106. COMPOSITIONS, COATING OR PLASTIC

Examiner

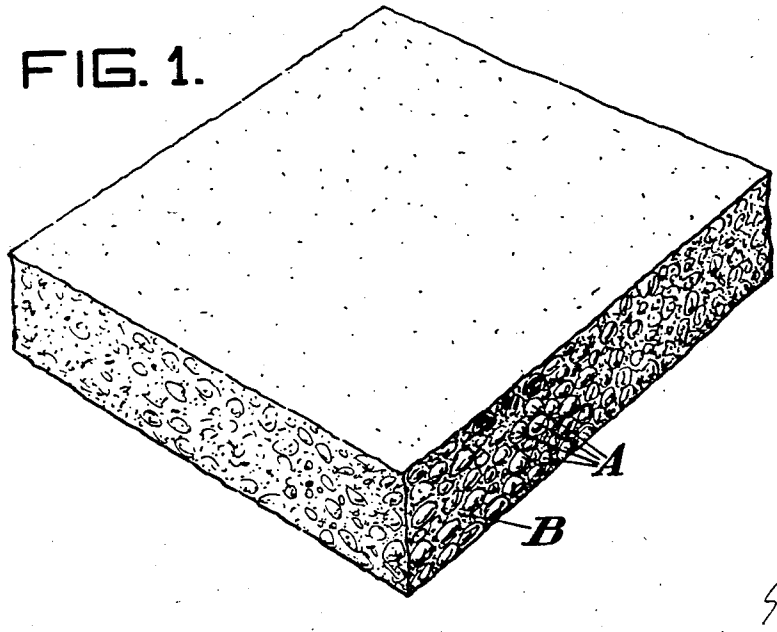
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May 26, 1942. F. T. LLEWELLYN ET AL 2,284,400

THERMAL INSULATION

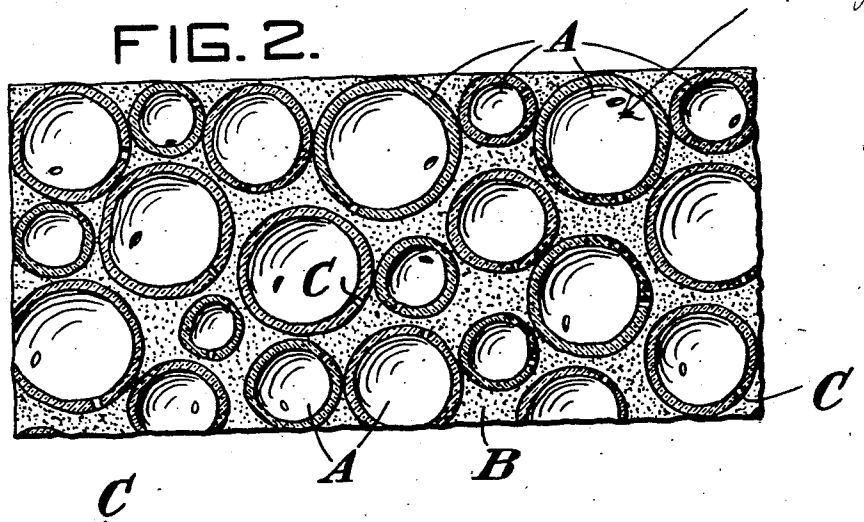
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FIG. 1.



slag

FIG. 2.



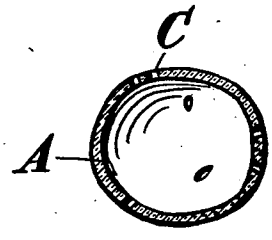


FIG. 3.

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THERMAL INSULATION

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Application April 7, 1939, Serial No. 266,622

1 Claim. (Cl. 106—84)

This invention relates to a thermal insulating material comprising a multiplicity of hollow components of globular slag held en masse by a binder effective to seal the openings in the walls of substantially or approximately all of said hollow components. In the interest of brevity, the hollow components will be herein referred to as "bubble slag," and the material which binds them together will be referred to as the "binder."

Among the objects of the invention are to produce a relatively low cost, yet effective thermal insulating material from the slag by-products of blast furnaces that have heretofore been either wholly or partly wasted; to produce a thermal insulating material having an efficiency substantially greater than that of usual non-flammable insulating materials of comparable thickness or having the same efficiency with substantially less thickness; to produce a thermal insulating material whose cost is substantially less than that of usual insulating materials having the same or comparable efficiency; to produce a thermal insulating material whose untreated exposed surface presents a finish of sufficiently pleasing appearance for many purposes, and which in all cases is of a character suited to receive either decorative or utilitarian finishes; and to produce a thermal insulating material extremely light in weight per unit of volume, yet whose strength and stiffness characteristics are adapted for use as a backing for other materials.

For a complete disclosure of the invention, reference should be had to the following detail description, the accompanying drawing and the definitions thereof in the appended claim.

In the drawing:

Figure 1 is a perspective view of a body of thermal insulation made of the novel composition herein claimed;

Figure 2 is a somewhat diagrammatic fragmentary section of the composition; and

Figure 3 is a section of one of the hollow slag particles constituting one of the essential elements of the novel insulation.

The essential components of the novel insulating material of the present invention are slag bubbles A, herein sometimes referred to as bubble slag, and a suitable binder B, the composition of which will be later referred to. The bubble slag components are roughly globular in form. We have found that they can be produced from suitable blast furnace slag by a known steam blowing process such as that disclosed in the patent to Stephen W. Schott, No. 1,950,932. The novel material of the present invention differs from that disclosed in the Schott patent in that it contemplates the maintenance of the slag product in hollow globular form, whereas under the teachings of the Schott patent the slag particles are intended to be crushed prior to use. Such crushing of the cellular product is also contemplated by others skilled in the art, as is evidenced by the teachings of the Hunsaker Patent No. 1,849,090.

We have discovered that for insulating purposes uncrushed slag particles in the form of individual hollow bubbles held en masse by a binder which seals the major openings C of substantially all the bubbles on the interior of the structure are superior. We have also discovered that the bubble slag can be produced as a by-product during the production of pig iron without detriment to the normal operation of the blast furnace. It is regarded of considerable importance that the slag must be ultra high in silica and flushed or poured at an ultra high temperature.

There is no critical size of bubble required. By the usual steam blowing practice the bubbles will range in size from about ½ inch in diameter down to a size corresponding to fine powder. The shell thickness of a given bubble does not decrease as rapidly as its diameter; hence the ratio of the volume of air that the bubbles enclose to their shell volume varies roughly with their diameter. Their insulating value varies correspondingly.

In practice slag bubbles of different sizes will be employed, depending upon the purpose for which the insulation is to serve. Where a light weight composition is desired for insulation against atmospheric thermal changes, we have found that bubbles which will pass through a screen having 4 meshes per inch, but which will not pass through a screen of 14 meshes per inch, are most suitable. Where the composition is to be used for fireproofing purposes, somewhat smaller bubbles are more effective. For example, for this purpose bubbles that will pass through screens of 14 to 28 meshes per inch are better.

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For either use, it is imperative that the bubbles be unground or uncrushed; that is, an esential feature of the invention is to employ a composition wherein the multiplicity of hollow bodies are held together by a binder. The binder serves two essential functions. First, it causes the multiplicity of hollow slag bodies or bubbles to cohere so that the composition can be transformed into a unitary, plastic slag body which may be attached to the articles it is desired to insulate; second, it serves to seal any major openings C that may penetrate the shell of individual bubbles. This sealing function of the binder is important because slag bubbles of the character herein referred to usually are somewhat pervious, the shell thereof frequently containing at least one or more small openings C. The binder thus serves to seal such penetrating openings and render the bubble shells substantially impervious. The insulating composition as a whole contains a great multiplicity of small, dead air spaces which is an important characteristic of any material for use as thermal insulation. Theoretically it would be feasible to render the shell of all bubbles impervious by means of a suitable binder, but from a practical standpoint it is sufficient to close approximately all of the bubbles located in the body of the product and permit those lying on the exposed surface to be closed or not closed, depending upon whether the binder happens to extend into or seal their openings. Experience has shown that the presence of a few unclosed bubbles on the surface is negligible.

The composition of the material and the particular binder used will vary somewhat, depending upon the environment in which the same is used. When used on the walls of buildings to insulate against thermal atmospheric changes ranging up to approximately 150 degrees Fahrenheit, the following composition is suitable:

Ingredients	Percentage by volume
Bubble slag, 4–14 mesh (weighing 16 lbs. per cu. ft.)	80
Binder: Cement	10
Binder: Combined water	10

In use, this composition developed a K factor of 0.89, the term K factor indicating to those skilled in the art the number of British thermal units that in one hour will pass through 1 square foot of the material, 1 inch thick, for each degree of Fahrenheit of difference in temperature on the opposite surfaces of the material. This value is somewhat better than that of ordinary low cost non-flammable materials in general use for comparable purposes.

Where our improved composition is to be used for fireproofing steel floor joists or other metal structures where the temperature on the exposed surface may reach 1700 degrees Fahrenheit in a one hour standard fire test or 1850 degrees Fahrenheit in a two hour test, the following composition has proved to be effective:

Ingredients	Percentage by weight	
Bubble slag (weighing 40 lbs. per cu. ft.):		
14–20 mesh	20.0	
20–28 mesh	20.0	
200 mesh	15.8	55.8
Binder: Asbestos		5.0
Binder: Zinc oxide		4.2
Binder: Sodium silicate:		
41 Beaumé	12.6	
47 Beaumé	22.4	35.0

Test has shown that a thickness of only ⅛ inch of the above composition will satisfactorily stand the standard one hour fire test, with a temperature on the steel surface of about one-half that on its exposed surface. In a test of two hours' duration equally satisfactory results have been obtained. To give comparable performance, ordinary low cost insulating materials heretofore available required a thickness of at least ¾ inch.

The cost of production of our improved composition will be low due to the fact that it is made from an otherwise valueless slag by-product which can be rendered suitable for use in the composition by a comparatively inexpensive steam blowing process. The screening or sorting of the slag bubbles into suitable sizes may be economically effected by automatic vibrating screening operations.

The composition can be applied to the walls of buildings by means of a low pressure air gun. The heavier composition in which the smaller bubbles are used possesses a natural surface finish of pleasing appearance, and for many purposes no additional finish will be required. However, if for aesthetic reasons an additional finish is desired, the natural surface of the composition is suitable to receive paint, plaster or other finishes.

While we have described quite specifically certain characteristics of the components of the novel composition, it is to be understood that the disclosure is to be interpreted in an illustrative rather than a limiting sense.

We claim:

A composition of matter for fireproofing comprising approximately 55 per cent by weight of bubble slag held en masse by a binder comprising by weight approximately 5 per cent asbestos, 4 per cent zinc oxide and 35 per cent sodium silicate.

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