March 27, 1951 W. J. KROPP 2,546,266

APPARATUS FOR MAKING INSULATION BATTS AND BOARDS

Filed Oct. 20, 1948 3 Sheets-Sheet 1

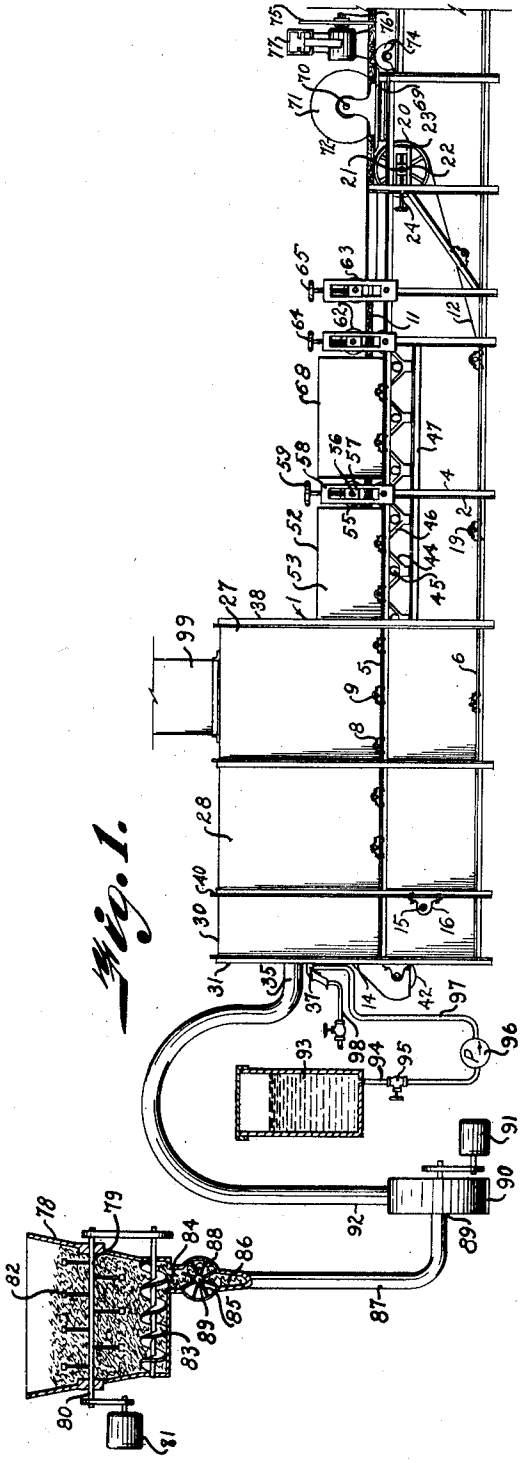


Fig. 1.

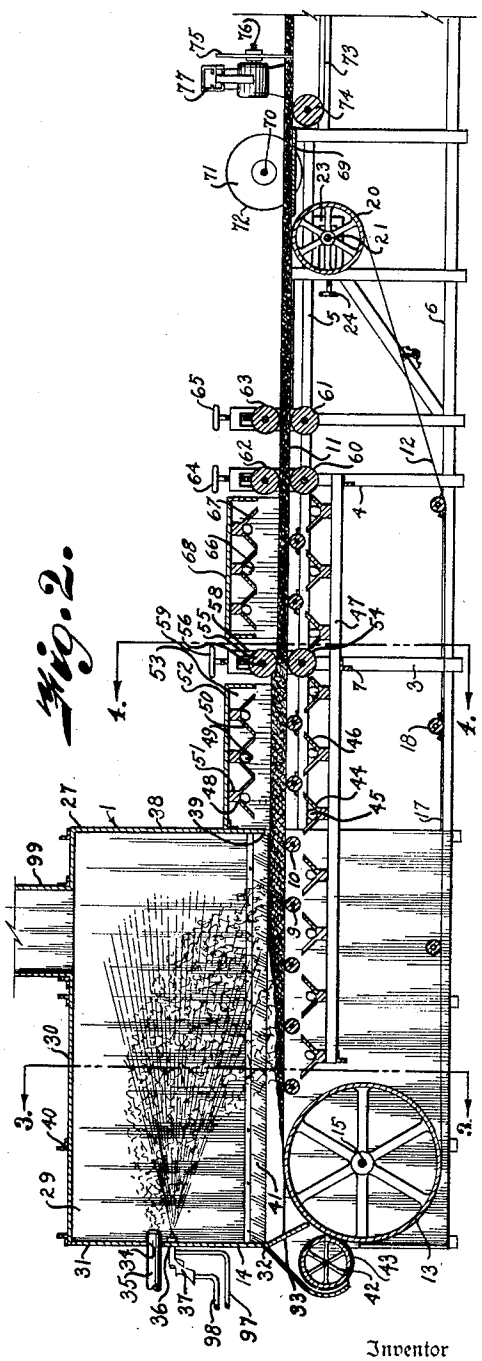


Fig. 2.

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March 27, 1951 W. J. KROPP 2,546,266

APPARATUS FOR MAKING INSULATION BATTS AND BOARDS

Filed Oct. 20, 1948 3 Sheets-Sheet 2

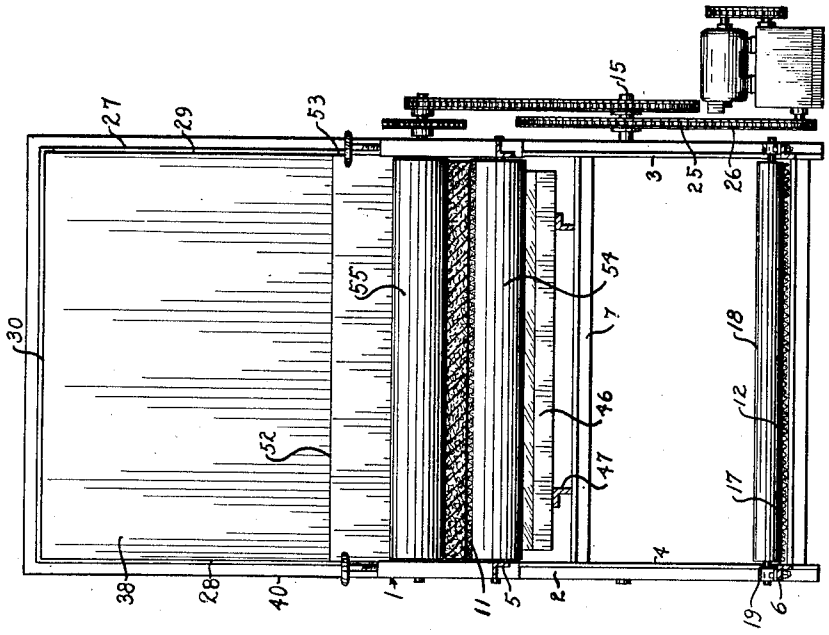



Fig. 1

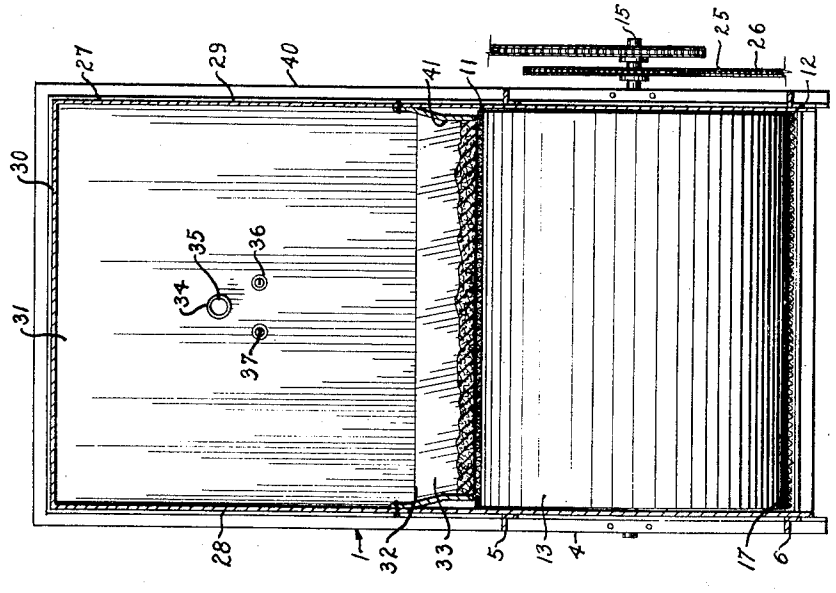



Fig. 3.

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APPARATUS FOR MAKING INSULATION BATTS AND BOARDS

Filed Oct. 20, 1948 3 Sheets-Sheet 3

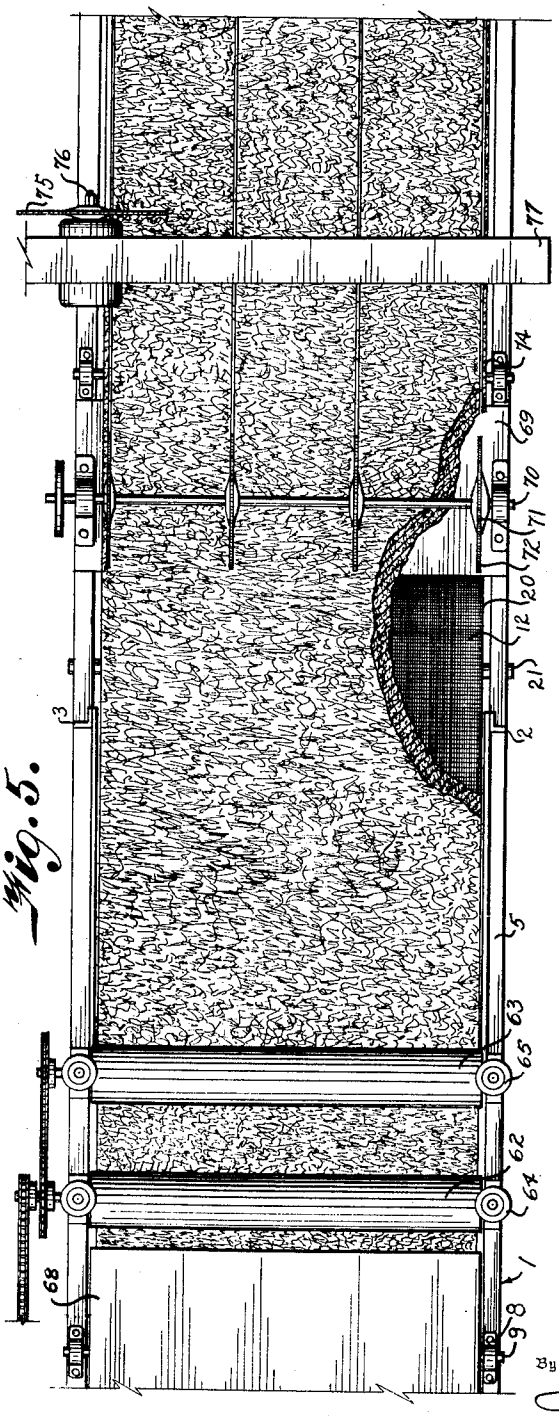



Fig. 5.

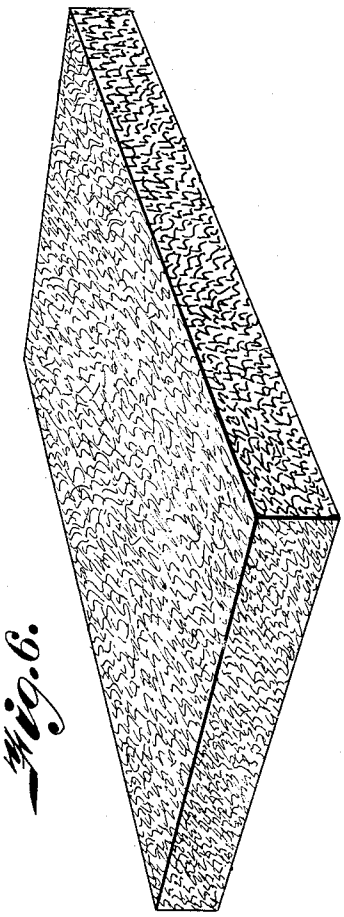


Fig. 6.

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# UNITED STATES PATENT OFFICE

2,546,266

## APPARATUS FOR MAKING INSULATION BATTS AND BOARDS

William J. Kropp, Wichita, Kans.

Application October 20, 1948, Serial No. 55,632

1 Claim. (Cl. 154—27)

1

This invention relates to apparatus for making insulation batts and boards, and more particularly to apparatus for forming such insulation from shredded paper, cardboard and like fibers, and has for its principal object to provide apparatus for air laying adhesive sprayed fibers in a web, partially drying the adhesive and compacting the fibers into a heterogeneous interlocked fiber batt or blanket of desired density and thickness.

Other objects of the invention are to provide apparatus for blowing fibers into a confined space for gravitational deposit on a carrier and spraying the fibers with adhesive while in the air above said carrier; to provide a foraminous carrier on which said fibers are deposited in a loose, fluffy, random arrangement of heterogeneous interlocked, fuzzy, fiber units; to provide for treating the carrier whereby the adhesive of the fibers will not adhere thereto; to provide heating devices adjacent the carrier for progressively drying the adhesive on the fiber units, said heat being directed onto the web for penetration into the mass of fibers on the carrier to reduce the moisture content at the center of said mass; to provide adjustable compression members for compacting the mass of fibers on the carrier into a web of desired thickness after the adhesive is partially dried; to provide apparatus for cutting the insulation web into sections of desired size; and to provide an efficient, insulation batt or blanket or board forming apparatus adapted to accurately control the density and thickness of said insulation product, the adherence and interlocking arrangement of the fibers preventing segregation or layer separation thereof.

In accomplishing these and other objects of the present invention, I have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevation of a machine for forming and cutting a web of insulation, the fiber and adhesive delivery mechanism being shown diagrammatically in relation to said machine.

Fig. 2 is a longitudinal sectional view through the insulation forming machine.

Fig. 3 is a transverse sectional view through the insulation forming machine on the line 3—3, Fig. 2.

Fig. 4 is a transverse sectional view through the insulation forming machine on the line 4—4, Fig. 2.

Fig. 5 is a plan view of the web compacting and cutting portion of the machine.

2

Fig. 6 is a perspective view of an insulation batt, blanket or board formed in said machine.

Referring more in detail to the drawings:

1 designates an insulation batt forming machine consisting of laterally spaced, longitudinal frames 2 and 3 having a plurality of spaced vertical members 4 and horizontal upper and lower rails 5 and 6. Each of the side frames is suitably braced to form a substantially rigid structure and are connected by transverse members 7 to form a rigid structure capable of supporting the operating parts of the machine. Suitably mounted and longitudinally spaced on the upper rails 5 and bearings 8, the bearings on one frame being in axial alignment with the bearing on the opposite frame whereby the aligned bearings rotatably mount shafts 9 carrying rolls 10, the upper periphery of which are all located in a horizontal plane for supporting the upper run 11 of a foraminous carrier 12 of wire cloth or the like of suitable width to substantially span the space between the frames 2 and 3, the width of said carrier preferably being slightly greater than the width of the web of insulation material to be formed.

A large terminal roll 13 is arranged within the confines of the frames and adjacent the feed end 14 of the machine and is carried on a shaft 15 rotatably supported in bearings 16 suitably mounted in axial alignment on the respective frame members, the roll 13 preferably being of such size that its upper periphery lies in the horizontal plane defined by the upper periphery of the rolls 10. The carrier 12 passes over the roll 13 and the lower run 17 of said carrier passed under spaced rolls 18 rotatably mounted in bearings 19 carried by the lower rails 6 of the respective frames 2 and 3. The other or discharge end of said machines is provided with a roll 20 having a shaft 21 rotatably mounted in horizontal axially aligned bearings 22 slidably mounted in guides 23 for horizontal movement longitudinally of the machine under control of adjusting screws 24 whereby the roll 20 may be moved to suitably tighten the foraminous carrier 12, the upper periphery of the roll 20 preferably being in the same horizontal plane as is defined by the upper peripheries of the roll 10.

Either of the terminal rolls 13 and 20 may be suitably driven so as to propel the carrier; however, it is preferred to drive the roll 13 by means of a sprocket 25 carried on the shaft 15 and connected by a chain 26 with a suitable source of power. The drive of the roll 13 may be by any suitable means but is preferably posi-

tive in nature whereby the movement of the carrier may be synchronized with fiber feeding equipment as later described.

A housing 27 is arranged over the carrier at the feed end thereof, said housing consisting of side walls 28 and 29 preferably extending upwardly from the lower rail 6 adjacent the ends of the rolls 13 and 10 to a point considerably above the carrier, the upper edges of the side walls being connected by a top wall 30, the feed end of said housing being provided with an end wall 31 connected to the side walls 28 and 29 and the top wall 30, said end wall preferably being arranged whereby the roll 13 is wholly under the housing 27. The lower end of the end wall 31 terminates as at 32 slightly above the horizontal plane of the upper run of the carrier in a downwardly and inwardly sloping portion 33, the lower edge of which terminates adjacent the carrier operating over the roll 13. The end wall 31 is preferably provided with an aperture 34 substantially and centrally of said end wall for receiving the discharge nozzle 35 of a fiber feeding apparatus as later described.

Arranged below the nozzle 35 and at the sides thereof are apertures 36 for spray nozzles 37 of pressure gun devices for applying adhesive on the fibers blown into the housing 27 from the nozzle 35. The housing is of such length relative to the machine that the velocity of the fibers and spray will disperse the fibers through said housing for gravitational deposit on the carrier during its movement through the housing. The edges of the side walls and top wall opposite the end wall 31 are connected by an end wall 38 which terminates in an edge 39 spaced from the carrier slightly more than the thickness of the air laid fiber web deposited on said carrier. The housing is provided with suitable framework 40 for making a rigid structure and mounted on said side walls 28 and 29 are horizontally arranged baffles 41 extending the full length of the housing and terminating at their lower edge slightly above the carrier. Said baffles extend inwardly and downwardly relative to the side walls whereby the lower edges are spaced inwardly relative to the sides of the carrier to limit the width of the web of fibers deposited thereon.

Mounted on the frames 2 and 3 at the feed end of the machine is a roller 42 having a fabric covering 43 preferably saturated with oil and in contact with the carrier operating over the roll 13, the roller 42 being suitably mounted whereby it will remain in contact with the carrier to coat same with oil to prevent the fibers and adhesive from adhering to said carrier. A plurality of banks of suitable heating devices or elements 44, for example, infrared ray bulbs 45, arranged in reflectors 46 are mounted on suitable framework 47 below the upper run of the carrier and preferably between the rolls 10 whereby the heat from the bulbs is directed upwardly through the wire screen carrier and into the web of fibers deposited thereon. The infrared bulbs and reflectors are preferably arranged whereby the heat therefrom is directed through substantially all of the wire screen carrier except where same is contacted by the rolls 10. The first of the series of heating devices is arranged adjacent the roll 13 under the housing 27 whereby the heat is directed into the loose, fluffy fibers as they are deposited on the carrier. Any suitable heating devices and method of application of the heat to the web may be used, the heat and length of the heated area of the carrier being proportioned according to the speed of movement thereof and the depth of the web of fibers deposited thereon whereby the product is substantially dry when it leaves the carrier.



Arranged adjacent the housing wall 38 and immediately above the web of loose fibers is the bank of suitable heating devices or elements 48, for example, infrared ray bulbs 49 arranged in reflectors 50 for directing heat downwardly into the loose fibers. The reflectors and bulbs are carried on suitable transverse supports 51 contained in a housing 52, the ends of which are supported by side members 53 mounted on the upper rails 5 of the frames 2 and 3. The longitudinal extent of the bank of heating elements 47 is such that in cooperation with the heating elements 44, below, the carrier, said fibers are suitably dried for the preliminary compression or compacting operation. A roll 54 is rotatably mounted in suitable bearings carried by the side frames adjacent the end of the bank of heating elements 47. Said roll cooperates with a compression roll 55 fixed to a shaft 56 which is rotatably mounted in bearings 57 slidably mounted in vertically arranged guides 58. The bearing blocks 57 are engaged by adjusting screws 59 for providing vertical adjustment of the roll 55 relative to the roll 54 whereby the web passing therebetween is compressed as desired. This is a preliminary compacting operation performed while the adhesive is only partially dried. Additional compacting devices are provided in the machine in spaced relation to the rolls 54 and 55. Obviously any desired number of stages may be provided; however, in the illustrated instance two additional stages are provided. Rolls 60 and 61 are provided under the carrier and cooperate with rolls 62 and 63 respectively carried in vertically arranged guides for adjustment by means of adjusting screws 64 and 65 respectively to arrange the spacing between the rolls as desired. Additional stages of compaction may be spaced as desired.

Since the preliminary compaction performed by rolls 54 and 55 is prior to the drying of the adhesive additional banks of heating elements are provided between the compacting rolls 54 and 60 above the webs, said banks consisting of infrared bulbs 66 or the like carried in suitable reflectors 67 and supported by a housing and frame members 68 substantially in the same manner as the support of the banks 48. The banks of heating elements under the carrier extend substantially to the compacting roll 60 or if additional stages of compaction are provided the lights may extend therebetween to adequately dry the adhesive whereby the heat in the web will substantially complete the drying of the insulation material by the time of the delivery from the machine.

The compacted web is delivered from the carrier adjacent the roll 20 onto a table 69. Supported over said table and suitably driven is a shaft 70 carrying spaced circular cutters 71 having serrated edges 72 for cutting the insulation material as it passes over the table. The cutters 71 are so arranged that one is adjacent each side of the web to trim any rough edge therefrom and other cutters spaced transversely of the machine to cut the insulation material in the desired number and width of strips. The insulation passes off of the table 69 and onto a carrier 73 operating over a roll 74 and suitably driven to convey the insulation material to a point of delivery of the machine.

In forming insulation batts, blankets or boards it is desirable to cut the strips transversely in pre-

determined lengths. The operation is performed by means of a circular cutter 75 rotatably mounted on the shaft of a motor 76 carried on a suitable support 77 preferably arranged at an angle whereby the motor and cutter are moved transversely of the web to cut same simultaneously with the forward movement, the angle being such that the cut is perpendicular to the direction of movement of the web. After a transverse cut is completed the support is so arranged that the motor is moved upwardly to lift the cutter from the web and then is retracted across the machine and lowered into position for another cut. The operation and movement of the motor and cutter are synchronized with the drive for the carrier 12 whereby uniform lengths of insulation material may be obtained.

The material used for forming an insulation product in the present machine preferably consists of comminuted, fibrous material such as finely comminuted cardboard wherein the comminuted material is fibers or pieces characterized by being narrow, fluffy, fuzzy, elongated fibers. Said fibers suitably treated as by impregnating same with a suitable fire-resistant salt are placed in a hopper 78. It is desirable to agitate the supply of fibers kept in the hopper and therefore I have shown a rotary agitator 79 whose shaft 80 extends horizontally through the hopper and is suitably driven by an electric motor 81. The agitator proper may consist of a series of bars 82 arranged at spaced intervals on the shaft 80. The lower part of the hopper is preferably provided with a spiral conveyor 83 suitably driven for moving fibers to the discharge opening 84. A star feed device 85 has its inlet connected with the outlet 86 of the hopper and its discharge 86 connected with a duct 87. The star feed has a plurality of blades 88 carried by a shaft 89 suitably rotated to provide a positive feed of fibers which is synchronized with the drive of the roll 13 and movement of the carrier 12 to regulate the density of the fibers in the final product. The duct 87 is connected with the inlet 89 or a suitable blower 90 driven by a motor 91. The blower is preferably of a rotary type and the intake end communicates with the discharge of the duct 87, said intake being larger then the duct whereby air is drawn into the blower together with the fibers and forced through a duct 92 terminating in the nozzle 35 for directing the fibers and air in a horizontal stream into the housing 27 above the carrier 12, whereby gravitation of the fibers effects disposition thereof on said carrier. Adhesive for the fibers, such as a mixture of starch and water, the starch being seven (7%) per cent by weight, is arranged in a cooking tank 93. A pipe 94 controlled by a valve 95 connects the bottom of the tank 93 with a positive pressure pump 96, the discharge of which is connected by a pipe 97 with the spray nozzles 37. The spray nozzles also have air connections 98 leading to a suitable source of air pressure whereby the air pressure supplied to the spray nozzles effects a forceful spray of adhesive into the housing 27 under the nozzle 35, the fibers and spray being directed in the same direction and the air and adhesive spray and the air moving the fibers tend to thoroughly disperse the fibers in the housing 27 whereby all of the fibers gravitate through the spray and receive an application of adhesive. The agitation caused by the air entering the housing 27 tends to maintain the fibers in suspension for a sufficient period for adequate coating of the fibers with adhesive. Also any fine, lightweight particles, such as dust and



the like, are carried by the air through a stack 99 located in the top wall 30 of the housing adjacent the end wall 38 thereof, said stack leading to a suitable dust collector for disposal of the dust.

The density of the final product is controlled by the relative speed of the carrier and the speed of the star feed 85. For example, in manufacturing insulation batts the carrier has been operated at a speed of eight inches per minute. The air pressure applied to the spray gun fifty pounds per square inch and the star feed 85 operated at such a rate as to deposit fibers to a depth of seven inches on said carrier, the rate of delivery of the pump 96 being such that the fibers have sufficient application of adhesive as they are deposited on said carrier. By compacting the fibers to a thickness of three and three-quarter inches, the final insulation batt has a weight of approximately eighteen ounces per cubic foot. The oil-impregnated roller 42 coats the carrier with a thin coating of oil which prevents the adhesive and fibers from adhering to said carrier. It has been found that the full depth of the fibers desired on the carrier is obtained adjacent the end 33 of the housing 27; however, the heating elements adjacent the roll 13 direct heat through the foraminous carrier and into the loose, fluffy fibers as they are deposited on the carrier, to start the drying of the adhesive as said fibers are deposited. Since the adhesive coating of each fiber is insufficient to obstruct the pores and interstices of the web or loose mass of fibers, the heat penetrates to the center of the air laid, loose, heterogeneously interlocked fibers to partially dry the adhesive thereon. The heat applied to the web is such that as the web reachs the compacting rolls 53 and 54 the adhesive is partially dried, but still retains sufficient tackiness to effect adherence of the individual compacting fibers. Any suitable amount of compaction may be performed at this stage; however, when the depth of the air laid fibers on the web is seven inches it is preferable that the spacing between the rolls 53 and 54 be approximately four and one-half inches. The heating of the web is continued to further dry the partially compacted web to reduce the moisture in the web and still effect adherence of the fibers at all stages of compaction. The spacing between the rolls 59 and 61 may be such as to compact the web to approximately four inches in thickness and the rolls 60 and 62 arranged to compact the web to three and three-quarters inches in thickness as when making a batt or blanket of insulation having that thickness. Obviously additional stages of compacting rolls may be arranged for obtaining any desired thickness and density of final product.

At the final compacting stage it is desirable that the batt, blanket, or board have sufficient moisture content whereby the adhesive on the coated fibers will provide adherence of adjacent interlocking fibers, there being sufficient heat in the batt or web whereby moisture continues to evaporate on further travel from the compacting rolls to a point adjacent the terminal roll 20 wherein the batt is delivered from the carrier with approximately ten per cent moisture content. As the web passes from the carrier it is delivered onto the table 68 and cut into longitudinal strips by the cutter 70, said strips passing onto the carrier 72 and being cut transversely thereof at predetermined intervals to cut the strips in desired length for suitable size finished insulation batts, blankets, or boards. The heat in the insulation continues to reduce the moisture con-

tent thereof whereby the final product in batt or blanket form is soft, resilient, extremely light in weight, having a random arrangement of heterogeneously interlocked, narrow, fuzzy, fiber units which adhere together by the interlocking and adhesive therein whereby it is impossible to segregate or remove in layers any portion of the final batt. The depth of loose fibers deposited on the carrier may be varied to provide batts, blankets or boards of different weight and density and different degrees of compaction may be used to vary the weight and density of the final product. Also since each of the fibers is treated with fire-resistant salt, the entire batt is fire-resistant. The adherence of the fibers due to the adhesive and interlocking arrangement of the fibers particularly characterizes the final insulation batt in that no paper or other coating is required on the faces of the product to hold it together or retain its shape. However, paper or other coating may be applied to the faces of the product if desired.

It is obvious that additional pressure and/or additional stages of compacting the fibers will create an insulation board of desired thickness having uniform density, the greater the compacting the greater hardness and strength of the final product.

What I claim and desire to secure by Letters Patent is:

Apparatus for making fibrous insulation batts comprising, a hopper for ground fibrous material, a housing having side, end and top walls, a foraminous carrier positioned for forming a bottom of said housing, means for continuously passing said carrier under said housing, a stack connected to the upper part of the housing for escape of air and dust therefrom, means for receiving fibrous material from the hopper and blowing said material with air into the housing above the carrier and in the same direction as the movement of the carrier, the movement of air in the housing and through the stack substantially suspending the fibers in the air above the carrier, means for spraying an adhesive solution into the housing below the discharge of fibers therein and above the carrier for applying adhesive solution to the fibers whereby the adhesive sprayed fibers become heavier and gravitate toward the carrier for air laying a web of substantially only loose adhesive coated fibers onto the carrier in a random arrangement of heterogeneously interlocked, narrow, fuzzy fiber units, means for feeding the fibrous material from the hopper to the blower in accordance with the rate of movement of the carrier to control the depth of fibers deposited thereon, a plurality of banks of infrared lamps under the carrier and extending from under the housing to a selected compacting stage of the web for directing heat through the carrier into the loose, fibrous material carried by the carrier, a plurality of banks of infrared lamps above the carrier from the housing to a selected stage of compaction of the web for directing heat into the web thereon for cooperation with the lamps under the carrier to progressively dry the adhesive coating of the fibers throughout the thickness of the web, means for compacting the fibers on the carrier while the adhesive is partially dried, means for further drying the adhesive in the fiber web, and a plurality of stages of compacting means for compressing the fiber web to a desired thickness and uniform density to form a self-contained insulation batt of only fibrous material in uncovered condition.



WILLIAM J. KROPP.


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