United States Patent Office

2,740,704

Patented Apr. 3, 1956

2,740,704

PROCESS FOR PRODUCING GLOBULAR PROPELLENT POWDER GRAINS

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No Drawing. Application March 9, 1950, Serial No. 148,742

2 Claims. (Cl. 52—20)

This invention relates generally to the manufacture of propellent powder, and particularly to the manufacture of spherical and near spherical grains of smokeless powder.

In United States Patent No. 2,027,114, granted January 7, 1936, there is disclosed a process of manufacturing smokeless powder wherein droplets of lacquer, composed of smokeless powder base and solvent, are solidified while suspended in a non-solvent medium. Such a process of manufacturing propellent powder has come to be known among those skilled in the art as the "globular powder" process. The technique of controlling the globular powder process so as to produce grains having various physical and chemical properties is further disclosed in United States Patents Nos. 2,160,626, granted May 30, 1939, 2,213,255, granted September 3, 1940, and 2,375,175, granted May 1, 1945. These patents disclose variations in the basic technique of manufacturing globular powder whereby to control the character, uniformity, and ballistic properties of the powder produced. While the globular powder process has proven eminently satisfactory for the production of powder grains suitable for use in small arms ammunition, i. e., where the diameter of the individual balls of powder does not exceed about ten to twenty-five thousandths of an inch, it has not heretofore been possible to produce globular powder grains of larger diameter, i. e., greater than about twenty-five thousandths of an inch, on a mass scale.

While it has heretofore been known, as pointed out in some of the patents above-mentioned, that control of the violence of agitation has its effect upon the granulation of the product—the more violent the agitation the smaller the grains and vice versa—it has not heretofore been possible to produce batches wherein more than a small percentage of the grains were of "large diameter" and well rounded. Efforts to produce large diameter grains by reducing the speed of agitation of the usual globular powder equipment have resulted in batches of grains, practically none of which were sufficiently spherical to meet the criteria set for globular powder.

The object of the present invention, generally stated, is to provide a process of producing globular powder grains of large diameter and wherein the yield of each batch is predominantly of large diameter.

A further object of the invention is to provide a process of manufacturing globular powder wherein the granulation may be controlled with greater uniformity than heretofore.

Other objects will become apparent to those skilled in the art when the following description is read:

The invention contemplates the production of globular powder grains, by presizing (as to volume) bodies of powder base lacquer, then suspending the bodies in a non-solvent medium until they become rounded; and then, while in their rounded condition, hardening them. The presized bodies are composed essentially of a solution of the powder base in a solvent which is substantially immiscible with the non-solvent medium, said solution being of a consistency such that the bodies are self-sustaining and self-coherent under the forces to which they are subjected while in suspension.

The presizing of the bodies to the volume which will yield spheres or near-spheres of the desired size, when hardened, may be accomplished in any of a variety of ways.

Bodies of sufficiently uniform volume may be produced in the apparatus employed for the manufacture of ordinary globular powder by agitating a curd of the high viscosity lacquer in a non-solvent medium and controlling the violence of the agitation to regulate the size of the bodies into which the curd is disintegrated, it being understood that the more violent the agitation, other variables being constant, the greater the degree of disintegration. Presizing the bodies in this manner to produce a high yield of large diameter grains requires that the viscosity of the lacquer be so high that the grains of 0.025 inch diameter or greater do not properly shape without further treatment to reduce their viscosity.

While the presized bodies are suspended in the non-solvent medium, it is important that the forces of agitation be only sufficient to maintain the suspension, and not of such violence as to subdivide the suspended bodies. Some subdivision and some coalescence of initially separate bodies is almost inevitable, but such are minimized by the precautions followed in the manufacture of globular powder generally, including in particular the addition of a protective colloid to the suspension.

Since the presized bodies of size such as to yield grains of 0.025 inch diameter or greater, when first suspended, are of consistency such that they do not readily yield under the interfacial tension exerted in the suspending medium, to approach the spherical shape, their viscosity is reduced, as by the introduction of some additional solvent into the suspending medium; said solvent, being not mutually soluble with the medium, is absorbed by the suspended bodies and softens them. Alternatively, the presized suspended bodies may be further softened by heating under pressure sufficient to inhibit vaporization of the solvent.

After the softening treatment, the bodies begin to yield to the forces of interfacial tension in the medium, and ultimately assume the spherical shape. Thereupon the solvent is removed from the bodies, while moderate agitation continues.

As an illustrative example of the process, a body of lacquer composed of 3.8 parts of ethyl acetate to each part of nitrocellulose, with the usual stabilizers, was disintegrated at a temperature of 68° C. in a water bath containing the solutes and colloids commonly used in the manufacture of globular powder. The disintegration was accomplished by moderate agitation (viz. at 32.5 R. P. M. with the device usually operated at 40 R. P. M. for the production of ordinary globular powder). The suspended bodies would not round by any of the usual techniques.

While the presized but misshapen lacquer bodies were in suspension, ethyl acetate was added to the water bath in the amount of 10% of the weight of the nitrocellulose. The additional ethyl acetate was introduced into the water bath as an emulsion, consisting of 40 parts ethyl acetate, 120 parts water, and 2 parts protective colloid. The agitation was reduced to 28.75 R. P. M. and continued for one and one-half hours, when the bodies were adequately rounded.

The resultant grains were nearly perfect spheres, with 58 per cent of the yield having a diameter greater than 0.0276 inch. Slower agitation speeds at the time of presizing result in an increase of the grain size, for example, whereas the product just mentioned was presized at 32.5 R. P. M., when the presizing is at 30 R. P. M., 79 per cent of the yield has a diameter greater than 0.0276.

Instead of introducing the additional solvent in the

form of an emulsion, as in the last example, it can be added in undiluted form gradually to the water bath, provided it is finely dispersed in the water bath.

From the foregoing description, those skilled in the art should understand that the invention accomplishes its objects and provides not only a process whereby globular powder grains of large diameter may be made with facility and on a mass scale, but also provides a process whereby globular powder grains of any granulation may be manufactured so as to produce grains within narrow limits of diameter. While one complete embodiment has been disclosed in detail and modifications therein suggested, it is to be understood that the example given is for the purpose of illustrating the invention, and not by way of limitation. It is recognized that those skilled in the art will make appropriate adjustment of the several variables in the process in order to adapt it to the peculiarities of any given operation, and consequently it is to be distinctly understood that the invention is not limited to the examples given, save as indicated in the appended claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In the manufacture of globular grains of propellent powder, the process of making grains having a diameter of at least 0.025 inch, comprising, presizing bodies of propellent powder base lacquer and suspending the presized bodies in a non-solvent medium, then thereafter, while the presized bodies remain so suspended, reducing the viscosity of the lacquer in the presized bodies, maintaining such reduced viscosity until the bodies approach spherical shape, and then hardening the shaped bodies, all while suspension is maintained.

2. The process of claim 1 wherein the presizing is accomplished by agitation of a curd of lacquer within the non-solvent medium.

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