

Aug. 29, 1944.

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2,356,827

METHOD AND APPARATUS FOR INSULATING STRUCTURES

Filed April 26, 1941

2 Sheets-Sheet 1

Fig. 1.

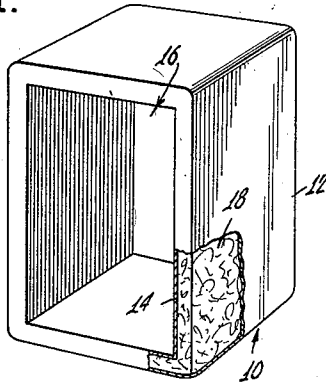


Fig. 2.

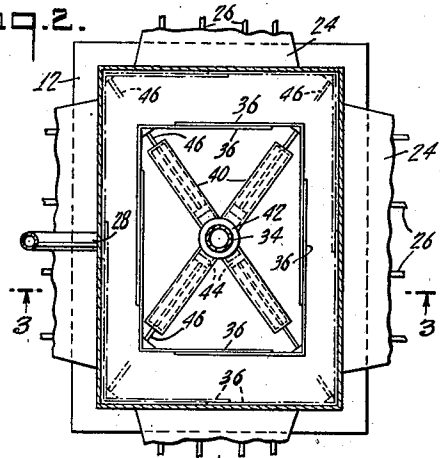


Fig. 3.

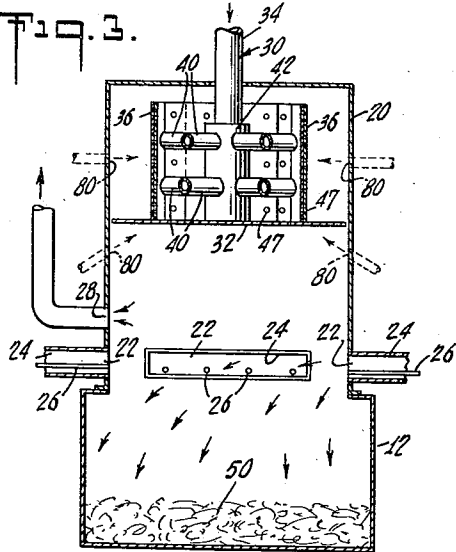


Fig. 4.

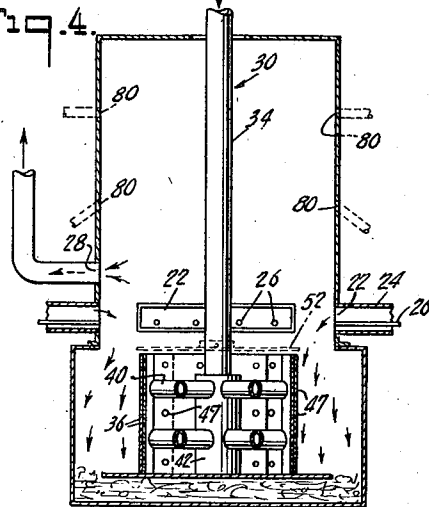


Fig. 5.

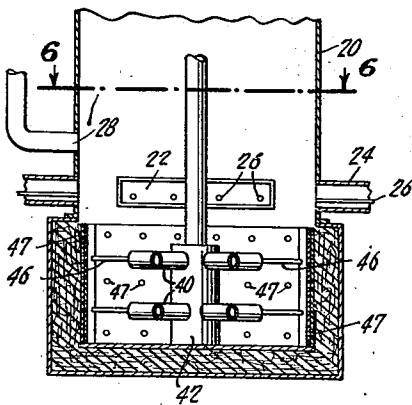
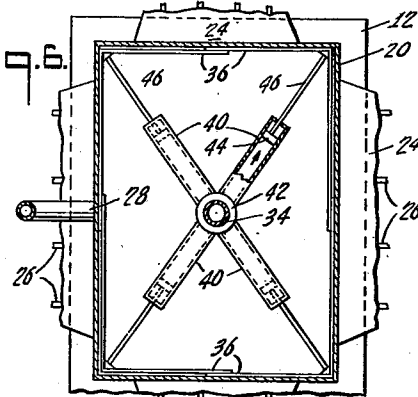


Fig. 6.



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2 Sheets-Sheet 2

Fig. 7.

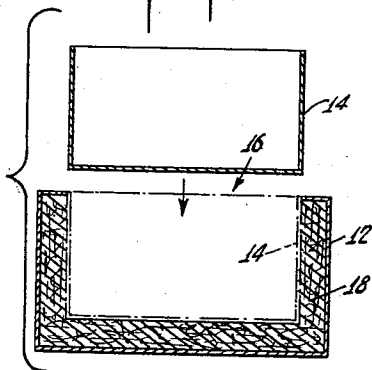


Fig. 8.

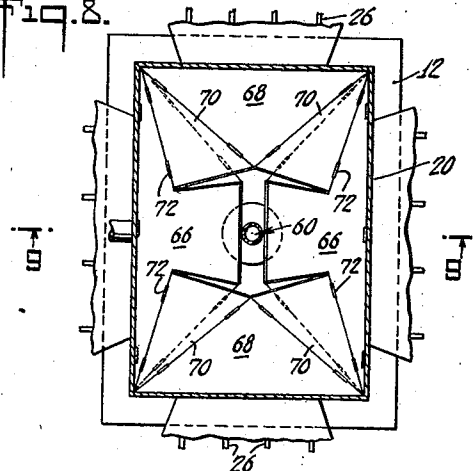


Fig. 9.

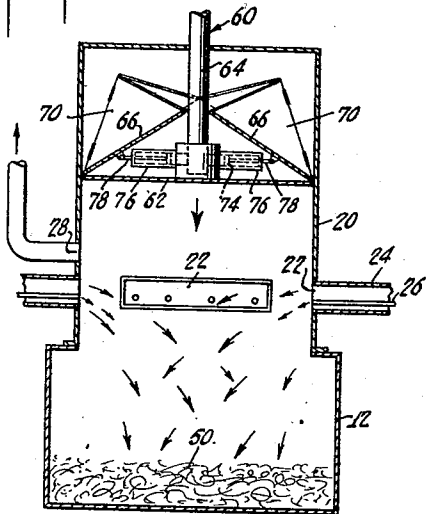


Fig. 10.

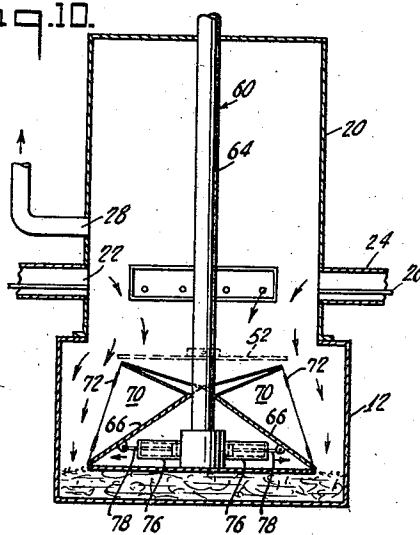


Fig. 11.

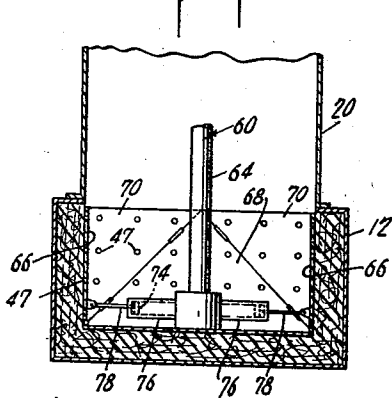
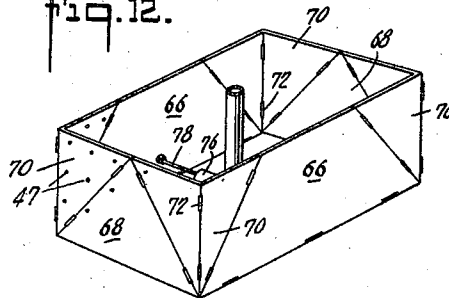


Fig. 12.



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METHOD AND APPARATUS FOR
INSULATING STRUCTURES

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Application April 26, 1941, Serial No. 390,633

16 Claims. (Cl. 226—19)

The present invention relates particularly to the insulating of refrigerator cabinets, and for the purposes of illustration it will be specifically described in this connection. It will be understood, however, that the invention is equally applicable to other similar structures.

Refrigerator cabinets as conventionally made comprise an inner shell or liner defining a food compartment preferably formed as a unitary or one-piece structure, an outer casing or shell, and insulating material filling the spaces between the shells. The liner is supported in a suitable manner in spaced relationship to the outer shell as by blocks upon which the inner shell rests, or by framing members which additionally serve as a skeleton support for the outer shell. Suitably, the inner and outer shells are secured together at the door opening by frame members composed of a substantially non-conducting material.

Heretofore the insulating material has conventionally been provided in preformed slabs or blocks, which are placed against the walls of the outer shell, and the inner shell then inserted. It has also been proposed to insulate such cabinets by pneumatically conveying or blowing a comminuted or loose insulating material, such as nodulated mineral wool, or the like, into the space between the walls of the inner and outer shells.

The principal object of the instant invention is the provision of an improved process and apparatus for insulating cabinets of the type referred to with a loose or nodulated material, in which the insulating material is pneumatically conveyed into and disposed against the walls of the outer shell, and the fibres thereof, deposited in random, heterogeneous arrangement, are rearranged to lie substantially in planes perpendicular to the path of heat flow.

Another object of the invention is the provision of such method and apparatus, permitting accurate control of the density of the installed insulating material.

A further object of the invention is the provision of a procedure which will insure uniformity in density of the insulating lining and which will prevent any appreciable settling of the insulation by vibrations or other movements to which the cabinet may be subjected.

A still further object of the invention is the provision of a method and apparatus which permits of rapid installation of the insulating linings and which is susceptible to mass production methods.

Briefly stated, the instant invention resides in the provision of a method and apparatus whereby a loose, comminuted, granular, or like insulating material including a tacky binder is deposited in the outer shell. A plunger including collapsible walls is lowered into the shell to compress the deposited insulation into a layer covering the rear wall, further insulation is supplied, and the plunger walls are expanded to force the insulation into uniform thickness layers covering the side and end walls of the shell. The plunger is removed and the insulation is retained in the layers of the desired thickness and density by the adhesive. The inner shell or liner is then inserted and secured to the outer shell in any suitable or conventional manner.

My invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the more detailed description thereof which is to follow and to the accompanying drawings, in which:

Fig. 1 is a perspective view of a refrigerator cabinet, or the like, insulated in accordance with the instant invention, with portions of a wall broken away for clearness of illustration;

Fig. 2 is a top plan view of an apparatus in accordance with the invention in position for operation;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2 and illustrating the position of the apparatus for an initial step of the method;

Fig. 4 is a view similar to Fig. 3, illustrating the operation of the apparatus for a further step of the method;

Fig. 5 is a view similar to Fig. 3, illustrating the apparatus at a later point in its operation;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a sectional view through an insulated cabinet, illustrating the installation of the permanent liner;

Fig. 8 is a view similar to Fig. 2, depicting a modified form of the apparatus;

Fig. 9 is a view similar to Fig. 3, illustrating the corresponding step in the method employing the modified apparatus;

Fig. 10 is a view similar to Fig. 4, illustrating a corresponding operation with the modified apparatus;

Fig. 11 is a view similar to Fig. 5, illustrating a corresponding operation with the modified apparatus; and

Fig. 12 is a perspective view of the plunger of the modified form of the apparatus.

Referring now to the drawings, a refrigerator-

tor or similar cabinet insulated in accordance with the invention is indicated generally at 10 in Fig. 1. The cabinet comprises an outer shell 12 and an inner liner or shell 14 secured together in any suitable manner about a door opening 16. Between the outer shell 12 and liner 14 there is disposed insulating material 18, which, in accordance with the instant invention, constitutes a suitable comminuted or granular material, preferably nodulated mineral wool, which is a form of mineral wool made, for example, by melting and fiberizing rock or slag, collecting the fibres in the form of a loose felt, disintegrating the felt, and then tumbling the material, with the result that small pellets or nodules are formed. The nodules may be waterproofed or treated with a binder during their manufacture if desired, it being understood that a high coverage insulation, that is, one which will provide a filling of low density, is most desirable. For example, it has been found that the optimum density of the installed insulation is about 4# per cubic foot. In lieu of nodulated mineral wool, loose mineral wool or other loose or comminuted insulating material, such, for example, as balsam wood, may be used. All of such and similar insulating materials will be described hereinafter by the generic term "loose insulating material."

Between the inner and outer shells of cabinet 10 of Fig. 1 there may be inserted suitable spacing blocks or framing members, or the like, of any conventional type, which have not been illustrated in any of the several views as they form no part of the instant invention and their use will be fully understood by those skilled in the art.

Referring now particularly to Figs. 2 to 7, inclusive, the method and the preferred apparatus for performing the method are depicted. The apparatus comprises a chamber 20 including an open side arranged to register with the door opening of an outer shell 12 placed in position beneath the chamber. The chamber is supported by any suitable means (not shown) to be lowered onto shell 12 and lifted therefrom, and is provided with ports 22 connected to supply ducts 24 which are in communication with an air pump, or the like, and a suitable source of supply of loose insulating material. Preferably, a port 22 is located in each of the four walls of chamber 20 adjacent the open side thereof and is suitably laterally elongated to promote even distribution of the insulating material. One or more exhaust ports 28 are provided in chamber 20 to permit escape of contained air as well as the blowing air entering with the insulation.

Located within and adjacent to the ports 22 are atomizing jets 26 of any suitable conventional type adapted to spray an atomized tacky binder onto the insulating material as it issues from ports 22. A sufficient number of jets 26 may be employed to obtain uniform distribution of the binder on the insulation. The binder may be any suitable or tacky, readily atomized material. For example, it has been found that a composition blended by heating and comprising 10# of spray oil and 0.55# of a high molecular weight hydrocarbon polymer, such as the material sold under the trade-mark "Vistanex #6," is highly suitable for this purpose. A similar blend of spray oil with a low or medium melt-point asphalt or with rubber or a resin may be employed. Also, compositions comprising a low or medium melt-point asphalt and rubber or Vistanex are suitable.

Located within chamber 20 is a plunger 30 including a forward plate 32 of substantially the dimensions of the interior cross section of the insulated cabinet. Plate 32 is carried by a hollow piston rod 34, operated in any suitable manner and by any conventional type of apparatus to permit the plunger to be moved upwardly and downwardly, to and from a position within the shell, as indicated in Figs. 3 and 4. The plunger has a collapsible side and end wall structure comprising segments 36. Each segment is made up of two walls at a right angle to one another and of a height at least equal to the depth of the finished box interior. Each segment 36 thus constitutes a corner and a portion of an adjacent side and end wall of the complete wall structure and slidably overlaps corresponding portions of adjacent segments, as indicated particularly in Fig. 2, whereby the segments may be moved outwardly on diagonal lines to form, when in fully expanded position, side and end walls substantially coincident with the side and end edges of plate 32 (see Figs. 5 and 6). The plunger, when the segments are in full expanded position, forms, in effect, a temporary inner shell or liner for the cabinet.

Movement of the wall-forming segments 36 from collapsed to expanded position and return may be accomplished by any suitable means. A preferred type of construction is shown for this purpose comprising a plurality of cylinders 40 carried by a hollow hub 42 and in communication with the hollow interior of piston rod 34. Slidable in cylinders 40 are pistons 44 carrying rods 46 passing through suitable apertures in the outer ends of the cylinders and connected with segments 36 as by welding, or the like. Two sets of the piston cylinder assemblies 44 may be employed, as indicated in Figs. 3, 4, and 5, at spaced levels to insure stability of the expanded wall structure. The hollow interior of piston rod 34 is in communication with any suitable source of fluid pressure, for example, a hydraulic pump, air pump, or the like. As will be readily understood, the application of fluid pressure to the hollow interior of piston rod 34 will be communicated to pistons 44, which will force the several segments outwardly to expand the plunger wall structure, and likewise, reduction of the pressure within the cylinders to below atmospheric pressure will cause pistons 44 to return, and hence, move the plunger wall structure to collapsed position.

In the operation of the method of the instant invention employing the above described apparatus, chamber 20 is positioned as shown in Fig. 3 and a loose insulating material is pneumatically conveyed or blown in a predetermined amount through ducts 24 and ports 22 to provide a mass of insulation 50 in the bottom of the shell 12, which, when compressed to the required thickness, will have a predetermined density. Coincident with the blowing in of the insulating material, an atomized tacky binder, such as previously referred to, is sprayed onto the insulating material from jets 26. The blowing air, as well as the air originally contained within chamber 20 and shell 12, escapes through port 28.

When the determined amount of insulation is within shell 12, the supplies of insulation and binder are cut off and plunger 30 is moved downwardly (see Fig. 4) to compress the insulating material to the required thickness. The blowing and binder spraying operations are then resumed until sufficient of the insulation material is dis-

tributed between the side and end walls of the shell and the side and end walls of the collapsed plunger to provide insulating layers for the side and end walls of the shell of the predetermined thickness and density. If desired, a shield, such as indicated at 52, may be secured to piston rod 34 to prevent any substantial quantity of the insulating material from entering the interior of the plunger structure during this operation.

The insulation and binder supplies are then again cut off and fluid pressure is applied to pistons 44 to move segments 36 outwardly to fully expanded position to compress the last blown insulating material between the plunger walls and the corresponding walls of shell 12 (see Figs. 5 and 6). Plunger 30 is then preferably collapsed and withdrawn and a permanent liner 14 (see Fig. 7) inserted in its place and secured to the outer shell in any suitable or conventional manner. To prevent any substantial suction being created upon collapse of the plunger walls, which might have a tendency to collapse the insulating layers, such walls may include perforations 47. If desirable, air pressure may be built up within the plunger to force air into the insulating layers and positively preclude suction difficulties, for example, by blowing in air through one or more of ducts 24 and closing off the other ports in chamber 20.

Due to the presence of the tacky binder, sprayed on the insulation as it enters the shell, the insulating material will retain its compressed condition to permit of assembly with the liner 14. Furthermore, when the binder is completely set, it retains the insulation in the form of a substantially integral slab to prevent objectionable settling when the cabinet is subjected to vibrations or jars of any kind, notwithstanding the fact that a relatively low density insulating layer is provided. The compressing of the loose fibre masses against the walls of the cabinet rearranges the greater proportion of the individual fibres from the random, heterogeneous orientations in which they are disposed by the blowing operation to a condition where they are in planes substantially perpendicular to the path of heat flow, i. e., in planes substantially parallel to the cabinet walls. By this arrangement of the fibres, a very substantial increase in heat insulating efficiency is obtained as compared to previous proposals employing loose insulating materials.

The apparatus and operations are readily susceptible to mass production methods. For example, the cabinet shells may be placed on a conveyor and carried beneath the chamber 20, the insulation installed, and movement of the conveyor resumed to carry the insulated shell to the next operation in the assembly of the completed cabinet.

Referring now to Figs. 8 to 12, inclusive, in the modified form of apparatus disclosed, the several operations are similar to those previously described. In this form of the invention, the plunger designated 60 includes a plate member 62, corresponding to plate 32 of the previously described construction, and a preferably hollow piston rod 64. Hingedly secured to plate 62 are side walls 66 and end walls 68. Hingedly secured to these side and end walls are triangular corner pieces 70, adjacent pieces being hingedly connected together as indicated at 72. Corner pieces 70 and side and end walls 66 and 68, respectively, are so proportioned that upon movement of side walls 66 and end walls 68 to a vertical position, the corner pieces provide continuations of said side

and end walls, as shown in Fig. 12, to provide a rectangular box-like structure.

Movement of the walls from inwardly folded or collapsed position to vertical position may be accomplished by means similar to that previously described. Thus, fluid operated pistons 74 are mounted for reciprocation in cylinders 76 in communication with the hollow interior of piston rod 64, which, in turn, is connected to any suitable source of fluid power, such as a hydraulic or air pump. Pistons 74 carry rods 78, which are hingedly connected to walls 66 and 68. In this case, the end walls of cylinders 76 may be slotted or the construction otherwise modified, as will be well understood, to permit some necessary vertical swinging movement of rods 78.

In the operation of the modified form of the apparatus, the plunger is moved from the position shown in Fig. 9 to that shown in Fig. 10 after the insulating material for the bottom layer has been deposited. A predetermined quantity of insulating material is then blown into the spaces between the collapsed side and end walls of the plunger and the shell 12. When the insulating material is in place, fluid pressure is applied to pistons 76 to force the collapsed plunger walls to swing outwardly into the positions shown in Fig. 11. The plunger is then withdrawn and the permanent liner installed as before.

Under certain conditions there may be a tendency for the walls of the collapsible plunger, in either of the forms shown and described, to collect tacky binder from the insulating material and become sufficiently sticky to make it difficult to effect a clean release between the plunger and insulating layers when the plunger is withdrawn. To overcome this difficulty, suitable means may be employed to intermittently apply a lubricant or powdered talc, or the like, to the plunger walls. For example, chamber 20 may include suitable ports, as indicated at 80 in Figs. 3 and 4, to permit the insertion of a nozzle or other device for applying lubricant or talc.

As previously explained, fluid pressure operated means have been illustrated for moving the collapsible walls of the plunger in both forms of the invention, but it will be understood that any suitable mechanical means may be substituted therefor. It will be also understood that although the invention has been described in rather full detail, other changes and modifications will suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What I claim is:

1. The method of installing an insulating lining in a hollow box, comprising conveying loose insulating material within said box, compressing said insulating material to form a layer over the rear wall of said box of a predetermined thickness and density, conveying further insulating material within said box, distributing the last-mentioned insulating material over the side and end walls of said box, and compressing the same to the desired thickness.

2. The method of installing an insulating lining in a hollow box, comprising conveying sufficient loose insulating material into said box to form a compressed layer of a predetermined thickness over the rear wall thereof, inserting a temporary liner including collapsed side and end walls within said box to compress said insulating material into a layer of said predetermined thickness and density between said liner and said rear wall, conveying further insulation

material within said box sufficient to form a layer of a predetermined thickness and density over the side and end walls thereof, moving the side and end walls of said liner from collapsed position into positions parallel to and spaced from the corresponding walls of said box to distribute and compress the insulation thereagainst, and removing said temporary liner.

3. The method of installing an insulating lining in a hollow box, comprising conveying sufficient loose insulating material carrying a tacky binder into said box to form a layer of a predetermined thickness and density over the rear wall thereof, compressing said insulating material to said desired thickness and density, conveying a further quantity of loose insulating material carrying a tacky binder into said box in an amount sufficient to form a layer of a predetermined thickness and density over the side and end walls thereof, and distributing and compressing said last-mentioned insulating material to form layers over said side and end walls of said predetermined thickness and density.

4. The method of installing an insulating lining in a hollow box including an open side, comprising conveying sufficient loose insulating material carrying a finely divided tacky binder into said box to form a layer of a predetermined thickness and density over the rear wall thereof, inserting a temporary liner including collapsed side and end walls within said box through said open side, and compressing said insulating material into a layer of the predetermined thickness and density between the bottom of said liner and said rear wall, conveying further insulating material carrying a tacky adhesive into said box in an amount sufficient to form a layer of a predetermined thickness and density over the side and end walls thereof, moving the side and end walls of said liner from collapsed position into positions to compress said insulating material into layers of desired thickness and density over the walls of the box, and removing said temporary liner.

5. The method of insulating a refrigerator cabinet including an open side, comprising conveying sufficient loose insulating material carrying a finely divided tacky binder into said box to form a layer of a predetermined thickness and density over the rear wall thereof, inserting a temporary liner including collapsed side and end walls within said box through said open side, and compressing said insulating material into a layer of the predetermined thickness and density between the bottom of said liner and said rear wall, conveying further insulating material carrying a tacky adhesive into said box in an amount sufficient to form a layer of a predetermined thickness and density over the side and end walls thereof, moving the side and end walls of said liner from collapsed position into positions to compress said insulating material into layers of desired thickness and density over the walls of the box, removing said temporary liner, and inserting a permanent liner in place thereof.

6. The method of installing an insulating lining in a hollow box, comprising pneumatically conveying a sufficient quantity of loose insulating material carrying dispersed, finely divided particles of a tacky binder into the box to form a layer of a predetermined thickness and density over a wall thereof, inserting a collapsed plunger of a character to be expanded to substantially the dimensions of the interior space defined by the completed insulating lining, compressing the

insulating material within said box to form a layer of said predetermined thickness and density over the rear wall thereof, pneumatically conveying further of said loose insulating material carrying dispersed, finely divided particles of a tacky binder into said box in sufficient quantities to form a layer of a predetermined thickness and density over the side and end walls thereof, bringing said collapsed plunger to expanded condition to compress said further insulating material to form such layers, and removing said plunger.

7. The method of installing an insulating lining in a hollow box, comprising pneumatically conveying a loose insulating material into the box in sufficient quantities to form a layer of a predetermined thickness and density over a wall thereof and simultaneously spraying a finely divided tacky binder thereon, inserting a collapsed plunger of a character to be expanded to substantially the dimensions of the interior space defined by the completed insulating lining, compressing the insulation within the box to form a layer over the rear wall thereof of said predetermined thickness and density, pneumatically conveying further of said loose insulating material into said box in a sufficient quantity to form a layer of a predetermined thickness and density over the side and end walls thereof while simultaneously spraying a finely divided tacky binder on said insulation, bringing said collapsed plunger into fully expanded condition to compress said last-mentioned insulating material into layers of said thickness and density, and removing said plunger.

8. An apparatus for installing an insulating lining in an open-sided, hollow box, comprising a plunger, means for moving the plunger into and removing it from said box through said open side, said plunger including a forward face of substantially the dimensions of the cross section of said box interior including the insulating lining and having side and end walls movable from a retracted position to positions substantially coinciding with the edges of said face, and means in communication with the open side of said box to convey insulating material into said box when said plunger is removed from and is within said box.

9. An apparatus for installing an insulating lining in an open-sided, hollow box, comprising a plunger, means for moving the plunger into and removing it from said box through said open side, said plunger including a forward face of substantially the dimensions of the cross section of said box interior including the insulating lining and side and end walls movable from a retracted position to positions substantially coinciding with the edges of said face, means in communication with the open side of said box to convey insulating material into said box when said plunger is removed from and is within said box, and means for moving the side and end walls of said plunger from retracted to expanded position.

10. An apparatus for installing an insulating lining in an open-sided, hollow box, comprising a plunger, means for moving the plunger into and removing it from said box through said open side, said plunger including a forward face of substantially the dimensions of the cross section of said box interior including the insulating lining and side and end walls movable from a retracted position to positions substantially coinciding with the edges of said face, means in

communication with the open side of said box to convey insulating material into said box when said plunger is removed from and is within said box, and means for spraying an atomized binder on said insulation during its conveyance into said box.

11. An apparatus for installing an insulating lining in an open-sided, hollow box, comprising a plunger, means for moving the plunger into and removing it from said box through said open side, said plunger including a forward face of substantially the dimensions of the cross section of said box interior including the insulating lining and side and end walls movable from a retracted position to positions substantially coinciding with the edges of said face, means in communication with the open side of said box to convey insulating material into said box when said plunger is removed from and is within said box, means for moving the side and end walls of said plunger from retracted to expanded position, and means for spraying an atomized binder on said insulation during its conveyance into said box.

12. An apparatus for installing an insulating lining in an open-sided, hollow box, comprising a plunger, means for moving the plunger into and removing it from said box through said open side, said plunger including a forward face of substantially the dimensions of the cross section of said box interior including the insulating lining and side and end walls movable from a retracted position to positions substantially coinciding with the edges of said face, means in communication with the open side of said box to convey insulating material into said box when said plunger is removed from and is within said box, and fluid operated means for moving said walls from retracted to expanded position.

13. An apparatus for installing an insulating lining in a cabinet, comprising a plunger arranged to be inserted within said cabinet to compress a loose insulating material into layers of a predetermined thickness and density against the walls of said cabinet, said plunger including a forward face member of substantially the cross sectional area of said box interior including the insulating lining, and a collapsible wall structure comprising a plurality of segments each forming a portion of an end and side wall of said plunger and overlapping portions of adjacent segments,

and means for moving said segments from a retracted position to an expanded position substantially in alignment with the outer edges of said face member.

14. An apparatus for installing an insulating lining in a hollow box, comprising a plunger arranged to be inserted within said box to compress a loose insulating material into layers of a predetermined thickness and density against the walls of said box, said plunger including a forward face member of substantially the cross sectional area of said box interior including the insulating lining, and side and end walls hingedly connected thereto adjacent the outer edges thereof, said side and end walls having hingedly connected, folding corner tabs permitting said walls to be folded over substantially onto said face.

15. An apparatus for installing an insulating lining in a hollow box, comprising a plunger arranged to be inserted within said box to compress a loose insulating material into layers of a predetermined thickness and density against the walls of said box, said plunger including a forward face member of substantially the cross sectional area of said box interior including the insulating lining, and side and end walls hingedly connected thereto adjacent the outer edges thereof, said side and end walls including hingedly connected, folding corner tabs permitting said walls to be folded over substantially onto said face, and means to move said side walls from a retracted position to an expanded position.

16. An apparatus for installing an insulating lining in a hollow box, comprising a plunger arranged to be inserted within said box to compress a loose insulating material into layers of a predetermined thickness and density against the walls of said box, said plunger including a forward face member of substantially the cross sectional area of said box interior including the insulating lining, and side and end walls hingedly connected thereto adjacent the outer edges thereof, said side and end walls including hingedly connected, folding corner tabs permitting said walls to be folded over substantially onto said face, and fluid operated means to move said side walls from a retracted position to an expanded position.

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