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MANUFACTURE OF MAGNESIUM ALLOY EXTRUSIONS

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2 Claims. (Cl. 207—10)

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The invention relates to methods of making extrusions of magnesium-base alloys. It more particularly concerns an improved method of making extrusions having high tensile strength and other desirable properties from magnesium-base alloys in the form of atomized powder.

Recently, it has been discovered that by die-expressing atomized powder instead of using solid ingots of a magnesium-base alloy, as in the usual extruding process, the resulting extrusions are stronger and otherwise more desirable except that the surface of the extrusions may be blemished by innumerable blisters which form in the surface layer of the extrusions while they are still hot on leaving the die opening. In some instances, blistering is increased by a subsequent anneal of the extrusion. Attempts to prevent the formation of the blisters by carefully preventing air from being entrapped in the atomized powder as it is compacted into solid metal during extrusion do not overcome the difficulty. I have discovered that the cause of the blistering on making extrusions of atomized magnesium-base alloys is the presence of relatively friable nonmetallic solid contaminants which are invariably present in conventionally atomized magnesium-base alloys. These alloys are atomized by impinging a jet of cool gas against a falling thin stream of the molten alloy. The molten alloy stream becomes broken up into fine spherical particles which quickly solidify. Each particle is a mass of extremely small crystals of the solid alloy. The atomization is carried out in steel equipment in an atmosphere of natural gas which issues from the jet and is reused. Microscopic examination of the atomized product shows the presence of up to about 0.2 percent by weight or more in some cases of nonmetallic contaminants among which are found magnesium oxide, magnesium hydroxide, hydrated iron oxides, magnesium carbonate, and hydrated magnesium chloride. The contaminants are in the form of irregular friable particles having more or less the same size as those of the atomized metal. It appears that in some way unknown to me these contaminants give rise to gas formation in the extruded metal, the gas having sufficient pressure to raise blisters in the surface layers of the hot extrusion as it issues from the die opening.

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I have discovered that by crushing these contaminants or otherwise comminuting them so that their particle size is reduced well below that of the atomized metal and disseminating the comminuted contaminants throughout the atomized powder the resulting mixture may be extruded into a blister free product. The comminution of the contaminants is carried out in the presence of the atomized metal particles, the dimensions of which are not substantially affected by the comminution operation. The comminuted contaminants need not be separated from the atomized metal prior to extrusion.

The invention then consists of the improved method of making extrusions of atomized magnesium-base alloys hereinafter fully described and particularly pointed out in the claims.

In carrying out the invention, the mass of atomized magnesium-base alloy to be extruded is subjected to a differential comminution in which the friable nonmetallic contaminants of the mass are comminuted in the presence of the atomized metal particles of the mass without substantially reducing the size of the metal particles. While the nonmetallic contaminants are reduced in particle size they are dispersed throughout the mass of atomized metal particles, thereby avoiding an excessive concentration of nonmetallic matter at any point in the mass of metallic particles. The comminution of the nonmetallic contaminants without substantially comminuting the metal particles can be effected in various ways as by placing the mass of atomized metal, as atomized, in a ball mill, hammer or impact mill, or like device and subjecting the mass therein to the forces of comminution. Prior to the differential comminution, particles coarser than 20 mesh and finer than about 200 mesh preferably are screened out and rejected. The rejected portion may amount to about 15 to 35 per cent by weight of the atomized mass. In the comminution operation, the forces applied are to be below a value which will cause comminution of the metal, yet strong enough to crush or abrade the nonmetallic contaminants and reduce their particle size to dust-like dimensions. The contaminants are much more friable than the metal particles and crush easily under comparatively light pressure to particles much finer than the metal particles compared to that needed to comminute the metal particles. At the same time as the mass of atomized material is being subjected to the crushing and abrading forces of the differential comminution operation, the resulting abraded or comminuted portion of the mass becomes therethrough, resulting in a uniform mixture of atomized metal particles and comminuted nonmetallic contaminants.

The amount of abrasion required has no substantial effect on the sieve analysis of the material treated. For example, a magnesium-base alloy as-atomized has the following sieve analysis before and after abrading in a hammer mill with sufficient force to crush and disperse the nonmetallic contaminants throughout the atomized powder.

Sieve Size		Wt. Percent before Comminution	Wt. Percent after Comminution
Passing through—	Retained on—		
--------	20	0.3	0.2
20	50	53.7	62.5
50	100	35.7	27.9
100	150	9.5	8.5
150	200	0.7	0.7
200	------	0.1	0.2

In the above example, it will be seen that the differential comminution operation produces no significant reduction in the as-atomized particle sizes in general, although there is 100 per cent increase in the very small proportion which passes through the 200 mesh sieve.

The treated mass thus obtained is subjected to heating, compacting, and extruding, the heating being performed preferably in the container of a conventional extrusion apparatus. The temperatures employed are those used in conventionally extruding magnesium-base alloys, e. g. about 550° F. to about 850° F. The atomized metal reaches extruding temperatures quickly on contact with the walls of the heated extruding container and extruding may be begun within a minute or two after charging the heated container. On applying extruding pressure to the heated mass, it becomes compacted into a solid mass and extrudes. The extrusion issuing from the die is smooth and free from surface defects in the form of blisters.

The following examples are illustrative of the invention.

Example I

A quantity of a magnesium-base alloy having a nominal composition of 3 per cent of aluminum, 1 per cent of zinc, 0.3 per cent of manganese, the balance being magnesium was atomized and the atomized mass was screened through a 20 mesh sieve to screen out particles larger than 20 mesh. The mass of atomized particles passing through the 20 mesh sieve was screened on a 150 mesh sieve and the portion passing through it was rejected. About 1 quart of the portion of atomized powder retained on the 150 mesh sieve was subjected to a differential comminution by passing it through a micropulverizer (hammer mill) 3 times in succession in which all the particles were subjected to hammering, abrading and mixing, the hammering and abrading being sufficient to comminute or crush the nonmetallic particles present in the atomized mass but insufficient to significantly reduce the particle size of the metallic particles. The so-treated mass of particles was charged into the 3-inch diameter container of an extrusion press. The container was at 650° F. and the charge of differentially comminuted atomized powder was held in the container for 5 minutes to allow the charge to reach 650° F. before the extrusion was begun. The heated charge was then compacted and extruded through a rectangular die opening, ⅛" x ⅞", at the rate of about 5 feet per minute to form a flat extruded strip about 20 feet long. The strip was free from blemishes in the form of blisters and exhibited normal values for the mechanical properties of tensile and compression strengths.

For comparison, another quart of the screened, as atomized, powder of the alloy was extruded from the same container through the same die at the same temperature and rate of extrusion but without subjecting the screened atomized powder to the differential comminution. The extrusion obtained had an average of 540 blisters per square foot of surface.

Example II

A quantity of a magnesium-base alloy having a nominal composition of 1 per cent of aluminum, 1 per cent of zinc, and 1 per cent of manganese, the balance being magnesium was atomized. The atomized powder obtained was screened. Particles coarser than 20 mesh and finer than 150 mesh were rejected. A quart of the screened portion retained on the 150 mesh sieve was subjected to the differential comminution as in Example I by passing the screened atomized powder through the same micropulverizer four times. The so-treated powder was extruded as in Example I with the result that about a 20-foot length of the extrusion was obtained, the surface of which was free from blisters.

In comparison, another portion of the same screened atomized powder was extruded in similar manner through the same die but without subjecting the powder to differential comminution with the result that the surface of the extrusion had an average of more than 450 blisters per square foot.

This application is a division of my prior copending application Serial No. 155,133, filed April 10, 1950, now abandoned.

I claim:

1. The method of making extrusions having a surface free from blisters of a magnesium-base alloy in the form of atomized powder, said powder consisting of spherical particles of the alloy and nonmetallic contaminants in the form of friable particles acquired as normal contaminants in the process of making the said atomized powder, which comprises subjecting the atomized particles to a differential comminution in which the solid friable nonmetallic contaminants are crushed in the presence of the metallic particles and the crushed particles disseminated uniformly throughout the mass of metallic particles without substantially reducing the dimensions of the metallic particles, heating the resulting mixture of metallic particles and crushed nonmetallic particles to extruding temperature, and die-expressing the heated mixture to form an extrusion.

2. The method of making extrusions having a surface free from blisters of a magnesium-base alloy in the form of atomized powder, said powder consisting of spherical particles of the alloy and nonmetallic contaminants in the form of friable particles acquired as normal contaminants in the process of making the said atomized powder, which comprises screening out of the atomized powder as made the particles larger than

about 20 mesh and smaller than about 200 mesh, subjecting the so-screened atomized particles to a differential comminution in which the solid friable nonmetallic contaminants are crushed in the presence of the metallic particles and the crushed particles disseminated uniformly throughout the mass of metallic particles without substantially reducing the dimensions of the metallic particles, heating the resulting mixture of metallic particles and crushed nonmetallic

particles to extruding temperature, and die-expressing the heated mixture to form an extrusion.

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