conduit 40 to the valve 30. The conduit continues to a reduction valve 41 in which the degree of pressure reduction is controlled by a screw 42. The conduit then continues to the measuring vessel 31 and then from the measuring vessel to a valve 33 and to the conduit 26.

The valves 30 and 33 are controlled by the cam discs 29 and 32 respectively. Each of the cam discs 29 and 32 are provided with cam followers 43 and 44 respectively which influence electrical contacts 45 and 46 respectively, for closing electrical circuits to the coils of magnets 47 and 48 respectively, the armature of which control valves 30 and 33 respectively.

The apparatus operates in the following manner. First the shaft 28 is made to rotate continuously by means well known in the art and not forming part of the present invention. The shaft 28 also causes rotation of the turret on which the vacuum chamber 15 together with a plurality of other similar vacuum chambers are mounted. The shaft 28 will also control the opening and closing of the vacuum chambers for insertion of filled but not yet finally

closed packages. The shaft will also control the opening and closing of the conduits 16 and 17 at the opening of the vacuum chamber for removal of the finished package. The detailed operation of the turret and the manner by which shaft 28 controls the various operations of the turret are not described in detail herein since they do not form a part of the present invention, and since such operation would be well known to one skilled in the art.

After the package 10 has been placed into the vacuum chamber 15 the vacuum chamber is closed and the vacuum conduit 16 is opened thereby evacuating the air from the vacuum chamber 15. As air is removed from the vacuum chamber the pressure in the package 10 will be greater than the pressure in the surrounding atmosphere within the vacuum chamber 15 as a result of which air will leave the package 10 through the opening 13. This outward flow of air from the package 10 into the chamber 15 through the opening 13 will widen the liner adjacent the opening 13 so that the opening approximates an oval window. In timed connection with this opening movement of the mouth of the liner the control device moves in such a way that the cam disc 27 by means of the cam follower 36 turns the oscillatable arm 34 in a counter clockwise direction thereby lowering the piston 19 together with the lancet 18 so that the lancet 18 is placed into the opening in the liner 13. It should be noted however that the flow of inert gas through the piston 19 does not start immediately upon lowering of the piston 19 since it must wait until the cams 29 and 32 so position the valves 30 and 33 to allow the inert gas to flow through the conduit 26 and down through the piston 19 and the lancet 18.

Simultaneous with, or possibly a little before, the downward movement of the piston 19 the valve 30 is opened by means of the movement of cam disc 29 and cam follower 43, as a result of which gas of high pressure is fed over the conduit 40 to the reduction valve 41. This valve substantially reduces the pressure of the gas in the conduit 40, the amount of the pressure reduction being controlled by the control screw 42. The gas then passes into the measuring vessel 31 which is then filled with gas until a predetermined pressure is attained in the vessel 31. When a desired pressure is contained in the vessel 31 the valve 30 is closed, again under the influence of cam disc 29 and cam follower 43. At this moment a given predetermined quantity of inert gas is contained between the valves 30 and 33. This quantity is regulated by means of the volume of the measuring vessel 31 and the pressure within the vessel as determined by the reduction valve 41.

When the evacuation of the vacuum chamber together with the evacuation of the package has been sufficiently fulfilled, which would normally be when one has achieved the lowest practical pressure, for instance 10 mb., the valve controlling conduit 16 is closed. Immediately thereafter the valve 33 is opened allowing inert gas to pass through the conduit 26. This inert gas will then move through recess 23 bores 24 and 25 and then into the lancet 18 from which the inert gas will pass into the package 10 through the opening in the liner 13. This creates an inner or super pressure within the package 10 causing part of the gas-air mixture existing in the package to pass out of the package through the opening 13 around the lancet portion 18 and into the vacuum chamber 15. Tests have shown that if the inert gas is allowed to pass into the package 10 until a pressure of 200 to 300 mb. exists in the package, the vacuum chamber and the measuring vessel, then the inert gas which was introduced into the package will have been thoroughly mixed with the air remaining in the package and will have carried such air out through the opening 13 on the sides of the lancet 18 to such an extent that the partial pressure of the air remaining in the package will be only about 2 to 3 mb.

In this manner one has been able to evacuate air from the package to a greater extent than would have been possible even by the pure evacuation method when carried

to its economical limit which required a pressure of 10 mb.'s of air remaining in the package.

It is important to note that by the present invention the inert gas is introduced directly into the package rather than merely into the vacuum chamber surrounding the package. In this manner the inert gas more thoroughly mixes with the air within the package and carries the same outwardly into the vacuum chamber **15**. In fact, if the inert gas had been introduced directly into the vacuum chamber instead of the package **10** then two undesirable results would have occurred.

First, an outer or super pressure would have been created in the chamber **15** causing the mouth **13** of the liner to be surpressed and urged inwardly thereby obstructing the flow of inert gas into the package **10**. The further introduction of the gas into the vacuum chamber would have further compressed the package **10** and may have caused crushing the brittle material within the package **10**. It is true that a small quantity of the inert gas would have entered into the package **10**, and after a while the pressure within the package **10** would have equalized that pressure in the chamber outside of the pressure **10**, but this result would have taken place slowly, greatly increasing the working time and decreasing the operating capacity of the machine.

Secondly, if the inert gas were introduced directly into the vacuum chamber instead of the package **10**, the gas would mix with the air in the vacuum chamber after which the mixture would enter the package through the opening **13** as opposed to the present invention whereby pure inert gas enters the package **10**. As a result, depending upon the magnitudes of the vacuum chamber, the final partial pressure of the air within the package would be approximately 40 to 50 mb.'s whereas according to the present invention test have shown that the partial pressure of the air within the package **10** can get down as low as 2 to 3 mb.'s.

After the pressure of the gas between valve **41** and the pressure vessel **15** have equalized the valve **33** is closed by the cam disc **32** and its cam follower **44** after which the lancet **18** is drawn upwardly from the mouth **13** of the package **10** under the influence of cam disc **27** and its cam follower **36**. Thereafter the welding blocks **14** are brought together to seal the open mouth **13** of the liner. The package may be subjected to the pressure of the outer atmosphere by the opening of the air inlet valve **17**. Thereafter the vacuum chamber can be opened and the package removed.

When the package is subjected to the pressure of the outer atmosphere it shrinks in size due to the pressure differential existing between the inside and the outside of the package wall. The shrinking in the present invention however is not nearly as severe as the shock-like pressure wave which occurs when one uses the pure vacuum method. Accordingly the brittle materials are not crushed. The shrinking of the package which does occur according to the present method causes adjacent parts of the package to come together gradually so that an interior bond created firmly holding the brittle pieces of material within the package to prevent interior movement of the material during careless handling or transporation of the packages and thereby prevent damage to the materials within the package during the handling operations. Consequently, when the housewife finally opens the package the packed material will be intact and undamaged. In addition, the closed package has contained therein a lesser quantity of air then could have been provided by means of even the best pure vacuum packaging method known heretofore.

The apparatus shown in FIGURE 2 is similar to the apparatus shown in FIGURE 1 and to the extent the two apparatuses are identical, like numerals have been used to designate like parts. The apparatus of FIGURE 2 differs mainly in the means for motivating the piston **19**.

In the apparatus of FIGURE 1 the movement of the lancet into the mouth opening **13** of the package **10** was controlled by direct mechanical linkage whereas according to the apparatus of FIGURE 2 the piston **19** and the lancet **18** are moved by pneumatic means in a manner depending upon the formation of a vacuum in the vacuum chamber **15**.

In the apparatus of FIGURE 2 the piston **19** passes through a bore in the upper wall of the vacuum chamber **15** which bore is provided with packing rings **50**. The portion of the piston **19** above the vacuum chamber is connected to a second piston **51** of a greater cross-sectional area causing a pressure differential action. The piston **51** moves in a cylinder **52**, a packing ring **43** being provided between the piston **51** and the cylinder **52**. The cylinder **52** will close at its upper end forming a closed chamber above the piston **51** which chamber communicates only with the tube **26** from the valve **33** and a bore **54** running through the pistons **51** and **19**. A small cataract or air passage **55** is provided between the vacuum chamber **15** and the cylinder **52** in the wall separating the chamber **15** and the cylinder **52**.

The apparatus shown in FIGURE 2 operates in the following manner: In the position of the pistons **51** and **19** as shown in FIGURE 2 the pressure of the inert gas from the measuring vessel **31** is equalized within the cylinder **52**, the bore **54**, the lancet **18**, and the package **10** and the vacuum chamber **15**. As soon as this pressure is equalized the piston **51** moves upwardly under the influence of a spring **56** contained within a spring casing **57** in the interior of the piston **51**. The lancet **18** is then drawn out of the mouth opening **13** of the package **10** and the piston **51** simultaneously covers the mouth of the tube **26** in the cylinder **52**. Movement of the piston **51** after the pressure in the piston is equalized takes place rather slowly since the air pressure below the piston **51** builds up very slowly since movement of air through the small passage **55** to the area below the piston **51** takes place rather slowly. However this slow movement or damping of the movement of the piston **51** is necessary to prevent injury to the liner **11** by the lancet **18** as the lancet moves upwardly. After the piston **51** has reached its uppermost position the opening in the liner mouth **13** is welded closed in the same manner as discused above with respect to FIGURE 1. After the liner mouth **13** is closed the pressure from the outer atmosphere is let in through the pipe **17** and the vacuum chamber **15** is exposed to atmospheric pressure in the same manner as was discused above with respect to FIGURE 1.

The package **10** may now be removed from the chamber **15** and a new opened package inserted therein. In the apparatus of FIGURE 2 the inert gas is fed to the measuring vessel **31** in the same manner as in the apparatus of FIGURE 1. It should be observed however that the valve **33** is, technically speaking, no longer necessary since the conduit from vessel **31** to the pressure chamber **15** is now closed by the side of the piston **51**. However it is clearly desirable to retain the valve **33** since it is very difficult and expensive to obtain a very tight seal between the side of the piston **51** and the entrance to the conduit **26**.

After a package is placed within the vacuum chamber **15** and the chamber is closed vacuum conduit **16** is opened thereby evacuating air from the chamber **15**. Next the mouth **13** of the liner **11** is open, as described above, and simultaneously gas starts leaking out from the lower chamber in the cylinder **52** (in the area of the springs **56**) through the passage **55** and into the vacuum chamber **15**. At this time the piston **51** is subjected to a differential pressure on its upper and lower sides. As soon as the presure differential urging the piston **51** downwardly overcome the force of the spring **56** urging the piston upwardly, the piston **51** will start moving downwardly and the lancet **18** will be displaced downwardly into the open mouth part at the end of the liner **11**. During its downward movement the piston **51** will successively open the connection between the tube **26** and the upper chamber in the cylinder **52** and, if no valve **33** exists or if this valve

has already been opened, inert gas will immediately flow from the tube 26 through the upper part of the cylinder 52 through the bore 54 in the lancet 18 and into the package 10. In this manner the inert gas will drive the remaining air from the package 10 in the manner discussed above with respect to FIGURE 1 until the pressure in the chambers 31, 52 and 15 are equalized in the manner discussed with respect to FIGURE 1. By controlling the tension in the spring 56 it is possible control the moment at which the piston 51 will start moving downwardly and thereby control the timing of the flow of inert gas to the lancet 18. In addition the valve 33 may be employed to obtain a more effective and more exact control of the timing of the flow of the inert gas.

In both the apparatus of FIGURE 1 and that of FIGURE 2 it would be assumed that the liner was made of such a weak and shapeable material that it would immediately open into an oval elongated mouth when air started moving out from the package due to the commencement of the evacuation of the vacuum chamber. However, it has been shown that some materials which are suitable for liners are nonetheless thicker or more stiff so that they will not open in this manner. In this case only a narrow slot is opened or alternatively the sides of the opening will be wavy or uneven. In the apparatus according to the present invention if one desires to evacuate a package having such a stiff liner one must employ additional means to aid in opening the liner mouth so that it assumes the oval shape so that the lancet can enter the package.

One possible apparatus for performing this function would be to provide a pair of suction nozzles as shown in FIGURES 1 and 2, preferably one on each side of the mouth of the package. These nozzles could be mounted on arms 59 (see FIGURE 2) which arms project through an air tight hole in the wall of the vacuum chamber 15. Outside of the vacuum chamber the arms 59 may be activated by some influencing means. For example referring to FIGURE 2 the contour 60 of a cam disc may control a cam follower 61 mounted on the outer extremity of the arm 59. The particular method for connecting the nozzle 58 to a vacuum source may be accomplished in many different ways.

The invention of course is not limited to the specific forms or apparatus described above and shown in the drawings, but would also include different modifications which may occur within the scope of the invention. For instance, one may independently of the sensitivity of the packed material to the oxygen of the atmosphere, choose the minimum pressure existing at the highest occuring vacuum in some manner other than the one described above.

What I claim is:

1. An arrangement for packaging comprising the combination of: means defining a vacuum chamber; an inlet and an outlet conduit connected to the interior of the chamber; means for positioning a package of material sealed except for a small open portion thereof in the chamber; means for withdrawing air from the interior of the chamber and the package through the outlet conduit until the interior of the chamber reaches a predetermined vacuum; a hollow lancet; means for introducing the lancet into the interior of the package during the withdrawing of air to the predetermined vacuum; means for feeding a controlled quantity of inert gas through the lancet into the interior of the package to create a pressure within the interior of the package removing additional air; means for withdrawing the lancet from the package; and means for sealing the small open portion of the package prior to reintroduction of air into the vacuum chamber through the inlet conduit.

2. The combination according to claim 1 wherein the means for introducing the lancet and the means for withdrawing the lancet comprise in combination, means defining a bore directed toward the interior of the chamber, a piston slidable in the bore, means at the chamber end of the piston for mounting the lancet thereon, and means at the other end of the piston for controlling the movement thereof.

3. The combination according to claim 2 wherein the movement controlling means comprises a lever operatively connected to the said other end of the piston, a rotatable shaft, and an eccentric cam mounted on the shaft for rotation therewith, the cam engaging the lever to control the motion thereof.

4. The combination according to claim 2 wherein the movement controlling means comprises a pneumatic cylinder, the other end of the piston having a second piston integral therewith and communicating with the pneumatic cylinder for movement in response to the differential in pressure between the interior of the penumatic cylinder and the interior of the vacuum chamber.

5. The combination according to claim 4 wherein the means defining the said bore comprises a wall separating the pneumatic cylinder and the vacuum chamber, and further comprising a spring mounted between the pneumatic piston and the wall to urge the lancet and first piston away from the interior of the package.

6. The combination according to claim 4 wherein the first piston and the pneumatic piston define a central opening communicating with the hollow lancet, and the means for introducing the inert gas includes a conduit connected to the interior of the pneumatic cylinder.

7. The combination according to claim 6 wherein the conduit is positioned on a side of the pneumatic cylinder, and the pneumatic piston defines a slide valve for closing and opening the conduit.

8. The combination according to claim 1 wherein the means for introducing the inert gas comprises an inert gas source maintained at a predetermined pressure, means defining a measuring vessel, valve means for introducing a controlled amount of gas into the measuring vessel from the inert gas source and means for controlling the said valve means, and second valve means for controlling the feeding of inert gas from the measuring vessel to the interior of the package.

9. The combination according to claim 8 wherein the second valve means includes an electrical control having a movable switch, and the control means of the first valve means comprises an electrical control having a movable switch, and further comprising a rotatable shaft and a pair of cams mounted on the shaft for rotation therewith, each of the cams controlling the movement of a respective switch.

10. The combination according to claim 1 and further comprising means defining a pair of suction nozzles arranged to engage the small open portion of the package and open it sufficiently to enable introduction of the lancet into the interior of the package.

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