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(54) **METAL INJECTION MOLDING PROCESS**

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(57) **ABSTRACT**

A metal injection molding process for manufacturing a MIM article with a final main body and a final threaded hole defined in the final main body, is provided. The metal injection molding process includes forming a green MIM article including a green body, the green body having the same shape as, but larger than the final main body; tapping the green body to define a green threaded hole in the green body, the green threaded hole having the same shape, but larger than the final threaded hole; debinding the green MIM article to remove the plastic binders from between the metal powders; and sintering the green MIM article to form the MIM article by shrinking the green body to form the final main body and shrinking the green threaded hole to form the final threaded hole.

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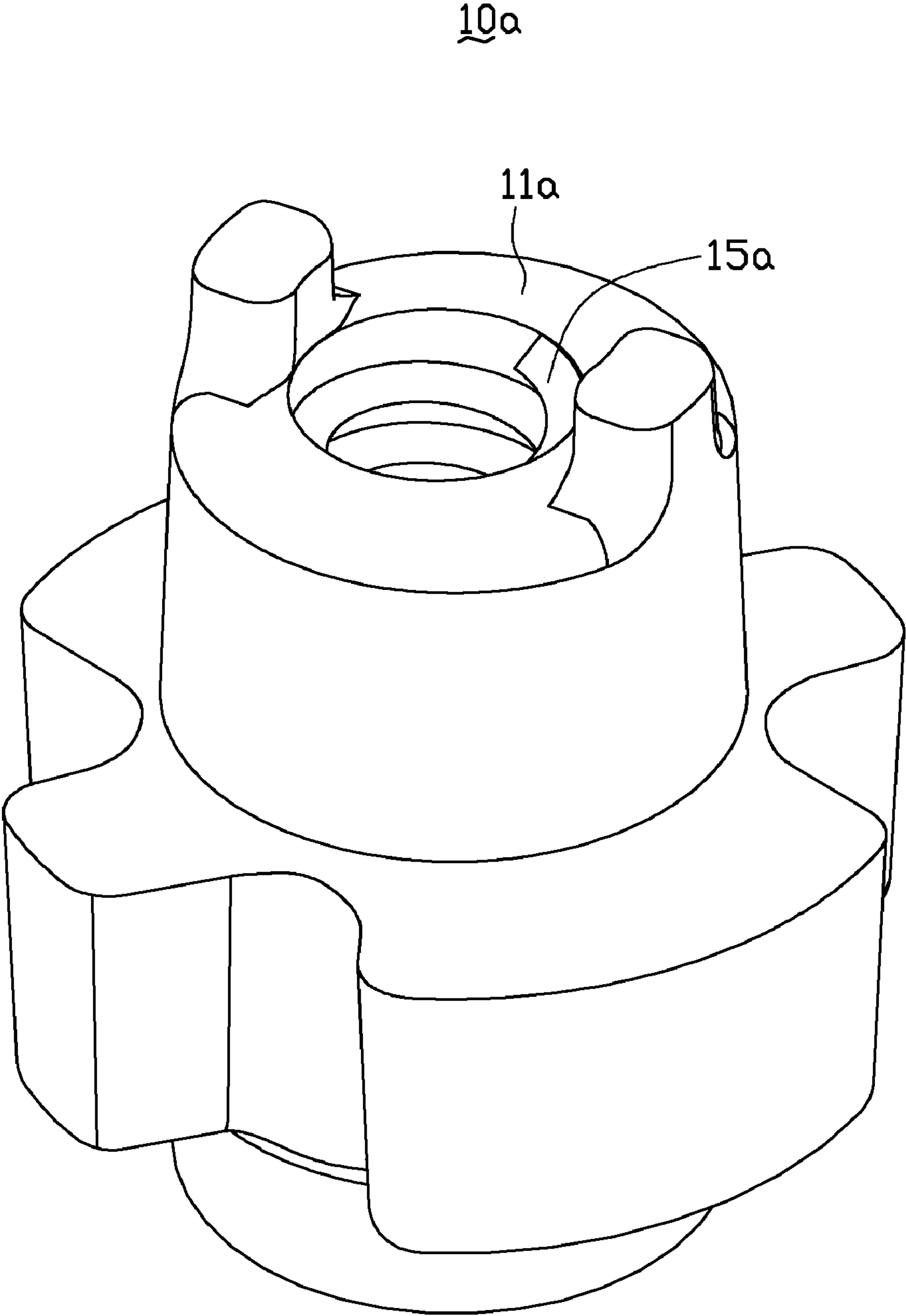


FIG. 1

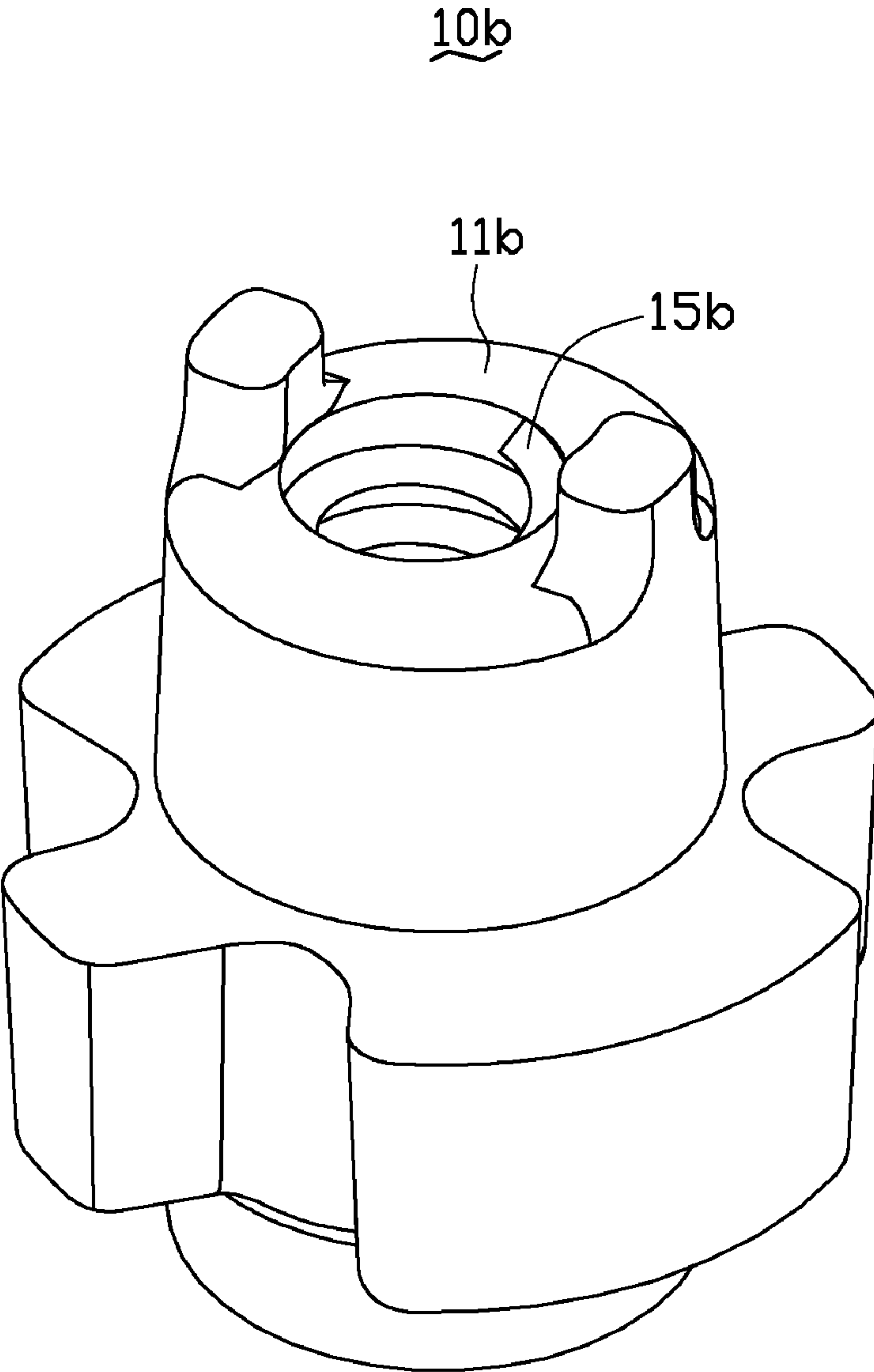


FIG. 2

METAL INJECTION MOLDING PROCESS

BACKGROUND

[0001] 1. Technical Field

[0002] The exemplary disclosure generally relates to metal injection molding processes, and particularly to metal injection molding processes for manufacturing articles having threaded holes.

[0003] 2. Description of Related Art

[0004] Metal injection molding (MIM) is a metalworking process which is used to create small, complex metal parts in high volumes for use in a variety of industries and applications. However, because the final metal injection molded article is very hard, can be difficult to tap a hole in the article.

[0005] Therefore, there is room for improvement within the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Many aspects of the embodiments can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the exemplary embodiment of metal injection molding process. Moreover, in the drawings like reference numerals designate corresponding parts throughout the several views. Wherever possible, the same reference numbers are used throughout the drawings to refer to the same or like elements of an embodiment.

[0007] FIG. 1 is a schematic view of a finished metal injection molded article manufactured by the exemplary metal injection molding process.

[0008] FIG. 2 is a schematic view of a green MIM article of an exemplary metal injection molding process.

DETAILED DESCRIPTION

[0009] Referring to FIGS. 1 and 2, this disclosure discloses a metal injection molding process for manufacturing a metal injection molded (MIM) article. In a green stage, the MIM article is called green MIM article 10a and in the finished stage is called MIM article 10b and can be, e.g., a housing or portion of a housing of an electronic device. The MIM article 10b includes a final main body 11b and a final threaded hole 15b defined in the final main body 11b. The metal injection molding process may include at least the following steps:

[0010] Metal powders and plastic binders are provided. In this exemplary embodiment, the metal powders are SUS17-4PH stainless steel powders; the plastic binders are made of polyvinyl chloride, polyethylene, polystyrene, polypropylene, polycarbonate, cellulose nitrate, phenol-formaldehyde, polyurethane, epoxide resin, monosaccharides, polysaccharide, or agar.

[0011] The metal powders are mixed with the plastic binders to form a mixture of the metal powders and the plastic binders.

[0012] The mixture is formed into feedstock. The feedstock may consist of pellets having diameters of about 2 micrometers to about 15 micrometers.

[0013] The feedstock is molded and cured into the green MIM article 10a. For example, the feedstock is heated to liquid state and then injected into a closed mold using equipment similar to standard plastic injection molding machines. After that, the heated feedstock is cured to mold the green

MIM article 10a. The green MIM article 10a includes a green body 11a having the same shape as the final main body 11b.

[0014] The green body 11a is tapped to define a green threaded hole 15a in the green body 11a. The green threaded hole 15a has the same shape as the final threaded hole 15b. The green body 11a and the green threaded hole 15a are larger than the final threaded hole 15b and the final main body 11b.

[0015] The plastic binders are chemically or thermally removed from between the metal powders with the application of solvents and/or thermal processes. In this exemplary embodiment, the plastic binders are thermally removed from the metal powders at a temperature from about 400° C. (Celsius) to about 700° C. (Celsius).

[0016] The green MIM article 10a is sintered at a temperature from about 1000° C. to about 1300° C. During the sintering process, the individual metal powders metallurgically bond together as material diffusion occurs to remove most of the porosity left by the removal of the plastic binders; the green body 11a shrinks and becomes the finished MIM article 10b.

[0017] In this disclosure, the green threaded hole 15a is tapped after the liquid feedstock is molded into the green MIM article 10a, but before the green MIM article 10a is heated and sintered. Because the green MIM article 10a has a low density before being heated and sintered, it is easy to tap the green threaded hole 15a.

[0018] It is to be understood, however, that even through numerous characteristics and advantages of the exemplary disclosure have been set forth in the foregoing description, together with details of the system and function of the disclosure, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the disclosure to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A metal injection molding process for manufacturing a MIM article having a final main body and a final threaded hole defined in the final main body, the metal injection molding process comprising:

forming a green MIM article including a green body, the green body having the same shape as, but larger than the final main body;

tapping the green body to define a green threaded hole in the green body, the green threaded hole having the same shape, but larger than the threaded hole;

debinding the green MIM article to remove the plastic binders from between the metal powders; and

sintering the green MIM article to form the MIM article by shrinking the green body to form the final main body and shrinking the green threaded hole to form the final threaded hole.

2. The metal injection molding process as claimed in claim 1, wherein the step of forming a green MIM article includes the following steps:

providing metal powders and plastic binders;

mixing the metal powders with the plastic binders to form a mixture of the metal powders and the plastic binders;

forming the mixture into feedstock;

molding and curing the feedstock to form the green MIM article.

3. The metal injection molding process as claimed in claim 2, wherein the metal powders are SUS17-4PH stainless steel powders.

4. The metal injection molding process as claimed in claim 2, wherein the plastic binders are made of polyvinyl chloride, polyethylene, polystyrene, polypropylene, polycarbonate, cellulose nitrate, phenol-formaldehyde, polyurethane, epoxide resin, monosaccharides, polysaccharide, or agar.

5. The metal injection molding process as claimed in claim 2, wherein the feedstock has a particulate size of about 2 micrometers to about 15 micrometers.

6. The metal injection molding process as claimed in claim 2, wherein the plastic binders are thermally removed from the metal powders at a temperature from about 400° C. to about 700° C.

7. The metal injection molding process as claimed in claim 1, wherein the green MIM article is sintered at a temperature from about 1000° C. to about 1300° C.

8. A metal injection molding process for manufacturing a MIM article with a final main body and a final threaded hole defined in the final main body, the metal injection molding process comprising:

forming a green MIM article including a green body, the green body having the same shape as, but larger than the final main body;

tapping the green body to define a green threaded hole in the green body, the green threaded hole having the same shape, but larger than the final threaded hole;

debinding the green MIM article to remove the plastic binders from between the metal powders; and

sintering the green MIM article to the metal injection molded article;

wherein the green threaded hole is tapped after the green MIM article is molded, but before the green MIM article is heated and sintered.

9. The metal injection molding process as claimed in claim 8, wherein green MIM article the step of forming a green MIM article includes the following steps:

providing metal powders and plastic binders;

mixing the metal powders being with the plastic binders to get a mixture of the metal powders and the plastic binders;

forming the mixture being into feedstock;

molding and curing the feedstock to form the green MIM article.

10. The metal injection molding process as claimed in claim 9, wherein the metal powders are SUS17-4PH stainless steel powders.

11. The metal injection molding process as claimed in claim 9, wherein the plastic binders are made of polyvinyl chloride, polyethylene, polystyrene, polypropylene, polycarbonate, cellulose nitrate, phenol-formaldehyde, polyurethane, epoxide resin, monosaccharides, polysaccharide, or agar.

12. The metal injection molding process as claimed in claim 9, wherein each feedstock has a size of about 2 micrometers to about 15 micrometers.

13. The metal injection molding process as claimed in claim 9, wherein the plastic binders are thermally removed from the metal powders at a temperature from about 400° C. to about 700° C.

14. The metal injection molding process as claimed in claim 8, wherein the green MIM article is sintered at a temperature from about 1000° C. to about 1300° C.

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