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LIQUID MATERIALS TO FIBERS

2,707,690

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2 Sheets-Sheet 1

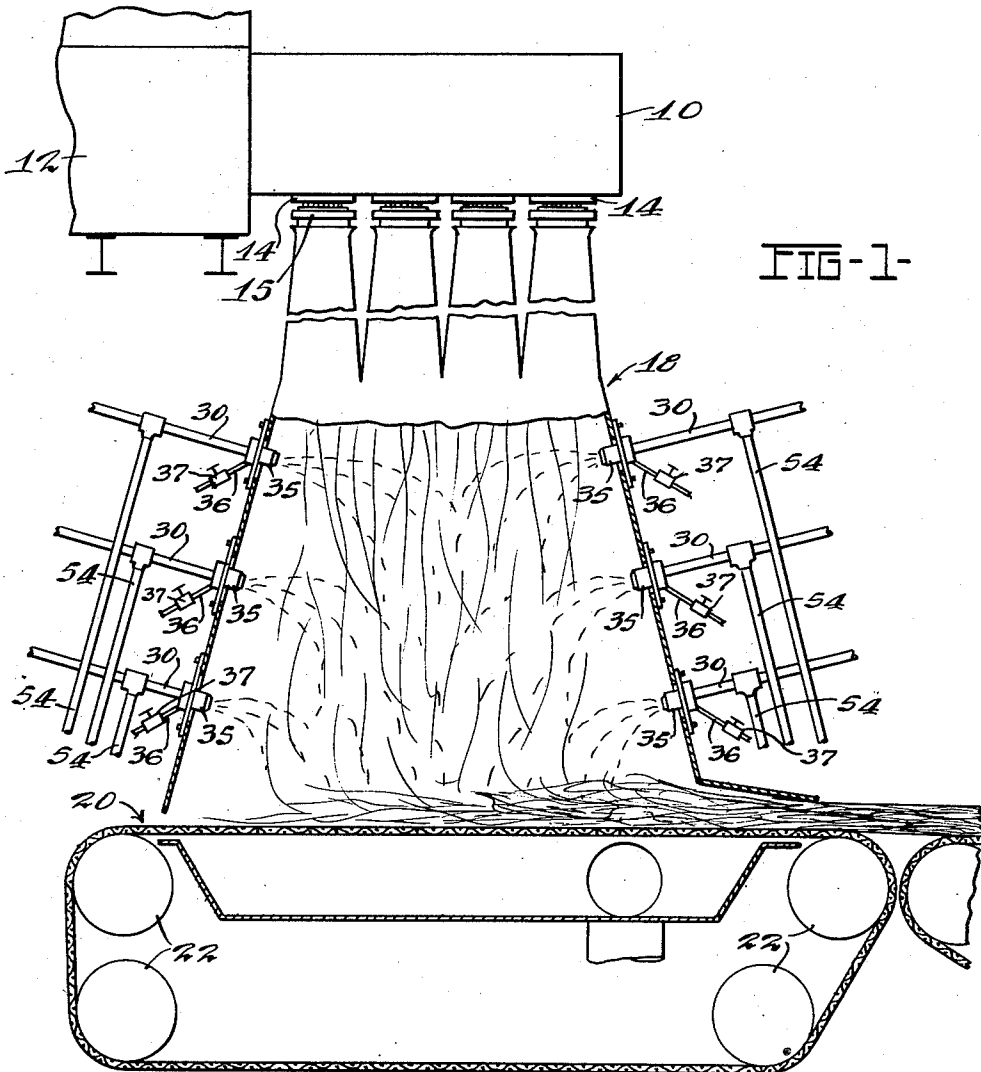


FIG-1-

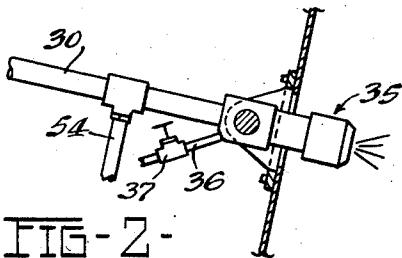


FIG-2-

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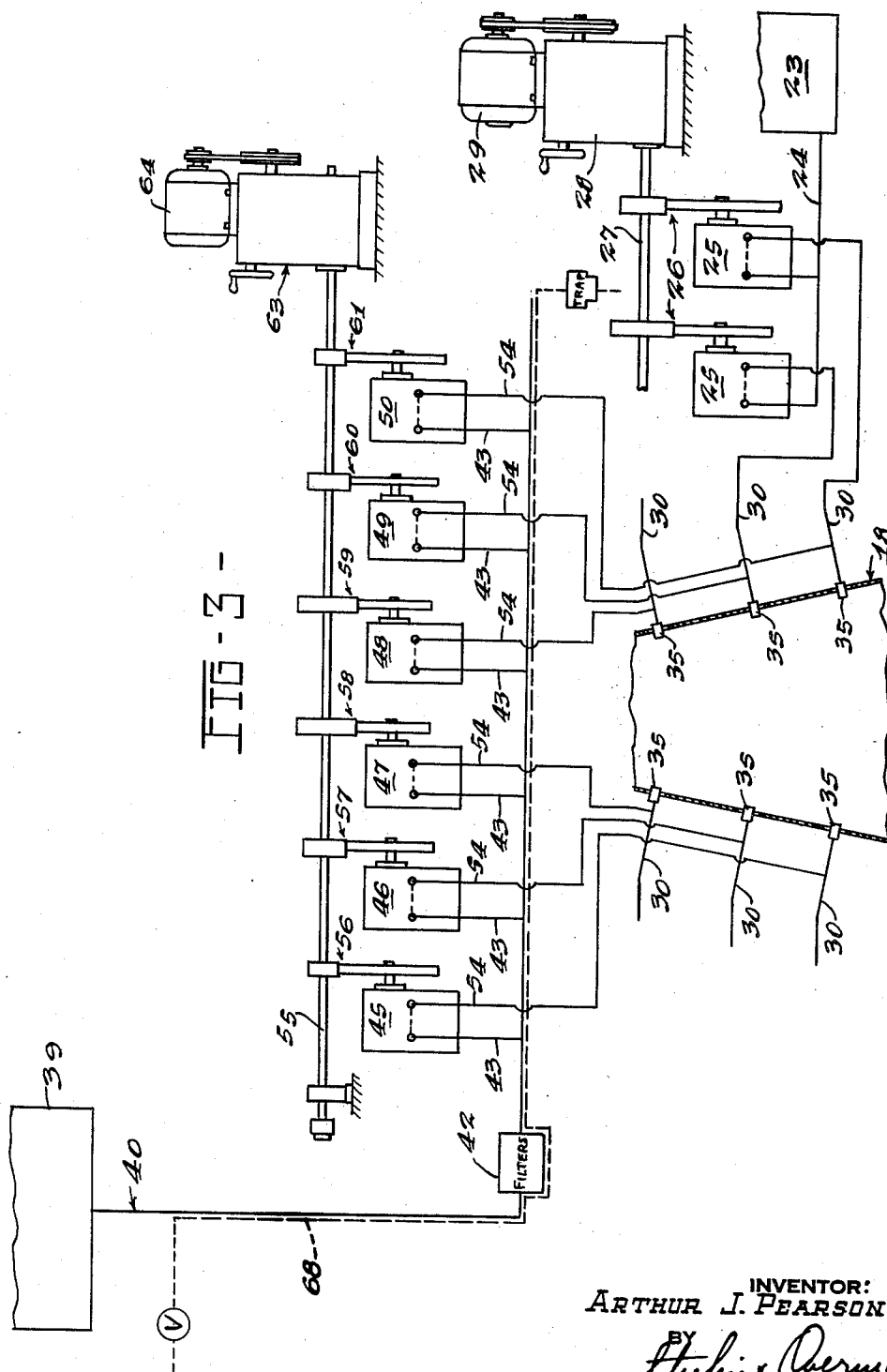
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METHOD AND APPARATUS FOR APPLYING LIQUID MATERIALS TO FIBERS

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15 Claims. (Cl. 117—104)

This invention relates to the formation and processing of fibers formed from heat softenable material and more particularly to a method and apparatus of applying lubricant or other antifriction coating to fibers.

In the formation of fibers from heat softenable material such as glass, it has been a practice to flow streams of molten glass from a forehearth and direct blasts of steam or air onto the streams to attenuate them into fibers which are collected upon a moving foraminous conveyor. The fibers may be accumulated to a desired thickness on the conveyor and utilized in such form for the production of mats, insulating bats or other fibrous articles of manufacture. The fiber attenuating blasts of steam or compressed air are projected downwardly into engagement with the molten streams of fiber forming material and into an enclosure or forming hood within which the fibers are formed. A suction area or zone of reduced pressure is generally established beneath the foraminous conveyor to facilitate the collection and distribution of the fibers as well as to dispose of the spent steam or air of the blasts.

In order to reduce brashiness as well as to minimize interabrasion of the fibers, endeavors have been pursued to apply oil to the fibers but distribution of the oil without a suitable carrier has been unsatisfactory and comparatively large amounts of oil were required in order to wet the fibers.

In order to eliminate or reduce these difficulties, oil emulsions have been employed but such emulsions or suspensions contain a comparatively high percentage of water. While an emulsion provided a means for distributing the oil on the fibers, the processing and formation of an emulsion suitable for the purpose is expensive. Moreover, by reason of the comparatively large water content in an emulsion, the cost of transportation of a prepared emulsion is necessarily high. Emulsifying agents usually have lower fire and flash temperatures than the base oil employed and hence the liability of the material on the mats of fibers to ignite and burn as the mats are conveyed through a heated curing zone or oven presents a serious hazard.

The present invention embraces the provision of a method and apparatus for introducing an oil or lubricant onto the fibers in a manner whereby the lubrication characteristics of the oil are fully utilized without involving emulsification of the oil.

The invention has for an object the provision of a method of introducing an unemulsified oil into a liquid resinous fiber bonding agent immediately prior to the extrusion of the bonding agent from spray nozzles onto the fibers in the forming hood whereby the bonding agent functions in a measure as a vehicle or carrier to assist in conveying the oil onto the fibers.

An object of the invention resides in the provision of a method of applying a lubricant to fibers concomitantly with their formation involving the introduction of an unemulsified oil into a stream of liquid bonding agent adapted to be sprayed upon the formed fibers by a jet of

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steam or other gas which effects an atomization of the oil and bonding agent to a fine mist to facilitate a uniform distribution of the oil and bonding agent through the accumulated mass of fibers.

Another object of the invention resides in a method of applying oil to fibers which are adapted to be bonded by a resin or other suitable medium wherein the oil serves to reduce "fly" or dust otherwise existent at the cutting devices where the resin bonded mass of fibers is cut or subdivided into mats or bats of predetermined dimension.

Another object of the invention resides in a method of introducing an oil in an unemulsified form onto formed fibers concomitantly with a resinous binder in a manner whereby an operator is enabled to visually inspect the operation of the oil application as unemulsified oil is of a different color than that of the resin and by reason of this facility or characteristic, an effective distribution of the lubricant on the fibers may be obtained.

Another object is the provision of a method and apparatus of metering or regulating the rate of flow of a lubricant for application to fibers in a manner facilitating accurate and effective control of the application and distribution of the lubricant to the fibers whereby an efficient utilization of the lubricant is effected without loss or wastage and avoidance of the use of excessive quantities of lubricant.

Another object of this invention resides in a method of applying a coating of an oleaginous material to mineral fibers in a manner eliminating the use of a compounded emulsion of the material.

Further objects and advantages are within the scope of this invention such as relate to the arrangement, operation and function of the related elements of the structure, to various details of construction and to combinations of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

Figure 1 is a semidiagrammatic elevational view of an arrangement for carrying out the method of the invention;

Figure 2 is a plan view illustrating one of the injection nozzles for introducing a resinous material and lubricant onto the fibers as they are produced by the fiber forming apparatus, and

Figure 3 is a diagrammatic view illustrating pumping and metering or control means for delivering lubricant to a fiber forming and collecting zone.

While the method and apparatus of the invention has particular utility in treating fibers formed from heat softenable fiber forming mineral materials such as glass, slag or fusible rock, it is to be understood that the method of fiber coating or treatment may be employed in the processing of fibers formed from resins or other materials.

The apparatus for carrying out the method is illustrated in connection with an arrangement for forming fibers from molten glass or other mineral material through the engagement therewith of blasts or jets of steam or compressed air of velocities sufficient to attenuate the molten material to fibers. Referring to the drawings and initially to Figure 1, there is illustrated a forehearth 10 which is supplied with molten glass or other heat softenable material from a melting tank or furnace 12, the forehearth being provided with a plurality of feeders 14 disposed beneath the same. Each of the feeders is formed with a plurality of orifices through which flow streams of molten glass. Disposed adjacent and beneath the feeders are blowers 15, there being one blower for each glass feeder, each blower being provided with downwardly extending slots or openings (not shown) for directing a jet of steam or air under pressure in

the general direction of flow of the streams and into contact therewith to fiberize or attenuate the streams into fibers. Fibers formed in this manner are conventionally referred to as blown fibers, mineral or glass wool.

Situated immediately beneath the blowers is a fiber forming hood or enclosure 18 into which the formed fibers and fiber attenuating blasts are directed, the fibers being conveyed downwardly by the force of the blast. The forming hood 18 is preferably of frusto-pyramidal shape to facilitate expansion of the steam or air blasts. Disposed beneath the forming hood is a foraminous conveyor 20, the upper flight of which is adapted to receive and collect the fibers moving downwardly through the forming hood. The foraminous conveyor is of a movable character for continuously conveying the accumulation or mass of fibers away from the fiber forming zone. The conveyor may be mounted upon suitable guide rollers 22, one of which may be driven in order to move the conveyor.

Among the various end products formed of the mineral fibers are mats in which the fibers are bonded by a suitable medium or agent to impart mass integrity to the mats which have particular utility for heat and sound insulation purposes, for filters and other allied uses.

It is desirable to introduce a lubricant or oleaginous material onto the fibers in order to minimize brashiness and to reduce fiber interabrasion and a lubricant is essential for these purposes in addition to the bonding medium for integrating the fibers into bonded mat formation. Heretofore lubricant or oil has been introduced onto the fibers in emulsion form. Emulsions are compounded with emulsifying agents to render the oil compatible in an aqueous solution and the methods of forming or compounding emulsions or suspensions usable for the above mentioned purposes are comparatively expensive. The present arrangement eliminates the use of an emulsion as the oleaginous liquid or lubricant in the present method is introduced or sprayed onto the fibers by introducing the lubricant with the bonding resin or medium immediately prior to the extrusion or ejection of the resin and lubricant from spray nozzles or other applicator means.

The apparatus for carrying out the method is inclusive of an arrangement for metering and conveying resin such as phenolformaldehyde or other bonding resin or mixture of resins for application to the fibers in the forming hood. The resin conveying system includes a plurality of tubes or feed lines 30, each of which is individually connected with a metering or flow controlling device, two of such devices being illustrated diagrammatically at 25 in Figure 3. The metering devices 25 are connected with a supply of resin in a tank 23 by a feed line 24. Each of the metering devices may be in the form of a gear pump connected by gearing 26 with a drive shaft 27 operated through a variable speed drive contained in a housing 28 driven by a motor 29. The several resin metering devices connected with the respective feed lines 30 may also be driven from the shaft 27. The pumps or metering devices 25 are adapted to regulate or meter the resin or binding agent and provide a motivating means for feeding the material to zones for distribution onto the fibers.

Each of the tubes 30 terminates adjacent a wall of the forming hood 18 and is provided with a nozzle 35 preferably of the steam or gas pressure ejector type for spraying the liquid bonding resin onto the fibers. Each of the ejector nozzles is connected by means of a tube 36 with a source of steam or other pressure fluid providing the motivating force for ejecting the resin and lubricant onto the fibers in atomized condition. The pressure steam lines or tubes 36 may each be provided with a control or regulating valve 37 for controlling the ejection of material from the nozzles.

The method and apparatus include means for metering, allocating and conveying unemulsified oil or other

oleaginous material into the resin streams flowing in the feed lines 30 in a manner whereby the oil or lubricant is concomitantly ejected from the nozzles 35 with the resin or bonding medium. As diagrammatically illustrated in Figure 3, a series of oil metering and feed pumps are provided which are individual to each of a series of lubricant conveying tubes for carrying the lubricant into the resin conveying lines 30. The oil or other lubricant is conveyed from a tank 39 or other supply by a main feed line 40 to the pumps through suitable filters 42 to individual branch tubes 43 for conveying lubricant to individual metering and feed pumps 45, 46, 47, 48, 49 and 50. The oil feeding intermeshing gears (not shown) provides a pumping action for circulating the oil. Each of the pumps 45 through 50 inclusive is provided with a duct or tube 54 which respectively is joined with the resin conveying tubes 30 as shown in Figures 1 and 3 so that the oil is mixed with the resin immediately prior to ejection of the resin and oil mixture through the nozzles 35 into the forming hood onto the fibers.

The pumps 45 through 50 inclusive are driven from a shaft 55 through individual sets of gears 56, 57, 58, 59, 60 and 61 whereby each pump is individually operative to accurately meter the flow of and direct lubricant into one of the resin lines. The gear driving arrangement for the pumps may be of a character whereby certain of the pumps operate at different speeds to thereby meter and control the amount or flow rate of lubricant conveyed to the resin lines for ejection from the individual nozzles. For example in the illustrated embodiment, the drive gears of the sets of gears 56 and 61 are arranged to drive the pumps 45 and 50 at lesser speeds than the gearing 57 and 60 operating the pumps 46 and 49 while the pumps 47 and 48 may be driven at a different speed than the other pumps through the gearing 58 and 59. In this manner the amount of oil delivered to a particular resin line may be metered or controlled by a continuously operating pumping means so as to obtain a constant flow rate of lubricant to any particular nozzle. Furthermore the distribution of lubricant among the fibers may thus be controlled through the rate of operation or lubricant flow established by the pumps 45 through 50 to attain any apportionment, allocation or distribution of lubricant onto the fibers at the various zones of the forming hood.

The mixture of resin and oil is extruded or projected into the forming hood by steam delivered to the nozzles through the lines or pipes 36, the force of the steam emanating from the nozzles being effective to break up or atomize the resin and oil into a fine spray or mist which enhances and facilitates distribution of the materials onto the attenuated fibers moving downwardly through the forming hood 18.

The shaft 55 or other means connected to the pump mechanism for operating the same may be driven by a variable speed mechanism of conventional character contained within a housing 63 and operated by a motor 64. Thus by employment of a variable speed drive for the pump operating shaft 55 which with the individual drive for each pump varied through the gear train connecting the pumps with the common drive shaft 55, metering and conveying means may be driven at variable rates affording a wide range of control over the rate of flow of lubricant to the nozzles.

In order to further assure uniform flow characteristics of the oil, it is desirable to employ a heat transfer or heat applying means for maintaining the oil at a predetermined temperature and thus insure a substantially uniform viscosity therefor. To accomplish this the oil supply line 40 may be surrounded or disposed in heat transferring relation with a jacket or tube 68 carrying steam or other heated fluid at a desired temperature adequate to maintain the viscosity of the lubricant at a substantially constant value and thereby attain an accurate

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metering or regulation of the oil by the flow regulating and feed pumps 45 through 50 inclusive.

Through the above mentioned method and apparatus, unemulsified oil may be introduced into a liquid resin with which it is compatible such as phenolformaldehyde per se or a mixture thereof with other resins and entrained with the resin by the jets or blasts of steam ejected from the nozzles 35 so that thorough distribution of the oil in atomized or fine globule condition is attained without the previous preparation of an aqueous emulsion. The present method therefore eliminates the use of emulsifying agents which are expensive and the aqueous constituent which increases the cost of transporting the emulsion from its locale of production to the fiber forming facilities. Moreover, after the bonding agent and oil constituents have been applied to the fibers, the impregnated mass or mat is conveyed through a suitable oven wherein the binding agent or resin is set or cured through the application of heat. When oil emulsions were used, the flash and fire points or temperatures of the emulsifying agent or agents were usually less than that of the base oil and in many instances were the cause of oven fires during the curing operations. Through the method and arrangement of the present invention, the use of emulsifying agents is avoided and hence the liability of oven fires greatly reduced.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

I claim:

1. A method of treating fibers of mineral materials formed by attenuating flowing streams of mineral material in an enclosed fiber forming zone; of conveying a stream of bonding medium from a supply thereof to the fiber forming zone; of conveying a stream of lubricant into the stream of bonding medium adjacent the enclosed fiber forming zone; of controlling the quantities of bonding medium and lubricant in the individual streams thereof, and of concomitantly delivering the mixture of bonding medium and lubricant by a stream of gas under pressure into the fiber forming zone in atomized condition whereby the lubricant and bonding medium are distributed throughout the fibers.

2. A method of treating fibers of mineral material formed from flowing streams of the mineral material by engaging the streams with blasts of gas to attenuate the streams to fibers; of flowing a plurality of streams of a bonding agent for delivery onto the fibers; of flowing a corresponding number of streams of oil into the respective streams of bonding agent; of individually controlling the rate of flow of the streams of bonding agent and oil; and of injecting the individual mixtures of bonding agent and oil at spaced zones onto the fibers by jets of pressure fluid.

3. A method of treating fibers produced from flowing streams of the mineral material by engaging the streams with blasts of gas to attenuate the streams to fibers; of pumping a stream of resin for delivery onto the fibers; of pumping a stream of unemulsified oil into the resin stream; of regulating the pumping rates for selectively proportioning the amounts of resin and oil, and of injecting the mixture of resin and oil into the attenuating zone by a gas stream in a manner whereby the resin and oil are atomized and directed onto the fibers.

4. A method of treating fibers formed of mineral material including the steps of moving mineral fibers through an enclosed treating zone; of pumping a metered stream of resin to a point of discharge arranged adjacent the treating zone; of continuously pumping a metered stream of unemulsified oil into the stream of resin adjacent the point of discharge whereby a combined stream of resin and unemulsified oil is delivered to the point of this charge, and of utilizing a gas under pressure to project

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the resin and oil mixture in atomized form onto the fibers.

5. Apparatus for distributing a flowable bonding material and lubricant onto fibers including a zone to which fibers are conveyed; an instrumentality for delivering the bonding material and lubricant to said zone; means including a duct for conveying the bonding material from a supply thereof to said instrumentality; pumping means intercalated with said duct for controlling the flow of bonding material in the duct; means including a second duct for conveying lubricant from a supply thereof into said bonding material conveying duct in advance of said instrumentality whereby a mixture of the bonding material and lubricant is delivered by said instrumentality onto the fibers in said zone, and a second pumping means intercalated with said lubricant conveying duct for controlling the flow of lubricant therein.

6. Apparatus for distributing a liquid resinous material and an unemulsified oil onto fibers including, in combination, a zone through which fibers are conveyed; a plurality of nozzles for delivering a mixture of the resinous material and oil into said zone; a plurality of ducts for conveying resinous material from a supply; a material flow metering pump for each of said ducts; means for actuating the metering pumps; a plurality of ducts for conveying oil from a supply; an oil flow metering pump for each of said oil conveying ducts; means for actuating the oil metering pumps; each of said oil conveying ducts being individually joined with a resinous material conveying duct adjacent said nozzles; each of said nozzles being in communication with a juncture of said pairs of ducts whereby a metered mixture of resinous material and unemulsified oil is supplied to each of said nozzles, and fluid pressure means effective at said nozzles for discharging the resinous material and lubricant in atomized condition onto the fibers.

7. A method of coating fibers produced from heat-softenable material by attenuating streams of the material by high velocity gaseous blasts including the steps of feeding a metered stream of a liquid bonding agent to a distributing zone; feeding a stream of oil into the stream of bonding agent adjacent to but in advance of the distributing zone, and injecting the mixture of bonding agent and oil by a pressure fluid from the distributing zone into the fiber attenuating zone whereby the bonding agent and oil are atomized and deposited on the fibers.

8. A method of treating fibers including the steps of moving the fibers through a fiber treating zone; pumping a resin to a nozzle in the fiber treating zone; pumping a stream of unemulsified oil into the resin at a zone in advance of the nozzle whereby a mixture of resin and unemulsified oil is delivered to the nozzle; regulating the pumping rates of the resin stream and the oil stream to vary the proportions of oil and resin delivered to the nozzle, and spraying the resin and oil mixture from the nozzle onto the fibers by gas under pressure.

9. A method of coating fibers formed by attenuating a plurality of streams of fiber forming material in a chamber including the steps of pumping a stream of liquid bonding agent to a series of outlets arranged to deliver the bonding agent into the chamber; pumping an unemulsified lubricant into the stream of liquid bonding agent in advance of the outlets; delivering the mixture of liquid bonding agent and unemulsified lubricant under pressure of a gas through the outlets onto the fibers, and regulating the rates of flow of the liquid bonding agent and unemulsified lubricant delivered through each of the outlets whereby the quantities of liquid bonding agent and unemulsified lubricant delivered to the chamber and the distribution thereof upon the fibers in the chamber may be controlled.

10. Apparatus for coating fibers formed by attenuating a plurality of streams through engagement of blasts of gas therewith, a plurality of nozzles disposed adjacent the fiber attenuating zone; a plurality of ducts for conveying individual streams of resin from a supply to the

nozzles respectively; a plurality of ducts for conveying individual streams of unemulsified lubricant from a supply into the respective resin conveying ducts adjacent to but in advance of the nozzles; means individual to each of the resin and lubricant conveying ducts for metering the streams of resin and lubricant flowing therethrough, and fluid pressure means for directing the mixture of resin and lubricant from the nozzles onto the fibers.

11. Apparatus for coating fibers formed by attenuating a plurality of streams of mineral fiber forming material through engagement of a blast of gas therewith a forming hood, means disposed beneath the forming hood for collecting the fibers in mass formation as they are formed; a plurality of ejector nozzles associated with the forming hood; a duct system for conveying resin from a supply to the nozzles; a second duct system having connection with said resin duct system adjacent the nozzles for conveying unemulsified lubricant from a supply into the resin duct system to combine the resin and lubricant flowing through the duct systems; fluid pressure means for directing the resin and lubricant mixture from the nozzles onto the fibers in the forming hood; pumping means for delivering the lubricant into the resin duct system, and means for regulating the pumping means for metering the rate of delivery of the lubricant into the resin duct system.

12. Apparatus for treating fibers formed by attenuation of streams of fiber forming material by gaseous blasts in a fiber forming zone, a plurality of spaced nozzles disposed adjacent the fiber forming zone; a duct system for conveying resin from a supply to the nozzles; a second duct system having connection with said resin duct system for conveying an unemulsified lubricant from a supply into the resin duct system in advance of the nozzles; fluid pressure means for projecting the resin and lubricant mixture from the nozzles onto the fibers in the forming zone, and metering means individual to each of the resin and lubricant conveying ducts of the systems for predetermining the rates of flow of resin and lubricant delivered to the nozzles.

13. In combination with apparatus for treating fibers formed by attenuating a plurality of streams of fiber forming material by blasts of gas engaging the streams in a fiber forming hood, a plurality of nozzles supported by the walls of the fiber forming hood; means including a plurality of ducts for conveying streams of bonding agent to the nozzles arranged to deliver the bonding agent onto the attenuated fibers; means including a plurality of ducts for conveying an unemulsified lubricant into the bonding agent in advance of the nozzles whereby mixtures of unemulsified lubricant and bonding agent are delivered by the respective nozzles onto the fibers, and metering means

individual to each of the lubricant conveying ducts for determining the rate of flow of lubricant to each nozzle whereby the lubricant delivered from each nozzle may be controlled.

14. Apparatus for coating fibers formed by attenuation of streams of molten fiber-forming material by gaseous blasts in a fiber forming hood; including in combination, a plurality of nozzles supported by the walls of the fiber forming hood; a plurality of fluid metering means; a plurality of tubes connectng said nozzles with said metering means and adapted to convey liquid resin from the metering means to the nozzles; a plurality of fluid metering means for metering unemulsified oil from a supply; a plurality of tubes for conveying oil from the oil metering means into the resin conveying tubes in advance of the nozzles, said metering means including fluid moving rotatable elements; means for rotating said elements at speeds to predetermine the fluid flow rates thereof; fluid pressure means for ejecting the resin and oil mixture from the nozzles onto the fibers, and means for controlling the temperature of the oil to establish a uniform viscosity thereof prior to the delivery of oil into the resin conveying tubes.

15. Apparatus for distributing liquid bonding material and lubricant onto fibers including, in combination, a chamber into which the fibers are delivered; a nozzle for delivering a mixture of liquid bonding material and lubricant into the chamber; a duct for conveying a stream of bonding material from a supply thereof to said nozzles; variable speed pumping means intercalated with said duct for metering the flow of liquid bonding material in the duct; a second duct for conveying lubricant from a supply thereof for delivery into said bonding material conveying duct adjacent but in advance of said nozzle; variable speed pumping means intercalated with said lubricant conveying duct for metering the flow of lubricant therein, and means for delivering a gas under pressure through said nozzle for ejecting the mixture of liquid bonding material and lubricant in atomized condition onto the fibers in the chamber.

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