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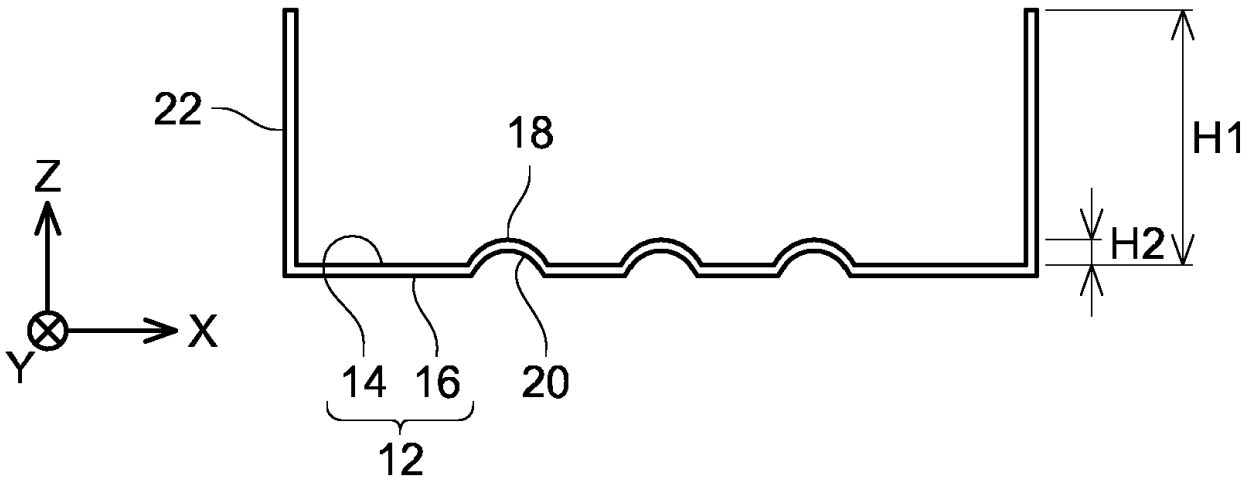
(54) SAGGAR

(57) A saggar may include: a bottom plate; and a sidewall surrounding a periphery of one surface of the bottom plate. One or more protrusions may be provided on the one surface.

FIG. 2



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Description

Cross-Reference

[0001] This application claims priority to Japanese Patent Application No. 2018-069048, filed on March 30, 2018, the entire contents of which are incorporated herein by reference.

Technical Field

[0002] The technique disclosed herein relates to a saggar, specifically, a saggar that is used to accommodate powder which is to be heat-treated in a heat treating furnace.

Background Art

[0003] For example, in heat-treating raw material powder for electronic products and raw material powder used for catalyst for automobile exhaust gas, these powders are accommodated in a container called saggar and heat treatment is performed thereon. Japanese Patent Application Publication No. 2015-59698 describes a saggar configured to accommodate powder in heat treatment, for example. The saggar of Japanese Patent Application Publication No. 2015-59698 has a box shape and is provided with a bottom plate that has a rectangular shape in its planar view and a sidewall vertical to the bottom plate. Inner and outer surfaces of the bottom plate of the saggar are both flat.

Summary

[0004] When heat treatment is performed to powder accommodated in a saggar, the heat treatment starts to progress from parts of the powder which are located at positions to which heat is easily transferred. That is, of all the powder accommodated in the saggar, the heat is directly transferred from a furnace to a part of the powder that is located on an upper side and exposed at a powder surface, at the same time the heat is also transferred through the saggar to a part of the powder that is in contact with inner wall surfaces of the saggar, such as a bottom plate and a sidewall thereof. Thus, the heat treatment progresses first in these parts of the powder. Accordingly, of all the powder accommodated in the saggar, it is more difficult for the heat in the heat treating furnace to be transferred to a part of the powder that is located in its center portion, and this part of the powder requires relatively a long time to be heat-treated. That is, the saggar of Japanese Patent Application Publication No. 2015-59698 has a problem that a long period of time is required to thoroughly heat-treat the powder because it takes time for heat to be transferred throughout the powder accommodated in the saggar. The disclosure herein discloses a technique capable of shortening a time period for heat-treating powder accommodated in a saggar.

[0005] A saggar disclosed herein may comprise a bottom plate; and a sidewall surrounding a periphery of one surface of the bottom plate. One or more protrusions may be provided on the one surface.

[0006] In the saggar described above, the one or more protrusions provided on the one surface of the bottom plate increase a contact area between powder accommodated in the saggar and the bottom plate of the saggar, by which heat is more easily transferred throughout the powder accommodated in the saggar. Due to this, a time required to thoroughly heat-treat the powder accommodated in the saggar can be shortened.

[0007] Some of the features characteristic to below-described embodiment will herein be listed. It should be noted that the respective technical elements are independent of one another, and are useful solely or in combinations. The combinations thereof are not limited to those described in the claims as originally filed.

[0008] In the saggar disclosed herein, one or more recesses may be provided on another surface of the bottom plate at positions corresponding to positions where the one or more protrusions are provided. The one or more recesses may have a shape following a shape of the one or more protrusions. According to such a configuration, the one or more recesses provided on the other surface of the bottom plate can reduce a thickness of the bottom plate at the positions where the one or more protrusions are provided. Due to this, heat capacity of the bottom plate is reduced, and heat from a heat treating furnace is efficiently transferred to the powder. Therefore, the time required to thoroughly heat-treat the powder accommodated in the saggar can further be shortened.

[0009] In the saggar disclosed herein, a plurality of the protrusions may be provided on the one surface. The plurality of protrusions may be arranged on a circle, a center of the circle being positioned at a center of the bottom plate. According to such a configuration, the plurality of protrusions facilitates thorough heat transfer to the powder. Further, the concentric arrangement of the plurality of protrusions with respect to the center of the bottom plate makes heat transfer to take place evenly throughout the powder accommodated in the saggar. Due to this, the time required to thoroughly heat-treat the powder accommodated in the saggar can further be shortened.

Brief Description of Drawings

[0010]

FIG 1 is a top view of a saggar according to an embodiment.

FIG. 2 is a cross sectional view along a line II-II in FIG. 1

Embodiment

[0011] A saggar 10 according to an embodiment will

be described hereinbelow. The saggar 10 is used, for example, in heat-treating raw material powder used for catalyst for automobile exhaust gas and the like (which may be simply termed "powder" hereinbelow). The saggar 10 is conveyed in a heat treating furnace in a state of accommodating the powder therein. The saggar 10 is conveyed, for example, in a roller hearth kiln including a plurality of conveyor rollers. While the saggar 10 is conveyed by the conveyor rollers in the roller hearth kiln, the powder accommodated in the saggar 10 is heat-treated.

[0012] As shown in FIGS. 1 and 2, the saggar 10 includes a bottom plate 12 and a sidewall 22. The bottom plate 12 is constituted of metal and has a substantially square plate shape in its planar view. In the present embodiment, a dimension L1 of one side of the bottom plate 12 is approximately 300 mm. A thickness of the bottom plate 12 is constant, and it is approximately 2.0 mm in the present embodiment. The bottom plate 12 is provided with a plurality of protrusions 18 on its inner surface 14 and is provided with a plurality of recesses 20 on its outer surface 16. The protrusions 18 and the recesses 20 will be described later.

[0013] The sidewall 22 is provided on an inner surface 14 side of the bottom plate 12 to protrude therefrom, and surrounds a periphery of the bottom plate 12. The sidewall 22 includes four walls. The sidewall 22 is constituted of the same metal as the bottom plate 12. A heightwise dimension H1 of the sidewall 22 (which means a dimension thereof in a Z direction in FIG. 2) is constant, and it is approximately 80 mm in this embodiment. A thickness of the sidewall 22 is constant and is the same as the thickness of the bottom plate 12. That is, the thickness of the sidewall 22 is approximately 2.0 mm in this embodiment. A connection portion between the sidewall 22 and the bottom plate 12 and connection portions between the adjacent walls of the sidewall 22 are bent or bonded by welding. Although the thickness of the sidewall and the thickness of the bottom plate 12 are the same in the present embodiment, they may be different. Further, the thickness of the sidewall 22 and the thickness of the bottom plate 12 are not limited to 2.0 mm. The saggar 10 can accommodate the powder, for example, up to a level of approximately 1/3 the heightwise dimension H1 of the sidewall 22. The saggar 10 can suppress the powder from falling out from the saggar 10 by accommodating the powder up to the level of 1/3 the heightwise dimension H1 of the sidewall 22 or less.

[0014] The protrusions 18 and the recesses 20 will be described. Each of the protrusions 18 has a hemispherical shape and is provided on the inner surface 14 of the bottom plate 12. That is, each protrusion 18 protrudes in a height direction (in the Z direction in FIG. 2), and its height at a center portion thereof protruding the most (this height may be termed a heightwise dimension H2 of the protrusions 18, hereinbelow) is approximately 10 mm in the present embodiment. The heightwise dimension H2 of the protrusions 18 may be in a range of 1/9 to 1/6 the heightwise dimension H1 of the sidewall 22. As described above, the powder is accommodated up to the level of approximately 1/3 the heightwise dimension H1 of the sidewall 22. Due to this, when the heightwise dimension H2 of the profusions 18 is set to be in the range of 1/9 to 1/6 the heightwise dimension H1 of the sidewall 22, upper ends of the protrusions 18 are located at a position that corresponds to 1/3 to 1/2 the height up to which the powder is accommodated. When the heightwise dimension H2 of the protrusions 18 is set to be 1/9 the heightwise dimension H1 of the sidewall 22 or greater, the protrusions 18 are in contact with the powder over their entireties, and a contact area between the powder and the bottom plate 12 can thereby be increased by efficiently using the protrusions 18. Due to this, heat can be easily transferred thoroughly to a center part of the powder accommodated in the saggar 10. Therefore, a time required for the heat to be transferred throughout the powder accommodated in the saggar 10 can be shortened, by which a time required to thoroughly heat-treat the powder can be shortened. Further, when the heightwise dimension H2 of the protrusions 18 is set to be 1/6 the heightwise dimension H1 of the sidewall 22 or less, the protrusions 18 and the recesses 20 can be easily formed on the bottom plate 12.

[0015] The protrusions 18 are provided in plurality on the inner surface 14 of the saggar 10, and the plurality of protrusions 18 is arranged on a circle being concentric to a center of the bottom plate 12 regularly in a planar view of the saggar 10 (when the saggar 10 is seen from a +Z direction side toward a -Z direction side). In this embodiment, seven protrusions 18 are provided. Specifically, one of the seven protrusions 18 is arranged in a center portion of the bottom plate 12 and the remaining six protrusions 18 are arranged to each have a regular distance from the protrusion 18 arranged in the center portion. The six protrusions 18 are spaced from each other at regular intervals in a circumferential direction. The plurality of protrusions 18 provided on the bottom plate 12 can facilitate heat transfer throughout the powder accommodated in the saggar 10. Further, the concentric arrangement of the plurality of protrusions 18 with respect to the center of the bottom plate 12 can make heat transfer to take place evenly throughout the powder accommodated in the saggar 10. The protrusions 18 according to the present embodiment have the hemispherical shape, however, no limitation is placed thereon. The protrusions may simply need to be provided on the inner surface 14 of the bottom plate 12 such that the contact area between the powder accommodated in the saggar 10 and the bottom plate 12 is increased, and no limitation is placed on their shape.

[0016] The recesses 20 are provided on an outer surface 16 side of the bottom plate 12 at positions corresponding to positions where the protrusions 18 are provided, and they have a shape following the shape of the protrusions 18. As described above, the thickness of the bottom plate 12 is constant. That is, the thickness in portions of the bottom plate 12 where the recesses 20 and

the protrusions 18 are provided is approximately the same as the thickness in a flat portion of the bottom plate 12 where none of the recesses 20 nor the protrusions 18 are provided. Therefore, in the present embodiment, the thickness in the portions of the bottom plate 12 where the recesses 20 and the protrusions 18 are provided is approximately 2.0 mm. The recesses 20 provided on the bottom plate 12 can make the thickness in the portions of the bottom plate 12 where the protrusions 18 are provided equal to the thickness in the flat portion thereof where no protrusions 18 are provided. Since the saggar 10 is constituted of metal, the protrusions 18 and the recesses 20 can be formed by stamping with a die. Further, since the thickness in the portions of the bottom plate 12 where the protrusions 18 are provided is not thicker, an increase in heat capacity of the bottom plate 12 can be avoided and the heat from the heat treating furnace can be efficiently transferred throughout the whole powder.

[0017] Further, the recesses 20 may be provided to account for 3% to 10% of an entirety of the outer surface 16 of the bottom plate 12 when the outer surface 16 of the bottom plate 12 is seen from below toward above (when seen from the +Z direction side toward the -Z direction side). If the number of the recesses 20 provided on the outer surface 16 of the bottom plate 12 is small, the number of the protrusions 18 provided on the bottom plate 12 is also small accordingly, by which it becomes difficult to transfer the heat throughout the powder accommodated in the saggar 10. When the recesses 20 are provided to account for 3% or more of the outer surface 16 of the bottom plate 12, the protrusions 18 provided on the bottom plate 12 can be prevented from decreasing in number. Further, if an area of the flat portion of the outer surface 16 of the bottom plate 12 is small, the saggar 10 easily meanders when conveyed on the conveyor rollers. When the recesses 20 are provided to account for 10% or less of the outer surface 16 of the bottom plate 12, the area of the flat portion of the outer surface 16 of the bottom plate 12 can be prevented from decreasing. Due to this, the saggar 10 can be suppressed from meandering in the heat treating furnace.

[0018] As described above, the saggar 10 is constituted of metal. Due to this, when the powder is collected from the saggar 10 after the heat treatment, the powder easily comes off the surface of the saggar 10. Therefore, a collection rate of the powder can be improved.

[0019] The saggar 10 according to the present embodiment is provided with the protrusions 18 and the recesses 20, by which it can thoroughly heat-treat the powder accommodated therein in a short time and also can suppress the powder from falling out from the saggar 10 during the heat treatment. Powder prior to heat treatment often contains moisture. In conventional saggars, inner surfaces of their bottom plates are flat over their entireties (that is, they are not provided with the protrusions 18), thus heat is easily transferred to a part of the powder located on an upper side and exposed at a powder surface, while the heat is poorly transferred to a part of the powder located at a center thereof. Due to this, the moisture contained in the center part of the powder evaporates after the upper-side part of the powder has been dried. At this occasion, if the moisture contained in the center part of the powder evaporates rapidly, the dried powder located above the center part of the powder is stirred up and falls out from the saggar. Since the saggar 10 according to the present embodiment is provided with the protrusions 18 on the bottom plate 12, the heat is transferred throughout the powder in a short time. Due to this, a temperature difference is less likely generated between the upper-side part of the powder and the center part of the powder during the heat treatment, by which the moisture contained in the center part of the powder can be suppressed from evaporating after the upper-side part of the powder has been dried. Therefore, the saggar 10 can suppress the powder from falling out from the saggar 10. Further, since the powder less likely falls out due to the evaporation of moisture contained in the center part of the powder in the saggar 10 according to the present embodiment, the saggar 10 can accommodate the powder up to a higher level to the sidewall 22, as compared to the conventional saggars. Due to this, the saggar 10 can accommodate a larger amount of powder at once, and productivity of the heat treatment can thereby be increased.

[0020] Although the total number of the protrusions 18 provided on the bottom plate 12 is seven in this embodiment, no limitation is placed thereon. The protrusions 18 may simply need to be arranged at positions that allow the heat to be easily transferred throughout the powder accommodated in the saggar 10, and no limitation is placed on the number of the protrusions 18 nor on their arrangement positions. For example, more than six protrusions 18 may be positioned regularly from one protrusion 18 arranged at the center portion of the bottom plate 12, or less than six protrusions 18 may be positioned therefrom. Further, the protrusions 18 may be arranged according to how the powder is accommodated in the saggar. In accommodating powder in a saggar, the powder is usually dropped from above the saggar to a center portion thereof. In this case, an upper surface of the powder bulges more in a center portion of a bottom plate of the saggar than in a peripheral portion thereof. In a case where the powder is accommodated as such, more protrusions 18 may be arranged in the center portion of the bottom plate of the saggar than in the peripheral portion thereof, for example. On the other hand, in a case where the powder is accommodated in the saggar such that the upper surface of the powder bulges more in the peripheral portion of the bottom plate of the saggar than in the center portion thereof, more protrusions 18 may be arranged in the peripheral portion of the bottom plate of the saggar than in the center portion thereof. Further, although the bottom plate 12 of the saggar 10 according to the present embodiment has the substantially square shape, the bottom plate may have a substantially circular shape, a sub-

stantially rectangular shape, or a substantially elliptical shape.

[0021] Further, although the saggar 10 according to the present embodiment is constituted of metal, no limitation is placed thereon. For example, the saggar may be constituted of a refractory such as ceramic. In a case where the saggar is formed by a refractory, the saggar provided with the protrusions on the bottom plate can be formed by forming the saggar using a mold.

[0022] Further, although the saggar 10 according to the present embodiment is conveyed by the conveyor rollers in the roller hearth kiln in the heat treatment for the accommodated powder, no limitation is placed thereon. The powder in the saggar 10 may simply need to be heat-treated by putting the saggar 10 accommodating the powder in a heat treating furnace, and no limitation is placed on a type of the heat treating furnace.

[0023] Specific examples of the disclosure herein have been described in detail, however, these are mere exemplary indications and thus do not limit the scope of the claims. The art described in the claims includes modifications and variations of the specific examples presented above. Technical features described in the description and the drawings may technically be useful alone or in various combinations, and are not limited to the combinations as originally claimed.

Claims

1. A saggar (10) comprising:

a bottom plate (12); and
a sidewall (22) surrounding a periphery of one surface (14) of the bottom plate (12), wherein one or more protrusions (18) are provided on the one surface (14).

2. The saggar (10) according to claim 1, wherein
one or more recesses (20) are provided on another surface (16) of the bottom plate (12) at positions corresponding to positions where the one or more protrusions (18) are provided, and
the one or more recesses (20) have a shape following a shape of the one or more protrusions (18).

3. The saggar (10) according to claim 1 or 2, wherein
a plurality of the protrusions (18) is provided on the one surface (14), and
the plurality of protrusions (18) is arranged on a circle, a center of the circle being positioned at a center of the bottom plate (12).

FIG. 1

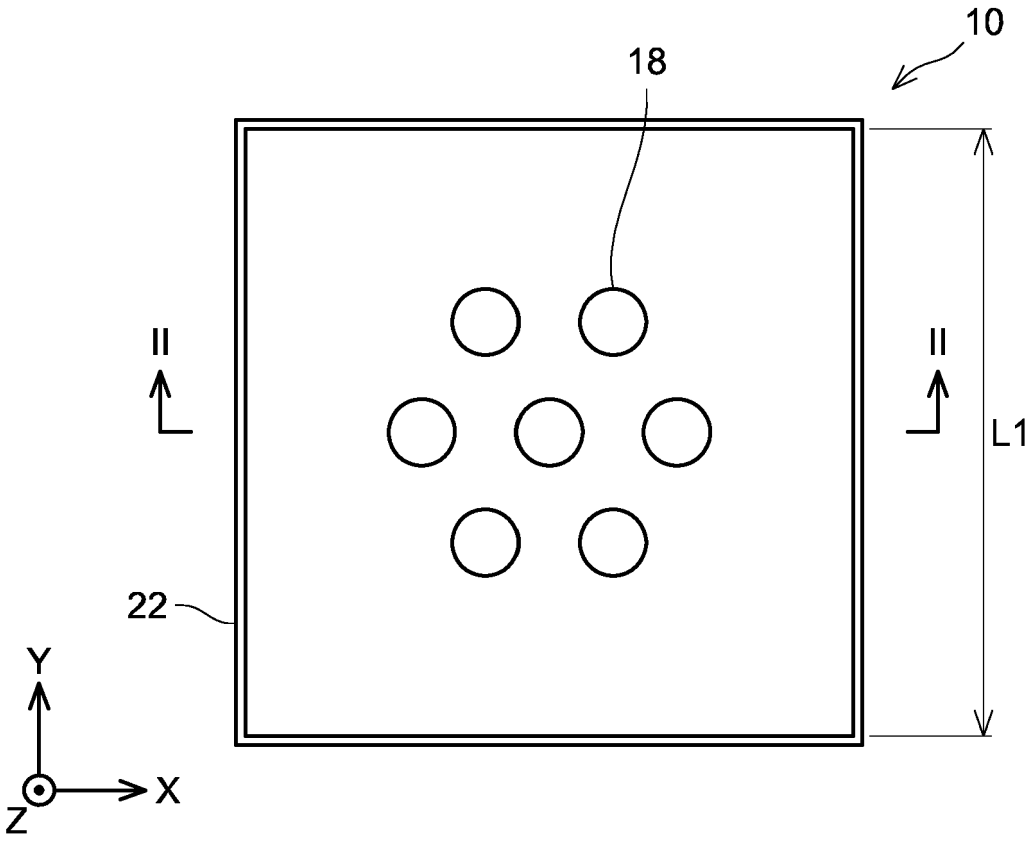
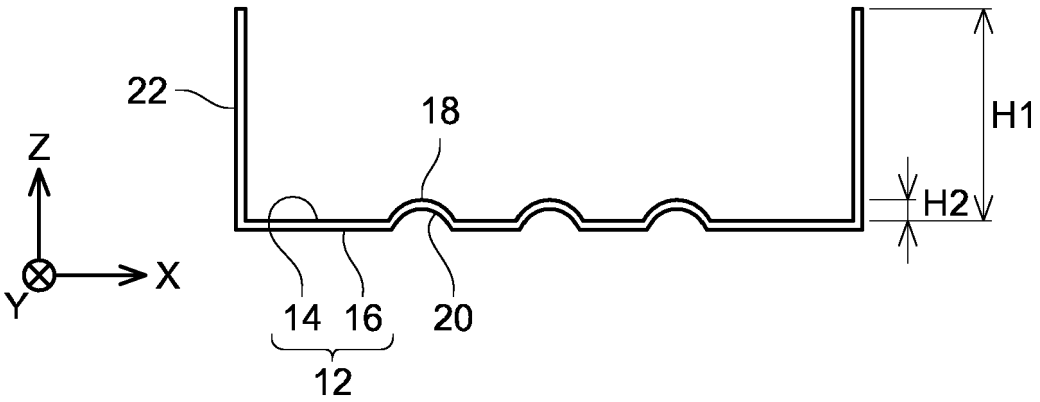


FIG. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 19 16 5240

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 201 007 610 Y (QINGYI SU [CN]) 16 January 2008 (2008-01-16) * claims 1-3; figures 1,2 *	1-3	INV. F27D5/00 C21D9/00
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 May 2019	Desvignes, Rémi

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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22-05-2019

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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