March 10, 1942. R. ERICSON 2,275,816

FLOWABLE HEAT INSULATING MATERIAL AND METHOD AND APPARATUS FOR FORMING THE SAME

Filed March 14, 1938 2 Sheets-Sheet 1

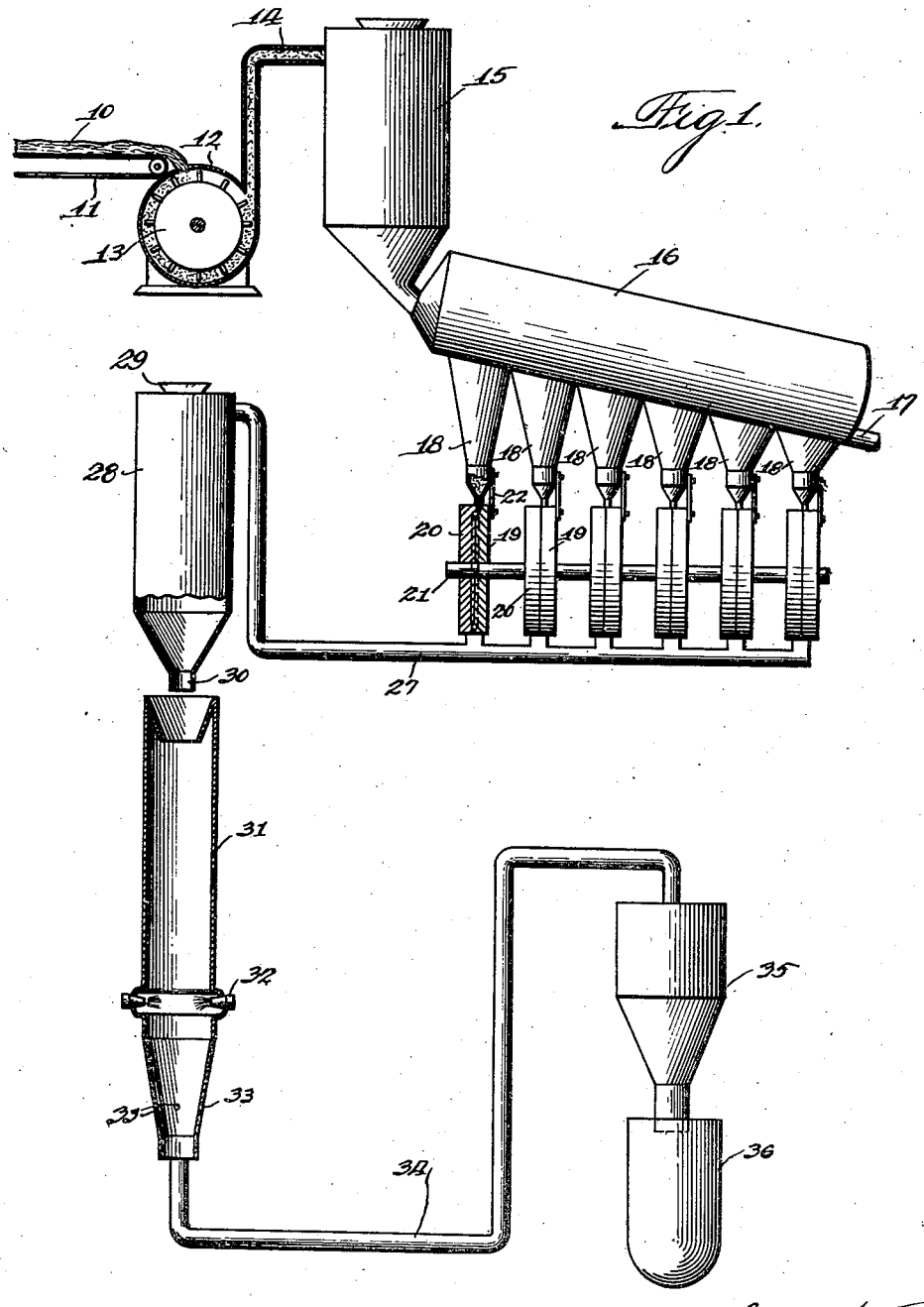


Fig. 1.

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Filed March 14, 1938 2 Sheets-Sheet 2

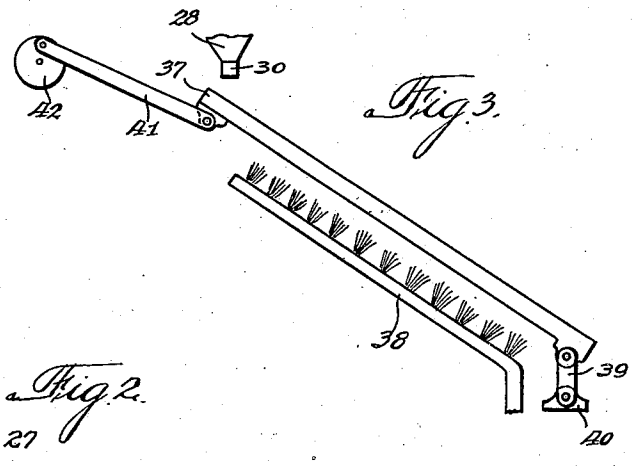


Fig. 3.

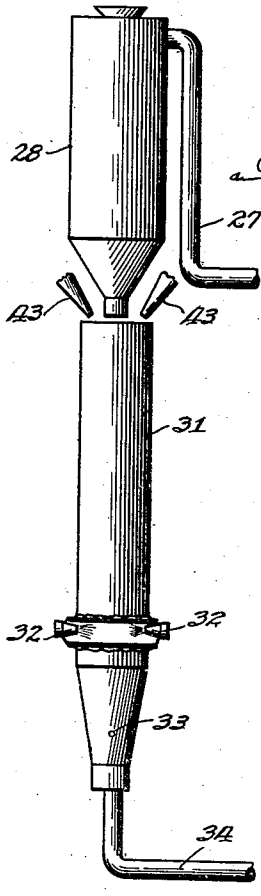


Fig. 2.

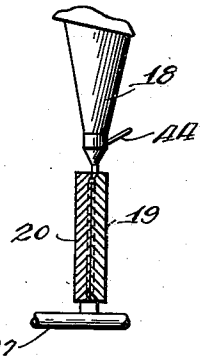


Fig. 4.

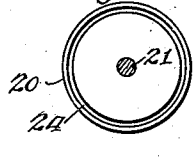


Fig. 5

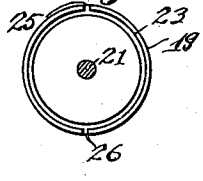


Fig. 5a

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UNITED STATES PATENT OFFICE

2,275,816

FLOWABLE HEAT INSULATING MATERIAL AND METHOD AND APPARATUS FOR FORMING THE SAME

Richard Ericson, Chicago, Ill., assignor to United States Gypsum Company, Chicago, Ill., a corporation of Illinois

Application March 14, 1938, Serial No. 195,831

9 Claims. (Cl. 154—28)

My invention relates to heat insulating materials and to methods and apparatus for producing the same. More particularly, the invention relates to the manufacture of flowable heat insulating materials of a fibrous character and has for an object the provision of a product, process, and apparatus of this type.

In the insulation of buildings and other similar structures it is now common practice to introduce into the hollow wall spaces thereof granular types of insulating materials so as to decrease the flow of heat therethrough. Various attempts have heretofore been made to increase the flowability of granular fibrous materials so as to duplicate the flowability of other types of granular insulation such, for example, as ground cork, "pop corn" slag, or expanded vermiculite, but so far as I am aware none of these attempts have been entirely successful.

One method of treatment which is now common in the art, is to pass the fibrous material through nodulating or granulating machines so as to roll the material into small irregular shaped particles to facilitate blowing or pouring the material into a space to be insulated. The fibrous insulating material thus formed is more spreadable than ordinary fibrous particles not so treated, but it cannot be considered as flowable. In other words, while the material can with some difficulty be spread out between joists to a fairly uniform thickness, considerable difficulty is encountered when it is attempted to pour the material into a hollow wall space or into similar voids of appreciable depth.

An examination of the fibrous particles now sold on the market as nodulated or granulated wool indicates that the exterior surfaces of the particles consist of extending threads of fibers which interlock with similar fibers on adjacent particles, thus preventing free flowability of the material. It will also be found that fibrous particles thus formed are composed of fibers which have broken considerably during the process of nodulating or granulating. It will thus be apparent that something is yet to be desired in fibrous insulating materials of this character, and accordingly it is a further object of my invention to provide an improved method and apparatus whereby a granular fibrous insulating material may be provided having a high degree of flowability due to the fact that the exterior surfaces of the resulting nodules or particles are substantially free from projecting fibers.

In carrying out my invention in one form I first form the fibrous insulating material, such for example as mineral wool, into particles of predetermined size and treat the particles so as to remove the projecting fibers from the exterior surfaces thereof. More particularly, the particles after being formed to a predetermined size are subjected to a rolling action to form substantially spherical particles which are then subjected to a surface-treating operation to remove the projecting fibers. This surface-treating operation may be accomplished by heating the spherical particles sufficiently to fuse the external surfaces thereof and remove the projecting fibers while forming a slight incrustation on the surface, or a similar incrustated surface may be provided by coating the exterior surfaces of the spherical particles with a suitable adhesive material so as to bind the projecting fibers together and form an incrustation or coating.

It will of course be understood that the nodules thus formed may be of various desired sizes and shapes, and a very effective flowable heat insulating material may be obtained by intermingling nodules of several different sizes, the nodules of each particular size being formed in accordance with my invention to provide incrustated or smooth surfaced particles.

As a further aspect of my invention I provide an improved apparatus for subjecting the particles to a rolling action so as to provide a spherical configuration, and in some cases it may be desired to apply the coating material to the particles prior to the rolling action.

For a more complete understanding of my invention reference should now be had to the drawings in which:

Figure 1 is a somewhat diagrammatic representation of a preferred form of apparatus embodying my invention for producing, by my improved process, granular heat insulating materials embodying my invention;

Fig. 2 is a fragmentary view of a modified form of apparatus embodying my invention;

Fig. 3 is a diagrammatic representation of a still further form of apparatus which may be utilized in carrying out my invention;

Fig. 4 is a fragmentary view of a portion of the apparatus used when it is desired to apply the coating material to the particles prior to the rolling operation;

Fig. 5 is a disassembled detail view of a portion of the rolling means illustrated generally in Fig. 1; and

Fig. 5ª is another disassembled detail view of a portion of the rolling means illustrated generally in Fig. 1.

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Referring now to the drawings, in the preferred embodiment of my invention illustrated in Fig. 1 a body of fibrous material 10, such for example as mineral wool, glass wool, etc., is continuously fed, as for example by a conveyor 11, to a suitable disintegrator 12 which is here shown as including a multi-bladed rotating chopping member 13, by means of which the fibrous material is reduced to particles of varying size. From the disintegrator 12 the particles of fibrous material are conducted through a suitable conduit 14 to a separator 15 which may be of any desired type, such, for example, as a cyclone separator in which the particles are vigorously agitated to prevent adherence of the particles to each other to form large agglomerates or bodies, and from the separator 15 the particles are introduced into a rotating trommel 16 for closely grading the particles. The trommel 16 is of a type well known in the art and includes a plurality of screens of various sizes, the smallest screen being adjacent the inlet end of the trommel and the largest screen being adjacent the discharge end from which end oversize particles are returned to the disintegrator through a duct 17, only a portion of this duct being shown.

As shown, the trommel 16 discharges the closely graded particles into a plurality of funnel-like conduits 18, the lower end of each of the funnels 18 communicating with a rolling device for reducing the particles to a substantially spherical shape. Each rolling device, as shown, consists of a stationary disc or plate 19 arranged in face-to-face engagement with a rotating disc 20, the disc 20 being keyed to a rotatable shaft 21 which may be driven by any suitable means, not shown, and the stationary disc 19 being rigidly mounted, as for example by a bracket 22, and being provided with a suitable aperture through which the rotating shaft 21 loosely extends.

As shown best in Figs. 5 and 5a, the stationary disc 19 is provided with a substantially circular groove 23 in one face thereof and the corresponding face of the rotatable disc 20 is provided with a cooperating groove 24, so that when the discs are arranged in face-to-face engagement the grooves 23 and 24 form a passageway which is substantially circular in cross section. Adjacent its upper end the stationary disc 19 is provided with an inlet 25, and a similar outlet passageway 26 is provided in the disc 19 adjacent its lower end.

It will thus be apparent that when the closely graded particles are introduced into the inlet passageway 25 in the various rolling devices, rotation of the rotatable discs 20 will effect movement of the particles through the passageways formed by the grooves 23 and 24 and will subject the particles to a rolling action so as to impart thereto a substantially spherical shape before the particles are discharged through the outlet 26. It will of course be understood that the grooves 23 and 24 in the various discs 19 and 20 are so formed as to provide passageways corresponding in size to the size of the graded particles supplied thereto.

From the outlet passageways 26 of the rolling devices the fibrous particles which are now substantially spherical in form are discharged into a suitable conduit 27 or other suitable conveying means, and are thereby introduced into a separating chamber 28 which may, if desired, be similar in construction to the separator 15. While any suitable means may be provided for conveying the particles from the disintegrator 12 through the various portions of the apparatus, I prefer to provide a closed system of the type shown and to convey the particles pneumatically through the apparatus by means of suction, which may be accomplished by connecting to the conduit 29 at the top of the separator 28 suitable suction applying means not shown.

The lower end of the separator 28 is provided with a discharge opening 30 as shown, from which the particles drop by gravity through a treating chamber 31 in which the surfaces of the particles are so treated as to remove the extending fibers therefrom and form a surface incrustation thereon so as to form a free flowing heat insulating material of the character described above.

It will be apparent that during passage through the duct or conduit 27, the separating chamber 28, and the treating chamber 31, the various size particles discharged from the rolling means comprising the discs 19 and 20 are thoroughly intermingled and accordingly the flowable heat insulating material as it reaches the sacking bin 35 consists of intermingled, smooth-surfaced, fibrous nodules of several different sizes. If desired of course the nodules of each particular size may be separated as they leave the rolling devices and may be separately treated thereafter to provide a final product made up entirely of nodules of similar size. Ordinarily a more closely packed insulation will be obtained by employing a material made up of intermingled nodules of several different sizes.

In the embodiment of my invention here shown, this surface treatment of the particles is accomplished by fusing the exterior surfaces to such an extent as to remove any projecting fibers and form a slight incrustation. Thus the treating chamber 31 is provided with a plurality of burners 32 which may be gas, oil, or powdered coal burners, and which discharge directly into the chamber 31 so as to provide a heating zone in the chamber, the gases of combustion passing upwardly through the chamber 31 and out of the top thereof. As the particles pass downwardly through the combustion chamber 31 in counter-current relation to the hot gases, the external surfaces thereof are fused and the temperature produced in the combustion chamber by the burners 32 is so controlled with respect to the character of the fibrous particles and to the length of time that the particles remain in the chamber, as to cause only the surface of the particles to be fused.

As the resulting smooth-surfaced nodules pass through the portion of the chamber 31 below the burners 32, they are cooled by any suitable means, as for example by air introduced through suitable apertures 33, and the nodules are then conducted through a suitable conduit 34 to a sacking bin 35 from where they may be packed in bags as indicated by the reference numeral 33 for shipping or storage. It will of course be understood that in place of the conduit 34, to which suction is preferably applied, any suitable type of conveyor means may be provided for conducting the fibrous nodules to the sacking bin 35.

Although I prefer to use a treating chamber, such as the chamber 31, for fusing the spherical particles after they are discharged from the separator 28, it will of course be understood that my invention is not limited to this particular treating means, and in Fig. 3 I have shown a somewhat different arrangement for fusing the external surfaces of the particles to provide an incrustated surface. In this embodiment of my invention a

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vibrating screen 37 is arranged immediately below the outlet passageway 30 of the separator 28, and a battery of burners 38 of any suitable type is disposed beneath the vibrating screen for fusing the particles as they move downwardly along the inclined screen 37. Vibrating screens of the type here shown are of course well known in the art, and any suitable means may be provided for accomplishing the desired movement of the screen 37. For purposes of illustration I have shown the screen as pivoted at its lower end on a link 39 which is in turn pivotally mounted on a fixed support 40, the upper end of the screen 37 being pivotally connected to a crank arm 41 the opposite end of which is connected as shown to a rotatable crank disc 42. This disc 42 may, of course, be driven from any suitable source of power and it will be apparent that as the disc 42 rotates the screen 37 will be reciprocated or vibrated, whereby movement of the fibrous particles downwardly along the screen 37 and over the battery of burners 38 will be assured. Suitable conveying means, not shown, are of course provided adjacent the lower end of the screen 37 for conveying the resulting smooth-surfaced particles or nodules to a suitable sacking bin or storage chamber.

In some cases it may be desirable to coat the exterior surfaces of the fibrous particles with a suitable adhesive so as to bind the projecting particles together and form an incrustation or coating on the surface of the particles. While various organic glues may be used for this purpose, I prefer to utilize inorganic binding materials because of their non-combustible nature. Thus, suitable binding materials or adhesives which may be employed, for example, are water soluble silicates, clays such as highly colloidal bentonite, cementitious materials such as Portland cement, magnesium oxysulfate and chlorides, lime, calcined gypsum, pozzolan cements, fusible silicate mixtures which can be applied when heated, and other fusible materials such as borax.

While the adhesive or coating material can of course be applied to the particles in any suitable manner, I prefer to apply the adhesive by spraying the particles as they fall through the treating chamber 31 or as they pass down the vibrating screen 37. Thus in Fig. 2 I have shown an embodiment of my invention in which suitable spraying nozzles 43 are provided adjacent the upper end of the treating chamber 31 for spraying the fibrous particles with a suitable coating or adhesive material as the particles pass through the treating chamber. During their passage through the chamber 31 the particles are baked and dried by the combustion gases traveling upwardly through the chamber in counter-current relation to the movement of the particles, and the incrustated particles or nodules are discharged from the bottom of the treating chamber 31 by suitable conveying means, such for example as the conduit 34 described above in connection with Fig. 1.

As a further embodiment of my invention I have also found that it is sometimes desirable to apply a fluid water-clay mixture or other suitable slurry to the fibrous particles before they are subjected to a rolling action between the discs 19 and 20. This may be accomplished, as shown in Fig. 4, simply by introducing a suitable fluid slurry into the conduits 18, as for example through a suitable supply pipe 44. The addition of a slurry at this point in the treatment of the fibrous particles, assists in the rolling of the fibers into spherical particles provided that the slurry is in a fluid condition. A sticky or thick mass of clay would of course interfere with proper rolling of the particles.

After the clay-coated particles have been subjected to the proper rolling action, the clay surface or incrustation may then be dried or baked by passing the particles through a suitable treating chamber such as the chamber 31.

It will of course be understood that the apparatus and the various processes described above are simply illustrative, and that my invention is not limited to the detailed apparatus and steps specifically described. For example, in place of the disintegrator 12 any suitable means may be provided for initially reducing the fibrous material to particles, one suitable arrangement being the provision of means for forming a thin continuous bat of fibrous material, which bat is then sliced into thin strips, the strips rolled, and the long tubular strip thus formed cut into lengths of desired size. Furthermore, my invention is not limited to an arrangement in which the particles are exposed directly to the products of combustion in the heating chamber, since the chamber 31 may obviously be indirectly heated by means of a conventional firebox surrounding the lower end of the chamber 31.

By fibrous insulating materials I intend to include any type of fibrous material used for insulating purposes, such for example as glass, mineral rock, or slag wool, and certain types of asbestos fibers. In general, I have found that a shorter length fiber rolls more readily than longer fibers and that rock wool rolls better than glass wool, but it should be understood that the rollability in each case depends upon the chemical composition, the fiber lengths, the diameter of the particles, etc.

While I have shown particular embodiments of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A flowable heat insulating material comprising nodules of fusible mineral fibers the surfaces of which are fused to provide an incrustation thereon.

2. A flowable heat insulating material comprising mineral wool nodules the exterior surfaces of which are fused to provide an incrustation thereon.

3. The process of forming flowable heat insulating material which comprises forming fusible fibrous mineral material into nodules of predetermined size and fusing the exterior surfaces of said nodules to remove projecting fibers.

4. The process of forming flowable heat insulating material which comprises forming mineral wool into particles of predetermined size, subjecting said particles to a rolling action to form substantially spherical nodules, and fusing the exterior surfaces of said nodules to remove projecting fibers therefrom.

5. The process of forming flowable heat insulating material which comprises forming mineral wool into particles of predetermined size, subjecting said particles to a rolling action to form substantially spherical nodules, and passing said nodules through a zone in countercurrent rela-

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tion to a stream of hot gaseous medium to fuse the exterior surfaces of said nodules.

6. In a process for improving the flowability of mineral wool nodules adapted for use as insulating material the step which comprises fusing the exterior surfaces of said nodules to remove projecting fibers therefrom.

7. Apparatus for forming flowable fibrous insulating materials of fusible mineral fibers comprising means for forming said fibers into particles of predetermined size, means for rolling said particles to form nodules having a substantially spherical shape, means for heating said spherically shaped nodules to fuse the exterior surfaces thereof, and means for agitating said nodules during said fusing operation.

8. Apparatus for forming flowable fibrous insulating materials of fusible mineral fibers comprising means for forming said fibers into particles of predetermined size, means for rolling said particles to form nodules having a substantially spherical shape, a treating tower having inlet means adjacent one end thereof for said spherical nodules, and heating means in said tower for fusing the exterior surfaces of said spherical nodules as they pass through said tower.

9. The process of forming flowable heat insulating material which includes the steps of forming fusible mineral fibers into nodules of several selected sizes, fusing the exterior surfaces of said nodules to remove projecting fibers therefrom and intermingling the nodules to form a mass of smooth surfaced fibrous nodules of said selected different sizes.

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