Apr. 17, 1923. 1,452,245

S. P. MARSHALL

APPARATUS FOR CASTING ARTICLES OF METAL

Filed Oct. 22, 1921 2 Sheets-Sheet 1

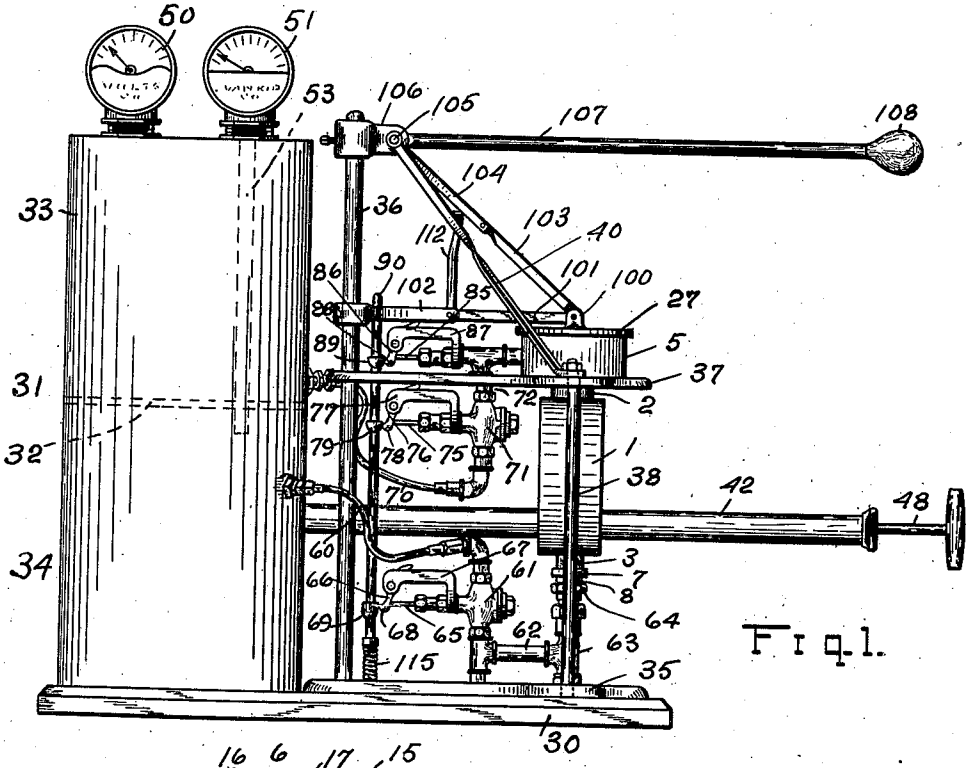


Fig. 1.

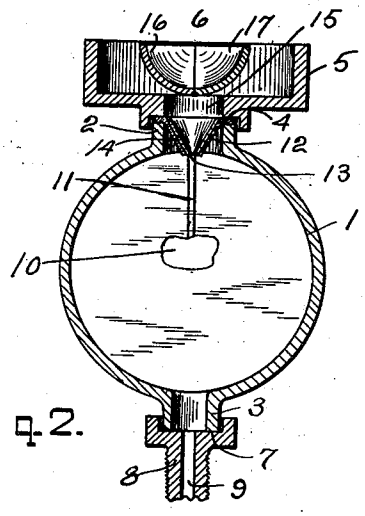


Fig. 2.

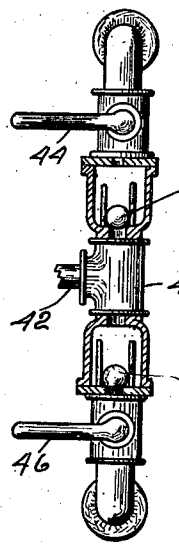


Fig. 3.

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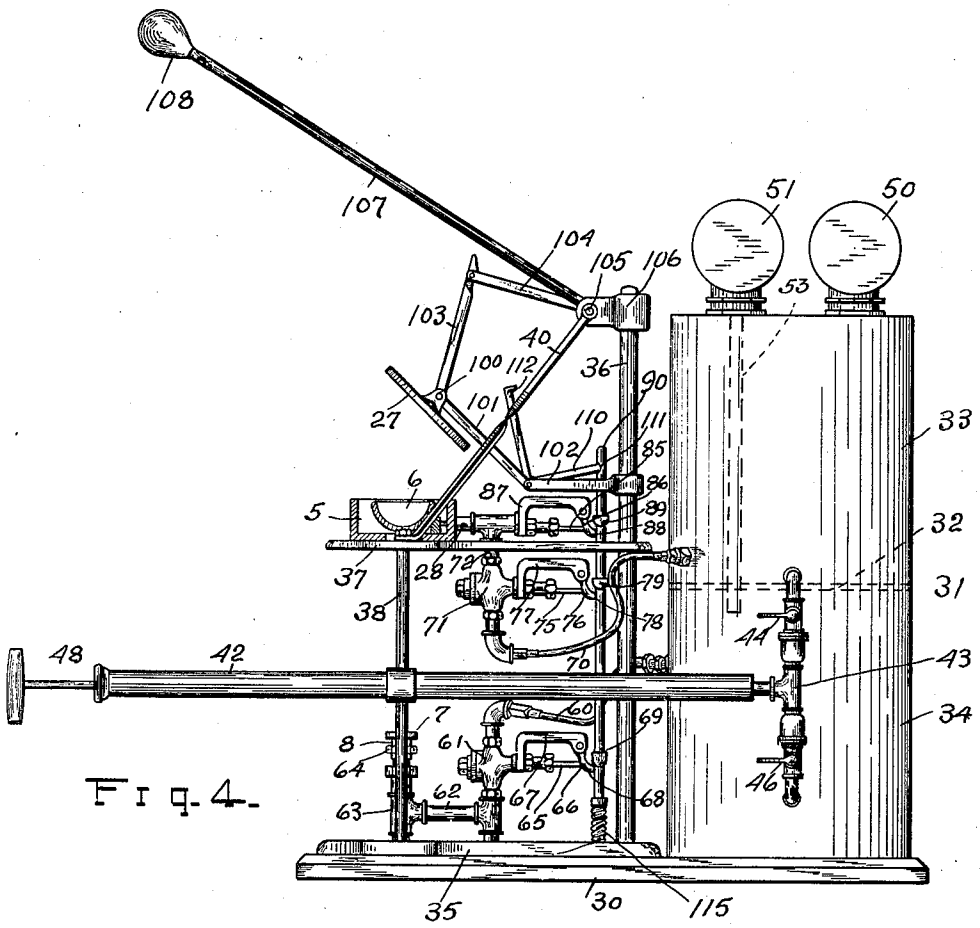


Fig. 4.

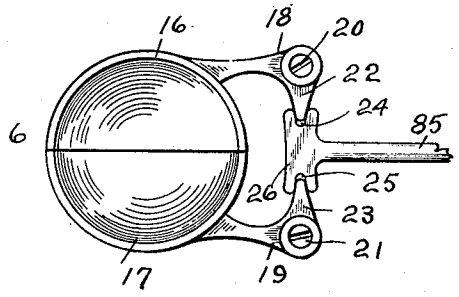


Fig. 5.

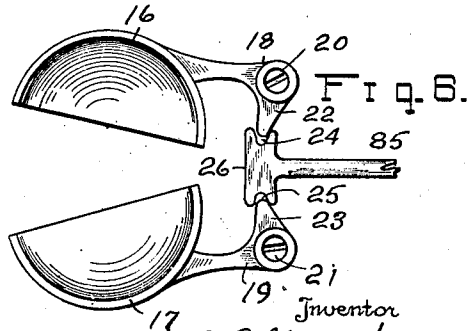


Fig. 6.

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Patented Apr. 17, 1923. 1,452,245

UNITED STATES PATENT OFFICE.

STANMORE PICKENS MARSHALL, OF CINCINNATI, OHIO, ASSIGNOR TO H. B. BYRD MANUFACTURING COMPANY, INCORPORATED, OF WASHINGTON, DISTRICT OF COLUMBIA, A CORPORATION OF VIRGINIA.

APPARATUS FOR CASTING ARTICLES OF METAL.

Application filed October 22, 1921. Serial No. 509,593.

To all whom it may concern:

Be it known that I, STANMORE P. MARSHALL, a citizen of the United States, residing in the city of Cincinnati, county of Hamilton, and State of Ohio, have invented certain new and useful Improvements in Apparatus for Casting Articles of Metal, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

My invention relates to an apparatus for casting metal particularly intended for dental castings, that is for the production of relatively small castings of gold or other valuable metal for use as inlays for filling cavities, or as bridges or plates for supporting artificial teeth. In order to cast inlays, bridges, plates or other articles for use in dental work it is customary to make a pattern by taking an impression in wax of the cavity to be filled or to make the pattern from an impression of the portion of the mouth against which the bridge or plate is to fit, and to form a mold or investment by packing investment material usually consisting mainly of plaster of Paris, about the wax pattern, allowing the investment material to set and heating it to melt out the wax pattern.

Much difficulty has been found in making perfect castings even under pressure or vacuum for the reason that if the mold is cold, the molten metal will chill to such an extent as not to reach the more delicate parts of the mold and, if the mold is heated sufficiently to avoid chilling, the mold and the casting is distorted.

It is the object of my invention to provide an apparatus by which the delicate castings required may be perfectly formed in a cold mold, thus avoiding any chilling before the molten metal reaches every part of the mold and also avoiding the distortion resulting from casting in a hot mold.

A further object of my invention is to provide a compact and simple apparatus adapted for carrying out my method which will not readily get out of order and will be adapted for general use and will not require special skill. A further object of the invention is to provide an apparatus in which the operation of casting, after the metal has been melted, may be effected by the operation of a single lever. A further object of the invention is to provide an apparatus making use of both vacuum and pressure and in which leakage of air into the mold to fill the partial vacuum created is avoided and leakage of air pressure out of the mold is also avoided. A further object of the invention is to provide an apparatus by which the full force of the air pressure and vacuum used is caused to act directly on the molten metal to force it into the mold. A further object of the invention is to provide a method and apparatus by which a mold having a single relatively large sprue hole may be used.

With the objects above set forth and other objects hereinafter explained, in view my invention consists in the apparatus hereinafter described and claimed.

Referring to the drawings:

Figure 1 is a side view of a complete dental casting apparatus embodying my invention looking toward the right.

Fig. 2 is a vertical central sectional view of the flash, melting crucible and connected parts.

Fig. 3 is a detail view partly in section of the pipe connecting the pump with the pressure and vacuum chambers of the tank.

Fig. 4 is a side view similar to Figure 1 but taken from the opposite side and showing the device without the flask, and

Figs. 5 and 6 are detail views showing the casting crucible in closed and open position.

In the drawings 1 indicates a flask in which the mold is held. This flask is here shown as cylindrical metal box but may be of any convenient shape and is provided with an upper neck 2 and a lower neck 3, the ends of which are faced off so that the end of the upper neck is adapted to fit tightly against a seat 4 in the bottom of an enclosing receptacle 5 in which is arranged the melting crucible 6, and the end of the lower neck is adapted to fit tightly against a seat 7 on the upper end of an adjustable support 8 having a central passage 9 formed through it. Within this flask is formed the mold 10 having a single sprue hole 11 of relatively large diameter leading to it from a point in line with the axial center of the upper neck 2. The mold is formed in the usual way by enclosing a pattern consisting of a wax impression of the inlay, bridge, plate or other article to be cast, in a suitable investment com-

position, usually comprising plaster of Paris as its principal ingredient, and, after the composition has set, heating it sufficiently to melt the wax pattern, so that it is absorbed by the material of the mold.

In the upper neck 2 is arranged a funnel 12 with the opening 13 at its lower end in line with the upper end of the sprue 11. A lining 14 of sheet asbestos is usualy arranged in this crucible to protect the molten metal from contact with the metal of the funnel 12 and consequent chilling, as it passes into the mold. The funnel is supported in the neck 2 in any convenient manner. In the construction shown the funnel is provided at its upper edge with an annular flange which rests on the upper end of the neck 2 and is clamped between it and the seat 4.

The receptacle 5 has an opening 15 in its bottom in line with the opening in the upper neck 2 and around this opening, at its lower end, the seat 4 is formed. In the receptacle 5 and above and concentric with the opening 15 is arranged the melting crucible, which is formed in two halves 16 and 17, which come together in a vertical plane. These halves 16 and 17 are carried respectively by the forwardly extending arms of bell crank levers 18 and 19 carried by fixed pivots 20 and 21 and having inwardly extending arms 22 and 23 respectively which are engaged by oppositely arranged notches 24 and 25 in a cross head 26 which is arranged to be reciprocated by mechanism hereinafter described.

The receptacle 5 is provided with a removable cover 27 which, by mechanism hereinafter described, is clamped down upon it.

Into the receptacle 5 leads a pipe 28 which is in communication with a supply of compressed air and the central passage 9 of the adjustable support 8 is in communication with means for exhausting the air from the mold through it.

30 indicates a base plate on which is supported, at the rear, a tank 31 divided by a partition 32 into an upper pressure chamber 33 and a lower vacuum chamber 34. A secondary base plate 35 forward of the tank supports the mold and the operating mechanism. From this secondary base plate 35 a vertical post 36 extends upward near the tank. An upper plate 37 supported on the post 36 and forward legs 38 carries the receptacle 5. From the forward end of this upper plate 37 brace rods 40 extend to the upper end of the vertical post 36 forming a rigid structure.

A pump barrel 42 is connected at its rear end with a vertical pipe 43, the upper end of which leads into the pressure chamber 33 and the lower end of which leads into the vacuum chamber 34. Between the point at which the pump barrel is connected with this vertical pipe and its upper end is a hand valve 44 and an upwardly opening check valve 45 and between the point at which the pump barrel is connected with this vertical pipe and its lower end is a hand valve 46 and a check valve 47. The pump rod 48 is provided on its end with a piston 49 arranged for both pressure and exhaust.

The tank is provided with gauges 50 and 51 of which gauge 50 is in communication with the pressure chamber 33 and gauge 51 is in communication by pipe 53 with vacuum chamber 34.

On reciprocating the pump rod, the hand valves 44 and 46 being open, air will be forced into the pressure chamber and withdrawn from the vacuum chamber. When the gauges show the required pressure and vacuum the hand valves should be closed.

From the vacuum chamber 34 a pipe 60 leads to a valve 61 from which a pipe 62 leads to a vertical pipe 63 into the upper end of which the adjustable support 8 extends. A nut 64 turning on the upper end of pipe 63 and engaging the screw thread of the adjustable support serves to force it upward.

From the pressure chamber 33 a pipe 70 leads to a valve 71 from which pipe 72 leads to pipe 28 which is in communication with the interior of the receptacle 5.

The valves 61 and 71 are self closing valves of any ordinary type, such as the ordinary steam whistle valve, and are arranged to be opened by pushing forward the valve rods 65 and 75.

The cross head 26 for operating the bell crank levers 18 and 19 is carried by a rearwardly extending rod 85. These valve rods 65 and 75 and the rod 85 are parallel and in the same vertical plane. The levers 66, 76 and 86 for operating these rods are pivoted respectively in supports 67, 77 and 87 and their lower ends 68, 78 and 88 bear against the rear ends of the respective rods in position to be operated by cams 69, 79 and 89 carried by a vertically sliding rod 90.

The cover 27 for the receptacle 5 is provided on its upper face with a boss 100 in which is pivoted the forward end of an arm 101 the rear end of which is pivoted in the forward end of a fixed arm 102 carried by and extending forward from the post 36. Also pivoted to the boss 100 of the cover 27 is the lower end of the lower member 103 of an elbow lever, the upper member 104 of which is pivoted at 105 to a bracket 106 carried at the upper end of post 36. On the pivot 105 is secured the end of operating lever 107 provided with handle 108, being so arranged that swinging this lever will swing the upper member 104 with it. The members 103 and 104 of the elbow member are so constructed that when the operating lever is swung down into the position shown in Figure 1 these members 103 and 104 will

be in a straight line and will hold the cover 27 firmly onto the receptacle 5.

Also pivoted in the forward end of fixed arm 102 is a bell crank lever having its horizontal arm 110 extending rearward and engaging a notch 111 in the upper end of the vertically sliding rod 90, and having its vertical arm 112 in position to be struck and forced rearward by the upper member 104 of the elbow lever as it nears the limit of its downward swing, the movement thus imparted to the vertical arm of this bell crank lever causing its horizontal arm to depress the vertical rod 90 and cause its cams 69, 79 and 89 to act against the lower ends 68, 78 and 88 of the levers 66, 76 and 86 to cause them to push forward the valve rods 65 and 75 and the rod 85 to open valves 61 and 71 and to operate the bell crank levers 18 and 19 to separate the halves 16 and 17 of the melting crucible.

The cam 69 is made slightly longer than the cams 79 and 89 so as to effect the operation of valve 61 slightly before the valve 71 and the rod 85 are operated.

A spring 115 on the vertically sliding rod 90 serves to restore it to initial position when the operating lever 107 is raised.

In making use of this apparatus the flask 1 having the mold in it is secured in place with its upper neck against the seat 4 and its lower neck resting on seat 7, the nut 64 being rotated to raise support 8 until tight joints are formed between the necks and their respective seats, as well as a tight joint between the funnel 12 and the seat 4 and neck 2. The pump rod 48 is then operated to produce the proper pressure in the pressure chamber and the proper vacuum in the vacuum chamber. Gold or other metal to be used is then melted in the crucible 6, usually by a blow pipe. When it is sufficiently liquid the lever 107 is brought down to bring the cover 27 down onto the receptacle 5. As the cover is about to make close contact with the top of receptacle 5, the upper member 104 of the elbow lever acts on the arm 112 of the bell crank lever to force vertically sliding rod 90 downward against the force of spring 115. As the rod 90 begins to move downward it carries cam 69 against the lever through which valve 61 is opened, thus connecting the flask with the vacuum chamber and exhausting the air from the mold. Almost instantly thereafter the cams 89 and 79 act to effect the separation of the halves of the melting crucible, dropping the molten metal into the funnel 12, and also opening valve 71 to permit air under pressure to enter the receptacle 5 and act downward on the molten metal which has dropped or is dropping into the funnel 12. By thus forcing the molten metal into the mold previously exhausted of air, it is driven into the mold with such rapidity that it flows into the most delicate parts of the mold before it is sufficiently chilled to be sluggish.

While of course the operator needs to be skilled in melting the gold or other metal used, and must see to it that the proper pressure and vacuum is shown by the gauges and that the nut 64 is turned sufficiently to insure tight joints at the ends of the necks of the flask, no special skill is required as, when the metal is melted, all that remains to be done is to bring down the lever 107 until it can be forced down no further.

It is of course to be understood that the flask 1 is substantially air-tight except at the openings formed by the necks 2 and 3, so that when the valve 61 is opened the suction of the vacuum chamber will exhaust the air from the mold, there being no place at which air can enter the flask except through the small opening 13 at the lower end of the funnel 12, and this opening is filled by the molten metal as it is discharged from the crucible. The molten metal is then between the suction of the vacuum chamber and, the receptacle 5 being closed and the valve 71 being opened, the pressure from the pressure chamber, and is thus both drawn into and forced into the mold.

The parts of the crucible 6 when brought together should fit together sufficiently closely to prevent any of the molten metal from dropping through into the funnel 12 and the sprue hole 11 before these parts are separated to permit the mass to drop. There is thus no danger of the sprue hole becoming choked by metal before the casting operation, as is liable to happen when the metal is melted directly on the mold, as is usually done in dental casting. By reason of the fact that the molten metal, in carrying out my invention as above described, is discharged in a single mass at one time into the funnel 12 and through it into the sprue hole 11 and is instantly forced into the sprue hole by the suction below the mold and the air pressure above the metal, the metal entering the single sprue hole will be distributed to all parts of a mold cavity even of such extensive area as that for casting a plate. The necessity for a plurality of sprue holes heretofore found necessary in casting a plate or other article of extensive area and the necessity for the metal flowing in through the separate sprue holes to unite in the cavity of the mold is avoided. It has heretofore been found practically impossible to cause the metal entering the mold through separate sprue holes to unite satisfactorily in the cavity of a cold mold and very difficult to secure satisfactory union even in a highly heated mold.

In the ordinary vacuum dental casting device the metal being melted directly on the top of the mold over the sprue hole or sprue

holes covers only the central portion of the depression formed to receive it. Consequently when the air is exhausted from the mold more or less air will be drawn in through the portion of its top surrounding the molten metal, the mold being of porous material. This necessarily reduces the effective pressure on the molten metal so that the pressure gauge does not correctly indicate the effective pressure and there is thus no way of determining what the effective pressure really is. In the use of my invention this uncertainty is avoided as there is no opportunity for leakage of air about the molten metal, the top of the mold being protected by the funnel 12 with its tight connection with the neck 2 and seat 4. The operator can thus be sure that the pressure indicated by the pressure gauge is the effective pressure upon the molten metal.

The mold being formed of the usual investment material used in forming molds for dental casting is somewhat porous, sufficiently so as to permit the air to be exhausted through it. It may be formed of any material of a similar porous nature, and the exhausting of the air from it may be facilitated in any usual way as by forming vent holes in it leading from the lower opening of the flask; such vent holes, however, preferably not extending to the cavity of the mold.

While the apparatus is particularly adapted for dentists' use in making the relatively small casting used in dental work, I do not desire to be understood that the invention is limited to making castings of any particular size or of any particular metal.

Having thus described my invention what I claim is:

1. In an apparatus for casting articles of metal the combination with a flask adapted to enclose a mold of porous material and having an upper and a lower opening, of a receptacle above the upper opening of the flask and in communication therewith, a crucible within the receptacle above the upper opening of the flask and at such distance from it as to leave a substantial air space between the crucible and the flask, means for creating a partial vacuum within the flask, and means for discharging the contents of the crucible into the upper opening of the flask.

2. In an apparatus for casting articles of metal the combination with a flask adapted to enclose a mold of porous material and having an upper and a lower opening, of a normally open receptacle above the upper opening of the flask and in communication therewith, a crucible within the receptacle above the upper opening of the flask and at such distance from it as to leave a substantial air space between the crucible and the flask, means for creating a partial vacuum in the flask, means for closing the receptacle and for forcing air under pressure into it, and means for discharging the contents of the crucible into the upper opening of the flask.

3. In an apparatus for casting articles of metal the combination with a flask adapted to enclose a mold of porous material and having an upper and a lower opening, of a receptacle above the upper opening of the flask and in communication therewith, a crucible within the receptacle above the upper opening of the flask and at such distance from it as to leave a substantial air space between the crucible and the flask, means for creating a partial vacuum in the flask, means for discharging the contents of the crucible into the upper opening of the flask, and means carried by the flask for guiding the contents of the crucible into the sprue hole of the mold enclosed therein.

4. In an apparatus for casting articles of metal the combination with a flask adapted to enclose a mold of porous material and having an upper and a lower opening, of a receptacle above the upper opening of the flask and in communication therewith, a crucible within the receptacle above the upper opening of the flask and at such distance from it as to leave a substantial air space between the crucible and the flask, means for creating a partial vacuum in the flask, means for discharging the contents of the crucible into the upper opening of the flask and a funnel carried by the flask for guiding the contents of the crucible into the sprue hole of the mold enclosed therein.

5. In an apparatus for casting articles of metal the combination with a flask adapted to enclose a mold of porous material and having an upper opening and a lower opening, of a receptacle above the upper opening of the flask and in communication therewith, a crucible within the receptacle above the upper opening of the flask and at such distance therefrom as to leave a substantial air space between it and the flask, means for holding the upper opening of the flask tightly against the bottom of the receptacle, air exhausting means adapted to be placed in communication with the lower opening of the flask, and means for discharging the contents of the crucible into the upper opening of the flask, and means for connecting the exhausting means with the flask to create a partial vacuum therein and then discharging the contents of the crucible.

6. In an apparatus for casting articles of metal the combination with a flask adapted to enclose a mold of porous material and having an upper opening and a lower opening, of a normally open receptacle above the upper opening of the flask and in communi-

cation therewith, a crucible within the receptacle above the upper opening of the flask and at such distance therefrom as to leave a substantial air space between it and the flask, means for holding the upper opening of the flask tightly against the bottom of the receptacle, air exhausting means adapted to be placed in communication with the lower opening of the flask, means for closing the receptacle, air pressure means adapted to be placed in communication with the receptacle, and means for discharging the contents of the crucible into the upper opening of the flask.

7. In an apparatus for casting articles of metal the combination with a flask adapted to enclose a mold of porous material and having an upper opening and a lower opening, of a normally open receptacle above the upper opening of the flask and in communication therewith, a crucible within the receptacle above the upper opening of the flask and at such distance therefrom as to leave a substantial air space between it and the flask, means for holding the upper opening of the flask tightly against the bottom of the receptacle, air exhausting means adapted to be placed in communication with the lower opening of the flask, means for closing the receptacle, air pressure means adapted to be placed in communication with the receptacle, and means for discharging the contents of the crucible into the upper opening of the flask, and means for first connecting the exhausting means with the flask to create a partial vacuum therein and then simultaneously closing the receptacle, discharging the contents of the crucible and turning on the air pressure.

8. In an apparatus for casting articles of metal the combination with a flask adapted to enclose a mold of porous material and having an upper opening and a lower opening, of a normally open receptacle above the upper opening of the flask and in communication therewith, a crucible within the receptacle above the upper opening of the flask and at such distance therefrom as to leave a substantial air space between it and the flask, means for holding the upper opening of the flask tightly against the bottom of the receptacle, air exhausting means adapted to be placed in communication with the lower opening of the flask, means for closing the receptacle, air pressure means adapted to be placed in communication with the receptacle, and means for discharging the contents of the crucible into the upper opening of the flask, an operating handle and means operated thereby for first connecting the exhausting means with the flask to create a partial vacuum therein and then simultaneously closing the receptacle, discharging the contents of the crucible and turning on the air pressure.

9. In an apparatus for casting articles of metal the combination with a flask adapted to enclose a mold of porous material and having an upper opening and a lower opening, of a normally open receptacle above the upper opening of the flask and in communication therewith, and having a removable cover, a crucible within the receptacle above the upper opening of the flask and at such distance therefrom as to leave a substantial air space between it and the flask, means for holding the upper opening of the flask tightly against the bottom of the receptacle, air exhausting means adapted to be placed in communication with the lower opening of the flask, a controlling valve for the air exhausting means, means for closing the receptacle, air pressure means adapted to be placed in communication with the receptacle, a controlling valve for the air pressure means, and means for discharging the contents of the crucible into the upper opening of the flask, and means for first connecting the exhausting means with the flask to create a partial vacuum therein and then simultaneously closing the receptacle, discharging the contents of the crucible and turning on the air pressure, comprising a lever arranged to force the cover onto the receptacle and a vertically movable rod carrying cams for operating the valves of the air exhausting and air pressure means and for operating the means for discharging the contents of the crucible.

In testimony whereof I hereunto affix my signature.

STANMORE PICKENS MARSHALL.

Certificate of Correction.

It is hereby certified that Letters Patent No. 1,452,245, granted April 17, 1923, upon the application of Stanmore Pickens Marshall, of Cincinnati, Ohio, for an improvement in "Apparatus for Casting Articles of Metal," were erroneously issued to "H. B. Byrd Manufacturing Company, Incorporated, of Washington, District of Columbia, a Corporation of Virginia," as assignee of the entire interest in said invention, whereas said Letters Patent should have issued to the inventor, said *Marshall*, and *H. B. Byrd Manufacturing Company, Incorporated*, said corporation being assignee of *one-half* interest only in said invention, as shown by the records of assignments in this office; 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 29th day of May, A. D., 1923.

[SEAL.]

KARL FENNING,
Acting Commissioner of Patents.