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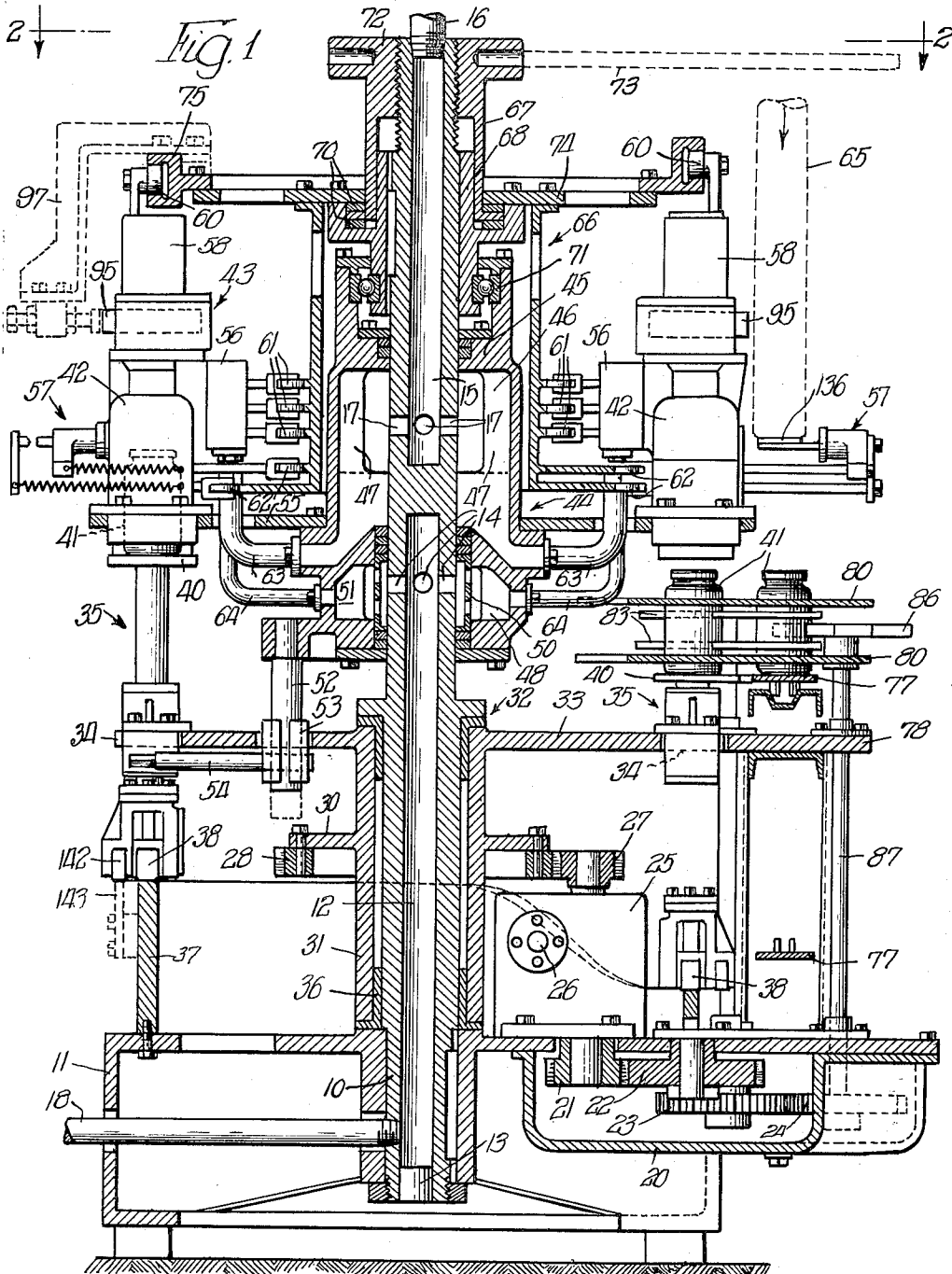
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3,220,153

CONTAINER VACUUM CAPPING METHOD

Filed July 10, 1961

5 Sheets-Sheet 1



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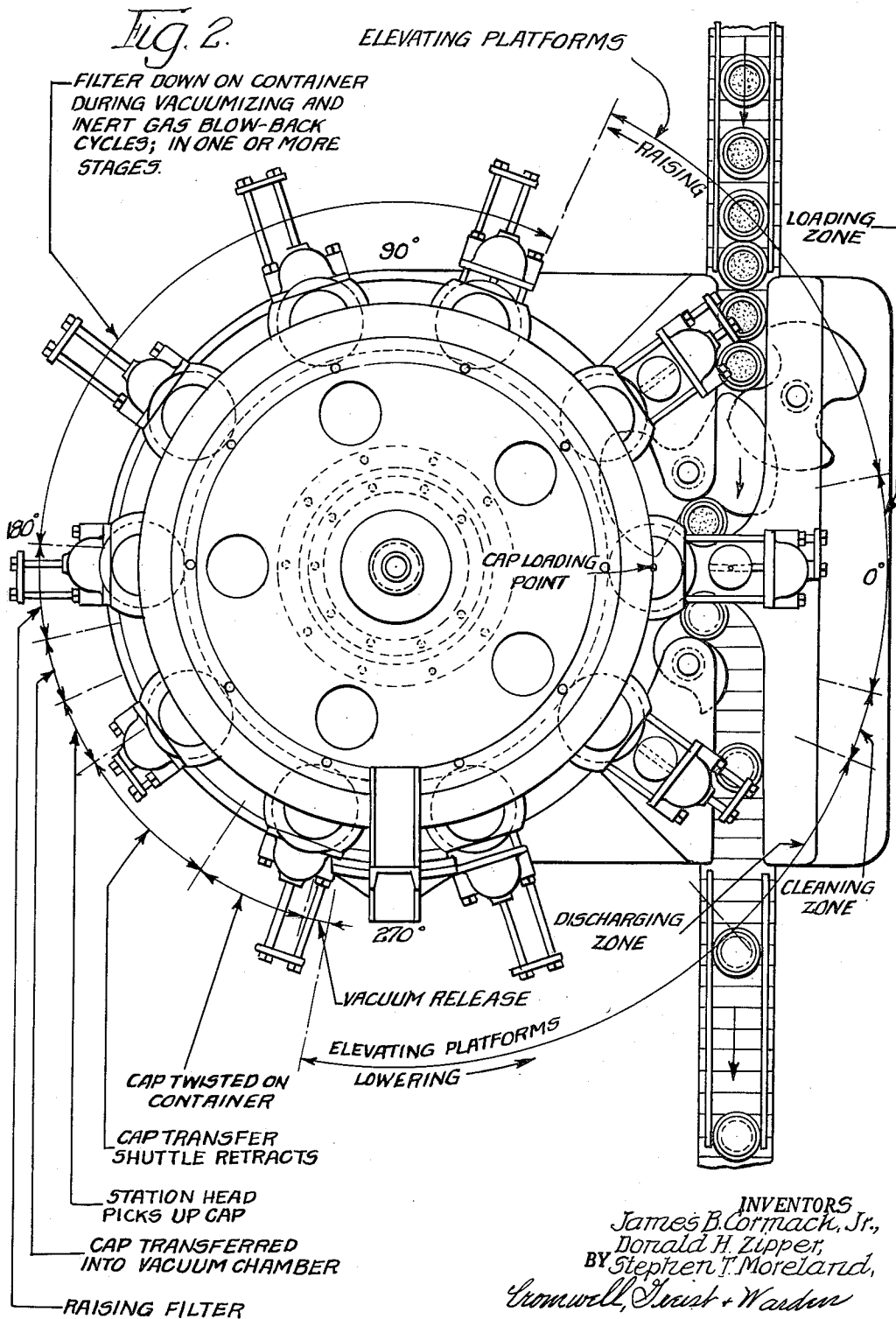
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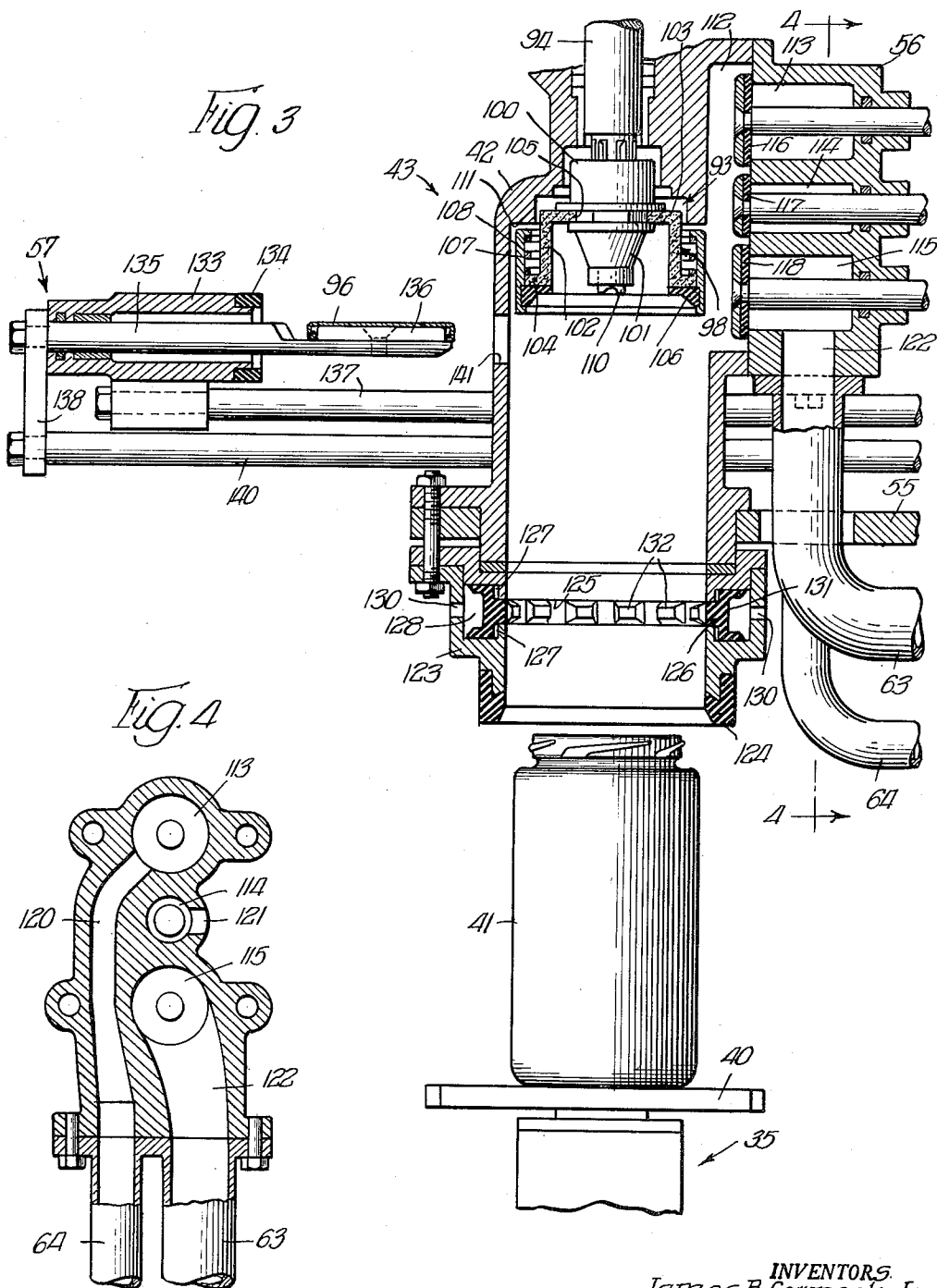
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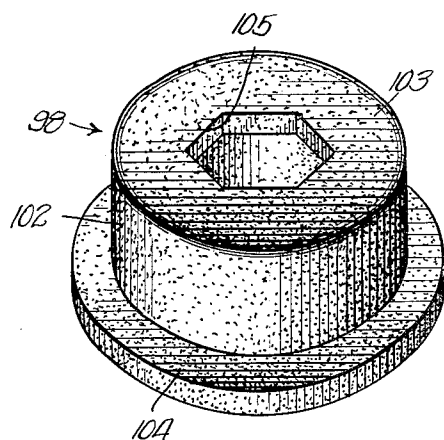
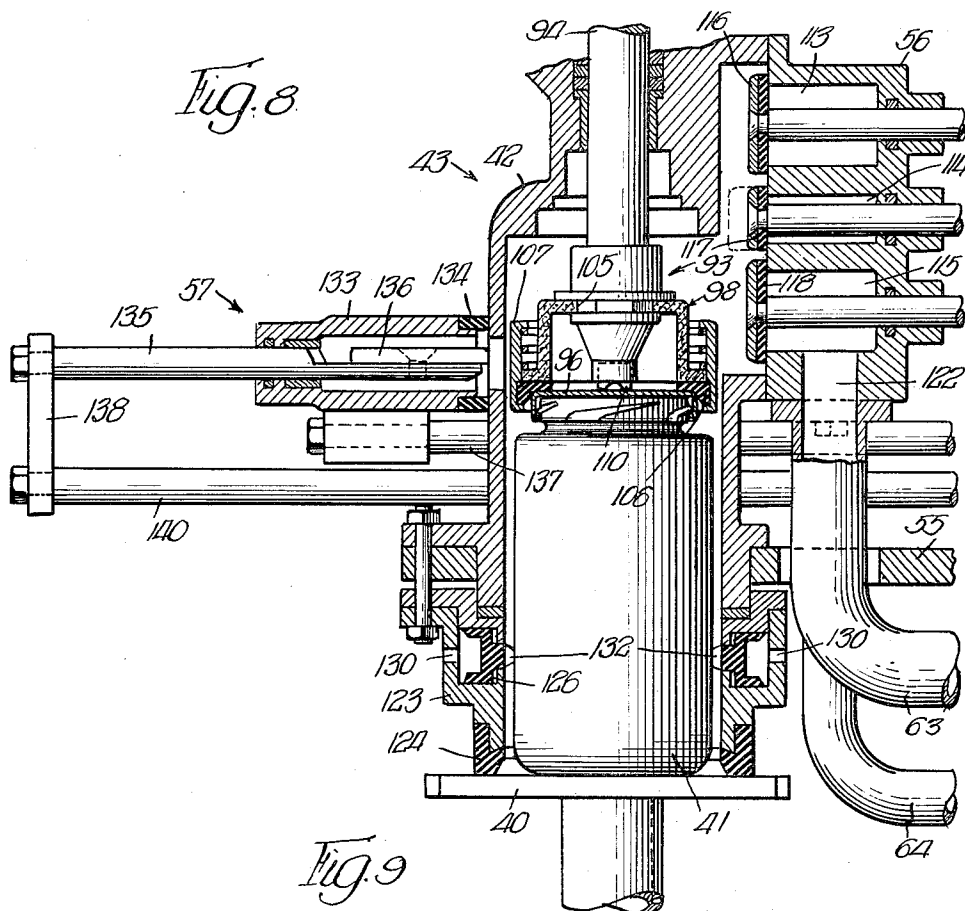
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CONTAINER VACUUM CAPPING METHOD

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6 Claims. (Cl. 53—22)

The invention relates to new and improved means for use in container vacuum capping and a new and improved method for obtaining a low oxygen content in a container undergoing vacuumizing before capping. More specifically, the invention is directed to a new and improved vacuum capping machine having a special filter and cap application unit forming a part thereof, the machine being particularly adapted for capping containers filled with particulate or powdery material the retention of which is difficult to control during normal container evacuation and capping operations. With regard to the operation of the vacuum capping machine including the special container filter and cap application unit forming a part thereof, the invention further is specifically directed to a special method of treating the filled container to obtain a low oxygen content in the same in a new and improved manner.

There are many different proposed types of vacuum capping machines some of which are capable of efficient use. Such machines are quite complicated with regard to structural and operational aspects and are difficult to maintain in efficient operating condition. Furthermore, vacuum sealing machines as known prior to this invention are often limited in use depending on the particular product with which the containers are filled. By way of example, powdery particulate material, such as instant coffee and the like, create vacuum packaging difficulties due to their tendency to be readily displaced from the container when subjected to the vacuumization process conditions. Filtering means such as a cloth or screen have been proposed for positioning over the open top or mouth of a container during evacuation thereof. However, a low oxygen content condition must exist at the time the cap or closure is applied to the container and the attempts to meet this requirement have led to very complicated, often unworkable, mechanical arrangements. In this regard, the fine and powdery material is often drawn against the cap and interferes with the forming of an effective hermetic seal.

A number of the powdery food products, such as instant coffee, are very sensitive to oxygen deterioration at least in certain respects. With regard to instant coffee, certain aromatic constituents therein are quite sensitive to the residual oxygen remaining in the capped container. During the filling of containers with particulate materials, it has been the general practice to provide means to establish and maintain a surrounding nitrogen blanket thus eliminating air from the filling operation and preventing occlusion thereof throughout the loose mass of coffee particles introduced into the container. While this procedure aids materially in improving the keeping qualities of the coffee product, it nevertheless has been quite difficult to provide suitable mechanical means whereby the head space of the filled container and the interstices between the particles of product can be evacuated to an extent that the residual oxygen content therein is quite low. In this regard it is considered that a residual oxygen content of more than 2% is undesirable.

A specially designed high speed vacuum capping machine particularly adapted for use in capping containers filled with particulate material such as instant coffee is disclosed and claimed in the copending application Serial No. 122,498 filed July 7, 1961. This machine is capable

of vacuum treating a container filled with particulate or powdery material to provide for a residual oxygen content of at least as low as 2% oxygen on the basis of the free volume of the container and capping containers at a rate of about 300 containers per minute. The capping speed and evacuation efficiency of this machine constitutes a material advance in the art as prior to the development of the machine, a residual oxygen content of about 2% could be obtained but not at the speed of operation desired. The present invention deals with unique container evacuation and filter unit means forming a part of the aforesaid machine which materially contribute to the efficiency of operation of the same. This invention is further directed to the special method of container evacuation used in the machine to obtain the high speed low residual oxygen results.

It is an object of the present invention to provide a new and improved filter means for use in a vacuum capping machine during evacuation of a filled container and cap application thereto.

Another object is to provide a new and improved vacuum capping machine having as a part thereof a special filter and cap application unit adapted for efficient operation with a container during evacuation thereof and cap application thereto, the filter portion of the unit being of a design permitting dual functioning thereof and especially being capable of preventing excessive displacement of particulate material from the container during evacuation thereof.

Still another object is to provide a new and improved method of treating a filled container to obtain a low oxygen content in the same, the method being particularly adapted for incorporation in a special form of vacuum capping machine as an operational concept thereof.

Another object is to provide a new and improved method of treating a container filled with powdery-like material to obtain low oxygen content in the same, this method involving the utilization of a barometric leg effect in the filtered retention of particulate material in the container during evacuation thereof.

Other objects are specifically set forth will become apparent from the following detailed description of the invention made in conjunction with the accompanying drawings wherein:

FIG. 1 is a partial vertical section of a special vacuum capping machine with certain parts thereof being illustrated in elevation, this machine making use of the new and improved filter and cap application unit and method of operation of the present invention;

FIG. 2 is a top plan of the machine as viewed generally along line 2—2 in FIG. 1, this view further including legends as to the various portions of the cycle of operation of the machine;

FIG. 3 is an enlarged fragmentary, partial vertical section of one of the vacuum chamber and cap application assemblies of the machine and illustrating the filter and cap application unit of the present invention as well as other means adapting the machine for operation in accordance with the method of the present invention;

FIG. 4 is a vertical section of the valve assembly shown in FIG. 3 taken generally along line 4—4 therein;

FIG. 5 is a view similar to FIG. 3 illustrating operational aspects of the assembly during operation of the machine;

FIG. 6 is a transverse section of the jar gripping arrangement of the assembly of FIG. 5 taken generally along line 6—6 therein;

FIG. 7 is a partial view similar to FIG. 5 illustrating additional operational aspects of the assembly;

FIG. 8 is a view similar to FIG. 3 illustrating cap application to a container; and

FIG. 9 is perspective of one form of filter member of the present invention.

The vacuum capping machine of FIGS. 1 and 2 is fully disclosed in the aforementioned copending application and will be briefly described herein. The machine as best shown in FIG. 1 includes a center upstanding column 10 suitably secured at the bottom thereof to a base member 11. The column 10 is provided with an axially extending passage 12 closed off at the bottom thereof by a plug 13 and terminating upwardly beyond the mid-point of the column. The upper end of the passage 12 has associated therewith a plurality of radially outwardly directed openings 14 extending through the column 10. The upper end of the column 10 is provided with a separate axially directed passage 15 which at the upper end thereof is in communication with a conduit 16 suitably attached to the column 10. The lower end of the passage 15 communicates with a plurality of radially directed openings 17 extending through the column 10. The lower end of the passage 12 is in communication with a conduit 18 which is suitably secured to the column 10 and extends radially outwardly therefrom through the base member 11. The passage 12 including the conduit 18 provides for the delivery of an inert gas, such as nitrogen, for use in the machine in a manner to be described. The passage 15 through its associated conduit 16 is connected to a suitable vacuum source (not shown) for a purpose to be described.

The base member 11 has as a part thereof a drive arrangement including a gear housing 20 in which a plurality of gears 21, 22, 23 and 24 are suitably mounted. The gear 21 is driven through a gear box 25 suitably mounted on the base member 11 and provided with a drive shaft 26 extending therefrom for suitable connection to a motor (not shown). The gear box 25 further includes an upwardly directed driven gear 27 which is meshed with a large gear 28 fixedly secured to an annular flange member 30 formed integral with a vertical sleeve portion 31 of a container supporting assembly which is generally designated by the numeral 32.

The container supporting assembly 32 basically includes an annular radially projecting platform portion 33 integrally formed with the sleeve portion 31 and mounting therein through peripherally located, circumferentially spaced groove-like openings 34 a plurality of container supporting and lifting platform or platen assemblies generally designated by the numeral 35. The sleeve portion 31 of the container supporting assembly 32 is supported on sleeve bearings 36 at its upper and lower ends about the column 10 for rotation thereabout as driven by the gears 27 and 28. The top surface of the base member 11 has secured thereto an annular cam track 37 the top surface of which operatively engages a cam roller 38 forming a part of each platen assembly 35. The track 37 functions to control operation of the platen assemblies 35 during rotation thereof about the center column 10. In this regard, each platen assembly 35 includes a container supporting and lifting platen 40 on which a container 41 is positioned, the left-hand platen 40 as viewed in FIG. 1 having been raised by the cam track 37 to place the container 41 supported thereon in a bell-shaped chamber 42 of a vacuum chamber and cap application assembly 43 positioned thereabove. The right-hand platen 40 as viewed in FIG. 1 is in its lowermost position as controlled by the associated portion of the cam track 37 and the container 41 supported thereon is free from the chamber 42 of the assembly 43 positioned thereabove.

Mounted above the container supporting assembly 32 is a container evacuation and capping assembly generally designated by the numeral 44. This assembly includes a housing 45 mounted on the center column 10 for rotation thereabout in synchronized relation with the container supporting assembly 32. The housing 45 defines a large annular vacuum chamber 46 with which the passage 15 of the column 10 is in communication through the open-

ings 17. The chamber 46 has mounted therein a plurality of circumferentially spaced, radially directed strengthening fins 47 which also function as baffle plates in cooperation with the relatively large size of the chamber to dampen pulsation of air drawn through the chamber 46 during operation of the machine. Below the chamber 46, the housing 45 is formed with a second smaller annular chamber 48 having therein an apertured annular insert 50 and circumferentially spaced strengthening fin baffles 51. The insert 50 provides communication with the openings 14 of the passage 12 of the column 10 for a supply of inert gas during operation of the machine. The lower end of the housing 45 has depending therefrom a plurality of circumferentially spaced, fixed drive pins 52 the lower ends of which are clamped in locking collars 53 mounted in the radial plate 33 of the container supporting assembly 32. Each locking collar 53 is provided with a locking rod 54 which may be operated externally of the machine to loosen or tighten the collar during vertical adjustment of the upper assemblies as will be described. By means of the drive pins 52, the upper assembly 44 is rotatably driven by the lower assembly 32 to thus make use of a single power source in operating the machine. Furthermore, the provision of the plurality of vertically adjustable means including the pins 52 eliminates lost motion between the interconnected assemblies.

The container evacuation and capping assembly 44 further includes a radially directed annular plate member 55 provided with a plurality of circumferentially spaced openings therein adjacent the outer periphery thereof in which the vacuum chamber and cap application assemblies 43 are removably mounted. Each of these assemblies generally includes the bell-shaped container receiving chamber 42, a valve assembly 56, a cap delivery assembly 57 (see FIG. 2), and an upwardly projecting cam actuated operating portion 58. The operating portion 58 is controlled by a cam roller 60. The valve assembly 56 is operated by a plurality of cam rollers 61. The cap delivery device 57 is operated by a pair of cam rollers 62. The valve assembly 56 is suitably connected to the vacuumization chamber 46 by a pipe 63 and is suitably connected to the inert gas supply chamber 48 through a pipe 64. A suitable cap delivery chute is positioned relative to the machine as indicated by the broken lines identified by the numerals 65. Caps are delivered by this chute to each cap delivery device 57 when the same is withdrawn outwardly from its associated chamber 42 as shown in the right-hand portion of FIG. 1. The left-hand portion of FIG. 1 illustrates a cap delivery device 57 engaged with its associated chamber 42 during container evacuation and cap application operation of the machine.

The machine further includes a cam actuating assembly generally designated by the numeral 66. This assembly includes an internally threaded vertical adjustment sleeve 67 received about the upper end of the column 10 and supporting a vertically slidable, non-rotatable, spline connected sleeve portion 68 on the column. Annular thrust bearings 70 are mounted at the lower end of the sleeve 67 in supporting engagement with portions of the sleeve 68. The upper end of the housing 45 of the container evacuation and cap application assembly 44 is at least partially supported on the sleeve 68 through a rotatable bearing structure 71. The top portion of the sleeve 67 is provided with a collar 72 to which a suitable lever or wrench bar 73 may be attached to raise or lower the sleeve 67.

The cam actuating assembly 66 further includes a radially directed annular plate 74 which has mounted thereon about the outer periphery thereof a cam track member 75 in which the cam rollers 60 of the vacuum chamber and cap application assemblies 43 are received. The cam track 75 opens outwardly of the machine thus permitting ready withdrawal of the cam rollers 60 therefrom. The assembly 66 further includes a depending sleeve-like cam track portion 76 which on the outer surface thereof is provided with a plurality of circumferen-

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tially variable cam tracks engaging the cam rollers 61 and 62 of the vacuum chamber and cap application assemblies 43.

The particular arrangement described regarding the positioning and type of cam tracks used in the machine provides for efficiency in machine operation and maintenance. The cam actuation assembly 66 is fixed against rotation on the center column 10 and the cam track portion 76 thereof extends downwardly between the chamber assemblies 43 and the center column to permit ready removal of any assembly 43 for maintenance or replacement purposes. In other words, the chamber assemblies 43 may be individually removed from the machine without disturbing any other operating mechanism or part of the machine and the arrangement is such that replacement of a chamber assembly 43 on the machine results in automatic alignment of the various cam actuated parts thereof with the cam track portions of the assembly 66. Furthermore, regardless of from what portion of the cycle a chamber assembly is removed, replacement of the same or a new assembly in the same portion results in immediate adjustment of the assembly to conform to the particular portion of the cycle.

The container evacuation and capping assembly 44 is vertically adjustable with the cam actuating assembly 66 along the center column 10. The assembly 44 is, in effect, rotatably supported on the sleeve 68 through the rotatable bearing means 71. Of course, this assembly is further supported by the container supporting assembly 32 through the drive pin arrangement including the pins 52 and locking collars 53. The interconnected assemblies 44 and 66 may be adjusted vertically relative to the container supporting assembly 32 by threaded movement of the sleeve member 67 of the assembly 66 along the upper threaded end of the column 10. All other column engaging parts will slide therealong upon loosening of the drive pin arrangement. A change in vertical positioning of the upper assemblies will be necessary when the machine is used with containers of less than maximum height. During vertical adjustment of the interconnected assemblies 44 and 66, the interengaging operational parts thereof will maintain their cooperative positions. Thus no special adjustments are necessary other than a raising and lowering of the interconnected assemblies.

FIGS. 1 and 2 further show that to one side of the machine and arranged tangentially relative thereto is an endless conveyor 77 carried on a suitable frame 78 (FIG. 1) and adapted to deliver containers to and from the vacuum capping machine. A container guide plate assembly 80 is suitably mounted over the conveyor 77 and projects over an adjacent portion of the plate 33 of the container supporting assembly 32. The guide plate assembly is provided with a container delivery slot portion 81 and a container removal slot portion 82. The conveyor 77 and guide plate assembly 80 constitute a portion of a container feed and take-off device which among its elements includes a container position control means 83 rotatably mounted on a shaft 84 connected to the gear 23. The control means is in the form of a pair of cooperating disc-like members as best shown in FIG. 1. The control means includes at least one pocket portion 85 in which a container is received from the conveyor 77 and delivered onto a platen 40 of the plate 33. Each pocket portion 85 is specially designed to provide for the introduction of a container onto the container supporting assembly 32 at a velocity equal to the rotational speed of the supporting assembly and further providing for positive holding of the container on a platen 40 until at least the top of the container is received in a capping chamber 42.

A synchronizing container feed control means in the form of a rotating disc-like member 86 is mounted on a shaft 87 operated by the gear 24. This member is provided with at least one container receiving pocket portion 88 and operates to positively separate each container delivered thereto on the conveyor 77 for proper feeding

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thereof to the container position control means 83. The container feed and take-off device is completed with the provision of a container helper member 90 which projects into the slot portion 82 of the guide plate assembly 80. The helper member 90 rotates on a shaft 91 driven by a gear member mounted in the drive arrangement housing 20. The helper member is provided with at least one concave edge portion 92 designed to engage a container and move the same from a platen 40 of the container supporting assembly 32 onto the conveyor 77 following capping of the container.

With the general arrangement of the machine having been described, FIG. 2 illustrates the operational portions of a complete cycle of operation involving 360° rotation. Capless containers 41 are delivered by the conveyor 77 into the slot portion 81 of the guide plate assembly. The synchronizing feeding member 86 provides for controlled delivery of the containers to the container position control means 83 which automatically places each container on a lowered platen 40 carried by the container supporting assembly 32. As the container moves counterclockwise in the machine as viewed in FIG. 2, the platen supporting the same is raised by the cam track 37 and eventually the top of the container is at least partially received in a chamber 42 of an overhead vacuum chamber and cap application assembly 43. The position control means 83 maintains engagement with the container until the overhead chamber receives at least a portion thereof thus preventing spilling or crushing of the container during high speed operation of the machine.

The cycle of the operation continues through the second quadrant during which the chamber 42 is evacuated with the container confined within and inert gas is used to sweep the same. Upon passing through the third quadrant, the container still confined in a chamber 42 is supplied with a cap which is automatically twisted thereon in complete sealing engagement. Additional operations occur in the third quadrant of the cycle as indicated by the legends on FIG. 2 and these particular operations will be subsequently referred to. Upon entering the fourth quadrant, the vacuum established in the chamber 42 containing the capped container therein is released and the platen 40 supporting the container is lowered in time for the container to be received in the slot portion 82 of the guide assembly 80. The container is then ultimately engaged by the helper member 90 which provides for positive movement of the container onto the conveyor 77 by means of which it is taken away from the machine. As indicated in FIG. 2, the empty platen as it passes through the guide plate assembly 80 after having a capped container removed therefrom and prior to receiving an uncapped container thereon may be subjected to automatic cleaning to remove any product that might accumulate thereon. Any suitable means may be utilized to provide a cleaning action in the cleaning zone such as an air jet.

Each vacuum chamber and cap application assembly 43 as shown in FIG. 3 includes a special filter unit 93 positioned in the top portion of the chamber 42. The filter unit 93 is suitably mounted on the bottom end of a vertically directed shaft 94 which constitutes a part of the operating assembly 58 previously described. Vertical reciprocal operation of the shaft 94 and the attached filter unit 93 is controlled by the cam roller 60 in engagement with the cam track 75 of the cam actuating assembly 66. As will be described in detail, the shaft 94 is cam operated to raise and lower the filter unit 93 several times during a complete cycle of operation of the machine to first provide for container evacuation and then provide for container cap application. With regard to container cap application, the shaft 94 has suitably received thereon a pulley-type wheel 95 a projecting portion of which is shown in FIGS. 1 and 2. This wheel is mounted within the operating portion 58

including the shaft 94 and is designed to permit reciprocal movement of the shaft 94 through the center of the same and yet impart rotation to the shaft 94 and the attached filter unit 93 when the pulley wheel is rotated. In this regard the type of cap applied to the container 41 by the machine is a rotatable cap which includes a flat top panel portion formed with a depending skirt portion along the inner surface of which locking lug-type means are provided for engagement with outer surface threaded portions of the neck of a container. The cap is also provided with a sealing gasket on the inner face thereof. A cap 96 is shown in FIG. 3 as carried by the cap delivery device 57. Rotation of the shaft 94 and filter unit 93 to provide for the twisting of a cap 96 onto a container 41 is brought about by a friction shoe assembly 97 fixedly mounted on the radial plate 74 of the cam actuating assembly 66 as shown in FIGS. 1 and 2. The shoe assembly 97 extends downwardly over the cam track 75 and is located at a point on the machine which corresponds to the cap application portion of the cycle of operation as shown in FIG. 2. Thus as the upper assembly 44 rotates relative to the cam actuating assembly 66, the pulley wheels 95 of successive assemblies 43 will be engaged by the fixed shoe assembly 97 and the shaft 94 and attached filter unit 93 will be rotated through a prescribed arc for cap application to a container.

Referring particularly to FIG. 3, the filter unit 93 is mounted against rotation on the bottom end of the shaft 94 and includes a rigid porous filter member 98 of inverted cup-like shape fixedly mounted between a collar member 100 suitably attached to the shaft 94 and a magnet holder 101. The filter member 98 as best shown in FIG. 9 is formed with an annular side wall portion 102 of substantial height, a generally flat top wall portion 103 and a bottom edge radially outwardly directed flange 104. The top wall portion 103 is provided centrally thereof with a flat sided aperture 105 which engages a similarly shaped portion forming a part of the filter mounting means including the collar 100 and magnet holder 101. The flat sided aperture 105 fixes the filter member 98 to the mounting means therefor to provide for positive rotation of the filter member 98 upon rotation of the shaft 94. The filter member 98 may be formed from any suitable adequately rigid material which establishes a plurality of rigidly defined pores throughout the entire filter member with the pores being smaller than the particle size of the material in a container 41. The height of the side wall portion 102 must be sufficient to provide a barometric leg effect during head space evacuation to permit efficient retention of the particulate material in the container. The details of filter member construction will be subsequently described.

The bottom edge of the filter member 98 including the circumferentially continuous radial flange portion 104 is held in engagement with a gasket 106 which is of generally L-shape in cross section. The gasket 106 is fixedly mounted in an inner circumferential groove of a collar 107 which is received about the filter member 98. The upper end of the collar 107 is provided with an inwardly directed flange portion which retains therein a spring member 108 in abutment with the upper surface of the flange portion 104 of the filter member 98. The magnet holder 101 has projecting from the bottom portion thereof a permanent magnet 110 which is designed to magnetically hold a cap 96 in the gasket 106 as shown in FIG. 8.

The arrangement described provides for unused cap rejection by the filter unit 93 in the event that a cap is not accepted by a container 41 or if the supply of containers is interrupted and a chamber 42 does not receive a container therein. The top inner portion of the chamber 42 includes an annular shoulder 111 arranged for abutment with the top surface of the collar 107 upon extreme upward movement of the shaft 94 and filter unit 93. Im-

mediately following vacuum release in the portion of the cycle shown in FIG. 2, the overhead cam track 75 operates to raise the shaft 94 and filter unit 93 to a height exceeding its height at any other time during the cycle of operation. This special raising results in abutment between the upper end of the collar 107 with the shoulder 111 and the spring 108 is compressed permitting separation between the gasket 106 and the bottom surface of the filter member 98. During this operation the magnet 110 is raised well above the gasket 106 and its attraction to an unused cap held by the gasket 106 is eliminated with the result that the unused cap will fall downwardly out of the chamber 42 onto an exposed portion of the machine from which it can be removed.

FIG. 3 adequately illustrates the details of the valve assembly 56 which is attached to each chamber 42. The valve assembly includes a valve housing suitably detachably mounted on a chamber 42 in association with an open side manifold portion 112 of the chamber. The valve assembly housing includes three valve chambers 113, 114 and 115. The outer ends of the chambers define valve seats in the manifold area. Poppet valves 116, 117 and 118 close off the valve chambers and are operated on rods which carry at their opposite ends the cam rollers 61 previously described in FIG. 1. Any suitable spring arrangement (not shown) may be used in maintaining the valves in chamber sealing engagement with their respective seats. FIG. 4 illustrates the valve housing 56 as including a passage 120 extending from the chamber 113 into communication with the pipe 64 through which inert gas is supplied. The chamber 114 is in communication with an atmospheric vent 121 and the chamber 115 communicates through a passage 122 with the pipe 63 through which a vacuum is drawn.

The bottom open end of each chamber 42 is defined by a container gripping assembly 123 which is grooved along the bottom edge thereof and seats a platen engaging gasket 124. The assembly 123 is formed with a circumferentially continuous slot 125 in which a resilient container gripping member 126 is mounted. This member has a base portion of generally outwardly opening channel-like shape which is located outwardly of the slot 125. The gripping member is dimensioned to define spaces 127 between the same and the outer surfaces above and below the slot 125 for movement toward the surfaces into container gripping relation during operation of the machine. The channel-shaped base portion of the gripping member 126 is received in a chamber 128 formed between the top and bottom chamber defining members of assembly 123 and which is in communication with atmospheric pressure through a plurality of openings 130 therein. The outer surface of the base portion is identified by the numeral 131 and is of substantial area for responsive action to atmospheric or other suitable pressure. The portion of the gripping member 126 which projects through the slot 125 is formed with a plurality of circumferentially spaced rib-like members 132. The projecting faces of these members are designed to engage the outer surface of a container. Upon evacuation of the chamber 42 following bottom sealing thereof by a platen 40, atmospheric pressure will act on the outer surface 131 of the gripping member 126 and the same will contract and fill the spaces 127 during movement of the projections 132 into tight container gripping engagement as shown in FIG. 6. In this manner the container 41 is held against rotation during that portion of the cycle of operation in which the cap is twisted onto the container.

Each vacuum chamber and cap application assembly 43 includes a cap delivery device 57 as previously described. FIG. 3 illustrates this device as including a sleeve-like housing 133 which at one end is open and seats a continuous gasket 134 thereabout, the other end of the housing being closed and journaling therethrough a rod 135. The rod at its inner end mounts a cap supporting boss 136 on which a cap 96 may be deposited as shown

in FIG. 3. The housing 133 is slidable along the rod 135 toward and away from the chamber 42 by means of supporting rods 137 only one of which is shown, these rods being suitably reciprocally journaled in a portion of the chamber 42 with the rod 137 illustrated extending inwardly beyond the chamber 42 and carrying thereon one of the cam rollers 62 previously described. The outer end of the rod 135 is fixedly secured through a link 138 to an operating rod 140 which is also suitably journaled for reciprocating movement in a portion of the chamber 42 not shown, the rod 140 projecting inwardly beyond the chamber 42 and carrying thereon the other cam roller 62 previously described.

The chamber 42 includes in an outer side portion thereof a cap delivery opening 141 which is dimensioned to receive therethrough the boss 136 and a cap 96 mounted thereon. The open end of the sleeve housing 133 and the gasket 134 are dimensioned to completely surround the cap delivery opening 141 and seal the same. By reason of the operating rods 137 and 140 being controlled by cam track portions carried on the depending sleeve 76 of the cam actuating assembly 66, the boss 136 may be moved into and out of the chamber 42 and the sleeve housing 133 may be moved into and out of sealed engagement with the opening 141 as well as into and out of enclosing relation with the boss 136.

FIG. 3 illustrates the positions of the various operative elements of a single evacuation and capping station at the time that a filled container 41 is placed on a supporting platen 40 below a chamber 42. This occurs during movement of the station through the loading zone as designated in FIG. 2. As shown in FIGS. 1, 2 and 3, by reason of cam actuation, the sleeve housing 133 of the cap delivery device 57 is fully retracted on the rod 135 to expose the cap supporting boss 136 and a cap 96 is deposited thereon from the chute 65. The station then moves through the portion of the cycle during which the platform or platen 40 is raised lifting the container 41 into the chamber 42 to the extent illustrated in FIG. 5. The platen 40 engages the chamber bottom sealing gasket 124 and the cap delivery sleeve housing 133 is cam actuated into sealing engagement with the chamber 42 about the cap delivery opening 141. In this portion of the cycle the cap supporting boss 136 is positioned within the sleeve housing 133 out of the chamber 42.

During the vacuumization and inert gas sweeping portions of the cycle as shown in FIG. 2, the filter unit 93 is lowered into engagement with the open top surface or mouth of the container 41. FIG. 5 illustrates the engagement of the top edge of the container by the gasket 106. The poppet valve 118 is opened by cam actuation and the chamber is evacuated. The container 41 is evacuated through the filter member 98 the outer surface portions of which are at least substantially exposed for efficient evacuation. During evacuation of the chamber 42, atmospheric pressure acting on the outer large face area 131 of the container gripping member 126 results in inward projection of the ribs 132 into engagement with the outer surface of the container as shown in FIG. 6. Thus with a differential pressure condition the ribs will engage the container and hold the same against rotation within the chamber 42. The circumferential spacing of the ribs 132 provides for pressure equalization above and below the container gripping member 126 within the chamber 42 and the establishment of a vacuum condition below the container gripping member 126 aids in maintaining a tight seal between the platen 40 and the chamber gasket 124.

Following adequate evacuation of the chamber 42 and container 41, the vacuum control poppet valve 118 is closed as a result of cam actuation and the poppet valve 116 is opened as shown in FIG. 7. With the opening of this valve a supply of inert gas is placed in communication with the chamber 42 and this gas fills the chamber and passes in reverse flow through the filter member 98

into the head space of the container. This operational step is preferred in that the reverse flow through the filter member tends to keep the same clean and redeposit any particulate material collected thereon back into the container. Furthermore, as will be described in detail, the improved method of operation of a vacuum capping machine forming a part of this invention involves the combination of at least several steps of vacuumization and inert gas feed back. The details of the method of operation as well as a preferred concept thereof will be described in detail.

Following inert gas injection, the inert gas valve 116 is closed and the vacuum control valve 118 is reopened to reduce the pressure in the chamber 42 and remove the inert gas therefrom. Still further, subsequent controlled feed back of inert gas will preferably be relied upon for purposes of reducing the vacuum established in the container to permit ready removal of a cap from a container by the user thereof.

FIG. 8 illustrates the portion of the cycle in which the cap 96 is twisted onto the container 41 in hermetically sealed relation. Following completion of the vacuumization and inert gas injection cycles, the rod 135 of the cap delivery device 57 is cam actuated to move the cap supporting boss 136 thereof through the cap delivery opening 141 into the interior of the chamber 42. During this operation the filter unit 93 is retracted upwardly by the shaft 94. Thus the boss 136 injects the cap 96 between the filter unit 93 and the open top of the container 41. Prescribed vacuum conditions are maintained during this operation.

The filter unit 93 is then lowered to place the gasket 106 thereof into engagement with the cap 96 and the magnet 110 engages the cap to provide for lifting thereof with the filter unit 93 when the same is again retracted upwardly into the chamber 42. The boss 136 is then withdrawn from the chamber 42 back into the sleeve housing 133. The filter unit with the cap 96 carried thereby is then moved downwardly in the chamber 42 to place the cap on the top of the evacuated container 41 as shown in FIG. 8. The shaft 94 is rotated in the manner previously described and the cap 96 is tightly applied to the container in hermetic sealing relation.

Proper hermetic sealing requires the embedding of the top edge of the container 41 in the gasket material carried in the cap 96. Thus the downward pressure of the filter unit 93 must be rather substantial. In order to prevent the reaction force from separating the platen 40 from the bottom gasket 124 of the chamber 42, a special outer cam roller 142 forms a part of each platen assembly 35 as shown in FIG. 1. The cam roller 142 is fixedly mounted to rigid portions of the platen assembly and at the cap application portion of the cycle of operation, the roller 142 engages a cam track segment 143 mounted on the outer surface of the cam track 37. This momentary rigid contact between the roller 142 and the cam track segment 143 provides a solid base for the platen assembly adequate to overcome any cap application reaction force.

Referring again to FIG. 8, following completion of the cap application portion of the cycle, the poppet valve 117 is opened by cam actuation as indicated in broken lines and the chamber 42 is vented to the atmosphere. In this manner the vacuum within the chamber is broken and the container gripping member 126 retracts to its original position to permit ready withdrawal of the container from the chamber. Furthermore, the sleeve housing 133 of the cap delivery device 57 is free to move away from the chamber 42 and back along the rod 135 to completely expose the boss 136 as in FIGS. 1 and 2 to permit delivery of another cap thereto to start the cycle again. The filter unit 93 is moved upwardly in the chamber 42 and the platen 40 is lowered to withdraw the container from the chamber. The platen 40 readily separates from the chamber 42 by reason of the vacuum having been broken therein.

As set forth above, the filter member 98 may be formed from any suitable rigid porous material capable of providing the requisite porosity and strength for use in the manner described. The filter member may be formed from sintered metallic particles such as beads or the like having an average particle size of from 26 to 51 microns. The metal used may be brass and the beads are suitably charged in a mold which is heated to a temperature of approximately 1680° F. where a hydrogen atmosphere is used and 1620° F. where a nitrogen atmosphere is used. At such temperatures the accumulated mass of beads in the mold cavity combine in the well-known manner to form a sintered article which is uniformly porous throughout.

The filter member may also be formed from sintered nylon powder or other suitable materials. Ultrafine nylon powder on the order of 1 to 3 microns is compacted in a mold at about 15 to 50 tons per square inch pressure and sintered at about 450° F. Sintering is carried out in a non-oxidizing atmosphere such as inert gas, vacuum, or under oil. A filter of this type may have the same shape as described above and the pore walls thereof are sufficiently rigid to prevent product particle entrapment.

Regardless of the manner in which the filter member 98 is made, the shape thereof is such that a barometric leg effect is provided. This constitutes an important aspect of the present invention in that, as previously described, powdery materials are rather difficult to handle during evacuation of a container filled with the same. The provision of the side wall portion 102 of the filter member 98 with an adequate height provides a substantial amount of space confined by the filter member in communication with the head space of the container. Thus the evacuation procedure is substantially completed before the particulate material can rise well above the container. For efficient high speed operation of the capping machine it is essential that the vacuum conditions be established virtually instantaneously and the immediate subjection of a strong vacuum on particulate material tends to lift the same. The barometric leg defined by the filter member preferably ranges from about 1½ to 3½ inches in height. A height of 3 inches has been found quite satisfactory in a capping machine of the type described operating at a rate of approximately 300 containers per minute. The barometric leg provides an area in which the granular or powdery materials may expand upwardly resulting in separation of the particles by means of which air may be readily withdrawn at a maximum velocity from the container. Furthermore, this particular arrangement making use of the type of filter member disclosed provides for the use of maximum possible filter area. This rigid porous filter member not only provides means by which cap application pressure may be transmitted to the cap and container, but also provides greater pore wall strength in that any product particles impinging against the filter will readily fall therefrom as they cannot expand the rigid pore walls of the filter and thus become stuck or trapped therein. In this regard the rigid porous filter member constitutes a substantial improvement over the use of conventional silk filters or screens.

The method of treating the interior of a container to obtain low oxygen content therein will be described in conjunction with the establishment of vacuum conditions expressed in inches of mercury vacuum. The expressing of vacuum conditions in these terms is fully accepted and widely practiced in the art. Atmospheric pressure will normally read between 29 and 30 inches of mercury. It is in this range of 29 to 30 inches of mercury between atmospheric pressure and absolute zero pressure the container capping industry works. Thus the vacuum conditions existing between atmospheric pressure and absolute zero pressure are expressed in inches of mercury vacuum. In this regard if the atmospheric pressure is approximately 30 inches of mercury and a vacuum is

drawn in a container to an extent of 10 inches of mercury vacuum, the resulting absolute pressure in the container would be 20 inches. This is merely the difference in pressure within the container and the existing atmospheric pressure. Mechanical capping machines are conventionally supplied with gauges which provide readings in terms of inches of mercury vacuum.

With regard to high speed capping operations, it has been found that a vacuum of 26½ inches can be quickly established (approximately 0.2 second) in a container. Drawing a vacuum to 28½ inches is quite difficult and requires a substantially longer period of time because the air molecules remaining are widely dispersed. As previously described, with many oxygen sensitive food products the container should preferably be evacuated to an extent that residual oxygen is not substantially greater than 2%. This would require the establishment of a vacuum on the order of at least 28 inches. The time required to do this in accordance with vacuum capping machine operational methods practiced prior to this invention is prohibitive insofar as the maintaining of high speed capping operations is concerned.

In order to obtain the desired minimum residual oxygen in a container, it has been found that by the use of a series of evacuations interspersed with inert gas feed back, the desired residual oxygen content can be established while maintaining high capping speed operation. Specifically, the vacuumization cycle comprises subjecting the vacuum chamber to vacuumization conditions to establish therein a vacuum of at least about 25 inches of mercury vacuum. This vacuum is then reduced by the injection of an inert gas, such as nitrogen, to decrease the vacuum to no less than 10 inches of mercury vacuum. The feed back of nitrogen to the vacuum chamber causes a diffusion of the air within the chamber. The residual air, mixing with the feed back nitrogen thus provides a new gas mixture with a low percent oxygen. Subsequent vacuumization therefore becomes more effective with regard to percent of oxygen relative to standard air. In this regard the barometric leg portion of the filter member contributes substantially as it provides an increased nitrogen fill area to assure good mixing of the residual air and oxygen. The next step in the cycle involves the re-establishing of the original vacuum conditions, namely, evacuating to at least about 25 inches of mercury vacuum. In this step the nitrogen mixed with the residual air is removed from the container and a material reduction in residual oxygen content occurs.

Preferably, the first evacuation step will be carried out under vacuumization conditions which will result in the establishment of 26½ inches of mercury vacuum in the container. A vacuum source of about 29 inches is adequate for this purpose. The container vacuum will preferably be reduced only to about 15 inches of mercury vacuum by feed back of nitrogen. The original 26½ inches of mercury vacuum will then be re-established for the purpose described above. Again, preferably the 26½ inches of vacuum will be subsequently reduced to no less than 10 inches of vacuum, or about 15 inches of vacuum, by re-introduction of nitrogen. This last step results in reducing the capping vacuum and permitting easier removal of the cap from the container by the user of the product. Obviously, the subsequent re-filling with nitrogen will not disturb the desired residual oxygen content originally established.

The method described does not interfere with high speed capping operations. As previously set forth, a vacuum of 26½ inches can be established in the head space of a container virtually instantaneously (approximately 0.2 second). While this initial vacuumization is not adequate to reduce the residual oxygen content to the extent desired, the subsequent re-filling with nitrogen followed by evacuation again to re-establish the initial 26½ inches of vacuum assures a reduction in residual oxygen content to the desired level. Each step may be accom-

plished in a fraction of a second and thus the combination of steps does not hinder high speed capping operations. The sequence of steps may be repeated to any extent desired. This method when used in connection with products which are not immediately oxygen sensitive can be effective to completely eliminate existing practices requiring container filling under nitrogen blanket conditions. Elimination of this highly controlled step can be quite important with regard to savings in cost and reduction in product packaging time and equipment.

Obviously certain modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. In a method of vacuum capping containers having a loose powdery-like material packed therein, the steps of covering the mouth of the container with a rigid cap-like filter member which provides a substantial area above the mouth of the container for expansion of the product when subject to vacuum for withdrawal of air through the mouth of the container, the filter being of a fineness sufficient to prevent excessive displacement of the powdery-like material from the container, forming a vacuum chamber about the filter covered mouth of the container, evacuating the chamber to withdraw air from the container through the filter, feeding into the chamber an inert gas so as to pass the gas in reverse flow through the filter into the head space, again vacuumizing the chamber to remove substantially all of the inert gas, lifting the filter above the mouth of the container when the chamber is evacuated and positioning a closure cap between the open bottom of the filter and the open top of the container, lowering the filter and cap onto the top of the container and using the filter member as an applicator in applying the cap to the mouth of the evacuated container in hermetic sealing relation thereon.

2. In a method of vacuum capping containers having a loose powdery-like material packed therein, the steps of covering the mouth of the container with a rigid cap-like porous filter member which provides a downwardly opening chamber of substantial depth above the mouth of the container for expansion of the product when subject to vacuum for withdrawal of air out of the container through the filter, the filter pores being of a size relative to the material particle size to prevent passage of the powdery-like material, forming a vacuum chamber about the filter covered mouth of the container, evacuating the chamber to withdraw air from the container through the porous filter member, feeding into the chamber an inert gas so as to pass the gas in reverse flow through the pores of the filter member into the head space in the mouth of the container, again vacuumizing the chamber to remove the inert gas, lifting the filter member above the mouth of the container after the chamber is evacuated, positioning a closure cap between the open bottom of the filter member and the open mouth of the evacuated container, lowering the filter member and the cap onto the top of the container and using the filter member as an applicator in applying the cap to the evacuated container in hermetic sealing relation.

3. In a method of vacuum capping containers having a loose powdery-like material packed therein, the steps of covering the mouth of the container with a porous filter member having a downwardly opening cup-like shape providing an area of substantial depth above the mouth of the container for expansion of the product when subject to vacuum for withdrawal of air through the mouth of the container and the filter member, the filter member having pores smaller than the size of the particles of the powdery-like material so as to prevent passage of the powdery-like material through the filter

member, forming a vacuum chamber about the covered mouth of the container, evacuating the chamber to withdraw air from the container, feeding into the chamber an inert gas so as to pass the gas in reverse flow through the pores of the filter member into the head space within the mouth of the container, vacuumizing the chamber to remove substantially all of the inert gas, raising the filter member above the mouth of the container when the chamber is again evacuated, seating a closure cap on the open bottom of the filter member above the open top of the container, lowering the filter member and cap onto the top of the container and using the filter member as an applicator in applying the cap to the evacuated container in hermetic sealing relation.

4. A method of treating a container filled with powdery-like material to obtain low oxygen content in the same, said method comprising covering the mouth of the container with an inverted cup-shaped filter member which defines a barometric leg of from about 1½ to 3 inches in height so as to provide a substantial area above the head space in which the material may expand upwardly, evacuating the container through the filter member with the evacuation being carried out to an extent to establish at least about 25 inches of mercury vacuum, reducing the vacuum to no less than 10 inches of mercury vacuum by introducing therein an inert gas, again evacuating the container through the filter to about 25 inches of mercury vacuum, again reducing the vacuum to no less than 10 inches of mercury vacuum by introducing therein an inert gas, and hermetically capping the container.

5. A method of treating a container filled with powdery-like material to obtain low oxygen content in the same, said method comprising covering the mouth of the container with an inverted cup-shaped filter member which defines a barometric leg of from about 1½ to 3 inches in height so as to provide a substantial area above the head space in which the material may expand upwardly, evacuating the container through the filter member with the evacuation being carried out to an extent to establish 26½ inches of mercury vacuum, reducing the vacuum to about 15 inches of mercury vacuum by introducing therein an inert gas, again evacuating the container through the filter to about 25 inches of mercury vacuum, again reducing the vacuum to about 15 inches of mercury vacuum by introducing therein an inert gas, and hermetically capping the container.

6. In a method of vacuum capping containers having a loose powdery-like material packed therein, the steps of covering the mouth of the container with a porous filter member having a downwardly opening cup-like shape providing an area of substantial depth above the mouth of the container for expansion of the product when subject to vacuum for withdrawal of air through the mouth of the container and the filter member, the filter member having pores smaller than the size of the particles of the powdery-like material so as to prevent passage of the powdery-like material through the filter member, forming a vacuum chamber about the covered mouth of the container, evacuating the chamber to an extent sufficient to establish at least about 25 inches of mercury vacuum, introducing into the chamber an inert gas so as to reduce the vacuum to no less than 10 inches of mercury vacuum with the gas passing in reverse flow through the pores of the filter member into the head space within the mouth of the container, again evacuating the chamber to about 25 inches of mercury vacuum, introducing an inert gas into the chamber to again reduce the vacuum to no less than 10 inches of mercury vacuum, raising the filter member above the mouth of the container, seating a closure cap on the open bottom of the filter member above the open top of the container, lowering the filter member onto the top of the container and

applying the cap to the container in hermetic sealing relation.

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