

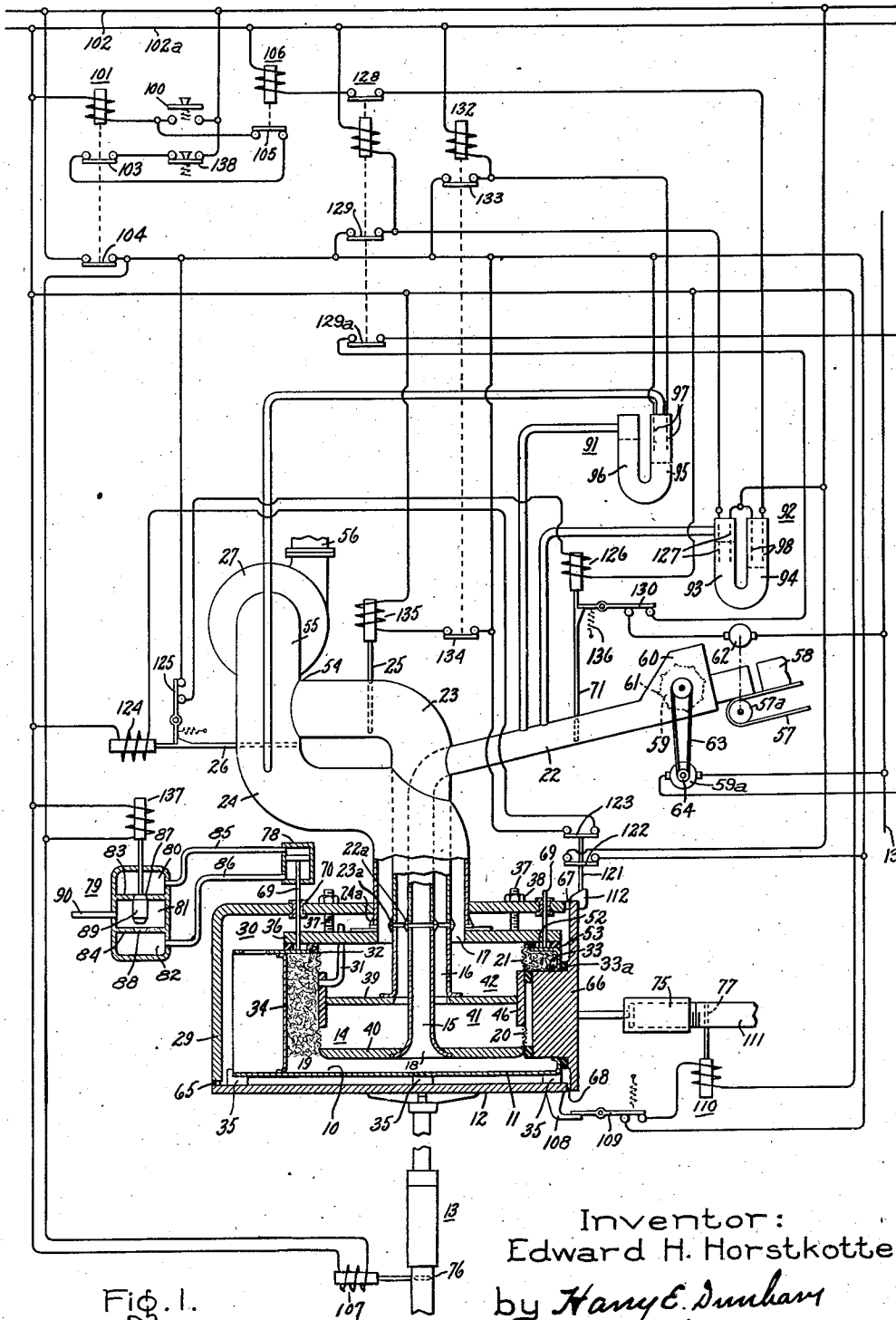
Oct. 14, 1947.

E. H. HORSTKOTTE
REFRIGERATION INSULATION

2,429,059

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 2.

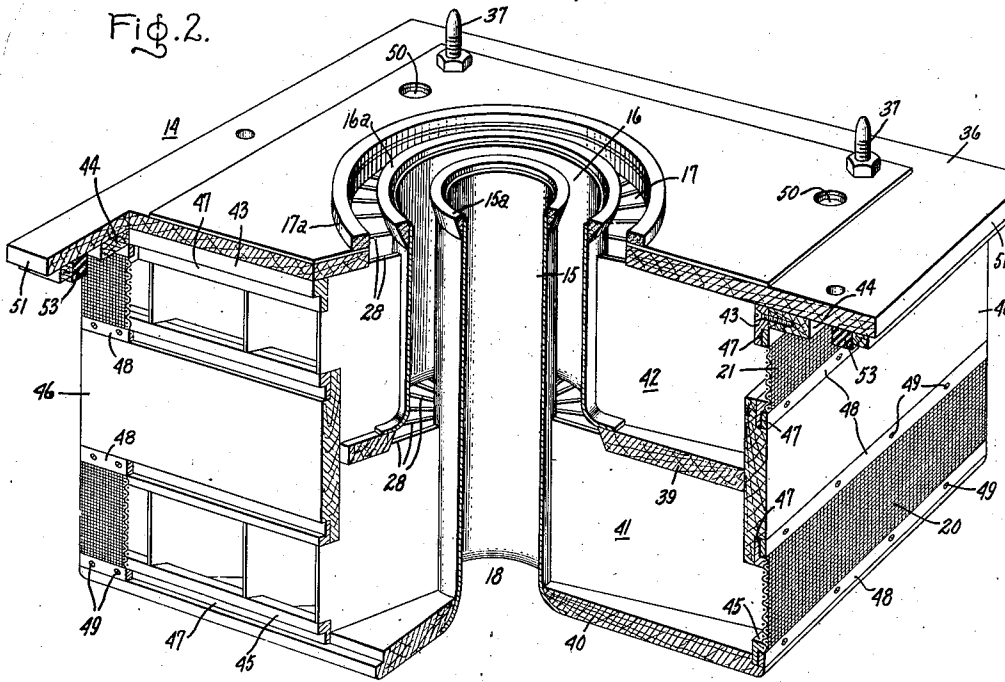


Fig. 3.

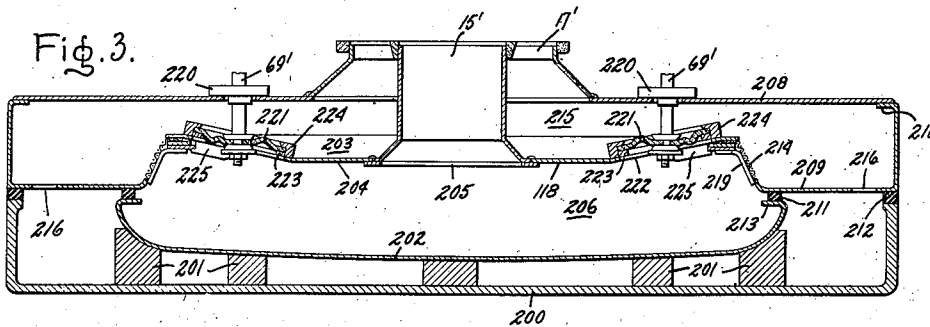
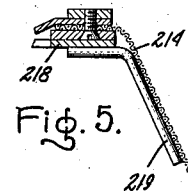
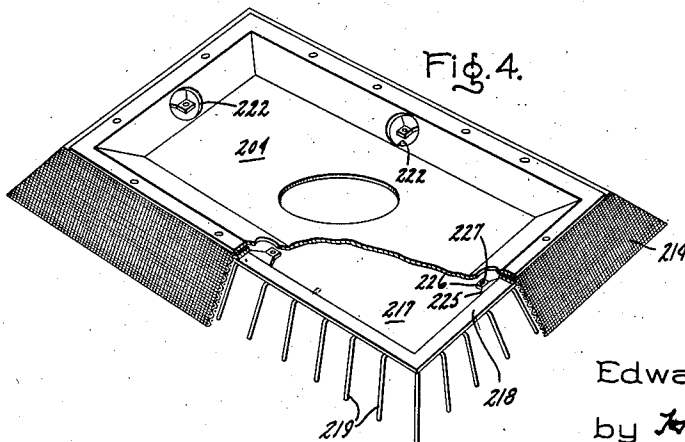


Fig. 4.



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UNITED STATES PATENT OFFICE

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REFRIGERATION INSULATION

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25 Claims. (Cl. 20-101)

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My invention relates to cabinets and more particularly to thermally insulated walls for cabinets, such as cabinets of refrigerators, ranges, and the like.

It has been proposed to use thermal insulating material in relatively loose form, as shredded wood or mineral fibers for example, for thermally insulating cabinets of the above character because of the relative cheapness and relatively high insulating characteristics of such materials. However, difficulty has been encountered in packing the loose materials to the desired density necessary for good thermal insulation and yet preventing settling of the material with the passage of time.

Accordingly, it is an object of my invention to provide a new and improved method for economically and simply applying such thermal insulating materials, in loose form, to thermally insulated cabinets.

Another object of my invention is to provide a new and improved method of applying loose thermal insulation to thermally insulated cabinets in such a way that there will be substantially no settling of the insulation after assembly.

A further object of my invention is to provide new and improved apparatus for accomplishing the above objects which is rugged in construction and economical in operation and construction.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of my invention reference may be had to the accompanying drawing in which Fig. 1 is a schematic diagram illustrating the apparatus and method for filling a cabinet with heat insulation; Fig. 2 is an enlarged perspective view, partly in section, of a dummy liner used in my method of applying thermal insulation to cabinets; Fig. 3 is a side view in section illustrating a dummy liner and support for thermally insulating a cabinet door; and Figs. 4 and 5 are enlarged views of certain details of the apparatus disclosed in Fig. 3.

I have provided a method and apparatus for conducting thermal insulating material in relatively loose form into the space normally defined by the inner and outer walls or casings of a refrigerator or other thermally insulated cabinet at a velocity high enough to felt or pad the material until the space is filled to the required den-

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sity. Referring to Fig. 1, there is shown a refrigerator cabinet 10 with an outer liner or shell 11 but without an inner liner on the platform 12 of an elevating mechanism 13, such as an hydraulic lift for example. The elevating mechanism 13 is vertically movable between the position shown in Fig. 1, in which position the outer liner or wall member 11 of the cabinet 10 fits around a temporary lining means or dummy liner 14, the outer faces of the dummy liner 14 having the contour and fitting in place of the conventional inner liner during the application of thermal insulation to the cabinet 10, and a lower position of suitable height to enable unfilled cabinets to be placed on the platform 12 and filled cabinets to be removed therefrom.

The dummy liner 14 is provided with concentric conduits 15, 16 and 17, the first serving as an inlet passage or conduit for the loose insulating material. The inlet passage 15 extends entirely through the dummy liner 14 and is open at the inner end, as indicated by the numeral 18. The outlet passages or conduits 16 and 17 serve as outlets or exhaust passages for the fluid, preferably air, employed to carry the insulating material into the space 19 to be filled with insulation and communicating with the space 19 between the outer liner 11 and the dummy liner 14 through screens 20 and 21, respectively. The conduits 15, 16 and 17 communicate with an inlet conduit or feed pipe 22 and exhaust conduits 23 and 24, respectively, as shown in Fig. 1. In order to control the flow of insulating material, valves or blast gates 25 and 26 are located in the passages or conduits 23 and 24, respectively, and a valve or blast gate 27 is positioned in feed pipe 22.

In order to create a flow of fluid through the dummy liner 14 and space 19 in order to conduct the insulating material to the space 19, I have provided a suction fan or blower 27, suitably driven as by an electric motor, not shown. It will be seen that the suction created by the suction or exhaust fan 27 will draw thermal insulation into the space 19 through the inlet conduits 15 and 22. The air withdrawn by the exhaust fan or blower 27 passes through screen 20 or screen 21, or both, depending upon the positions of blast gates 25 and 26, and insulation is removed from the air stream by the screen and retained in the space 19.

In order to reduce eddies in the air currents within the space 19 which may cause holes to be formed in the insulation, I have provided radially extending vanes or baffles 28 between outlet

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screens 20 and 21 and the exhaust passages 16 and 17, respectively, as seen in Fig. 2.

In order to prevent deformation of the liner 11 caused by the difference in pressures on the opposite sides of the liner 11 during the filling operation, I have provided an outer shell or casing 29, the interior space 30 of which is connected by means of a conduit 31 to the space 19 in order to permit equalization of the pressures on both sides of the liner 11.

The outer casing or liner 11 of the cabinet 10 is suitably formed before being brought to the insulation applying apparatus. For example, the cabinet 10 illustrated in the drawings is depicted as having the outer wall or casing 11 forming the side walls of a domestic type refrigerator cabinet, a door opening 32 and an opening 33 at the top to permit insertion of the evaporator (not shown) being provided. A partition 34 is arranged in the lower portion of the cabinet 10 and forms a part of the wall dividing the cabinet into a food storage compartment and a machinery compartment. The above-described assembly is conducted to the insulation applying point where the pre-formed cabinet is placed on the platform 12 of the lifting mechanism 13. The cabinet 10 is accurately positioned on the platform 12 by means of a suitable fixture or blocks 35 suitably secured to the upper surface of the lifting platform 12.

The dummy liner 14 is arranged above the platform 12 so that it will be in alignment with the door opening 32 of the cabinet 10. The dummy liner 14 may be supported in any suitable manner. In the arrangement shown, the dummy liner is provided with a top plate 36 and a plurality of threaded studs 37 arranged to be inserted through suitable openings in the outer shell 29 for engagement with fastening members or nuts 38. The shell 29 in turn may be suitably supported in any desired manner. For example, the shell 29 may be supported from the ceiling of the room employed in the insulating operation or to the conduits 15, 16 and 17, as shown in Fig. 1. As best seen in Fig. 2, the dummy liner comprises a top plate 36, an intermediate plate 39 and a bottom plate 40 arranged in spaced-apart relationship with respect to each other. While I have illustrated the use of wood for plates 36, 39 and 40, any desired material may be employed so long as it is substantially impermeable. In this manner there is provided an air passage 41 communicating between screen 20 and conduit 16 and a second air passage 42 communicating between screen 21 and the exhaust conduit 17. In order to retain the screens 20 and 21 in the desired position, I have provided peripherally extending strips 43 and 44 suitably secured together and to the top plate 36, peripherally extending strip 45 suitably secured to the bottom plate 40 and a peripherally extending strip 46 suitably secured to the intermediate plate 39. Each of the strips 43, 45 and 46 is provided with cut-away portions or grooves 47 for reception of the edges of the screens and peripherally extending locking strips 48 which serve to clamp the screen material tightly in position. Suitable fastening members as screws 49, for example, may be employed to maintain the strips 48 in position. The above-described parts of the dummy liner 14 are held together by suitable fastening means as a bolt 50 extending vertically through the assembled liner and nut (not shown). The head of the bolt 50 and nut are preferably ar-

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ranged in such a manner that they do not project beyond the surface of the dummy liner.

It will be observed that the top plate or member 36 extends beyond the side walls of the dummy liner 14, the extended portion 51 being arranged to rest on the front surface 52 of the liner 11 and in order to seal the space between the portion 51 and the front surface 52 I have provided a sealing member or gasket 53.

The radially extending ribs or partition members 28 may be supported in the passages 41 and 42 in any desired manner. For example, two sets of the members 28 may be disposed one set in radially extending slots in the surfaces of the members 36 and 39 defining the air passage 42 and the other set in similar slots in the surfaces of the members 39 and 40 defining the passages 41. An opening 18 is provided approximately centrally of the lower plate 40 of the dummy liner 14 of a size to accommodate the conduit 15. An opening in vertical alignment with the opening 18 is provided in the intermediate plate 39 in alignment with the conduit 16 and an opening aligned with the openings in the lower and intermediate plates is provided in the top plate 36 in alignment with the exhaust conduit 17 and provides communication between the passage 42 and the conduit 24. Thus, the inlet conduit 15 extends entirely through the dummy liner 14, the exhaust conduit 16 extends to the passage 41 and the outlet conduit 17 extends to the passage 42. The conduits 15, 16 and 17 have been illustrated as disposed in a concentric relationship centrally of the dummy liner in order to provide a relatively even distribution of the fluid current throughout the dummy liner and in the space 19 but various dispositions of the inlet and exhaust conduits may be had. The conduits may be secured in spaced-apart relationship in any desired way. Gaskets 15a, 16a and 17a are provided at the upper ends of conduits 15, 16 and 17, respectively, and cooperate with gaskets 22a, 23a and 24a on the lower ends of conduits 22, 23 and 24, respectively, to seal the adjacent edges of the various conduits.

The duct system for conveying thermal insulation to the dummy liner 14 includes the outlet or exhaust conduits 23 and 24 provided with blast gates or valves 25 and 26, respectively, and inlet conduit 22 provided with blast gate or valve 71 in order to control the flow of fluid and entrained insulating material through the apparatus. The conduits 23 and 24 joint as indicated by the numeral 54 to form a main outlet or discharge conduit 55. The exhaust fan or blower 27 is disposed at the end of the conduit 55 and is arranged to provide a suction in the conduit 23 or 24 or both depending upon the positions of the flow controlling members or gates 25 and 26, respectively. The fluid withdrawn by the blower 27 may be exhausted by means of a conduit 56. In the form illustrated, blast gates 25, 26 and 71 are solenoid operated, parts thereof being disposed externally of the conduits 22, 23 and 24, respectively. The blast gates and operators therefor are made fluid-tight at the point of egress from the conduits in any suitable manner. If desired, any type of valve may be employed, but in order to provide automatic control of the apparatus it is preferable that electrically operated valves or blast gates be provided.

In Fig. 1, the major portion of the inlet conduit 22 is inclined upwardly. Where sufficient head room is available, it is preferable to have the conduit 22 substantially vertical in order to

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utilize gravity to keep the conduit clear of insulating material when the apparatus is not being operated. Loose thermal insulating material may be supplied to the inlet conduit 22 in any suitable manner. I have illustrated a conveyor, such as a belt 57, running over rollers 57a for conducting bales 58 of insulating material to an insulation breaker 59 located in the flared out portion 60 of the inlet conduit 22. The insulation breaker 59 may be of any desired type but I have illustrated a cylinder having teeth or knife edges 61 arranged to break up the insulation 58. I have illustrated a motor 62 for imparting motion to the conveyor 57. The insulation breaker 59 may be driven in any suitable manner as by a belt 63 driven from the pulley 64 attached to the shaft of a motor 59a connected to electric supply lines 131.

The liner 11 is customarily formed of comparatively light material and I have found that because of the decrease in pressure on the inner side of the liner 11 during the insulating operation it may be desirable to provide means for preventing the collapse of the liner 11. For this purpose I have provided the shell 29 with a peripherally extending gasket 65 for sealing the space between the shell 29 and the platform 12. In the form of apparatus disclosed in Fig. 1, I have provided an end gate 66 for closing the opening 33 in the top of the cabinet 10, the spaces between the end gate 66 and the shell 29 and also between the end gate and the platform 12 being sealed by gaskets 67 and 68, respectively, and the space between the end gate and opening 33 being sealed by a gasket 33a. Thus a fluid-tight chamber or space 30 is provided exteriorly of the cabinet 10. Communication is provided between the spaces 19 and 30 by means of a conduit 31, thereby permitting equalization of the pressures on both sides of liner 11. It will be observed that the conduits 22, 23 and 24 extend through an opening in a wall of shell 29, the space between the conduit 24 and the shell 29 being rendered fluid-tight in any desired manner.

In order to assist in separating the dummy liner and the insulated cabinet 10 after completion of the insulating operation, I have provided hydraulically operated strippers 69 extending through suitable fluid-tight seals or bushings 70 in the outer shell 29. The lifting platform 12, the end gate 66 and the strippers 69 are, in the illustrated embodiment of my invention, hydraulically operated. Any desired arrangement for moving these elements may be employed. In connection with platform 12 and end gate 66, I have schematically shown hydraulic cylinders 13 and 75, respectively, the flow of hydraulic fluid thereto and therefrom being controlled by valves or gates 76 and 77, respectively, the numerals 76 and 77 being employed in an explanatory manner and not to represent details of apparatus inasmuch as the details of the hydraulic apparatus form no part of the present invention, except that electrically operable apparatus is preferable in order to permit automatic operation of the apparatus. With reference to the push-off rods or strippers 69, I have illustrated an hydraulic push-off cylinder 78 having a piston reciprocable therein and operatively connected in suitable fashion to stripper 69. A control element 79 is provided for controlling the flow of hydraulic fluid to the cylinder 78. The element 79 comprises three chambers 80, 81 and 82 separated by partitions 83 and 84. Communication between chamber 80 and the upper end of cylinder 78 is had through a conduit 85 while communication between cham-

ber 82 and the lower end of cylinder 78 is had through a conduit 86. The partitions 83 and 84 are provided with openings 87 and 88, respectively, forming valve seats for a solenoid-controlled, reciprocable valve element 89. Hydraulic fluid is conducted to the central chamber 81 through a conduit 90. In operation, when the valve element 89 is in the position shown, fluid will flow through opening 88, conduit 86, to the cylinder 78, causing the piston to move upwardly. When the element 89 moves to its lower position, as by gravity or under the action of a spring when solenoid 137 is deenergized, fluid is conducted to the upper side of the piston by way of opening 87, and conduit 85. Thus, the piston will be forced downwardly causing the stripper 69 to press against the front wall of the liner 11, thereby tending to strip the liner 11 from the dummy liner 14. Suitable venting arrangements will be provided in connection with cylinders 75, 78 and mechanism 13. This exemplification is illustrative only and any suitable venting means may be employed for the purpose.

In order to control the sequence of steps in the insulating filling operation, I have provided control equipment which is automatic from the time the apparatus is started until the cabinet has been filled with insulation and lowered away from the dummy liner.

I have provided pressure responsive devices 91 and 92 for initiating the conduction of thermal insulating material to the space 19, for shifting the flow of insulation conducting fluid from conduits 17 and 24 to conduits 16 and 23, respectively, and for halting the operation of the apparatus when space 19 is filled. The devices 91 and 92 are shown in the form of U-tubes, one or both columns of which contain electrical contacts. Both U-tubes contain an electrically conductive liquid. Column 93 of device 92 is in communication with conduit 22 and column 94 thereof is open to atmosphere. Thus, device 92 compares the pressure within conduit 22 with atmospheric pressure and is disposed in the control system in such a manner that insulation cannot be supplied to conduit 22 until the suction pressure, dependent on velocity, in conduit 22 attains a predetermined value thereby insuring supply of insulating material to the conduit 22 only when air is passing through the feed pipe 22 to the filling fixture or dummy liner 14. In this way it is made certain that the feed pipe 22 is substantially unobstructed and free of any plug of insulating material and prevents feeding additional material into the inlet conduit until any accumulated material, as from a previous filling, has been removed. Device 91 is connected up differentially between the feed side and the suction side of the dummy liner, for example, between inlet conduit 22 and outlet conduit 24. Assuming that operation of the apparatus has been initiated with valve 26 open and valve 25 closed insulating material will be drawn into the space 19 adjacent the screen 21. As the material collects, resistance to flow results and as such resistance to flow increases, the differential between pressures likewise increases, the liquid level in column 95 rising and the level in column 96 dropping, until at a predetermined point the liquid level in column 95 becomes sufficiently unbalanced to short circuit contacts 97 and complete a circuit to open blast gate 25 and direct the flow of air through screen 20 as well as screen 21. At this point, resistance to flow is again a minimum, and consequently the velocity of the incoming air with en-

trained insulating material is again a maximum. As the remainder of the space 19 becomes filled, resistance to flow again develops, the velocity in conduit 22 again decreases so that the pressure in conduit 22 again rises toward atmospheric pressure. In order to insure felting of material in space 19 at the opening 18, insulation is permitted to build up in conduit 15, as about six inches, for example. Therefore, the liquid levels in device 92 tend to equalize until when space 19 becomes filled and some material is felted in conduit 15, contacts 98 in column 94 become short circuited by the fluid therein and a circuit is completed to cause cessation of the supply of insulating material to the space 19 and initiate stripping of the insulated cabinet from the dummy liner 14.

It is desirable to shift the area of principal suction before the velocity in feed pipe 22 decreases to a point at which the velocity is insufficient to insure adequate packing or felting of the material to a density sufficiently high to minimize the danger of settling. I have found that when one material comprising substantially individualized wood fibres is used a density of approximately 4 lbs. per cu. ft. is adequate and may be obtained in a cabinet of approximately 4 cu. ft. capacity by conducting the material into the cabinet at an initially high velocity, as with an initial velocity in conduit 15 of the order of approximately 18,000 ft. per minute, for example, and two levels of suction or screens, although any desired number of levels of suction may be employed. The necessary number of screens is best determined by trial. From the above, it will be seen that I have provided an arrangement in which the insulating material is supplied to the space 19 in successive stages at a high initial velocity in each stage.

In order to render the sequence of operations automatic, I have also provided various interlocks and limit switches of suitable construction, the operation of which will be described hereinafter.

While Fig. 1 illustrates the apparatus in the positions assumed by the various control elements when the cabinet is approximately half filled, the following description of the sequence of operation will start from the very beginning.

With the platform 12 in its lowered position a preformed outer casing or liner 11 is placed in the proper position as determined by the blocks 35 with the wall containing the door opening uppermost and the end opening 33 adjacent the end gate 66. The blast gates 25 and 26 and the blast gate 71 in inlet conduit 22 are all in the closed position. It is also assumed that the blower 27 is running. As soon as the start button 100 is pressed, relay 101 is energized from the electric supply lines 102 and 102a. Energization of the relay 101 causes switches 103 and 104 of relay 101 to move to their closed positions. A holding circuit for the relay 101 is completed through switch 103, stop button 138 and normally closed switch 105 of relay 106.

When the relay 101 is picked up, a circuit is also closed to operate the air valve 76 for initiating operation of the lifting mechanism 13. This circuit extends from conductor 102 through switch 104 to solenoid 107, the other side of solenoid 107 being connected to the other line 102a. When solenoid 107 is energized, the gate 76 is opened thereby permitting a flow of fluid to the lifting mechanism 13 for elevating the platform 12. When the platform 12 reaches the limit of its upward movement, an arm 108 secured to the

platform engages the limit switch 109 normally biased to the open position as by a spring. The closure of limit switch 109 completes a circuit for the energization of the solenoid 110 in order to withdraw valve 77 from the air supply conduit 111 to the cylinder 75. Current is supplied to the solenoid winding 110 from the electric supply lines 102 and 102a over a circuit including switch 104 and limit switch 109. When the gate or valve 77 is moved to the open position due to the energization of solenoid 110, hydraulic fluid is supplied to the cylinder 75 for moving the end gate 66 into position to close the opening 33 in the top wall of the cabinet 10 and seal space 30.

End gate 66 is provided with a suitable form of limit switch. In Fig. 1, I have illustrated a cam member 112 suitably secured to the end gate 66 arranged to engage a switch operating member 121 for controlling the position of switches 122 and 123, respectively. When the end gate 66 is in its closed position, a holding circuit is completed for solenoid 107 through switch 122 so that the elevating platform 12 cannot be lowered until the end gate 66 is returned to its open position. Thus, it will be seen that even though relay 101 drops out, thereby opening the circuit through switch 104, solenoid 107 will remain energized as long as switch 122 is closed.

When the end gate 66 is in its closed position, a circuit is completed for energizing solenoid 124 to move the valve or blast gate 26 into its open position thereby permitting air to be withdrawn from the dummy liner 14 through the passage 42 and conduits 17 and 24. The circuit for this operation includes limit switch 123 and switch 104. When blast gate 26 is moved to its open position by operation of the solenoid 124, suction is applied to the upper level of the dummy liner 14. When the blast gate 26 is in the open position, a limit switch 125 is operated to complete a circuit through switch 104 to the solenoid 126 in order to open the damper or valve 71 in the inlet conduit 22.

When blast gate 26 opens, suction is applied to column 93 of device 92 and since the pressure in column 93 is then less than that in column 94 the liquid in device 92 rises in column 93 to complete a circuit across contacts 127 in the column 93. Closure of contacts 127 completes a circuit to the coil of relay 128. A holding circuit for the coil of relay 128 is completed through switch 104 of relay 101 and switch 129 of relay 128.

When the valve 71 is in its wide open position, a limit switch 130 is moved to its circuit closing position in order to start the feed motor 62 to operate the conveyer 57. Any suitable motor, including a motor starter, if desired, may be provided. I have illustrated a simple direct-connected motor 62 energized from supply lines 131 through limit switch 130 and switch 129a of relay 128. With this arrangement it will be seen that it is impossible to start the feed motor 62 until the suction pressure in column 93 of pressure responsive device 92 has attained a predetermined value. This condition can only occur when air is passing through the inlet feed pipe or conduit 22 to the filling fixture or dummy liner 14, that is, when the suction in conduit 22 has attained a value which causes relay 128 to pick up and close switch 129a. This insures that the conduit 15 is free from any plug of insulating material and prevents feeding any additional insulating material into the inlet conduit and feed

pipe 22 until any accumulated material from the previous filling has been removed.

With the above-described arrangement of parts insulating material will be conducted through the inlet conduit 22 and inlet passage 15 into the space 19. Inasmuch as gate 25 is closed at this point there will be little tendency for air to be drawn through the screen 20 but since blast gate 26 is open, the insulation conducting fluid (air, in this case) will be drawn through the space 19, screen 21, passage 42, and conduit 17 into the exhaust conduit 24. Because of the arrangement of radial ribs, the insulating material will be drawn through space 19 in all directions from the opening 18 at the end of the passage 15. Since the pressure responsive device 91 is connected differentially between the feed pipe 22 and the blower side of the dummy liner 14, the level of liquid in the columns 96 and 95 will be indicative of the differential of pressure between the feed pipe 22 and the exhaust conduit 24. When the space 19 is partly filled, it will be seen that the differential pressure in the U-tube 91 becomes unbalanced because the accumulation of insulation tends to reduce the suction in the inlet conduit 22. Therefore, the pressure in inlet conduit 22 and consequently the pressure on the liquid level in column 96 increases in comparison with the pressure in exhaust conduit 24 and column 95. Therefore, the liquid in device 91 will rise in column 95, finally short-circuiting the contacts 97. Upon the closing of the gap between contacts 97 current is supplied to the winding of the relay 132 over a circuit including switch 104 and contacts 97. A holding circuit for relay 132 is completed through switches 133 and 104. Operation of relay 132 closes a switch 134 and current is supplied to the solenoid 135 of the blast gate 25 in order to open the blast gate in the exhaust conduit 23. Under this condition the exhaust air from the space 19 will be drawn through the screen 20 as well as the screen 21 in order to fill the lower portions of space 19 with insulating material.

As the cabinet becomes filled the suction pressure on the feed side of the filling fixture decreases, that is, the pressure in the inlet conduit 22 increases toward atmospheric pressure. The result of this change of pressure is the gradual decrease of the liquid level of column 93 of device 92 and the elevation of the liquid level in column 94. Inasmuch as the opening of the blast gate 25 takes place before the fluid velocity in conduit 22 decreases to a point where insufficient felting of the insulating material occurs and it is desired to continue the supply of insulating material until the material begins to collect in the lower end of the conduit 15, the contacts 98 are set so that the liquid level in arm 94 will not reach the contacts at the velocity existing at the changeover from blast gate 26 to gate 25 and will not short circuit the contacts 98 until the minimum velocity at the end of the complete cycle is reached. Thus, the contacts 98 in column 94 are arranged so that the gap therebetween will be bridged by the liquid in the device 92 when the space 19 is entirely filled with the desired amount of insulating material. When the liquid closes the gap between the contacts 98, current is supplied to the coil of relay 106. Energization of relay 106 opens the normally closed switch 105 thereby breaking the holding circuit of the coil of relay 101 and dropping out the relay 101. When relay 101 drops out holding circuits for the relays 128 and 132 are also

broken. When switch 104 of relay 101 opens solenoid 126 of blast gate 71 is deenergized permitting the gate 71 to move to its closed position. When the blast gate 71 is in its closed position, switch 130 moves to its normally open position under the impetus of spring 136 to deenergize the motor 62 and halt the conveyer 57. The aforementioned parts are so chosen and arranged that the feed motor 62 stops before gate 71 closes in order to prevent an accumulation of excess material in duct 22. Deenergization of relay 101 also deenergizes the winding 110 of the gate or valve 77 thereby permitting the gate 77 to move to its closed position cutting off the supply of air to the cylinder 75 and initiating withdrawal of the end gate 66. When the end gate 66 withdraws a sufficiently great distance to permit opening of the switch 122, solenoid 107 of the valve 76 will be moved to its closed position thereby permitting the platform 12 to move downwardly.

It will be observed that a solenoid 137 associated with the valve device 79 is in parallel with the solenoid 107. When the winding 107 is deenergized as previously described winding 137 will also be deenergized and valve 89 will drop to close opening 88 thereby directing the hydraulic fluid through opening 87 and conduit 85 to cylinder 78 above the piston. It will be seen that at this point the strippers 69 will be pressed downwardly against the cabinet 10 to assist in stripping insulated cabinet 10 from the dummy liner 14. Conversely, when solenoid 107 is energized winding 137 is likewise energized and fluid is delivered to the under side of the piston, whereupon the strippers 69 are withdrawn from engagement with the liner 11.

The above-described control circuit is arranged so that the cycle may be stopped at any point by depressing the normally closed stop button 138 which breaks the holding circuit for the coil of relay 101 with the same effect as previously described upon the energization of relay 106.

In Figs. 3, 4 and 5 there is illustrated a suitable fixture for use in insulating the door of the refrigerator cabinet. I have provided a fixture 200 which may be suitably positioned on the platform 12. On the upper side of the fixture 200 I have arranged a plurality of positioning blocks 201 for accurately locating the outer liner 202 of a refrigerator door. I have provided a dummy inner liner 203 which is designed to be substituted for the dummy liner 14 during the operation of filling the door. Thus, I have provided a centrally located inlet conduit or passage 15' together with an exhaust passage 17' concentrically arranged in spaced-apart relationship with respect to inlet conduit 15'. The inlet conduit, 15' is suitably secured to a sheet 204 of suitable material substantially centrally thereof providing an inlet opening 205 to the space 206 to be filled with insulation. The dummy liner 203 is provided with an outer shell 207 to which the exhaust conduit 17' is suitably secured. The outer shell 207 comprises an upper plate 208 and a lower plate 209, the lower plate 209 having an upwardly and inwardly extending flange 210 suitably secured to the upper plate 208. Peripherally extending gaskets 211 and 212 are provided on the lower plate 209 to seal the space between the lower plate 209 and the flange 213 of the outer door casing 202 and the edge of the fixture 200, respectively. The edges of the dummy liner plate 204 and the lower plate 209 are joined by a peripherally extending screen 214. In operation, the same procedure is followed as described in connection with the

dummy liner 14, the dummy liner 203 being suitably secured for cooperation with the conduits 22, 23 and 24. I have found that only one exhaust conduit is necessary for the proper filling of a door so that the conduit 17 may be made to match the exhaust conduit 24. Therefore, the space 215 will communicate with both exhaust conduits 24 and 23. It will be seen that insulating material will be drawn into the space 206 through the inlet conduit 15, the suction air passing out through the screen 214, chamber 215 and exhaust conduit 17 into conduit 23 or 24 or both. In order to equalize the pressure on both sides of the shell 202, I have provided openings 216 in the lower sheet 209. The door lining apparatus may be constructed for use with the shell 29 of the apparatus shown in Fig. 1 or may be designed as a complete substitution not only for dummy liner 14 but also shell 29.

While the temporary lining means or dummy liner described herein is relatively bulky, it will be understood that the shape and form of the dummy liner is dependent upon the shape and form of the object to be filled. For instance, the temporary lining means or wall member may be a plate. The expressions "dummy liner," "temporary lining means" and the like, are intended to be applied to any structure used during the filling operation to complete the defining of any space to be filled. The inlet and outlet passages associated with the space may or may not be incorporated as part of the dummy or temporary liner, as the aforesaid inlet and outlet may be provided through one of the permanent wall members, for example.

When a refrigerator door of the so-called "safe" type is insulated in this manner it will be clear that a substantial amount of unsupported insulating material extends above the flange 213 of the shell 202 and when the fixture 202 with the insulated door is separated from the temporary lining means 203, there is a tendency for the insulation to break at the unsupported corners. In order to maintain the corners in an unbroken form, I have provided a stripping device 217 as best seen in Figs. 4 and 5. The stripper 217 comprises a frame 218 having a plurality of downwardly extending fingers 219. The frame 218 has the same dimensions as the outer edge of the inner door shell and the fingers 219 are adapted to extend around the above-mentioned unsupported corners. When the insulated shell 202 is to be removed from the liner 203 I employ strippers 69' to exert a pressure against the stripper 217, the fingers 219 engaging the insulation at spaced-apart points and protecting the same during the stripping operation. As shown in Fig. 3, the strippers 69' extend through suitable bushings 220 and a flexible diaphragm 221 as leather, for example, is suitably secured to the lower end thereof. The outer edges of the diaphragm 221 are suitably secured in openings 222 in the plate 204 as by oppositely disposed rings 223 and 224 suitably secured to plate 204. The frame 218 is provided with downwardly extending brackets 225 terminating in lugs 226 having suitable openings 227 therethrough for the reception of the threaded end of strippers 69'. Thus, it will be seen that when the strippers 69' are depressed, the diaphragm 221 is moved downwardly together with the bracket 225 and frame 218.

Modifications of the above apparatus and method will occur to those skilled in the art. For example, while I have illustrated apparatus

for filling a refrigerator cabinet of the type having a door opening in a side wall and an opening in the top wall to permit the insertion of an evaporator, the principles of my invention are equally applicable to an arrangement into which the evaporator is inserted through an opening in the rear wall of the cabinet or through the door opening. Thus, if the evaporator is to be inserted from the rear it would be possible to conduct the material into the cabinet through the evaporator opening and draw the air out through the space between the inner and outer liners or shells of the cabinet around the door opening in which arrangement the dummy liner could be omitted. Furthermore, as many levels of screened outlets or vents as needed may be employed in connection with the dummy liner 14 although I have found two to be satisfactory. Further, the temporary lining means may take the place of the outer liner or shell of the refrigerator cabinet instead of the inner shell. The method herein described is applicable even though no dummy liner is used. Thus, for example, if the evaporator is to be inserted through the food compartment door opening, the cabinet may be completely assembled except for the insulating material and breaker strips following which the insulating material may be conducted into a space between two permanently disposed spaced-apart wall members as by conducting the material into the cabinet at one portion of the space and withdrawing the air at another portion thereof. The breaker strips may then be secured in place.

If desired, air may be blown into the space to be filled, or a combination of blowing and suction may be employed instead of suction, alone. The necessary changes, in such a case, will be obvious to those skilled in the art. For example, if blowing is to be utilized, a fan or blower can be placed at the outer end of duct 22, insulating material being fed to the feed pipe at a point intermediate the blower and the cabinet to be filled. The pressure responsive device 92 will be moved so as to compare the pressure in conduit 24 on the exhaust side of gate 26 with atmosphere and the circuits re-arranged to provide a sequence in which, following closure of end gate 66, blast gate 71 would be opened to blow air into the apparatus. The next operation would be to open valve 26. As soon as the pressure in conduit 24 builds up to a sufficient degree, the device 92 would be effective to energize the motor 62 for feeding insulating material to the feed pipe. It will be understood that the wiring for switches 130 and 125 will be interchanged so that operation of gate 71 will energize solenoid 124 and opening of gate 26 will condition the circuit for the energization of motor 62 upon closing of switch 129a.

While I have shown a particular embodiment of my invention, I do not desire my invention to be limited to the particular construction shown and described and I intend in the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, apparatus for conducting relatively loose, fibrous thermal insulating material into a cabinet of the type having inner and outer walls with thermal insulation disposed therebetween, temporary lining means arranged to be substituted for one of said walls while filling said cabinet with insulation, means for conducting said insulating material to said first-men-

tioned means, and means dependent upon the conduction of a predetermined amount of insulating material to said first-mentioned means for controlling the further conduction of said insulating material to said first-mentioned means.

2. In combination, apparatus for conducting relatively loose, fibrous thermal insulating material into a cabinet of the type having inner and outer walls with thermal insulation disposed therebetween, temporary lining means arranged to be substituted for one of said walls during the process of conducting insulation into the cabinet and cooperating with the other of said walls for defining a space to be filled with insulation, said temporary lining means having an inlet conduit and an outlet conduit associated therewith, means for introducing a fluid and entrained insulation into said inlet conduit and flow controlling means dependent upon the conduction of a predetermined amount of insulating material to said space for controlling the further conduction of insulating material thereto.

3. In combination, apparatus for conducting insulation into a cabinet of the type having inner and outer metallic liners with thermal insulation disposed therebetween, a dummy liner constructed and arranged to be substituted for one of said liners while said insulation is being conducted into said cabinet, the side walls of said dummy liner being provided with a peripherally extending opening, said dummy liner being provided with a substantially vertical passage therethrough, said passage being disposed inwardly from said side walls, a pair of concentric conduits extending into said vertical passage, the innermost of said concentric conduits extending through said dummy liner and serving as an inlet for said material conducting fluid and said insulating material, said dummy liner being provided with a passage communicating between said peripherally extending opening and the other of said concentric conduits, said other conduit serving as an outlet for the fluid, and means for preventing the passage of said insulating material through said peripherally extending opening.

4. In combination, apparatus for conducting insulation into a cabinet of the type having inner and outer metallic liners with thermal insulation disposed therebetween, a dummy liner arranged to be substituted for one of said liners while said insulation is being conducted into said cabinet, the walls of said dummy liner being provided with a peripherally extending opening, screen means closing said opening in said side walls, said dummy liner also being provided with a substantially vertical passage therethrough, said passage being spaced inwardly from said side walls, a pair of concentric conduits extending into said vertical passage, the innermost of said concentric conduits extending through said dummy liner and serving as an inlet for said insulating material and material conducting fluid, said dummy liner being provided with a passage communicating between said opening and the second concentric conduit, said second concentric conduit serving as an outlet for the fluid and the insulating material so entrained, said screen means causing said insulating material to be retained in said space.

5. In combination, apparatus for conducting thermal insulation into a cabinet of the type having inner and outer metallic liners with thermal insulation disposed in the space therebetween, temporary lining means arranged to be substituted for one of said liners during the operation

of filling said space with said insulation, said means being provided with an inlet conduit, said conduit communicating with an opening in a wall of said means, and insulation distributing members associated with said conduit and extending in a direction to cause said insulation to be conducted to all parts of said space between said temporary lining means and the other of said liners for substantially evenly distributing said insulation to all parts of said space.

6. In combination, apparatus for conducting thermal insulation into a portion of a cabinet of the type having inner and outer metallic liners with thermal insulation disposed therebetween, a dummy liner arranged to be substituted for one of said liners while insulation is being conducted to said cabinet, said dummy liner being provided with an inlet opening and also an outlet opening located substantially centrally of said dummy liner, means providing a passage between said inlet opening and said portion to be filled, conduits communicating with said inlet and outlet openings, respectively, means for conducting insulation to said inlet conduit and to said dummy liner, and insulation distributing means disposed in said passage, said distributing means comprising a plurality of spaced-apart members dividing said passage into sub-passages extending radially from said outlet conduit.

7. In combination, apparatus for conducting thermal insulation into a cabinet of the type having inner and outer metallic liners with thermal insulation disposed therebetween, a dummy liner constructed and arranged to be substituted for one of said liners while conducting insulation into the cabinet, said dummy liner being provided with an inlet conduit and an outlet conduit, means for conducting said insulation into said dummy liner through said inlet conduit, each of said conduits communicating with an opening in wall of said dummy liner, and radially extending vanes associated with one of said openings for obtaining a substantially uniform distribution of said thermal insulating material throughout said space.

8. In combination, apparatus for conducting thermal insulation into a cabinet, temporary lining means, said means having a supply conduit for conducting a fluid and entrained heat-insulating material to said means, a plurality of exhaust conduits for conducting said fluid away from said means, and means dependent upon the conduction of the predetermined amount of insulating material to said lining means for selectively controlling the flow of said fluid through one or more of said exhaust conduits.

9. In combination, apparatus for conducting thermal insulation into a cabinet of the type having permanent inner and outer metallic liners with thermal insulation disposed therebetween, a dummy liner adapted to be placed in said cabinet in the position to be occupied by said permanent inner liner in the final assembly of said cabinet, the walls of said dummy liner presented to the inner surface of said outer liner having the same contour as said permanent inner liner, the side walls of said dummy liner being provided with a peripherally extending opening, a screen closing said opening and being disposed in the plane of said side walls, said dummy liner being provided with a substantially vertical passage therethrough, said passage being spaced inwardly from said side walls, a pair of concentric conduits extending into said vertical passage, the innermost of said concentric conduits extend-

ing through said dummy liner and serving as an inlet for said insulating material and material conducting fluid, said dummy liner being provided with a passage communicating between said opening and the second concentric conduit, radially disposed members in said passage for distributing the flow of fluid and entrained insulating material to all portions of the space between said dummy liner and said outer liner in order to prevent formation of holes in said insulation, said second concentric conduit serving as an outlet for the fluid in which said insulating material was entrained, said screen causing said insulating material to be retained in said space.

10. In combination, apparatus for projecting thermal insulation into a cabinet of the type having permanent inner and outer metallic liners with thermal insulation disposed therebetween, a dummy liner adapted to be placed in said cabinet in the position to be occupied by said permanent inner liner in the final assembly of said cabinet, the walls of said dummy liner presented to the inner surface of said outer liner having the same contour as said permanent inner liner, the side walls of said dummy liner being provided with a plurality of openings extending around the periphery of said dummy liner, screens closing said openings and being disposed in the plane of said side walls, said dummy liner being provided with a substantially vertical passage there-through, said passage being spaced inwardly from said side walls, a plurality of concentric conduits extending into said vertical passage, the innermost of said conduits extending through said dummy liner and serving as an inlet for said insulating material and material conducting fluid, said dummy liner being provided with a plurality of passages, each of which communicates between one of said openings and one of the remaining conduits, radially disposed members in said passages for distributing the flow of fluid and entrained insulating material to all portions of the space between said dummy liner and said outer liner in order to prevent formation of holes in said insulation, said remaining conduits serving as outlets for the fluid in which said insulating material was entrained, and means in each of said remaining conduits for controlling the flow of fluid and insulating material through said dummy liner.

11. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed therebetween, said apparatus having an inlet opening and an outlet opening associated with the space between said walls and having a feed conduit for conveying insulating material to said inlet opening, means associated with one of said openings for establishing a flow of fluid to said space through said conduit, flow controlling means associated with said inlet opening, and control means responsive to the velocity of flow of fluid to permit said insulating material to be conducted to said space only when said flow establishing means is in operation.

12. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed therebetween, an inlet conduit and an outlet conduit associated with the space between said walls, means associated with one of said conduits for establishing a flow of fluid to said space, flow controlling means associated with said inlet con-

duit, and control means responsive to the velocity of flow of fluid in said inlet conduit for operating said flow controlling means to permit said insulating material to be conducted to said space only when the velocity of the flow of fluid established by said flow establishing means has attained a predetermined value.

13. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed therebetween, an inlet conduit and an outlet conduit associated with the space between said walls, means associated with said outlet conduit for establishing a flow of fluid to said space, a first flow controlling means associated with said inlet conduit, a second flow controlling means associated with said outlet conduit, said control means being responsive to the velocity of the fluid flowing in said inlet conduit for operating said flow controlling means such being responsive to the velocity of fluid flow in said inlet conduit for operating said first flow controlling means in such a way that said first means is moved to a position for permitting said insulating material to be conducted to said space only when said flow establishing means has established a predetermined velocity of fluid flow in said inlet conduit and said outlet conduit is substantially unobstructed.

14. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed therebetween, an inlet conduit associated with the space between said walls, a first outlet conduit associated with one portion of said space, a second outlet conduit associated with another portion of said space, means for establishing a flow of insulation conducting fluid to said space, a first flow controlling means associated with said first outlet conduit, a second flow controlling means associated with said second outlet conduit and a third flow controlling means associated with said inlet conduit, means dependent upon the establishment of a predetermined velocity of fluid in said inlet conduit for moving said first and said third flow controlling means into positions for permitting the conduction of insulating material to said space only when said flow establishing means has created said predetermined velocity of fluid flow, and means dependent upon the accumulation of a predetermined amount of insulating material in said space for opening said second flow controlling means in order to permit the conduction of insulating material to said another portion of said space.

15. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed therebetween, an inlet conduit associated with the space between said walls, a first outlet conduit associated with one portion of said space, a second outlet conduit associated with another portion of said space, means for establishing a flow of insulation conducting fluid to said space, a first flow controlling means associated with said first outlet conduit, a second flow controlling means associated with said second outlet conduit and a third flow controlling means associated with said inlet conduit, said flow controlling means being so arranged and constructed that said third flow controlling means does permit the conduction of insulating material to said space

only when said first flow controlling means is in a position to permit fluid flow through said first outlet conduit, said means including a pressure responsive element responsive to the pressure in said inlet conduit, and pressure responsive means responsive to the differential pressure between said inlet conduit and said first outlet conduit for opening said second flow controlling means upon the accumulation of a predetermined amount of insulating material in said space in order to permit the conduction of insulating material to said another portion of said space.

16. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed therebetween, an inlet conduit associated with the space between said walls, a first outlet conduit associated with one portion of said space, a second outlet conduit associated with another portion of said space, means for establishing a flow of insulation-conducting fluid to said space, a first flow controlling means associated with said first outlet conduit, a second flow controlling means associated with said second outlet conduit and a third flow controlling means associated with said inlet conduit, said flow controlling means being so arranged and constructed that said first and said third flow controlling means permits the conduction of insulating material to said space only when a predetermined velocity of said fluid has been attained, means for opening said second flow controlling means upon the accumulation of a predetermined amount of insulating material in said space in order to permit the conduction of insulating material to said another portion of said space, and means responsive to a predetermined decrease of pressure in said inlet conduit for stopping the supply of insulating material to said space when said space is filled.

17. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed therebetween, an inlet conduit associated with the space between said walls, a first outlet conduit associated with one portion of said space, a second outlet conduit associated with another portion of said space, means for establishing a flow of insulation conducting fluid to said space, a first flow controlling means associated with said first outlet conduit, a second flow controlling means associated with said second outlet conduit and a third flow controlling means associated with said inlet conduit, said flow controlling means being so arranged and constructed that said third flow controlling means permits the conduction of insulating material to said space only when a predetermined velocity of fluid flow has been established, said means including a pressure responsive element responsive to the pressure in said inlet conduit, and pressure responsive means responsive to the differential pressure between said inlet conduit and said first outlet conduit for opening said second flow controlling means upon the accumulation of a predetermined amount of insulating material in said space in order to permit the conduction of insulating material to said another portion of said space, said differential pressure responsive means also being operative to cut off the flow of fluid to said space when said space is filled with said insulating material.

18. The method of constructing a thermally insulated cabinet of the type having spaced-

apart walls with thermal insulation therebetween, comprising the steps of arranging wall members in spaced-apart relationship, conducting a fluid and entrained relatively loose fibrous thermal insulating material into different portions of the space between said members in successive stages at predetermined relatively high initial velocities, the change from one stage to the next being made when the velocity in the one stage falls to a predetermined minimum value, said minimum velocity in each stage being sufficiently high to felt the fibers to a predetermined density, said initial and minimum velocities for each space being selected to effect substantial filling of each portion of the space before change to a subsequent stage.

19. The method of constructing a thermally insulated cabinet of the type having spaced-apart walls with thermal insulation therebetween, comprising the steps of providing wall members, spacing said members to provide an air path therebetween, conducting relatively loose fibrous thermal insulating material into one portion of said space at an initially high velocity, the velocity decreasing as said one portion is filled, and, when the velocity of the material supplied to said one portion decreases to a predetermined value, conducting said material into another portion of said space, the initial velocity of the flow to said other portion being approximately the same as the aforesaid initial velocity, and continuing the flow of material to said other portion until the filling of said other portion causes a decrease of the velocity to a predetermined value.

20. In combination, apparatus for conducting relatively loose, fibrous thermal insulating material into a cabinet of the type having inner and outer walls with thermal insulation disposed therebetween, temporary lining means arranged to be substituted for one of said walls while filling said cabinet with insulation, means for conducting said insulation material to said first-mentioned means, and means associated with said temporary lining means for maintaining the insulating material in place during the separation between said temporary means and the other of said walls after the filling operation, said means being constructed and arranged to be maintained in engagement with said insulating material during said withdrawal.

21. In combination, apparatus for conducting relatively loose, fibrous thermal insulating material into a cabinet of the type having inner and outer walls with thermal insulation disposed therebetween, temporary lining means arranged to be substituted for one of said walls while filling said cabinet with insulation, means for conducting said insulation material to said first-mentioned means, and means carried by and movable with respect to said temporary lining means for maintaining the thermal insulation in place when said temporary means is withdrawn after the filling operation.

22. In combination, apparatus for conducting relatively loose, fibrous thermal insulating material into a cabinet of the type having inner and outer walls with thermal insulation disposed therebetween, temporary lining means arranged to be substituted for one of said walls while filling said cabinet with insulation, means for conducting said insulation material to said first-mentioned means, means comprising a frame carried by and movable with respect to said temporary means, and insulation engaging means extending from said frame for maintaining the

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insulating material in place as the temporary means is withdrawn on completion of the filling operation.

23. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed therebetween, said apparatus having an inlet opening and an outlet opening associated with the space between said walls and having a feed conduit communicating with said inlet opening for conveying insulating material to said space, means associated with one of said openings for establishing a flow of fluid through said conduit to said space, flow controlling means associated with said inlet opening, and control means responsive to the pressure at said outlet opening to permit said insulating material to be conducted to said space only when said flow establishing means is in operation.

24. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed therebetween, an inlet conduit and an outlet conduit associated with the space between said walls, means associated with one of said conduits for establishing a flow of fluid to said space, flow controlling means associated with said inlet conduit, and control means responsive to the pressure in said inlet conduit for operating said flow control means to permit said insulating material to be conducted to said space only when the velocity of the flow of fluid established by said flow establishing means has attained a predetermined value.

25. In combination, apparatus for conducting relatively loose fibrous insulating material into a cabinet of the type having inner and outer metallic walls with thermal insulation disposed

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therebetween, an inlet conduit associated with the space between said walls, a first outlet conduit associated with one portion of said space, a second outlet conduit associated with another portion of said space, means for establishing a flow of insulation conducting fluid to said space, a first flow controlling means associated with said first outlet conduit, a second flow controlling means associated with said second outlet conduit, and a third flow controlling means associated with said inlet conduit, and control means responsive to a predetermined difference in pressure existing between said inlet and said first outlet conduits for operating said second flow controlling means to permit the conduction of insulating material to another portion of said space.

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