Patented Aug. 19, 1947 2,426,072

UNITED STATES PATENT OFFICE

2,426,072

BLAST CLEANING

William C. Wall, Ridgewood, and George A. Wilkens, Ridgefield, N. J., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

No Drawing. Application July 17, 1945, Serial No. 605,622

3 Claims. (Cl. 51—282)

1

This invention relates to the blast cleaning of surfaces and, more particularly, to the blast cleaning of aluminum and magnesium parts, especially carbonized aircraft engine parts. The invention further relates to an improved grit material to be used in blast cleaning technique.

Blast cleaning of metal parts is, of course, well known. The operation comprises projecting solid particles at high velocity, by means of compressed air or other fluid, against the surface to be cleaned. As the cleaning agent or grit material there has been used heretofore a variety of substances such as cracked wheat, clover seed, and other grains. These grits have not been entirely satisfactory for a number of reasons including the fact that they create a heavy cloud of dust during the operation, such dust being highly inflammable and thus constituting a serious explosion hazard as well as obscuring the parts being cleaned from the operator's vision. Further, these cereal grits are objectionable due to the difficulty in storing them since they are attacked by mold or mildew and form a food for vermin besides being quite sensitive to changes in humidity and being relatively bulky.

A further serious objection to the grits heretofore used in blast cleaning is that they do not clean as thoroughly or as quickly as desired, it frequently being necessary to carry out a preliminary step comprising soaking the metal parts in a solvent to soften the carbon deposits and oil varnish, before these cereal grits can be effectively used. A still further serious objection to these grits is that they have a very limited useful life.

An object of the present invention is to provide an improved method of blast cleaning metal parts and the like which will permit a more thorough cleaning of the parts in less time than heretofore necessary. A further object is to provide an improved method which eliminates the necessity of carrying out the preliminary step of soaking the metal parts to soften the deposits thereon and which is in general more economical to carry out. A more particular object is to provide a greatly improved grit material which possesses a long useful life, does not create a dust hazard and may be stored without encountering the difficulties presented by the storage of the various grains which have been used heretofore. Other objects will be apparent from the description of the invention given hereinafter.

The above objects are accomplished according to the present invention by projecting solid particles at high velocity, according to conventional blast cleaning technique, against the surface to be cleaned, said solid particles consisting essentially of a synthetic resin having an impact strength of less than 0.6 foot pounds per inch and an elongation at brake not exceeding 8%. For practical purposes, the solid particles should be of a size to pass a U. S. Standard sieve No. 12 and to be retained on a U. S, Standard sieve No. 80, preferably, the particles should pass a U. S. Standard sieve No. 16 and be retained on a No. 60 sieve.

2

The impact strength referred to throughout the specification and claims is that measured on a 2.5 x 0.5 x 0.5 inch molded bar according to A. S. T. M. test method D-256-41T and the elongation is measured according to A. S. T. M. test method D-638-42T.

It has been discovered that synthetic resins, regardless of whether they are straight polymers or condensation products, copolymers or plasticized or otherwise modified resins, are outstandingly advantageous as grit material in blast cleaning providing they possess the two essential characteristics above mentioned, namely, an impact strength of less than 0.6 foot pounds per inch and an elongation at break not exceeding 8%. Polymethyl methacrylate resins having the requisite impact strength and elongation characteristics are particularly well adapted for use in the blast cleaning of metal such as aircraft engine parts and the like. The resin is pulverized or otherwise comminuted in standard machinery into small, hard, fractured particles possessing sharp corners and edges. The particles are then screened through sieves to separate the desired range of particle sizes as mentioned above. These particles are impinged at high velocity upon the dirty surfaces to be cleaned according to the conventional blasting procedure originally developed for various grains.

The following examples illustrate specific embodiments of the present invention:

Example I

The surfaces of an assortment of aircraft engine parts, including pistons, were subjected over a test period of twenty-nine 8 hour shifts to the high velocity impact of 200 lbs. of powdered cast polymethyl methacryclate resin comprising 90% methyl methacrylate polymer and 10% plasticizer, said resin having an impact strength of 0.47 ft. lb. per inch, and an elongation at break of 1%. The resin particles were of such size that they substantially all passed through a U. S. Standard sieve No. 16 and were retained on a U. S. Standard sieve No. 60. During this test period using

the polymethyl methacrylate resin, approximately 30% more parts were cleaned than during a comparable period in which one and one-half tons of wheat were used as the cleaning material under similar conditions. Furthermore, not a single piston in the group of parts cleaned by the polymethyl methacrylate resin was returned for incomplete cleaning of ring grooves and other inaccessible areas whereas rejections were commonplace when using wheat as the material and employing the same inspection standards.

Example II

Polymethyl methacrylate molding powder having an impact strength of 0.4 ft. lb. per inch and an elongation at break of 3%, was pulverized so that substantially all passed through a U. S. Standard sieve No. 16 but was retained on a U. S. Standard sieve No. 60. This molding powder thus screened was used in the blast cleaning of aircraft engine parts and was found to be appreciably more rapid and more complete than blast cleaning of similar parts with clover seed under comparable conditions.

Example III

Polystyrene resin having an impact strength of 0.3 ft. lb. per inch and an elongation at break of 3.4%, was pulverized so that substantially all passed through a U. S. Standard sieve No. 16 but was retained on a U. S. Standard sieve No. 60. This grit material was used in the blast cleaning of automotive engine parts in comparison with wheat grain and was markedly superior, both in rapidity and completeness of cleaning and in useful life of the grit material.

It will be understood the above examples are merely illustrative and that the invention broadly comprises blast cleaning metal parts and the like by projecting at high velocity synthetic resin particles of the hereinbefore described characteristics against the surface to be cleaned. In general, it is practical to keep the size of the particles such that they pass a U. S. Standard sieve No. 12 and are retained on a U. S. Standard sieve No. 80.

It is not fully understood why the characteristics of an impact strength less than 0.6 ft. lb. per inch and an elongation at break not in excess of 8% should so clearly establish the line of demarcation between synthetic resins highly useful for blast cleaning and other resins of only indifferent value for the purpose. It is not contended that there is a phenomenally sharp break in the performance of synthetic resins right at the specified line of demarcation but, nevertheless, as a practical matter, the performance of the resins as they exceed the line of demarcation falls off very rapidly. It is evident that the hardness of the resin particles combined with their resistance to fracture and their ability to retain sharp edges and to present new sharp edges when they do fracture in use, explains in large part their outstanding superiority for use in the blast cleaning technique and the impact strength and elongation of the resins gives a practical means of measuring these combined properties of the resins. The hardness of the resin particles is related to their rate of impact and should be such that, at the desired rate of impact, the surface being cleaned is not etched. Too hard a grit cannot be used at a high rate of impact without etching the surface and this factor has been a handicap in the use of walnut shells and

fruit pits because these materials etch the surfaces of aircraft engine parts when projected at an economically high rate of impact. Polymethyl methacrylate resin, on the other hand, has just the right hardness for rapid cleaning of these parts without any etching effect.

In so far as known, any synthetic resin having the requisite characteristics of impact strength and elongation are highly useful in blast cleaning. Among such resins may be mentioned the polymers and copolymers of esters of acrylic and substituted acrylic acids, styrene, vinyl halides, allyl esters, and urea-formaldehyde, and phenol-formaldehyde resins. Mixtures of resins may likewise be used. Among specific synthetic resins well adapted for this purpose in addition to the polymethyl methacrylate and poly-styrene mentioned in the examples, are copolymers of methyl methacrylate (approximately 90%) and approximately 10% of styrene, vinyl acetate, ethyl acrylate, n-butyl methacrylate, ethyl methacrylate, or various combinations thereof, and copolymers of vinyl chloride (approximately 95%) and 5% of either vinyl acetate or diethyl fumarate. Polymerized allyl esters particularly adapted for use in this invention include the polymerized esters of polyethylene glycols and acid esters of unsaturated alcohols and carbonic acid, such as diethylene glycol di(allyl carbonate).

It should be understood that it is only those specific resins of the various classes above mentioned, which possess the requisite characteristic of impact strength and elongation that are desirable for use in blast cleaning according to this invention. Specific resins not possessing the desired characteristics may be modified by plasticizers such as butyl phthalate, or other resins so that the resulting resin composition meets the herein stated requirements. The preferred synthetic resin is polymethyl methacrylate plasticized with 5% to 15% of a plasticizer such as butyl phthalate although copolymers consisting in large part of methyl methacrylate, such as mentioned in the preceding paragraph, are also exceedingly well suited for use in the present invention.

There are many advantages realized by the use of synthetic resins according to this invention. An increased cleaning rate, a more complete cleaning of parts, and, in general, decreased operational cost constitute the major improvements over the prior art. In addition, the synthetic resins herein contemplated may be used with freedom from dust. For example, when using polymethyl methacrylate resin, no dust is created due to the fact that the particles are so resistant to fracture and, hence, the operator can observe the progress of his work without stopping the blast, thereby increasing the cleaning rate. Further, workers are not subjected to the hazards of fine dust when using synthetic resins as not only is the fine dust practically eliminated but the resins may be chosen for their non-toxic effect and non-inflammability or slow burning rate.

Far less difficulty is experienced in storage with using synthetic resins as compared to the cereal grits commonly used heretofore. These resins are not attacked by mold or mildew nor are they eaten by vermin. Furthermore, they are not affected by changes in humidity. Polymethyl methacrylate resin, to illustrate, requires only about one-fifteenth of the storage space taken up by cereal grits for a given amount of cleaning. The use of these synthetic resins also decreases

the number of preliminary operations. When using wheat, it is customary after degreasing to soak engine parts in a solvent to soften carbon deposits and oil varnish to promote faster removal by the wheat but it has been found that polymethyl methacrylate resin cleans faster and the particles remain cleaner by eliminating this soaking operation entirely. The resin particles do not readily pick up dirt during the blast cleaning operation and can be reused many times. The particles have a high abrasion resistance and in repeated use by recirculation they retain their sharp edges and corners or produce new sharp edges in breaking down. Synthetic resins having properties outside the specified range of impact strength and elongation at break discussed above, do not possess the advantages of the herein considered synthetic resins. For example, polyamides and polymers of ethylene do not clean the metal surfaces efficiently because they are apparently not hard enough and do not have sharp enough edges. Cellulose acetate and cellulose acetate-butyrate, while having some cleaning action, do not possess the life of the resins of this invention; their edges and corners become rounded in a short period of time.

The present invention is applicable not only for cleaning and imparting a high surface finish to aircraft and automobile engine parts, plastic molding and extruding machine parts, and surfaces to be electroplated but they may be used generally to clean any dirty metal surface, such as aluminum and magnesium, which is carbonized or otherwise contaminated with material insoluble in known solvents and therefore not removable by conventional procedures. The present invention may also be used to advantage in finishing the surfaces of wood products of various kinds.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited

to the specific embodiments thereof except as defined in the appended claims.

We claim:

1. Method of blast cleaning a surface which comprises projecting solid particles at high velocity against said surface, said solid particles consisting essentially of polymethyl methacrylate resin having an impact strength of less than 0.6 foot pound per inch and an elongation at break not exceeding 8%.

2. Method of blast cleaning a surface which comprises projecting solid particles at high velocity against said surface, said solid particles consisting essentially of polymethyl-methacrylate resin having an impact strength of less than 0.6 foot pound per inch and an elongation at break not exceeding 8%, and being of a size to pass a U. S. Standard sieve No. 12 and to be retained on a U. S. Standard sieve No. 80.

3. Method of blast cleaning a carbonized metal surface which comprises projecting solid particles at high velocity against said surface, said solid particles consisting essentially of polymethyl methacrylate resin having an impact-strength of less than 0.6 foot pound per inch and an elongation at break not exceeding 8%, and being of a size to pass a U. S. Standard sieve No. 16 and to be retained on a U. S. Standard sieve No. 60.

WILLIAM C. WALE.
GEORGE A. WILKENS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,184,894	Taylor	May 30, 1916
1,750,499	Truax	Mar. 11, 1930
1,588,768	Moulton	June 15, 1926
2,185,262	Lupo	Jan. 2, 1940