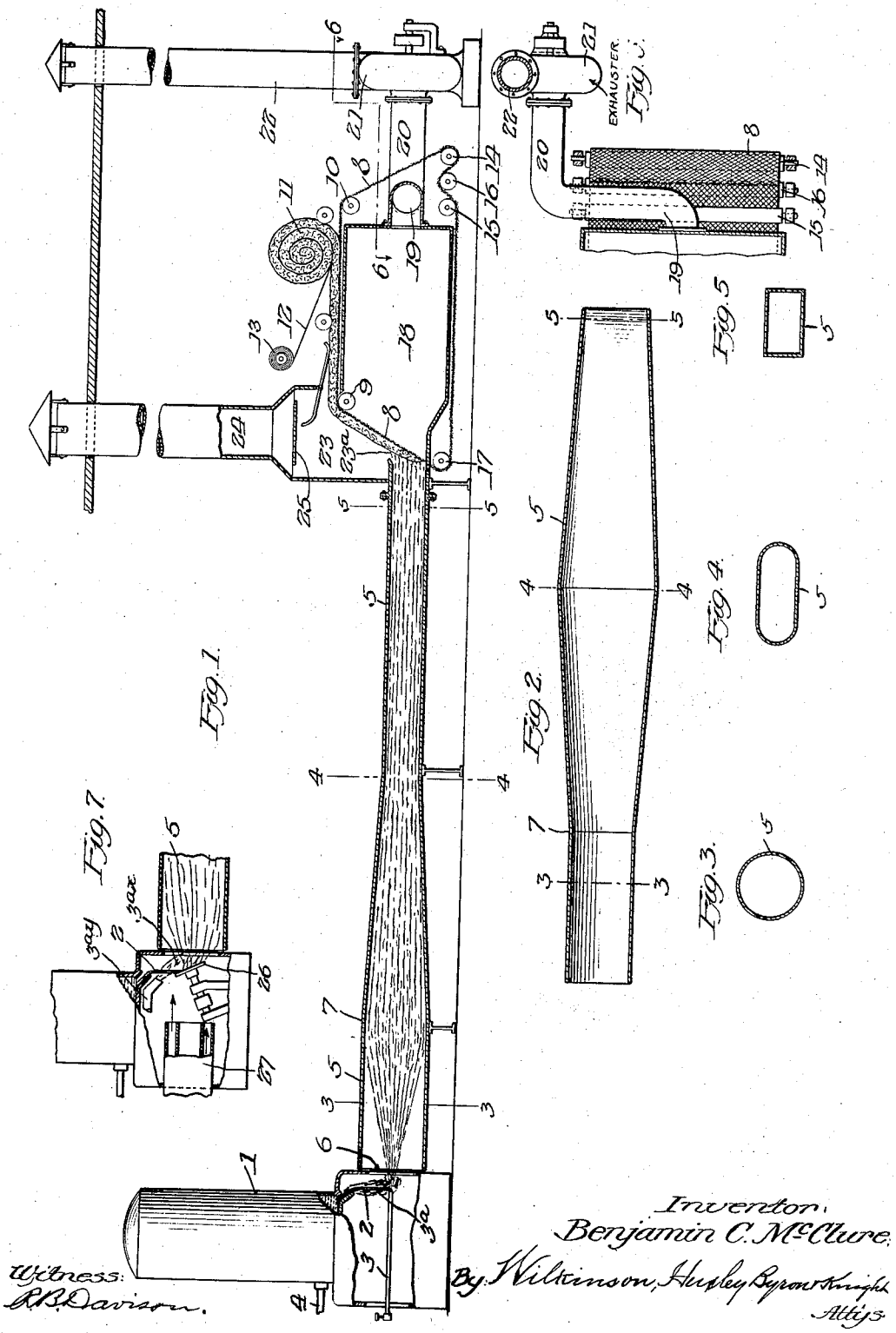
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PROCESS FOR FIBERIZING MINERAL COMPOUNDS

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PROCESS FOR FIBERIZING MINERAL COMPOUNDS

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This invention relates primarily to the method of and apparatus for producing the article of manufacture constituting the claimed subject-matter of United States Letters Patent No. 1,913,242, on June 6, 1933, whereof the present application is in part a continuation; and which said article of manufacture is constructed of fibers generated by subjecting to the reaction of a vehicular gaseous blast, molten inorganic material typified by a silica, alkali metal and alkali earth batch which, when so treated, becomes fibers of such lengths, fineness of caliber and degree of inherent resiliency as to cause them, when positively conveyed to and deposited upon a felting surface by the vehicular blast, to felt themselves into a body having mass integrity that insures retention of its form under manipulation and self sustention while occupying its position of use; and having mass resiliency that insures expansion of the body against the confines of the space into which it is introduced, which, under different degrees of compression and resultant density of the article, always maintains a volume of air spaces incident to insulation or other functions for which it is intended.

Collateral features which individually or collectively identify better forms of the invention, and all of which are desirable in the best form thereof, are—

First, enveloping the propelled fiber ladened gaseous vehicle by a housing, barrel or other duct of constricted transverse dimensions which is also directed toward and discharges upon the fabricating or felting means and the effect of which is to increase the force and control the direction of the fiber-ladened gaseous vehicle towards, as well as the condition of the fibers arriving at the fabricating apron, and thereby produce a better felt.

Second, augmenting the direct drive of the gaseous vehicle through and laying its fiber against the fabricating means by the creation of an evacuating influence on the side of the fabricating means remote from the accumulating fibers.

Third, so relating the aforesaid housing to the fabricating means that as the fiber accumulates on the fabricating means, it will be under pressure of the continuing flow of the propelled gaseous vehicle and thereby improved in quality.

Fourth, controlling a proportion of the gaseous vehicle to cause to escape in a direction approximating parallelism with the surface of the accumulating felt and causing some of the fibers to assume a direction in the felted fabric, longitudinal thereof and thereby further improving the product.

Fifth, keeping the molten material presented for fiberization, at the highest practicable temperature until fiberization takes place, and to thereafter graduate or slow down cooling so as to improve the quality of the resultant fibers and the mass which they produce. To this end, the fiberizing procedure is preferably carried on in a barrel of limited dimensions and with regulated intake, that permit such temperature control; the molten stream of mineral substance is accompanied by flame or equivalent hot gas for a distance that will materially aid the fiberization; and the air, which largely constitutes the gaseous vehicle, upon which the fiber is borne through the barrel, is caused to so contact this flame as to become highly heated.

Sixth, utilizing a fiber arresting and gas filtering surface or target of selected design and one comformable to the sectional area of the confining duct at least at the delivery end of the latter and thereby causing better distribution and more uniform thickness and density of the accumulated mat of fibers.

Seventh, delivering the fiber fiberized molten mineral into a confining duct which, including any extensions, additions or section-varying adjuncts thereof, is to be understood as being included in the term "barrel" as herein used, in a manner to develop and maintain a gaseous vehicle defined as to volume, and the mass of supported fibers conditioned as to density, intermingling and interlocking; and having said barrel so varied in sectional form that, from an initial section which favors the induction of the vehicle into the barrel, it will change to a section which will correspond generally to the outline of the target or arresting surface against which the fibers and gaseous vehicle are directed; this change of section being preferably arrived at, not abruptly, but gradually and by way of different intermediate characteristic sections; and preferably, also, involving the feature of reduction of area which tends to homogenizing of density and preliminary intermingling or partial interlocking of the fibers, before their impingement against the arresting surface.

Eighth, homogenizing the density and volume of floating fibers substantially throughout the sectional area of the duct herein sometimes referred to as the "barrel" especially at the delivery end of said duct, by converging opposite walls of the barrel, first, in the direction of one diameter

of the barrel in order to eliminate voids and correct un-uniformity of density in said direction, and then, while holding the volume of vehicle and fibers to this reduced dimension and increased density in said direction, converging the walls in the direction of a diameter at a substantial angle to the direction first named, preferably a right angle thereto, until the same corrective effect is produced in that direction; the degree of convergence in the two directions having the effect of bringing the section of that portion of the barrel which is nearer the discharge end to the characteristic section of the selected area of precipitation; and an important feature of this part of the invention resides in the condition that, having brought the volume of vehicle and supported fibers to a substantially uniform density throughout, the volume remains under confinement and control until precipitation takes place, as distinguished from release of the gaseous vehicle fibers into a space or room, as in those methods which rely on gravity for precipitation.

Ninth, causing the intermingled and interlocked fibers from the barrel, when they reach the arresting surface, to not only become further intermingled and interlocked with those already arrested, but to lie down and assume approximate parallelism with the surface of the blanket rather than assume parallelism with the thickness of the blanket. To which end, another feature of the invention consists in causing the projection of the vehicular medium and the fibers borne thereon to meet the exposed area of the arresting surface at a substantial angle materially less than a right angle so that there is a receding of the surface of deposit toward the direction of departure of the felt and this assists in the directing of the fibers; also by causing some of the gaseous vehicle to pass through the arresting surface and some of it to flow over the said surface or along the surface of the developing blanket. If the arresting surface or wall is stationary, the building up process is measured by the duration of its exposure to the volume of vehicle and fibers, some of which fibers are influenced by air passing through the wall and others by air being deflected over or parallel with the developing blanket. If the arresting wall is moved during the development of the blanket, then a definite relationship should be established between the dimension of the exposed area in the direction of travel, the rate of movement, the quantity of fiber projected per unit of time, and the proportions of air forced through the blanket and across the surface of the blanket; such relationship being selected so that the fibers of the mass will tend to lie more nearly parallel to the surface of the blanket than to its thickness, and the result being a better insulating value and a greater longitudinal and lateral strength or integrity of the mass.

In order that the invention may be fully understood, an illustrative embodiment thereof, including the method of procedure and one instrumentality that may be employed for practicing the method will now be described in detail in connection with the accompanying drawing. In said drawing—

Figure 1 is a sectional elevation of a typical apparatus suitable for use in practicing the invention.

Figure 2 is a longitudinal section of the characteristic barrel used for confining, slowing and cooling of, and giving form to the gaseous vehicle and partially intermingling the fibers borne thereon.

Figures 3, 4 and 5 are transverse sections taken, respectively, on the lines 3—3, 4—4 and 5—5 of Figure 2.

Figure 6 is a detail view in plan, partly in section on the line 6—6 of Figure 1, of the exhaust and discharge connections from the air trunk in rear of the fiber collecting wall; and

Figure 7 is a detail view showing modified means for acting upon the molten mass to fiberize it; also a means for developing a flame or hot gas environment around the molten mass for conserving its heat until fiberizing takes place, instead of the means shown in Figure 1 which contemplates taking some of the flame from the fire used for fusing the mass of mineral material.

1 represents a furnace that may be of any desired appropriate construction in which to melt a batch of mineral substances, producing a molten mass appropriate for use in practicing the present invention, said furnace being equipped with means for delivering a stream 2 of the batch in fused condition, and means being also provided for maintaining around this stream, and at least as far as the point of fiberization, a high temperature gaseous environment, for instance, flame from the furnace or from another adjacent source, having the capacity of retarding the cooling of the molten mass until fiberizing has taken place. 3 represents a nozzle through which may be delivered a fiberizing medium, such, for instance, as steam under a substantial pressure. 4 represents a liquid fuel supply for the furnace, and is merely typical of a means for maintaining a desired temperature in the furnace.

One constituency or formula for a batch appropriate for practicing the present invention, will be found described and claimed in my aforesaid application, now Patent No. 1,913,242, of which the present case is in part a division and in part a continuation, and which comprises generally, silica, an alkali metal and an alkali earth fused together in proportions that will produce fibers having length and fineness that cause them to automatically felt themselves into a body having mass integrity that enables the body to retain its shape during manipulation and while in position of use. But I may use other molten materials, for instance those constituting the subject-matter of my co-pending application Serial No. 672,235, filed of even date herewith, in which I have described and claimed a felted body of fiberized mineral compound consisting of a silica source and an amphoteric material, with or without a basic material.

5 represents a duct, passageway, tunnel, or the like, which, by reason of the effect which it produces upon the fiberized mass in the present invention and notwithstanding it may be of any desired section or of several sections at different places in its length, I herein refer to as the barrel. Barrel 5 has an opening of regulated capacity at its end 6 for the influx of air induced by the blast of the nozzle 3, and it is preferably of circular section at this point in order that the body of air taken in under the influence of the blast located at the center of the section, may be uniform throughout. This circular section will preferably continue for a material distance, for instance, to a point suggested by the transverse line 7 in Figure 2, where it will begin to change its section for the dual purpose of exercising a desirable influence upon the fibers that are being

borne through the barrel and causing the area of delivery of the said fibers as they leave the remote end of the barrel to assume a definite form in relation to the wall or surface upon which the fibers are collected. And this change of form is preferably attained by first reducing the transverse dimension of the barrel **5** in one direction, for instance, vertically, to bring it to a section typified by that shown in Figure 4 and which is attained at a point suggested by the line **4—4** of Figure 2; and thereafter reducing it in a direction perpendicular thereto and, in this illustrative instance, horizontally, until the barrel attains the form of section shown in Figure 5, by the time the discharge end is reached, as suggested by the line **5—5** in Figure 2. The section shown in Figure 5 may constitute a substantial diminution of capacity or sectional area as compared with either the section of Figure 3 or that of Figure 4; and this sectional reduction will have a beneficial effect upon the work, in that it condenses the mass of fibers, brings about increased intermingling or interlocking of the fibers while they are still borne upon the gaseous vehicle which is propelling them, and causes the mass to issue from the barrel in better condition to encounter the arresting wall.

The flame or gaseous heat sustaining environment **3***a* will become mingled with or added to the air that enters the barrel, since this air must pass through or around the said environment in entering the barrel and the result will be a material elevation of temperature in the vehicle upon which the fiber is borne, which has the effect of slowing down the cooling of the fiber and greatly improving its physical properties. It is also to be noted that the barrel confines against expansion the gaseous vehicle upon which the fibers are borne to the point of deposit and thereby retards dissipation of heat from the fibers, besides maintaining the density of the vehicle and better enabling it to serve its purpose as well as promoting intermingling of the fibers as an initial step toward the felting which results from their deposit upon the arresting wall.

The wall by which the fibers are arrested will preferably consist of a reticulated structure, such as woven wire or the like, as shown at **8**, and in order that this wall may be ever present at the point of fiber collection and at the same time given a travel which enables it to bear away the felted fibers as they accumulate at the desired thickness, the material of the wall is continued to produce an endless belt guided over rollers appropriately located to not only present it as a collecting wall at the discharge end of the barrel but to present the accumulating blanket in position for any desired manipulation appropriate for convenient handling. For instance, the reticulated endless belt or wall **8** may be guided around rollers **9** and **10** to present the blanket in position for developing into a roll **11** with a spacing sheet **12** fed from an endless roll **13**, and the said collecting wall may pass thence around drive rolls **14**, **15** with intervening tensioning roll **16** and guide roll **17** which, with the guide roll **9**, defines the position of the portion of the wall upon which the blanket is developed. But it is to be understood that the reticulated arresting wall need not be endless but could be in any other appropriate form, and its movement might be of other character, or even involve removal and replacement, manually or in any other way.

18 represents an air trunk which is so related to the rear side of the collecting wall **8** as to receive all that portion of the gaseous vehicle that passes through the wall **8** and prevent chokage or back pressure which would adversely influence the flow of the vehicle. **19** and **20** represent a discharge passage from the trunk **18**, suitably elbowed to avoid interference with the endless belt **8**. **21** represents an exhaust fan, typical of any means for inducing discharge from the trunk **18**, which means, however, could be the draft naturally induced in the stack **22** by the levity of the discharged vehicle, which, it will be understood, still retains a substantiall proportion of the temperature resulting from the molten stream, the flame that accompanied it, the fiberizing medium, or all of them.

The escape port **23***a*, maintained between the discharge end of barrel **5** or that portion of the developed blanket on the wall **8** which is leaving the area of the barrel, preferably delivers into a hood **23** having discharge stack **24** for carrying off dust and waste particles, communication between hood **23** and stack **24** being regulated by a baffle **25**. By regulating the draft at the port **23***a*, the flow of the fibers borne upon the upper portion of the gaseous vehicle, which might otherwise be undesirably reduced by reason of the thickening dimension of the blanket at that point, will be kept up so as to assure continued accumulation of fibers until the blanket passes from the influence of the barrel. Moreover, this deflection of flow of some of the gaseous vehicle toward the port **23***a* has the effect of directing the ultimate position of fibers which has a beneficial influence on the resultant blanket structure. To determine the proportion of this positioning effect, the volume of gaseous vehicle escaping through the port **23***a* in proportion to that which passes through the accumulating blanket and reticulated wall **8**, may be determined by proper adjustment of baffle **25** and pressure in the air trunk **18**.

As shown schematically in Figure 7, the stream **2**, which may issue from the same source as in Figure 1, may be kept up to fiberizing temperature by a flame environment **3***ax* issuing from an independent adjacent burner **3***ay* instead of from the furnace as in Figure 1; and in lieu of the steam or air jet as a means of fiberizing, as shown in Figure 1, the stream **2** may drop upon a rapidly rotating receiver **26** of concavo-convex or other form, which will throw it off in fibrous form in the path of a gaseous blast **27** of annular or other form which will deliver the fibers into the barrel **5** as in Figure 1.

A number of formulas are given in my Patent No. 1,913,242 for solutions of silica, alkali metal and stabilizing substances, all of which are appropriate to and available for the practice of the process herein described.

I claim:

1. The art of producing inorganic fibrous blankets with high inherent resiliency and mass integrity, which consists in fiberizing a fused solution of silica with a fluxing ingredient of the sodium group, together with a stabilizing ingredient and thereby producing resilient fibers of length and fineness causing the fibers to automatically felt when deposited; the fibers thereby generated being delivered into and conveyed by a vehicular gaseous beam; said beam and fibers being constricted in their flight by directing them through a duct which causes close intermingling of the fibers; and said vehicular gaseous beam bearing the fibers being positively directed

against a felting surface which arrests the fibers in a felted mass.

2. The method of fiberizing an inorganic material and forming therefrom a felted body having integrity of mass structure, which comprises blasting the material and delivering it in the form of fibers and in a state of diffused suspension into a projected gaseous conveyor, controlling the sectional area of said gaseous conveyor and directing its projection without suppressing the momentum of said conveyor and the fibers projected therewith, passing the gaseous conveyor through and collecting the fibers by a reticulated structure in a plane intersecting the path of projection, and continuing such projection of the fibers until a desired thickness of felted body accumulates on said structure.

3. The process described in claim 2, in which the accumulating bed of arrested fibers moves during its accumulation in said plane of intersection.

4. The art of producing structurally self sustaining and inherently resilient blankets of mineral fiber, which consists in fiberizing a fused siliceous solution into suspended fibers of a length and fineness that render the fibers self felting without the intervention of an adhesive, confining said fibers in suspension in a constricted beam of vehicular gaseous fluid, and directing the said beam and suspended fibers, while so confined, upon a reticulated felting and collecting surface.

5. The improvement described in claim 4, in which the gaseous vehicle and the fibers borne thereon are projected through a barrel which directs them against the arresting surface, and the arresting surface is presented across the discharge end of the barrel.

6. The improvement described in claim 4, in which the gaseous vehicle and the fibers borne thereon are projected through a barrel which directs them against the arresting surface, and the arresting surface is presented across the discharge end of the barrel in a plane that causes the axis of projection to meet the plane of the surface at an angle of incidence that is materially less than a right angle.

7. The improvement described in claim 4, in which the gaseous vehicle and the fibers borne thereon are projected through a barrel which directs them against the arresting surface, and the arresting surface is presented across the discharge end of the barrel in a plane that causes the axis of projection to meet the plane of the surface at an angle of incidence that is approximately 60°.

8. The improvement described in claim 4, in which the fibers and their vehicle are confined in a barrel until they reach the arresting surface and the discharge end of the barrel comprises an opening having a characteristic section corresponding in lateral dimension to the width of the fibrous mass that is to be accumulated.

9. The improvement described in claim 1, in which the gaseous vehicle with the fibers borne thereon is projected through a barrel which determines the axis of its delivery against the arresting surface; the transverse dimension of the barrel being diminished toward its discharge end in order to condense the sectional area of the vehicular medium upon which the fibers are borne.

10. The improvement described in claim 1, in which the blasted vehicle upon which the fibers are borne is projected in defined volume by a barrel having a desired characteristic section at its discharge end, and a portion of the barrel intermediate of the ends is changed in section so that the characteristic discharge section is approached gradually.

11. The improvement in the art of producing a blanket of felted fiberized mineral, which consists in bearing the fiberized mineral upon a gaseous vehicle against a collecting surface, and permitting escape of a portion of the said vehicle through a port which gives it a direction substantially parallel to the surface of the blanket, and thereby influencing the direction of fibers in the said blanket.

12. The improvement described in claim 11, in which the collecting surface is presented by a reticulated structure and permits a portion of the vehicle to flow through it while another portion flows through the said escape port.

13. The improvement described in claim 11, in which the collecting surface is presented by a reticulated structure and permits a portion of the vehicle to flow through it while another portion flows through the said escape port; and the volume of vehicle escaping through the said port is regulated in proportion to that which flows through the reticulated structure.

14. The improvement described in claim 11, in which a regulated portion of the vehicle flows through the collecting surface while another portion thereof flows parallel with the blanket; and the evacuation of the portion that flows through the collecting surface is promoted beyond the said surface.

15. In the art of fiberizing fused inorganic mineral substances, the improvement which consists in delivering the fibers, together with an impelled gaseous vehicle which holds them in suspension, into a barrel that confines the fibers and impelled vehicle in the form of a constricted and directed beam, promoting commingling of the fibers by continuing such constricted confinement, and causing said beam, with a sectional area and in a direction determined by the barrel, to impinge directly upon a felting and arresting surface.

16. The improvement described in claim 15, in which the fibers are delivered to the barrel at high temperature and subjected to controlled cooling by the continuance of the flow of the constricted beam in which they are suspended.

17. The improvement described in claim 15, in which the fused mineral substance enters the barrel while in ductile state, and the fibers are generated within the barrel and subjected to controlled cooling by their passage in suspension therethrough.

18. The improvement described in claim 15, in which the fiberized mineral substance enters the barrel at high temperature and accompanied by gaseous heating medium which forms part of the suspending vehicle of the fibers, and in which the fibers are subjected to controlled cooling by continued suspension in the constricted vehicular beam.

19. The method of producing a felted body of inorganic fibers having mass integrity under manipulation and mass resiliency in use, which method comprises flowing a stream of molten material of the type herein described, applying a blast of gas to the stream and thereby attenuating it into relatively long, fine caliber, inherently resilient and self-sustaining fibers and causing said fibers to solidify and to be carried without interruption forward with the blast and

at a high velocity substantially the same as that of the blast, and arresting the fibers at a plane extending through and at a high angle of incidence to the blast, thereby accumulating the fibers under pressure of the blast to form a sheet or web while the main body of the blast continues through the accumulating web without substantial diminution in force or change in direction; the said process also including the step of causing a minor portion of the blast to be drawn off in approximately the direction of the surface of the accumulating web.

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