

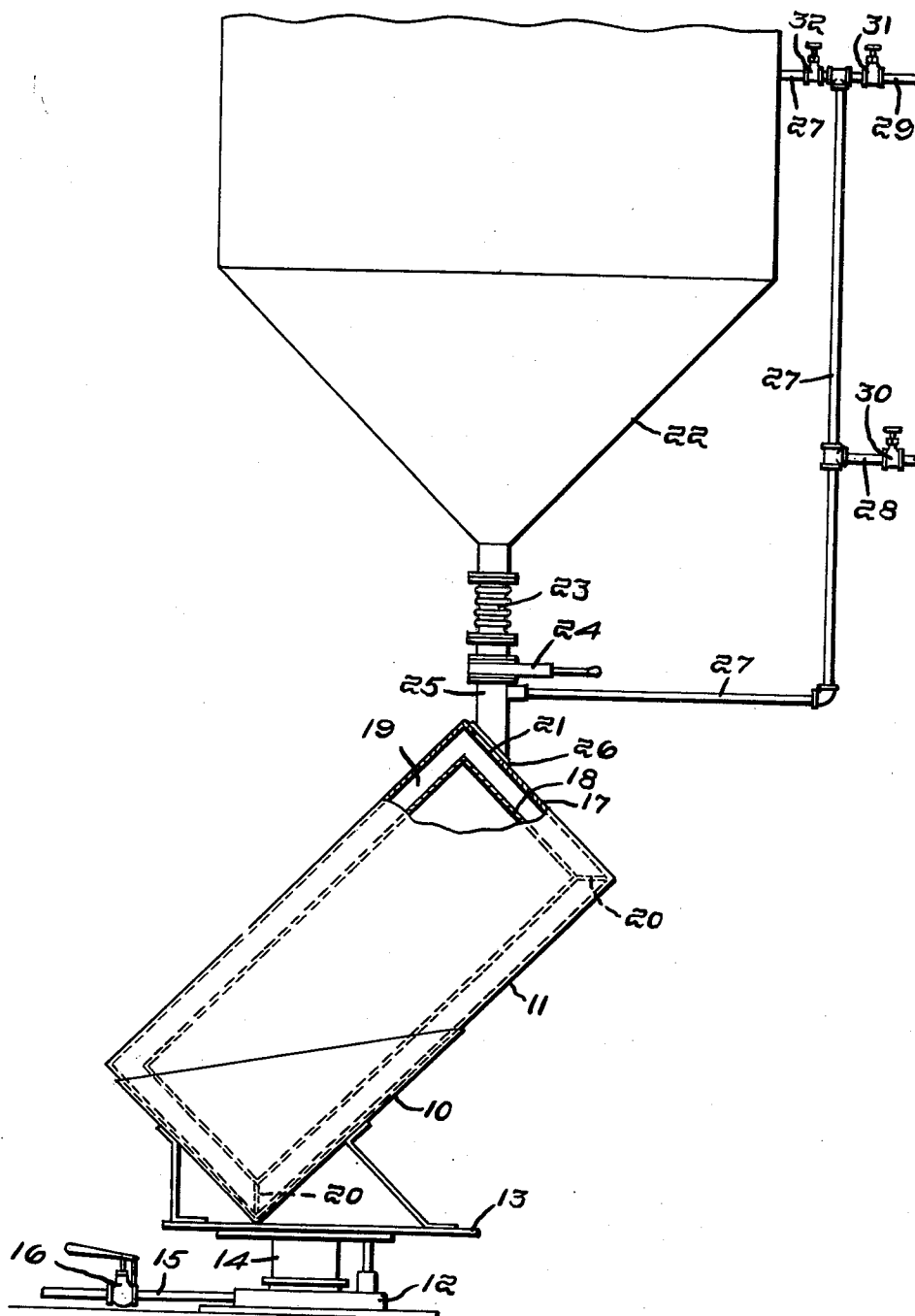
May 6, 1952

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2,595,262

METHOD AND APPARATUS FOR FILLING CONTAINERS

Filed March 26, 1949



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UNITED STATES PATENT OFFICE

2,595,262

METHOD AND APPARATUS FOR FILLING
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Application March 26, 1949, Serial No. 83,566

9 Claims. (Cl. 20—101)

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The present invention relates to improved methods and apparatus for filling containers with relatively free-flowing particles, and particularly for filling the hollow walls of refrigeration cabinets with particles of insulation.

It is one object of the present invention to provide simple and efficient methods for filling hollow or void spaces in containers with relatively free-flowing particles which normally are difficult to pack and settle.

A further object of this invention is to provide improved methods for filling the hollow walls of refrigeration cabinets with particles of insulation and to settle or pack such particles of insulation to such an extent that the tendency of such particles to settle further in normal use or during shipment of the cabinets is substantially eliminated.

A further object of this invention is to provide improved apparatus for filling containers, and especially the void space between the inner and outer walls of refrigeration cabinets, with particles of insulation and to subject the particles of insulation to a greater packing and settling force than the packing or settling force exerted on such particles during the normal conditions encountered in transporting or using such cabinets.

Still further objects and advantages of this invention will be apparent from the following description when taken together with the accompanying drawing and the appended claims.

The present invention is carried out, in general, by first feeding particles of insulation by gravity to a container to be filled or to the space in the hollow walls of completely assembled refrigerator cabinets while the container or cabinet is being jolted or subjected to vertical vibratory movement. The space to be filled may be filled only partially or it may be filled completely in the initial filling step, although partial filling is preferred in most instances. After the filling operation has been carried out to the desired extent in the manner described, the feeding operation is discontinued and, while the container is being jolted, compressed air is introduced into the container or into the void space above the surface of the insulating material in the refrigeration cabinet under sufficient pressure to bulge the walls of the container or cabinet thus creating a larger volume within the space to be filled. The particles of insulating material are thus packed down by the air pressure exerted and at the same time settle into the increased volume afforded by bulging the walls of the container or cabinet. The general operation of filling and supplying com-

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pressed air above the insulation is then repeated while the container is being jolted until the container or cabinet has been completely filled, or has been filled to the extent desired.

5 Suitable apparatus for carrying out this operation comprises, in general, a cradle in which the container or refrigerator cabinet to be filled is positioned together with means for jolting the cradle and container and means for supplying particles of insulating material to the container, 10 valve means for stopping the flow of the insulating material to the container and air supply means for supplying compressed air to the void space in the container above the insulating material.

One specific embodiment of such apparatus is illustrated in the accompanying drawing which represents in side elevation a refrigerator cabinet partly broken away to show interior construction, and in position to be filled, means for jolting the cabinet, a hopper for supplying particles of insulation thereto and means for supplying compressed air to the cabinet and means for allowing air to escape from the cabinet during filling.

25 In the drawing 10 represents a cradle in which a refrigerator cabinet 11 is positioned for filling with particles of insulation. The cradle is positioned over a suitable jolting device 12 which consists of a platform 13 mounted on a piston 14 which is actuated by a hydraulic fluid such as water, or by air pressure or the like which is supplied by pipe 15 (from a source not shown). A quick acting valve 16 is mounted in the pipe to start or stop the operation of the device. Although a hydraulic or compressed-air operated device is illustrated, other jolting devices may be employed.

Refrigerator cabinet 11 is of the conventional deep-freezer type and consists of an outer shell or walls of enameled sheet metal 17, an inner shell or walls of enameled sheet metal 18, positioned concentrically therein so that a hollow or void space 19 is present between the outer and inner shell around the entire periphery of the inner shell, the outer and inner shell being joined together at the door opening of the cabinet by conventional breaker strips 20 and at such other points as are necessary to make the assembly sufficiently rigid. Thus the cabinet is completely assembled except for the door or other access closing means and the insulating materials. The outer shell 17 is provided with a small opening or filling port 21 through which the particles of insulation will flow into the hollow space between the inner and outer shell of the cabinet. The

filling port is generally located near one of the corners of the cabinet. In the case of a cylindrical cabinet it is generally located in the top or bottom of the cabinet. This filling port should be located at the highest point on the cabinet when it is in filling position on the cradle. After filling is completed, the filling port is covered with a suitable cover plate.

It is not intended, however, that the invention be limited by the type or construction of the containers or cabinets to be filled, since the filling methods and apparatus employed herein are particularly suited for filling a large variety of containers or cabinets with relatively free-flowing particles or particles of insulation. Thus, the methods and apparatus described herein are suitable for filling containers and cabinets of any type or construction with particles of matter or in case of refrigeration cabinets with particles of insulation; providing the space to be filled is enclosed except for a filling port, the container or cabinet is not too large to be jolted, and the walls of the container or cabinet enclosing the space to be filled are sufficiently flexible to be flexed or bulged by air pressure and yet are sufficiently rigid transversely to withstand jolting without appreciable deformation, bending or structural damage. Sheet steel of the gauge normally used in refrigeration cabinets is illustrative of wall materials suitable for fulfilling the last mentioned condition.

Referring again to the drawing, the numeral 22 represents a supply hopper in which the particles of insulating material are stored. This hopper is positioned above the refrigerator cabinet so that the particles of insulating material therein will flow by gravity into the cabinet. The hopper and refrigerator cabinet are interconnected by means of a flexible rubber bellows tube 23, a blast gate valve 24 and a rigid pipe or casing 25, the latter being positioned over the open filling port 21 and fastened to the outer wall 17 so as to make a substantially air-tight fit with such wall. The rubber bellows tube, the valve and pipe may be of any desired cross-sectional configuration. Although a blast gate valve is illustrated, it is obvious that any valve may be used which stops the flow of material from the hopper. One form of valve which has been found to be especially suitable for this use consists of a casing which is lined with a thin tubular rubber membrane, the edges of which are cemented or otherwise fastened to the inner or outer walls of the casing thereby creating a substantially air-tight chamber or space between the inner wall of the casing and the outer wall of the membrane. The rubber membrane can be inflated or expanded by supplying air under pressure to the chamber thus formed, and when sufficiently expanded forms a substantially air-tight closure thus stopping the flow of insulating material from the hopper to the refrigerator cabinet. This valve is described in greater detail in my copending application Serial No. 62,267, filed November 27, 1948.

Any flexible piping other than the rubber bellows tube 23 may be used, if desired. The only requisite is that such pipe or tubing be sufficiently flexible and longitudinally collapsible to allow vertical upward and downward movement of the refrigerator cabinet with respect to the hopper without breaking the connective relationship between them.

As previously stated the casing 25 is positioned over the filling port 21 in the outer wall of the

refrigerator cabinet and is fastened to such wall or to the cabinet in any suitable manner. As shown in the drawing its lower portion contains a suitably gasketed integral flange 26 which may be bolted to the outer wall or clamped thereto during the filling operation. After the cabinet has been filled, the casing 25 is disconnected from the cabinet and a suitable cover plate is then placed over the filling port 21 and fastened to the outer wall of the cabinet while the cabinet is still in the cradle to prevent the insulating material from spilling out of the cabinet.

A flexible pipe or tubing 27 is connected at its lower end to the casing 25 so that it communicates with the interior thereof, and is generally mounted at some point above the cabinet and below valve 24, preferably at a point just below the flanges or other means which connect casing 25 and valve 24. Connected to pipe 27 is a vacuum line 28 and a compressed air line 29. The upper end of pipe 27 communicates with the top of the supply hopper above the insulating material therein and serves to vent the air displaced from the cabinet by the insulation. The vacuum line is connected to a suitable vacuum pump or other suitable exhausting means (not shown) and is suitably opened or closed by valve 30. The compressed air line is connected to a suitable air compressor or compressed air tank (not shown) and is suitably opened or closed by valve 31. The extension of pipe 27 which connects with the supply hopper also is provided with a valve 32. The valves used may be of the quick acting type. Moreover, the various lines and valves may be grouped at a single control board so that they can be operated by a single operator during the filling operation. In order to permit vertical movement of the cabinet relative to such lines without disruption, it is desirable to use rubber tubing or flexible metal tubing for such lines either wholly or in part.

The operation of the filling apparatus is as follows: After cabinet 11 has been placed on cradle 10 with its filling port 21 at the highest point, the filling port of the cabinet is connected to the supply hopper 22 in the manner hereinbefore described, the blast gate valve 24 being closed. The jolting device is then started and the blast gate valve is opened allowing particles of insulating material to fall by gravity from the supply hopper into the void space 19 between the walls of the cabinet. During this operation valve 32 is open and valves 30 and 31 are closed thus permitting the air displaced by the insulating material to escape to the hopper through pipe 27. After the hollow walls of the cabinet are approximately $\frac{1}{2}$ to $\frac{3}{4}$ full of insulation, the blast gate valve 24 is closed thus stopping the flow of insulation, and valve 32 is also closed. Valve 31 is opened and compressed air is supplied to the hollow space between the inner and outer shell of the cabinet, the amount and rate of air supplied and pressure used being sufficient to bulge or flex outwardly the walls of the cabinet. It is important to supply the compressed air rapidly in order to obtain maximum packing action. The cabinet is jolted throughout this operation. After the cabinet has been jolted for a period of time sufficient to settle and pack the particles of insulation in the increased volume afforded by the bulging action, valve 31 is closed and valves 24 and 32 are again opened. The entire refrigerator cabinet may be filled with insulation at this stage or only an increment of

insulating material need be added. Valves 24 and 32 are again closed and valve 31 is opened thus admitting compressed air to the space above the insulating material thereby causing the walls of the cabinet to flex or bulge and also packing the insulating material, together with the jolting action, into the increased volume thus afforded. The cabinet is jolted throughout the filling procedure. The procedure described above is repeated until the insulating material does not settle and the cabinet has been filled to the extent desired.

By employing the apparatus and procedure described above, it is possible to fill a refrigerator cabinet of the deep-freezer type and of the size ordinarily employed for household use in from 5 to 10 minutes depending upon the capacity of the cabinet and the skill of the operator. Moreover, the insulating material in the cabinet will not appreciably settle thereafter under ordinary conditions of use or during normal handling in shipping. Thus it is seen that the present invention provides a rapid and efficient method and apparatus for filling containers or cabinets or the hollow walls thereof with particles of insulation and at the same time enables the production of containers or cabinets, which are completely filled with particles of insulation, and in which the particles of insulation are resistant to further settling.

It is possible in accordance with one modification of this invention to pack the particles of insulating material into the cabinet walls to an even greater extent by partially evacuating the space above the insulating materials after each increment of insulating material has been added. This procedure enables the removal of air entrapped with the particles of insulation and also enables, to a certain extent, the walls of the cabinet to be flexed inwardly thus exerting a compressive force on the particles of insulation. This is accomplished by closing valves 24 and 32 after the desired increment of insulating material has been added to the cabinet, and then opening valve 30 on the vacuum line. After the cabinet has been partially evacuated to the extent desired, valve 30 is closed and valve 31 is opened thus admitting compressed air into the space above the insulating material and exerting a packing action on the particles of insulation and at the same time bulging the walls of the cabinet thereby increasing the available volume. When the cabinet is partially evacuated in the manner described, it is not necessary to partially evacuate the void space 19 during each stage of the filling operation as excellent results are obtained by using vacuum only after the initial $\frac{1}{3}$ or $\frac{1}{2}$ of the available insulating space has been filled with particles of insulation.

The invention is further illustrated in the following specific example which sets forth specific conditions used in filling a refrigerator cabinet in accordance with the methods and apparatus hereinbefore described.

Example

An 8 cubic foot refrigerator cabinet of the deep-freezer type was mounted on cradle 10 so that its filling port 21, an opening about 4 inches by 4 inches, was in the uppermost position on the cabinet. The cabinet was then connected with the supply hopper in the manner hereinbefore described. The cabinet was then jolted at the rate of 100 $\frac{1}{2}$ inch vertical strokes per minute. Valves 24 and 32 were opened, valves 30 and 31

being closed, and silica aerogel insulation (sugar-size) was allowed to run freely into the void space between the inner and outer shells of the cabinet until the available space was approximately $\frac{1}{3}$ full. Valves 24 and 32 were then closed. Valve 31 was opened and compressed air at a pressure of about $\frac{1}{2}$ pound per square inch (gauge) was supplied rapidly to the cabinet above the insulating material for a short time in order to bulge the cabinet walls and to allow the insulation to enter the increased volume thus created. Valve 31 was then closed and valve 32 was opened to allow the internal pressure in the cabinet walls to bleed down to atmospheric pressure. Valve 24 was opened and the insulating material was allowed to flow into the cabinet until the cabinet was $\frac{2}{3}$ full. Valves 24 and 32 were then closed and valve 31 was opened. The same quantum of compressed air was applied as described above, after which valve 31 was closed and valve 32 was opened. Valve 24 was then opened and the cabinet was completely filled with insulating material. Air pressure was then applied and more insulating material supplied according to the cycle described above until no further settling was observed. The cabinet was then disconnected from the supply hopper and the filling port was covered with a coverplate.

The cabinet so filled was placed on a truck and driven for 4 hours over rough and bumpy roads, this test being designed to simulate the treatment which would normally be given a cabinet during shipment. At the end of this test the cabinet was examined and it was found that no measurable amount of settling of the insulation had occurred.

An 8 cubic foot refrigerator cabinet of the same construction was filled by pouring the insulation (silica aerogel) into the filling port and then shaking the cabinet by hand to facilitate the flow of insulation into all parts of the available space. This operation was repeated until the cabinet was filled. The filling port was then covered and the cabinet was subjected to the test described above. On examining the cabinet it was found the 3% by volume of the available insulating space was void of insulation.

The invention is not limited to any particular type of insulating material. Instead of the silica aerogel employed in the foregoing example, other insulating materials in particle form may be used such as granulated cork; mineral fibers, for example, glass fibers and rock wool fibers; and wood particles or fibers and the like. The invention is best carried out, however, by employing finely divided or powdered insulation which is substantially free-flowing or flows readily under gravity. Finely divided silica aerogels are preferred for use in filling containers and refrigeration cabinets in accordance with this invention because of their excellent insulating properties and flow characteristics.

Silica aerogel suitable for insulating purposes is prepared, for example, by first mixing an acid such as sulfuric acid and a water-soluble silicate such as sodium silicate in proportions suitable to prepare an acid reacting mixture, allowing the mixture to set up as a gel, washing the gel with water until it is substantially free of electrolyte, replacing the water in the gel by continuously washing the gel with ethanol, heating the resulting alco-gel in an autoclave at a temperature slightly above the critical temperature of ethanol, and after the ethanol has been converted to the vapor phase releasing small

amounts of vapor until the ethanol has been substantially removed, and then removing the resulting aerogel from the autoclave. The above method is described in greater detail in the patent to Samul S. Kistler, No. 2,093,454. The silica aerogel is comminuted or pulverized until its particles are substantially sugar-size.

It is obvious that many changes or modifications may be made in the conditions given in the example for filling containers or refrigeration cabinets with insulating materials in accordance with the present invention. Thus it is possible to jolt the container or cabinet more rapidly or less rapidly, that is, the jolting frequency may be modified considerably. The jolting frequency used depends to a considerable extent on the vertical stroke employed since a lower jolting frequency is more desirable with larger vertical strokes, that is, greater vertical travel. On the other hand, a higher jolting frequency is often more desirable with smaller vertical strokes. In general, the jolting frequency and stroke used during the filling operation should be sufficient to subject the insulating material to at least the same settling force as that to which the cabinet is afterwards subjected during normal use and handling during shipment. On the other hand, the jolting force used should not be of such intensity as to cause structural damage of the cabinet.

The quantum and rate of flow of compressed air supplied to the container or cabinet may also be varied considerably depending upon the construction of the container or cabinet, the thickness of its walls, the material used in the construction of the walls, etc. However, it is preferred to use compressed air having sufficient pressure to bulge the walls of the cabinet or container so that there is no appreciable "oil can effect," that is, no appreciable tendency for the walls to buckle at various points as is common with a sheet metal panel. The quantum of pressure and rate of air flow used, however, should not cause permanent deformation of the walls of the cabinet or structural damage to the joints of the cabinet.

Various modifications in the methods and apparatus described herein may be made as will be apparent to those skilled in the art and it is intended that the present invention be limited only by the scope of the appended claims.

What is claimed is:

1. A method of filling containers and the like with particles of insulating material which comprises supplying particles of insulating material by gravity feed to the enclosed void space of a container having flexible walls until said void space is at least partially filled with insulating material, stopping the supply of said insulating material, supplying compressed air to the void space above the insulating material under sufficient pressure to pack the insulating material and to bulge the walls of said container, releasing the air pressure thus created on the walls of said container, the aforesaid operations being carried out while said container is being jolted, and then repeating the foregoing steps while the container is being jolted until the enclosed void space of the container has been filled with insulating material to the desired extent.

2. A method of filling the void space between the inner and outer walls of a refrigeration cabinet, the walls of which are flexible, which comprises supplying particles of insulating material by gravity feed to said void space until said space

is at least partially filled with insulating material, stopping the supply of said insulating material, supplying compressed air to the void space above the insulating material under sufficient pressure for a predetermined time to pack the insulating material and to bulge the walls of said cabinet, releasing the air pressure thus supplied, the aforesaid operations being carried out while said cabinet is being jolted, and then repeating the aforesaid operations while said cabinet is being jolted until said void space has been filled with insulating material.

3. A method according to claim 2 wherein the insulating material supplied is a comminuted silica aerogel.

4. A method of filling the void space between the inner and outer walls of a refrigeration cabinet, the walls of which are flexible, which comprises supplying particles of insulating material to said void space until said space is at least partially filled with said insulating material, stopping the supply of said insulating material, partially evacuating the void space above the insulating material thus supplied to remove air occluded therewith, supplying compressed air to the same void space above said insulating material under sufficient pressure for a predetermined period of time to pack said insulating material and to bulge the walls of said cabinet, releasing the air pressure thus supplied, the aforesaid operations being carried out while said cabinet is being jolted, and then repeating the aforesaid operations, except the evacuating step, while said cabinet is being jolted until said void space has been filled with insulating material.

5. A method of filling the void space between the inner and outer walls of a refrigerator cabinet, the walls of which are flexible, which comprises supplying particles of insulating material by gravity feed to said void space until said space is at least partially filled with said insulating material, stopping the supply of said insulating material, partially evacuating the void space above the insulating material thus supplied to remove air occluded therewith, supplying compressed air to the same void space above said insulating material under sufficient pressure for a predetermined period of time to pack said insulating material and to bulge the walls of said cabinet, releasing the air pressure thus supplied, the aforesaid operations being carried out while said cabinet is being jolted, and then repeating the aforesaid operations while said cabinet is being jolted until said void space has been filled with insulating material.

6. A method of filling the void space between the inner and outer walls of a refrigeration cabinet, the walls of which are flexible, which comprises supplying particles of insulating material by gravity feed to said void space until said void space has been loosely filled with said insulating material, stopping the supply of said insulating material, supplying compressed air to the upper surface of the insulating material in said cabinet under sufficient pressure for a predetermined period of time to pack said insulating material and to bulge the walls of said cabinet, releasing the air pressure thus supplied, the aforesaid operations being carried out while said cabinet is being jolted, and then repeating the aforesaid operations until said void space has been filled with insulating material and no further appreciable settling of said insulating material occurs on continued jolting.

7. In combination a container comprising flex-

ible walls enclosing a void space, said container having a filling port in a wall thereof communicating with said void space; a supply hopper for supplying particles of insulation positioned above said container; means for connecting the filling port in said container to said supply hopper, including a flexible tube and valve means for stopping the flow of particles of insulation from said supply hopper; means for supporting and jolting said container; valve controlled means for venting air from said space; valve controlled means for supplying compressed air to said space; and means for preventing the venting of air from said space when compressed air is supplied to said space.

8. An apparatus for filling refrigeration cabinets with particles of insulation comprising means for supporting and jolting a refrigeration cabinet; a refrigeration cabinet supported therein comprising flexible concentric inner and outer walls enclosing a void space, and a filling port in one of the outer walls of said cabinet communicating with said void space; said cabinet being positioned in said supporting and jolting means so that said filling port is near the uppermost portion of said cabinet; a hopper positioned above said cabinet for supplying particles of insulation thereto; means for connecting said hopper with the filling port in said cabinet, including a flexible tube and a valve for stopping the flow of particles of insulation from said hopper to said filling port; valve controlled means for allowing air in said void space to escape from said cabinet on being displaced by particles of insulation from said hopper; and valve controlled means for supplying compressed air to the enclosed space in said cabinet between the outer and inner walls thereof.

9. An apparatus for filling a refrigeration cabinet with particles of insulation comprising means for supporting and jolting a refrigeration

cabinet; a refrigeration cabinet supported therein comprising flexible concentric inner and outer walls enclosing a void space, and a filling port in one of the outer walls of said cabinet communicating with said void space; said cabinet being positioned in said supporting and jolting means so that the filling port is near the uppermost portion of said cabinet; a hopper positioned above said cabinet for supplying particles of insulation thereto; means for connecting said hopper with the filling port in said cabinet, including a flexible rubber bellows tube and a valve for stopping the flow of particles of insulation from said hopper to said filling port; valve controlled means for allowing air in said void space to escape from said cabinet on being displaced by said insulation; valve controlled means for partially evacuating the enclosed space between the inner and outer walls of said cabinet; and valve controlled means for supplying compressed air to said space.

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REFERENCES CITED

25 The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
30 870,215	Bates	Nov. 5, 1907
1,353,613	Renton	Sept. 21, 1920
2,128,336	Tortensson	Aug. 30, 1938
2,318,744	Brown	May 11, 1943
2,359,029	Goldberg	Sept. 26, 1944
35 2,429,059	Horstkotte	Oct. 14, 1947
2,437,831	Moore	Mar. 16, 1948
2,439,603	Heritage	Apr. 13, 1948

FOREIGN PATENTS

Number	Country	Date
40 408,810	Great Britain	1934