

May 14, 1940.

T. G. JUNGENSEN

2,200,449

CASTING

Original Filed April 28, 1937 3 Sheets-Sheet 1

Fig. 1.

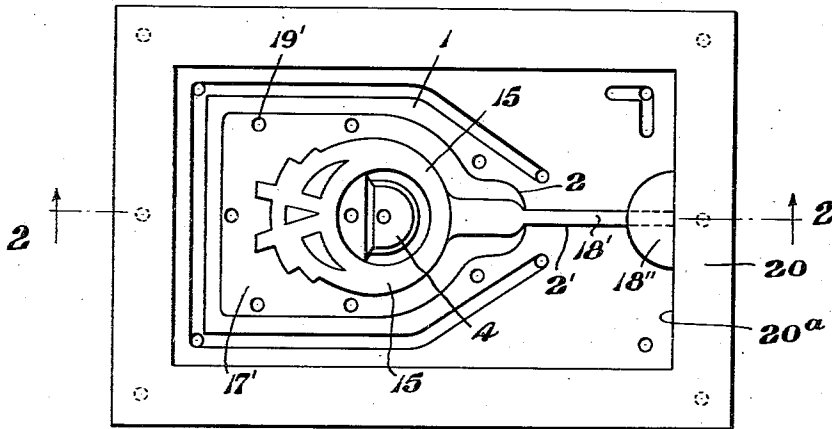


Fig. 2.

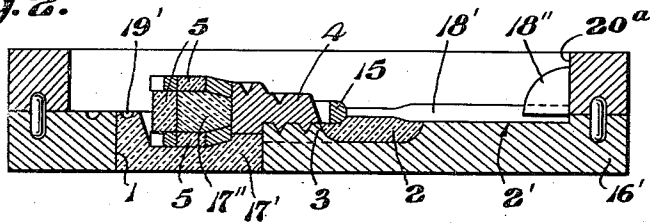


Fig. 3.

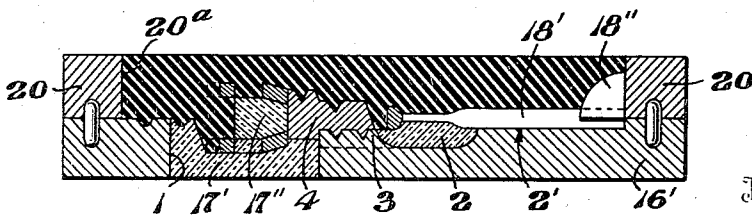
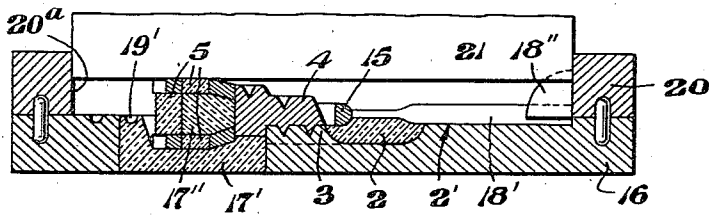


Fig. 3^a

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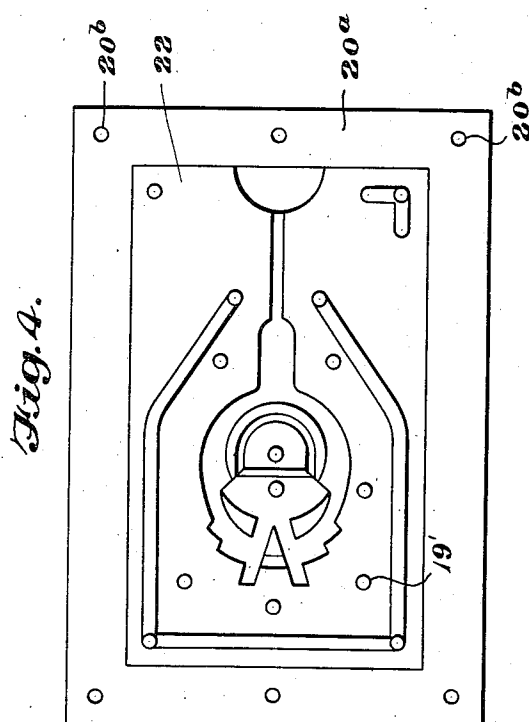
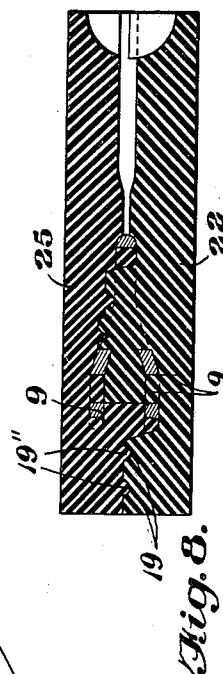
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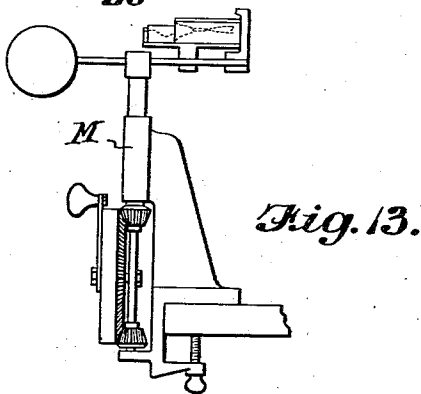
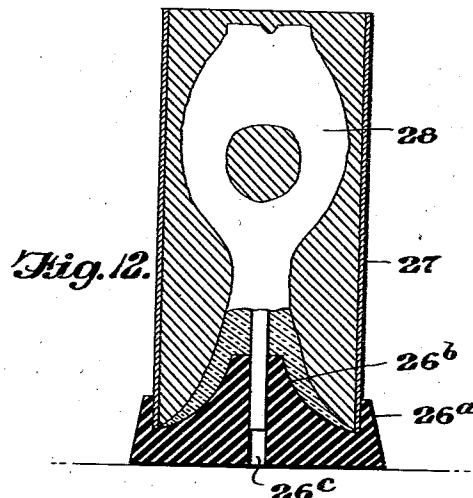
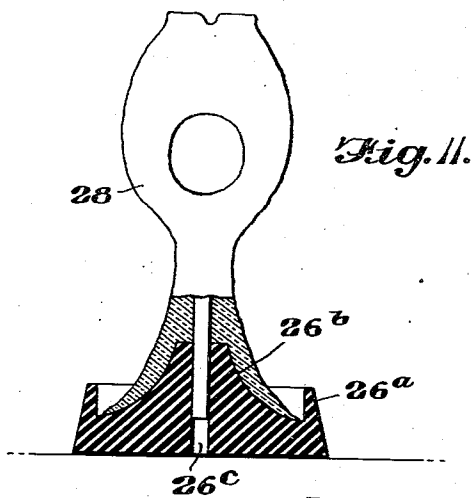
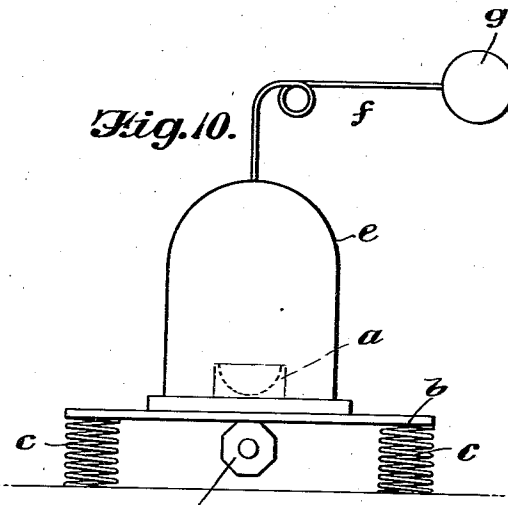
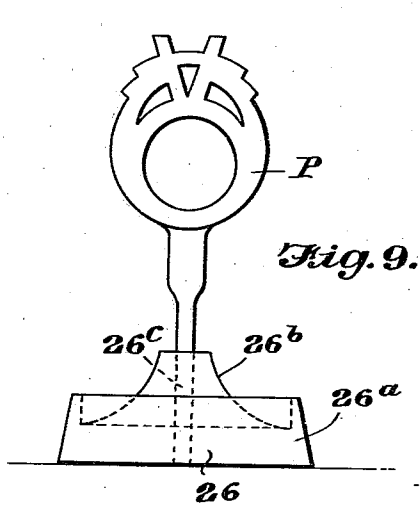
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CASTING

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CASTING

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8 Claims. (Cl. 22—188)

The present invention relates to the art of making jewelry and other small metal articles of intricate design and fine detail, and among other objects aims to provide an improved process or method of casting such articles.

This application is a division of co-pending application Serial No. 139,629 filed April 28, 1937 which is a continuation in part of application Serial No. 745,893, filed September 28, 1934 now issued as Patent No. 2,118,468 under date of May 24, 1938.

A further object of the invention is to enable the formation of intricate castings which will so closely resemble the original and finished product that the slow and tedious work of patterning and detailed cutting required in connection with present casting methods is eliminated.

Another object of the invention is to teach the use of particular classes of materials in connection with the formation of intermediate instrumentalities involved in the improved process such as for example primary molds, secondary molds, physical and other mold treatments.

Other objects and features of the invention will be evident, including the various steps of the improved process, and attendant advantages over anything heretofore known, as set out in the following description of a method and apparatus suitable for reproducing in platinum, gold, and other metal, articles and jewelry especially of intricate designs, such as articles containing hollows, undercut portions and perforations, and of certain materials preferred for use in practicing the invention.

Fig. 1 is a plan view of a model arranged in a mold casing ready for the making of a primary mold section thereabout;

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1 and looking in the direction of the arrows;

Fig. 3 is a view similar to Fig. 2 illustrating the application of mold material to the model;

Fig. 3a is a view similar to Fig. 3 illustrating the mold material in place about the model;

Fig. 4 is a plan view of a part of the primary mold within a mold casing section;

Fig. 5 is a view in perspective with parts cut away of the primary mold parts within mold casing sections;

Fig. 6 is a plan view of a primary mold part which complements that shown in Fig. 4;

Fig. 7 is a fragmentary sectional view of a primary mold part burned by a hot pointed instrument in order to facilitate removal of the "setting" portion of the ring mold;

Fig. 8 is a sectional view of a pair of complementary mold parts one of which is cut to facilitate removal of the model;

Fig. 9 is an elevation of a pattern mounted on a sprue holder;

Fig. 10 is a diagrammatic view illustrating special vacuum steps in the process;

Fig. 11 is an elevation, partly in section, of a mounted fusible pattern invested with a coating of a suitable mold forming material;

Fig. 12 is a view of the assembly shown in Fig. 11, mounted within a molding flask which is completely filled with suitable investment;

Fig. 13 is an elevational view of a centrifugal casting mechanism; and,

Fig. 14 is an elevation of a ring made in accordance with the invention.

Referring to the drawings and in particular Figs. 1, 2, 3, 3a, 4 and 5, the model 15 which may be first dipped in melted wax to fill all perforations and treated as by scraping to remove any excess wax at any desired point, is placed on the plastic material 17', and may be pressed down until it is embedded in it. Then a sprue or gate former 18' may be partly embedded in the plastic material in contact with the model 15, as illustrated in Figs. 1 and 2. A series of holes, grooves, projections, or the like, such as indicated in general at 19', may be arranged in the exposed plastic material either before or after it has set. These holes or the like preferably surround the model itself. The cavity 2 formed in the frame or mold casting section 16' contacts with the main cavity 1 which is also formed therein, and encircles a hub portion 3 of the base on which a removable mandrel core piece 4 of metal, rubber or other materials is adapted to be positioned as by interfitting projections or dowels as shown. This hub portion 3 may be shaped to snugly fit against the inner periphery of the head of the ring model, and if desired the hollow interior setting portion of the model may first be filled to a suitable or predetermined depth with a quantity of plastic base material, as shown at 17''. The perforations or piercings of the setting may be temporarily filled with wax 5 as illustrated in Figs. 2, 3 and 3a.

The removable mandrel core piece 4 may be omitted causing the formation of an integral core on the mold part 25 instead of on the mold part 22.

After the base mold section has been completed and suitably parted about the model by blocking out with plaster of Paris the space surrounding said model with the exception of that

portion for which a mold section is to be made, the entire assembly may be heated sufficiently to remove or disperse the wax 5 from the perforations or piercings of the model.

- 5 A groove 2' may be formed in the mold casting section 16' leading from the cavity 2 to receive and position the sprue former 18'. As illustrated, this sprue former has its inner end widened where it abuts the model and is embedded in the plastic material 17'. A spherical segment or other enlarged shape sprue throat 10 former 18'' cooperates with the sprue former 18' and may be a part thereof. This throat flatly abuts the inner face of the mold casing section 15 20 which is shown as interfitting directly with the mold casting section 16' at its marginal edges.

- Unvulcanized rubber, which may be in the form of a block 21 cut to fit the opening 20a of mold casting section 20, is laid inside the mold casting section, as illustrated in Fig. 3 in contact with the model 15 and the now hardened plastic material 17', and the whole assembly comprising the rubber 21 and mold section casing 20 is heated to a vulcanizing temperature while 25 subjecting the exposed rubber surface to an applied pressure for a period necessary to insure the flowing of the rubber around the model, and effecting the casting of a mold section 22 in rubber, see Fig. 4, which illustrates the mold section and the mold section casing. This rubber, which is preferably of a soft gum type, must be of a character which will not injure the model, if of metal, and it must also separate cleanly from the model for it is cast in contact therewith.

- 35 Instead of employing rubber or other similar or flexible material for the initial mold, I may use other materials such for instance as "Bakelite", plaster of Paris, or certain metals, for example, type metal, Wood's metal, comprising approximately 50% bismuth, 25% lead, 12.5% tin and 12.5% cadmium, or even a plurality of metals, which may be cast with an applied force or molded against the exposed surface of the model. Whereas under certain conditions these 40 alternative materials may be used in place of rubber, it has been found that rubber gives smoother results and is generally preferable.

- After vulcanizing of the rubber, or completing the first part of the mold, whatever the mold section material may be, the mold section casting 50 16', the plastic material 17', the plastic material 17', and the temporary mandrel or core piece 4 are removed to expose a second portion of the model, and the completed mold casting section 22 is inverted, as illustrated in Fig. 4. The mold section 20 is then cleaned to remove all traces of the plastic bedding material 17' and a parting composition such as an oil or powder which will not injure the rubber, is spread over 60 the parting surface of the clean rubber mold section 22. In the next step a frame or mold section casing 23, which is similar to and matches mold section casing 20 is placed over the latter and preferably interlocked therewith as by suitable pins entering predisposed openings 65 20b, see Fig. 5. A second sphere segment is then associated with the outer end of the gate former 18' to form the complete shaped inlet for the pattern forming material. Then a second mass 70 of unvulcanized rubber 24, or other mold materials such as specified above including plaster of Paris and low temperature fusing materials such as Wood's metal, is placed in the opening 23a of the mold section casing 23, and is vulcanized 75 while pressed in close contact with the now ex-

posed portion of the model and the treated parting surface of the previously vulcanized mold section illustrated in Fig. 4.

The product of this second vulcanizing process is a second mold section 25, see Fig. 5, which may 5 or may not be a substantial duplicate of the first depending upon whether or not the model itself is symmetrical. In any event, the second mold section fits the other first invested or embedded side of the model, which may not be symmetrical 10 with respect to the parting plane, and has dowel holes or the equivalent 19'' so arranged as to register with the interlocking means which were formed in the first mold section as a result of the holes or equivalent surface modifications 19' 15 in the plastic material.

The next step therefore is to cut the two rubber mold sections at various selected points, so that they may be easily removed from the wax or other readily fusible pattern P, see Figs. 7 20 and 8, which is to be cast therein.

If the pattern is to be quite plain in design, cutting may not be necessary, as the flexibility of the mold sections may be sufficient to permit their manual separation from the pattern. If 25 the pattern is intricate however, such cutting becomes necessary. The location and direction of the cuts, and their number, will be indicated by the particular design, the object being to insure separation of the rubber mold from the pattern, 30 which may be of wax, without any distortion or other injury whatsoever to the latter, and without detrimentally affecting the accuracy or detail of the mold. As an example, there is shown in Fig. 7, a rubber mold portion 22 with a deeply 35 undercut or hollowed model or pattern P, the actual volume of which may be reduced as by the insertion of a heated pointed instrument I to form a cavity 8. Moreover, a plurality of slits 9 are cut into the opposite sides to extend part 40 way across the mold body, so that the respective portions will be free to flex easily in being withdrawn through the opening 10 of the pattern.

The two registering rubber mold sections thus formed about the model are depicted in Fig. 8 45 of the drawings. According to the preferred embodiment of the invention, these two sections are intended to be used in casting a wax or other relatively readily fusible pattern preparatory to the production of the ultimate mold. 50

Prior to casting the wax or other pattern, the registering surface of the two mold sections may be covered with a fluid or other suitable substance or lubricant for facilitating their separation. Such a substance is preferably an oil which 55 will not injure the rubber, such as for example, castor oil. If the pattern is to be formed from a readily fusible metal, such as "Wood's" metal, the separating material may assume the form of a dry powder. The mold sections are brought 60 together and sufficiently tightly clamped to prevent their distortion, yet firmly enough to assure a faithful reproduction of the original model and the flexible mold is now ready for the casting therein of the pattern of wax or other readily 65 fusible material.

The flexible mold is now preferably put in a centrifugal casting machine. These machines are already available articles of commerce and an illustration of such a typical machine M is found 70 in Fig. 13, diagrammatically showing a mold in position therein. Instead of employing such a machine, the pattern may be cast by centrifugal force exerted manually, as by whirling the mold on the end of a string or cord. It is to be under- 75

stood that other force sufficient to effect the entrance of the pattern forming material within the intricacies of the mold may be utilized without departing from the spirit of the invention.

5 It is preferred to employ centrifugal force when casting a wax or other readily fusible pattern in a rubber mold, for the reason that centrifugal force acts in a peculiar way to cause the molten wax or other pattern-forming material to completely fill the mold space and yet permit escape of all the air through the center of the pattern while the wax or the like is still liquid, with the result that the pattern is a perfect reproduction of the cavity in the mold. Thus any air trapped in a recess of the mold will be crowded back into the fluid body under the pressure applied thereto and the fluid material will advance into the recess as it crowds the air therefrom and will progressively congeal against the wall of the recess until the extreme limit is reached so that the finest of cavities will be completely filled. Either centrifugal force or an applied pressure is very essential if perfect patterns in readily fusible material, particularly wax which is light in weight are to be secured, especially where the patterns are of small dimension and/or of intricate design.

As stated above, instead of wax, fusible alloys, such as Wood's metal may be used, and indeed may be preferred when the pattern is relatively large and hence likely to shrink too much if cast in wax. When the pattern is made of readily fusible alloys, it may be dipped in a solution of wax to fill any fine pores or imperfections occurring in the metal. This results in a superior final product because in this manner the formation of an oxide coating on the metal is practically obviated for the wax acts as a separating agent upon the application of heat to remove the readily fusible pattern from the mold, and thus causes the pattern to flow or separate away from the mold with a minimum disturbance or deposit of slag on the surfaces of the cavity of the finished mold.

The pattern is then inserted in a sprue holder 28, see Fig. 9. If the final product is to be of platinum, the wax pattern held by the sprue holder is preferably treated with a liquid such as sodium silicate. Then the pattern is dipped, preferably into a silica mix, which may comprise silica flour with a binder, for instance, sodium silicate. In some cases, alum or any common acid such as phosphoric acid or other suitable materials may be used to affect the time of setting of the mix.

55 The silica mixture is preferably treated to remove any air or other internally contained gases by subjecting the same to a vacuum, preferably in the manner illustrated in Fig. 10. The container *a* which holds the mix, is placed upon a plate *b* mounted on spring *c* above a rotatable cam or vibrator member *d*, so that by depressing the plate, it is moved into engagement with said vibrator member. A bell jar *e* connected by a diagrammatically shown tube *f* with a suitable vacuum pump *g* is placed over the container *a* and as the vibrations are produced, the vacuum pump withdraws the air or other gases from the mix. Investing of platinum may also be effected in the manner to be described for the casting of gold, silver, etc., wherein the pattern is surrounded with the platinum investing material and then subjected to vacuum with or without attending vibration and during or after the admission of air, whereby the mold material may be closely packed about the pattern.

After the pattern has been associated with the silica mix it will appear as shown in irregular profile in Fig. 11. Following this treatment, the invested pattern may be dried by being moderately heated so as not to fuse the pattern. The coated pattern may also be treated with an oil, wax, or acid solution to render the investment less subject to attack by water and add desirable properties. The flask 27 is then associated with the sprue holder and pattern, and the invested material or other filler is packed into the space between the pattern and into the walls of the flask.

In completely removing or destroying all traces of the wax pattern, and undesirable matter from the mold, the investment or casting mold is maintained at a red heat for a sufficient period, which temperature may range above 1200° F. The platinum is preferably cast in the thus prepared mold after the investment has cooled somewhat, say to about 800° F.

The heat treatment of the investment in this way alters its characteristics, so that it is capable of contact with the molten platinum with a minimum of gas formation, eruption, or undesirable effects.

While silica as an investment is preferred in the casting of platinum because it can be easily removed from undercuts, etc., by using acids; other suitable refractory substances such as alumina, zirconium silicate and the like with a suitable binder such as sodium silicate and such refractory materials as require no binder, can be used, although they introduce different problems in removal from the casting.

Certain types of patterns having small cavities are difficult to invest without entrapping air, in spite of the precautions described above. However, this can be accomplished by coating the pattern with a more or less liquid investment material and then subjecting it to a vacuum, with or without accompanying vibration, which will exhaust substantially all air entrapped under atmospheric pressure. The investment material will then be forced into the finest cavities or piercings completely to fill them without trapping air. When performing the very finest work, the investment material, before being placed about the pattern, may be vacuum treated to remove air bubbles and the vacuum process just described or substantially as described may then be carried out, or the pattern and investment material may first be separately treated in a vacuum chamber, then the pattern submerged in the vacuum treated investment before the vacuum is removed, with or without vibration during or after the admission of air.

Whether the final casting is of platinum or some other metal, the flask is heated to a temperature which will melt the pattern, which temperature may create a slight pressure due to the moisture vaporized from the investment material. This pressure will tend to force the pattern away from the surfaces of the cavity and out through the sprue hole, leaving said surface absolutely clean.

The mold in condition for the final casting is preferably placed in a centrifugal casting machine for casting in the prescribed manner. Instead of centrifugal force, applied pressure or vacuum may be used, where the nature of the metal or alloy will permit such a vibration. After the casting step has been completed, the flask may be dropped into water and allowed to remain for a time sufficient to facilitate removal of the investment material from the casting.

In the case of platinum, the casting may be pickled in acid, such as hydrofluoric, to remove all of the investment, prior to the final finishing operations. In the manufacture of certain types of jewelry, in accordance with my invention, the metal or material of the finished casting may be cast directly into the flexible molds already described with an applied force such as, for example, centrifugal force, pressure, or vacuum.

The silica and sodium silicate, intimate or primary investment, and plaster of Paris mixture, external or secondary investment, mentioned above, as the preferred investment material for platinum casting, may be replaced by a plastic mixture of silica or alumina and silica gel, or materials of a similar character.

While platinum is referred to above as the metal most likely to cause trouble when casting, it will be understood that commercial platinum, and commercial platinum alloys, especially platinum-iridium, are equally included since pure platinum is seldom used in the jewelry trade or dental trade, and the term "platinum" is to be construed as including such kindred alloys or metals offering similar problems, the casting of which will be facilitated by my process in whole or in part.

The resultant castings, whether of platinum, gold or other metals, require but extremely simple finishing operations to be ready for market. Thus the process in practice has effected very large savings, especially in the commercial manufacture of fine jewelry.

It will be obvious to those skilled in the art that various changes may be made in this device without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

What is claimed is:

1. A cast iridium platinum article of intricate design involving one or more small projections or depressions, said casting being non-brittle and substantially pore-free.

2. A cast article of the platinum group, having a fusing point higher than that of pure platinum, of intricate design involving one or more small projections or depressions, said casting being non-brittle and substantially pore-free.

3. A platinum casting or a part thereof of

a design intricate to the extent of having one or more small projections or depressions made by a process comprising, first, producing a model of the article to be cast, then forming about said model a primary mold, then removing the model from the primary mold, then introducing into the mold by force sufficient to deposit the material into the depression or depressions of the primary mold, molten wax or other material of low fusing point that will not injure the primary mold to form a pattern, employing the pattern so made for the manufacture of a casting mold, and casting platinum by centrifugal force into said casting mold.

4. A casting of metal of the platinum group of a design intricate to the extent of having one or more small projections or depressions made by a process comprising, first, producing a model of the article to be cast, then forming about said model a primary mold, then removing the model from the primary mold, then introducing into the mold by force sufficient to deposit the material into the depression or depressions of the primary mold, molten wax or other material of low fusing point that will not injure the primary mold to form a pattern, employing the pattern so made for the manufacture of a casting mold, and then casting by centrifugal force said metal into said casting mold.

5. The method of casting platinum metals and their alloys in articles of intricate design, comprising forming a mold of inert refractory material filler and alkali metal silicate binder, and casting molten platinum metal or an alloy thereof in said mold.

6. The method recited in claim 5 and adding a regulator to the ingredients of said mold to affect the time of setting thereof.

7. The method of casting metals of the platinum group and their alloys having a fusing point higher than pure platinum into articles of intricate design, comprising, forming a mold of silica and an alkali metal silicate and casting such molten material in said mold.

8. The method of casting platinum metals and their alloys in articles of intricate design, comprising forming a mold of silica and sodium silicate, and casting molten platinum metal or an alloy thereof in said mold.

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