3,020,244 METALLIC POWDER COMPOSITION
3 Claims. (Cl. 75—5)

This invention relates to putty-like material and particularly to a metallic structure of powder particles combined in plastic form to be molded into various shapes and act as a seal, interceping and blocking off injurious radiation.

This is a continuation-in-part application based upon original application Serial No. 349,565, filed April 17, 1953, now Patent 2,833,664, issued May 6, 1958, for Metallic Powder Composition.

The object of the invention is to provide a metal-carrying putty concentrating the metallic content to high density to serve as an effective barrier and seal against injurious radiation.

In the manufacture of equipment and buildings for atomic energy work, for instance, it is vitally important to avoid leakage of the resultant radiation. In spite of the care exercised and the expense involved, cracks and crevices are unavoidable and sometimes develop in use.

The metallic putty of my invention supplies an inexpensive, convenient and reliable seal for these openings, simplifying the original structure and avoiding the necessity of costly time-consuming repairs where leaks develop in use.

In the formation of the putty a metallic powder of protective ray-absorbing metal, such as lead, is mixed with a relatively slight amount of an oil or grease, acting to coat the individual particles. For example, 15% of Texas Company Crater crease, a semi-fluid lubricant, is mixed with 85% of lead powder by weight, the powder preferably being minus 200 mesh to give a thorough thin filming of the powder particles.

I have found that a greatly improved product may be obtained by increasing density providing a correspondingly more effective and reliable barrier to the rays.

The desired increase in density is attained by working of the mixture to agglomerate the lead powder particles and then compacting the agglomerate. The mixture and presenting a greatly increased ray absorption for a given thickness of the putty barrier. This increase is often critical rendering the material usable in situations where it would otherwise fail. The increase may be from lower density ranges to the compacting for any density desired in the final product.

The relatively greater increase in absorption over the mere gain in total quantity of interposed metal may be due to the greater effectiveness of the coated particles in blocking the paths of the rays. Whatever the explanation may be, there is an unexpected improvement in the concentration structure rendering it far more efficient in absorption of the injurious rays.

For example, a normal lead putty mixture of the above ingredients having a density in the range of 2 to 6.5 (grams per cubic centimeter), after running through an extruder under high pressure of five hundred pounds per square inch. Its density increased to over 9 and the resulting putty on microscopic examination shows its lead particles in agglomerates of various groupings in which many of the lead particles are in metal to metal contact. Under the pressure applied the grease films on the particle surfaces have been squeezed to extreme thinness and even ruptured either forming a film bond between the adjacent particles or establishing a bond of metal to metal.

Other agglomerating procedures such as beating, grinding, hammering and the like may be employed depending on the materials and quantities involved. The important object is to bring the density of the putty as high as possible while still maintaining its pliancy so that it may be pressure-shaped into the cracks and crevices to be filled. The number of particles involved in the agglomerates will vary widely and the individual agglomerates themselves are intermittently malleable in that, while firmer than the particle-vehicle mixture, they are more plastic than the solid lead.

Other examples of typical mixtures operating in the same way when mixed and coated are 15% Quaker State Viscous-Lube, a pressure gun grease, with 85% lead powder and 10% Dow Corning Fluid XP-200, a silicone lubricant, with 90% lead powder, both by weight. Any grease or oil acting to film the metal particles or agglomerates may be employed and the choice of the vehicle will depend on the locality and conditions of use, the crevices to be filled, the temperatures involved, etc.

Instead of the powders of other metals such as tungsten may be used, or mixtures thereof may be resorted to, where, for instance, the softer acts as a bonding between the others.

In the formation of the putty composition the precise proportions between the metal powder and the binder material are not critical, the objective being to employ as much powder as is practical. The oil or grease used should be only sufficient to give a putty-like mass of proper plasticity and a structure which will hold together and can be applied as putty is used to fill cracks, crevices, seams, etc.

The high density is the important criterion, reflecting as it does the necessary agglomeration of the great mass of the metal particles into aggregates in which the particles are closely bound together. The binding forces between the particle surfaces will be thin molecular layers of the oil or grease used and also, preferably in larger part, the cohesion of the metal to metal contact of the metal surfaces as they are forced together by the compressing action of the extrusion, beating, hammering or the like.

The resulting structure presents a cooperative barrier action between the thus aggregated metal particles, greatly augmenting the efficiency of the absorption and simplifying the application of the putty and reducing the expense involved.

The extruded formations may dispense with the binder and the degree of compression will be controlled by the temperature and the intensity of the pressures applied, the metallic surface skin being developed as a containing envelope. Particularly with powders of zinc, lead, tin and cadmium such extrusion may be carried on at room temperatures. With other less soft metals it is desirable to raise the temperature, for instance, to about the recrystallization level such as 150° C. for aluminum and magnesium or 200° C. for copper, silver and gold.

In general the extrusion of any metal at about its recrystallization temperature will give the interior compacting of the powder particles to about 70% to 95% of the density of the metal of the powder, and simultaneously the extrusion will develop a substantially continuous metallic surface layer. The result is a bendable rod of sufficient plasticity to be readily pressed and molded into desired shape.

The powders may be a mixture of different metals.

In the extruded formation of the powdery material the metal particles tend to accumulate and cohere at the surface of the rod-like extruding mass developing a metallic surface skin by the welding together of the particles under the pressures applied and the resulting attrition between the material and the containing walls.
of the casing. A metal tube formation is thus generated holding the compacted material within it and rendering the putty convenient and easy to handle and apply as plastic strips readily bent and compressed into tight and closely fitting engagement with the crevices and openings to be sealed.

The cross sectional shape of the extruded strips may be of any desired configuration, circular, triangular, rectangular or more intricate designs adapted for most advantageous positioning and interfitting with the surfaces of the parts of the apparatus to which they are applied, or of metal alloys. A soft metal powder such as lead may be mixed with particles of a harder metal, for instance tungsten, to serve as a binder for the latter to correspondingly reduce the temperature and pressure required for the compacting procedures, and the invention in its development of the ray absorption and plasticity attains substantially the full protection of the solid metal but in desired shape and plastic form.

It involves a combination of critical features contributing to the final ray absorbent strip or putty formation. The particle surfacing time cycle may consist of continuous or intermittent processing and aging to achieve the final stability required, depending upon the density of the ingredients and other criteria as follows:

(1) Fineness.—The metal (lead) should be in fine powder form to start with. The finer the powder, the greater the surface area involved per pound, and the thinner will be the finally formed powder flakes in the ultimate product.

(2) Multilication.—These fine powder particles must be formed into a plastic mass and this is done by bringing them into local contacts with each other under a spreading or flattening pressure.

(3) Temperature.—The temperature should be at or above the recrystallization temperature of the metal so that the localized energy at the minute areas of contact will form tiny cold welds.

(4) Particle surfacing.—Before the pressing operation the surfaces of the metal particles should be conditioned to provide for metal to metal contact. It is important that any surface oxide or other filming be very thin indeed so that as the particle is multilicated and has its surface area correspondingly increased under the pressure, the resultant thinning of the film will tend to spread it and make it easily disrupted at the tiny area of contact and concentrated pressure with resultant cold weld which cannot be made in any other way.

(3) Pressure.—The pressure must be sufficient to have the spreading flattening effect on the particles and supply the energy for the microscopic cold welds.

I claim:

1. A putty-like structured metallic sealing material having a hand pressure responsive pliancy adapting it to be hand pressure-shaped into place to intercept injurious radiation and consisting only of fine, protective ray-absorbing metal powder particles worked and reshaped and reformed together under pressure, said particles being largely compacted and agglomerated together and joined at metal-to-metal contact areas into a plastic entirely metallic structure of aggregates of various groupings of particles of shapes determined by said working with a spreading and flattening of individual metal-to-metal contacts between portions of the surfaces of the said particles developing metal-to-metal adherence at said contacts and a corresponding pliancy and a uniform composition with an overall density of the plastic metal structure of 70% to 95% of the density of the metal of the particles and forming a continuous barrier seal against radiation blocked by the metal of said particles.

2. A putty-like sealing material as set forth in claim 1 in which there are soft metal powder particles which are of lead and the density of the plastic metal structure is at least 95.

3. A putty-like sealing material as set forth in claim 1 in which there are metal particles of different metals forming a composition including particles of a metal relatively soft in comparison with the metal or metals of the remaining particles.

References Cited in the file of this patent

UNITED STATES PATENTS

1,847,796 Thurston ------------ Mar. 1, 1932
2,028,240 Palmer ------------ Jan. 21, 1936
2,386,604 Goetzke ------------ Oct. 9, 1945
2,689,398 Gaut et al. --------- Sept. 21, 1954
2,833,664 Knapp -------------- May 6, 1958