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R. E. GOULD

2,143,003

MAKING CERAMIC ARTICLES

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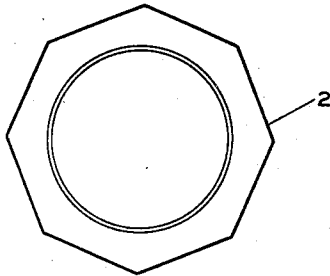


FIG. 1



FIG. 3

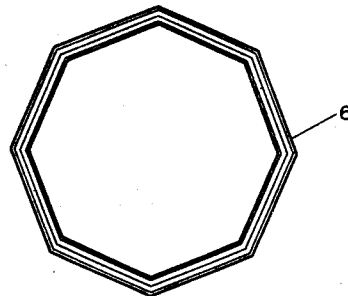


FIG. 5



FIG. 2



FIG. 4

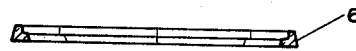


FIG. 6

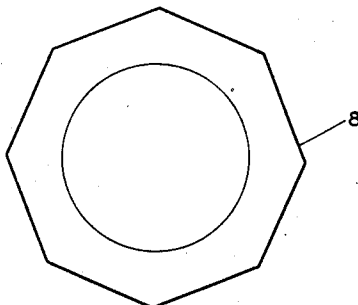


FIG. 7

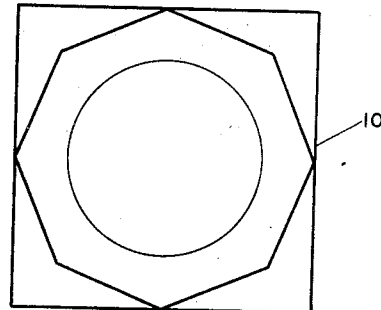


FIG. 9

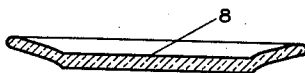


FIG. 8



FIG. 10

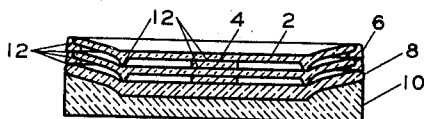


FIG. 11

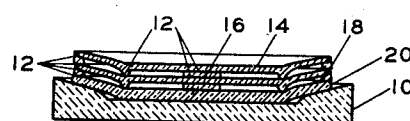


FIG. 12

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2,143,003

MAKING CERAMIC ARTICLES

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Application August 9, 1937, Serial No. 158,144

6 Claims. (Cl. 25—156)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention herein described may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to a process of making ceramic articles, particularly flatware of china or porcelain body.

One of the objects of this invention is to produce fired ceramic flatware articles with a minimum of deformation in those zones of stress where either the influence of gravity or internal strain causes such undesirable effects. Another object of this invention is to provide a method for forming ceramic articles rapidly and with a minimum of expense in order that deformation be practically eliminated in subsequent firing. Still another object of this invention is to provide a method for making ceramic flatware articles with a minimum of deformation of the finished article where the shape of the edge of the article is other than circular. Other objects of this invention include the provision of a method for rapid and automatic mechanism formation of formed ceramic articles, a method for forming very thin ceramic articles and a method for firing a stack of a plurality of formed ceramic articles with a resulting minimum deformation in the finished articles.

Ceramic flatware is easily formed by jiggering or casting from semi-vitreous or hotel china type bodies but such articles present a difficult problem in delivering the ware straight from the firing kiln. Deformation in fired ceramic articles is caused for the most part by internal strains arising from one or more of the following sources: characteristics of the plastic body from which the articles are formed, method of forming the ceramic articles, and skill or lack of skill exhibited during the forming operation. These internal strains are subsequently evidenced, first, during the drying of the formed ceramic articles, and secondly, during the firing of the dried formed ceramic articles. Kiln placing methods, such as used in the manufacture of true porcelain, Belleek, and bone china, result in a satisfactory product but the kiln capacities are severely restricted. This latter objectionable feature might be overcome provided a kiln fill equal to or better than that obtained using semi-vitreous or hotel china type ware could be employed wherein sand, calcined kaolin and mixtures of calcined kaolin and alumina are filled in between the plates. This has not, however, been hitherto attained particularly in connection with the use of porcelain type ceramic ware. In the hitherto known

methods of firing, the processes commonly used do not provide any way for bracing the centers of the ware, which have a tendency to drop if the ware is thin; the processes used do not make it possible to stack the ware to a sufficient height, say not more than 12 high; the processes used do not appear to overcome strains which are introduced into the ware during the forming operation; the processes used have a tendency to show up the internal strains after a biscuit is fired in spite of the bracing; the materials used for bracing carry an excessive amount of dust; the materials used for bracing considerably effect the translucency of the ware and have a tendency to pack and fuse into the ware; and the materials used for bracing have to be re-ground or otherwise treated before reuse.

I have discovered a process of making ceramic ware which provides for firing a plurality of the formed ceramic articles entirely separated from each other. The zone of greatest potential deformation of a formed ceramic article, namely, at or adjacent to the external edge or rim, is separated from a similar zone in an adjacent article by a formed ceramic ring-like element made of plastic clay of the same body or body of the same characteristics as that from which the ceramic articles are formed, each element of a shape such that a portion of the element is complementary to the reverse side of an article adjacent to the rim, such that a portion of it extends beyond the rim of an article and of a thickness corresponding to the distance between the obverse sides of the rims of two adjacent articles as subsequently assembled. Another zone of potential deformation of a formed ceramic article, namely, the center portion of the article inside its foot or equivalent position, is separated from a similar zone in an adjacent article by a formed ceramic disc-like element made of plastic clay of the same body or body of the same characteristics as that from which the ceramic articles are formed, each element of a shape such that its thickness corresponds to the distance between the center of the reverse side of an article and the center of the obverse side of another article below and adjacent to the first article as subsequently assembled.

The generic invention and another specific adaptation are described and claimed in my copending application Ser. No. 158,143, filed August 9, 1937, and still another specific adaptation is described and claimed in my copending application Ser. No. 158,145, filed August 9, 1937.

In the accompanying drawing, which forms a

part of the specification, and wherein reference symbols refer to like parts wherever they occur,

Fig. 1 is a plan view of the reverse side of one of the formed ceramic articles,

Fig. 2 is a vertical section of Fig. 1,

Fig. 3 is a plan view of a formed ceramic disc-like element used subsequently in the assembling of the articles for firing,

Fig. 4 is a vertical sectional view of Fig. 3,

Fig. 5 is a plan view of the obverse side of a formed ceramic ring-like element used subsequently in the assembling of the articles for firing,

Fig. 6 is a vertical sectional view of Fig. 5,

Fig. 7 is a plan view of the obverse side of a green ceramic setter,

Fig. 8 is a vertical sectional view of Fig. 7,

Fig. 9 is a plan view of a fired refractory setter,

Fig. 10 is a vertical sectional view of Fig. 9,

Fig. 11 is a vertical sectional view of a plurality of formed ceramic articles shown in Fig. 1 and Fig. 2 (with only two such articles shown for purposes of illustration) assembled on a green ceramic setter as shown in Fig. 7 and Fig. 8 separated by a disc-like element as shown in Fig. 3 and Fig. 4 and a ring-like element as shown in Fig. 5 and Fig. 6 resting on a fired refractory setter as shown in Fig. 9 and Fig. 10 and ready for firing to the desired maturity, and

Fig. 12 is a vertical sectional view of the assembly shown in Fig. 11 after firing to the desired maturity.

In Fig. 1 and Fig. 2, a formed ceramic article 2 is shown prepared for firing.

In Fig. 3 and Fig. 4, a formed ceramic disc-like element 4, of the same material or with the same physical properties as the material from which the article 2, is prepared is shown.

In Fig. 5 and Fig. 6, a formed ceramic ring-like element 6, of the same material or material of the same physical characteristics as article 2, is shown.

In Fig. 7 and Fig. 8, a green ceramic setter 8, of the same material or material of the same physical characteristics as article 2, has at least a part of its obverse side identical in shape to the obverse side of the formed ceramic article 2.

In Fig. 9 and Fig. 10, a fired true shaped refractory setter 10, has the obverse side complementary to the reverse side of the green ceramic setter 8.

In Fig. 11, a plurality of leather hard ceramic articles 2, with ceramic disc-like elements 4, as shown in Fig. 4 and ceramic ring-like elements 6, as shown in Fig. 6 are assembled on a green ceramic setter 8, as shown in Fig. 8, resting on a true shaped fired refractory setter 10, as shown in Fig. 10 with all the zones of contact between the ceramic articles 2, the disc-like elements 4, and the ring-like elements 6, separated by dusting with a finely divided refractory 12, which is neutral to the body of the ceramic article at the temperature of subsequent firing.

In Fig. 12, the fired ceramic article 14, with the fired disc-like element 16, and the fired ring-like element 18, rests on the fired setter 20, which in turn rests on the original true shaped fired refractory setter 10, with the first four elements separated by the finely divided refractory 12.

Due to the thinness of the layer of the finely divided refractory 12, referred to in connection with Fig. 11 and Fig. 12, the location only of the refractory is indicated by the legend.

It is evident that there are numerous factors which will influence conditions for the most satisfactory operation of my invention, the actual

limits of which cannot be established except by a detailed study of each set of raw materials and the intermediate and finished products involved.

The ceramic flatware articles may be formed by conventional methods, such as jiggering or casting. This particular invention relates specifically to the production of ceramic flatware articles with an exterior edge or rim of any desired shape. This invention is particularly adapted to the production of ceramic flatware articles having intricate design on the obverse side and/or rim.

The zones of deformation of a formed ceramic flatware article during firing are first, the center of the article at which gravity probably exerts the most predominate influence, secondly, the zone through the center line of the foot and thirdly, and by far the most important, the exterior rim of the article where deformation is caused by gravity on the one hand and marked unevenness by the effect of internal strains in the body of the formed ware on the other hand.

I have discovered that practically all deformation of ceramic flatware articles during firing can be eliminated by firing stacks of flatware articles with their respective zones of most serious deformation, except the foot, separated by unfired ceramic elements made of plastic clay of substantially the same characteristics as the body of the articles. Since the zone of most serious deformation lies at the rim of the formed ceramic article, the ceramic ring-like element used in this zone is of the most importance. The individual ceramic ring-like elements may be formed in any suitable manner, such as by jiggering or casting, but, in any event, should have substantially the same physical properties as the ceramic articles which they are to separate. The individual ceramic ring-like element used to separate the formed ceramic articles are of a shape such that a portion of the element is complementary to the reverse side of an article adjacent to the rim, such that a portion of it extends beyond the rim of an article and of a thickness corresponding to the distance between the obverse sides of the rims of two adjacent articles as subsequently assembled.

Since the other zone of deformation, namely, that of the center of the article, ordinarily requires another ceramic element to be placed beneath it so as to separate it from the article immediately below it, it is necessary to supply a ceramic element for this purpose. This second ceramic element may be of any suitable shape, preferably in the form of a disc. The ceramic disc-like element used to separate the formed ceramic articles, if unfired, is of a shape such that its thickness corresponds to the distance between the center of the reverse side of an article and the center of the obverse side of another article below and adjacent to the first article as subsequently assembled. The ceramic disc-like element used to separate the formed ceramic articles, if fired, is of a shape such that its thickness corresponds to the distance between the center of the reverse side of an article and the center of the obverse side of another article below and adjacent to the first article after firing.

It is necessary to separate all of the ceramic elements, whether they be articles proper or separating elements, from each other by the use of a finely divided refractory which is substantially neutral to the body from which these elements are made at the temperature of subsequent firing. A finely divided alumina, such as finer than 150 mesh, has been found suitable for this purpose.

It has been found desirable to use a formed unfired setter which has at least a portion of its obverse side identical in shape to the obverse side of the formed unfired ceramic article. This is preferable in order that an assembly of unfired elements as subsequently described may be prepared and a uniform shrinkage of all the elements obtained during firing.

The formed ceramic articles, the formed ceramic ring-like separating elements, the formed ceramic disc-like separating elements and the formed setter are dried to leather hardness so that the primary shrinkage has already taken place and any subsequent slight flexing may take place without undue distortion.

A true shaped fired refractory setter with its obverse side complementary to the reverse side of the unfired setter is provided as a base for assembling a stack of unfired elements.

A stack of the unfired elements is prepared for drying and firing by placing a fresh leather hard unfired setter on a true shaped fired refractory setter and by building up alternately on the fresh leather setter a ceramic ring-like separating element, a ceramic disc-like separating element and one of the formed ceramic articles, with the respective unfired articles, rings, discs and setter separated by a finely divided refractory which is neutral to the body of the ceramic article at the temperature of subsequent firing, with the respective rings and disc in substantial accurate vertical alignment and with the bottom article in accurate horizontal and vertical alignment with the obverse side of the fresh setter. It has been found possible to assemble much more than the usual number of ceramic articles in this manner for firing. Ordinarily the number may range from 18 to 36 articles, depending upon the size and shape of the article.

The assembly is fired under conditions of temperature, time and atmosphere to obtain a desired maturity. During the firing, there is an appreciable shrinkage of all the original unfired elements of the assembly, with this shrinkage varying considerably with the plastic material from which the articles are formed. It may, for example, vary from 8 to 18%.

After firing, the assembly is dismantled and the finely divided refractory adhering to the fired ceramic articles is removed from the articles.

Certain terms used throughout the description and claims are understood to have the following meaning: "obverse side" refers to the top of the article or element as assembled for firing regardless of how the article or element is actually formed and likewise "reverse side" refers to the bottom of the article or element as assembled for firing regardless of how the article or element is actually formed.

It will be seen, therefore, that this invention actually may be carried out by the modification of certain details without departing from its spirit or scope.

I claim:

1. In a process of making a plurality of ceramic flatware articles, which have substantially identical dimensions, the step which comprises, superposing for subsequent firing a plurality of ceramic elements comprising a plurality of leather hard ceramic articles, preformed from plastic material, and a leather hard ceramic separating element, subjacent to each ceramic article, preformed from the plastic material from which the ceramic articles are formed and so

shaped that a portion of the element is complementary to that portion of the reverse of a superposed article adjacent to its rim, that a portion of the element extends beyond the rim of the article and that the thickness of that portion of the element extending beyond the rim of the article corresponds to the maximum thickness of the articles.

2. In a process of making a plurality of ceramic flatware articles, which have substantially identical dimensions, the step which comprises, superposing for subsequent firing a plurality of ceramic elements comprising a plurality of leather hard ceramic articles, preformed from plastic material, and a leather hard ceramic separating element, subjacent to each ceramic article, preformed from a plastic material which has the same physical properties as the plastic material from which the ceramic articles are formed and so shaped that a portion of the element is complementary to that portion of the reverse of a superposed article adjacent to its rim, that a portion of the element extends beyond the rim of the article and that the thickness of that portion of the element extending beyond the rim of the article corresponds to the maximum thickness of the articles.

3. In a process of making a plurality of ceramic flatware articles, which have substantially identical dimensions, the step which comprises, superposing for subsequent firing a plurality of ceramic elements comprising a plurality of leather hard ceramic articles, preformed from plastic material, a leather hard ceramic separating element, subjacent to each ceramic article, preformed from the plastic material from which the ceramic articles are formed and so shaped that a portion of the element is complementary to that portion of the reverse of a superposed article adjacent to its rim, that a portion of the element extends beyond the rim of the article and that the thickness of that portion of the element extending beyond the rim of the article corresponds to the maximum thickness of the articles, a leather hard setter, preformed from the plastic material from which the ceramic articles are formed with at least a part of the obverse of the setter substantially identical to the obverse of the leather hard ceramic articles, and a fired refractory setter, with the obverse of the fired setter complementary to the reverse of the leather hard setter.

4. In a process of making a plurality of ceramic flatware articles, which have substantially identical dimensions, the step which comprises superposing for subsequent firing a plurality of ceramic elements comprising a plurality of leather hard ceramic articles, preformed from plastic material, a leather hard ceramic separating element, subjacent to each ceramic article, preformed from a plastic material which has the same physical properties as the plastic material from which the ceramic articles are formed and so shaped that a portion of the element is complementary to that portion of the reverse of a superposed article adjacent to its rim, that a portion of the element extends beyond the rim of the article and that the thickness of that portion of the element extending beyond the rim of the article corresponds to the maximum thickness of the articles, a leather hard setter, preformed from a plastic material which has the same physical properties as the plastic material from which the ceramic articles are formed, with at least a part of the obverse of the setter substan-

tially identical to the obverse of the leather hard ceramic articles, and a fired refractory setter, with the obverse of the fired setter complementary to the reverse of the leather hard setter.

- 5 5. In the process according to claim 3, wherein a leather hard separating element is placed subjacent to the center of each ceramic article with said separating element preformed from the plastic material from which the ceramic articles
10 are formed and so shaped that the thickness of the element corresponds to the distance between the center of the obverse of a ceramic article and the center of the reverse of a superposed ceramic article.

6. In the process according to claim 4, wherein a leather hard separating element is placed subjacent to the center of each ceramic article with said separating element preformed from a plastic material which has the same physical properties as the plastic material from which the ceramic articles are formed and so shaped that the thickness of the element corresponds to the distance between the center of the obverse of a ceramic article and the center of the reverse of a superposed ceramic article.

ROBERT E. GOULD.

CERTIFICATE OF CORRECTION.

Patent No. 2,143,003.

January 10, 1939.

ROBERT E. GOULD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 23, for the word "mechanism" read mechanical; page 2, second column, line 10, for "flataware" read flatware; page 3, first column, line 31, for "disc" read discs; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of February, A. D. 1939.

Henry Van Arsedale.

Acting Commissioner of Patents.

(Seal)