Nov. 17, 1925. 1,562,029

C. E. LARSON ET AL

CASTING APPARATUS

Filed Jan. 29, 1923 2 Sheets-Sheet 1

Fig. 1

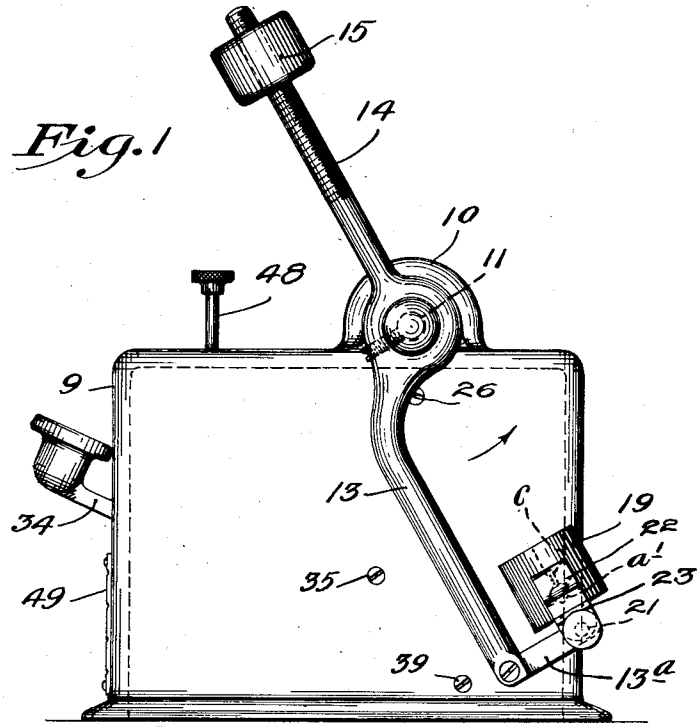


Fig. 2

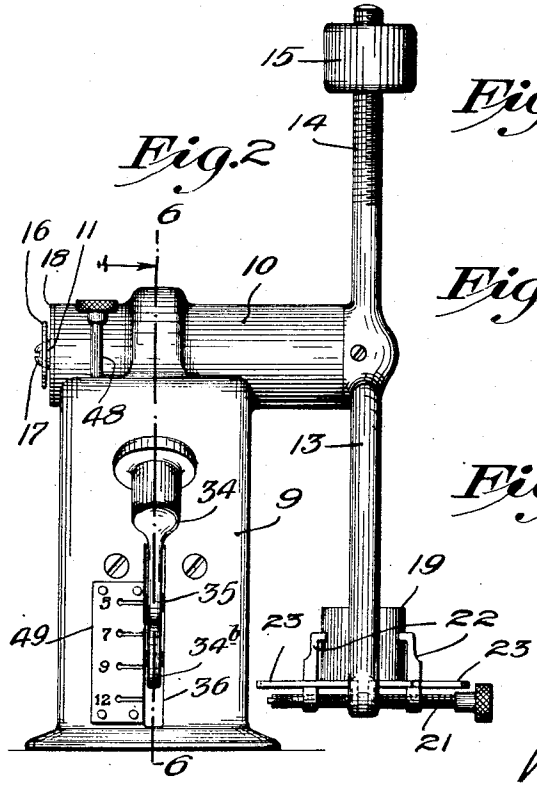


Fig. 5

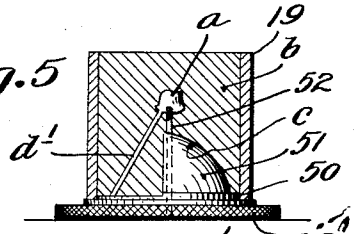


Fig. 4

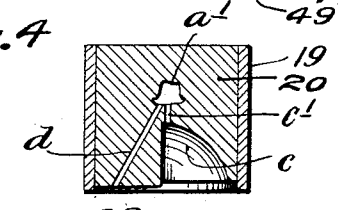
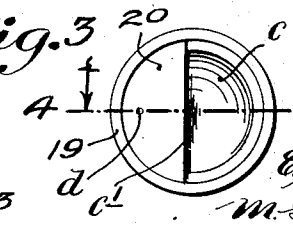


Fig. 3



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Filed Jan. 29. 1923 2 Sheets-Sheet 2

Fig. 6

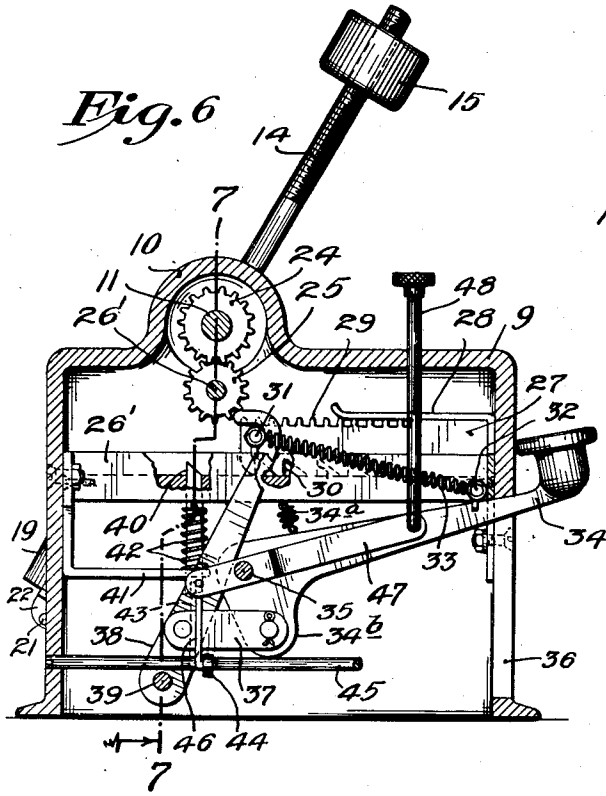


Fig. 7

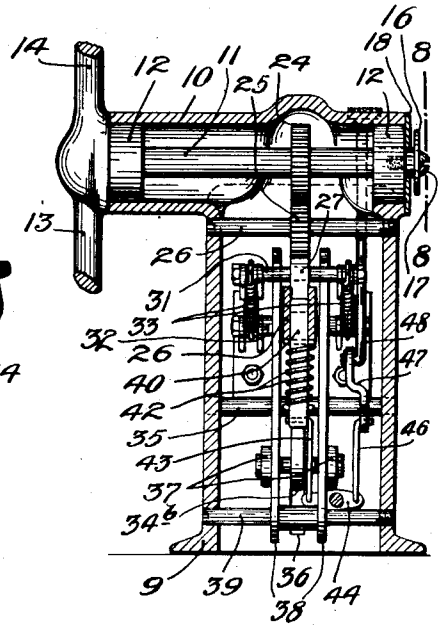
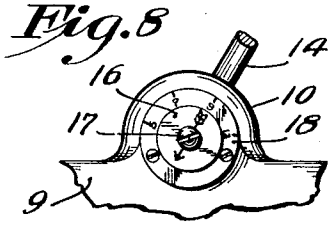


Fig. 8



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Patented Nov. 17, 1925. 1,562,029

UNITED STATES PATENT OFFICE.

CHARLES E. LARSON AND MERRILL G. SWENSON, OF MINNEAPOLIS, MINNESOTA.

CASTING APPARATUS.

Application filed January 29, 1923. Serial No. 615,584.

To all whom it may concern:

Be it known that we, CHARLES E. LARSON and MERRILL G. SWENSON, citizens of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Casting Apparatus; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention provides an improved device for use in casting metal in molds or matrices; and, generally stated, the invention consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

This improved casting device, while capable of use for casting various different objects, is, nevertheless, particularly adapted and has been especially designed for use in casting gold or other metal into molds or matrices for the purpose of producing dental inlays. In the art of making dental inlays, it is the well known and common practice to make in a suitable "investing material" a mold or matrix that is a duplicate of the tooth cavity and to produce inlays by casting gold or other metal into such mold or matrix.

In the accompanying drawings, which illustrate our invention, like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a front elevation showing the improved casting device;

Fig. 2 is a side elevation of the same;

Fig. 3 is a plan view showing the casting ring and the investing material, in which latter the crucible and the mold or matrix are formed;

Fig. 4 is a section on the line 4—4 of Fig. 3, showing the casting ring and investing material turned upside down;

Fig. 5 is a view corresponding to Fig. 4, but showing also the sprue base form on which the casting ring and investing material are set, said sprue base form being in full elevation;

Fig. 6 is a vertical section on the line 6—6 of Fig. 2;

Fig. 7 is a transverse vertical section on the line 7—7 of Fig. 6; and

Fig. 8 is a fragmentary detail in elevation, viewed from the right toward the left in respect to Fig. 7 and showing parts found in the vicinity of the line marked 8—8 on said view.

The numeral 9 indicates an approximately rectangular cast metal box or hollow base member, which, at its upper portion, is provided with transversely extended sleeve-like bearings 10. A driven shaft 11 is extended axially through the sleeve-like bearing 10 and is journaled therein by means of anti-friction bearing devices, such as ball bearings 12, inserted in the ends of said sleeve-like bearing. At one end, the shaft 11 is rigidly secured to a mold-carrying arm 13 and to a counterbalancing arm 14, the said two arms, as shown, being integrally formed and the latter being threaded and provided with an adjustable counterweight 15. At its other end, to wit: its right-hand end, as shown in Fig. 7, the shaft 11 is provided with a pointer shown as in the form of an arrow-marked washer 16 rigidly but detachably secured to said shaft 11 by an axially located screw 17. The arrow washer 16 cooperates with a graduated ring or washer 18 that is secured to the adjacent end of the sleeve-like bearing 10.

At its free end, the mold-carrying arm 13 is provided with a rigidly secured lateral extension 13^a, the end of which terminates on a line that radiates from the axis of the shaft 11 and is coincident with the axis of the arm 14, the purpose of this, as will presently more clearly appear, being to set the casting ring with its axis on said radial line. The casting ring 19 is preferably cylindrical but might be of any other suitable form that is adapted to be filled with investing material 20. This investing material is a well known substance, which, when plastic, may be readily molded into any desirable form but which quickly hardens and is then highly refractory.

To the end of the arm extension 13^a is is swiveled a vise screw 21 that is reversely threaded on opposite sides of its swivel, the reverse threads thereof being engageable with vice jaws 22. The jaws 22, at their flanged upper ends, are made to fit the walls of the casting ring 19, so that the latter will be centered on the radial axis above noted, when the vise is tightened. The jaws 22 are shown as guided by straight-line movements by slotted guide plates 23 that are rigidly secured to the arm extension

13ª and project in opposite directions therefrom.

At its intermediate portion, the shaft 11 is provided with a spur gear 24, which, as shown, meshes with a second spur gear 25 carried by a spindle 26 journaled in the sides of the box 9.

For rotating the mold-carrying arm 13 around the axis of the shaft 11, we provide an impelling device or motor that is adapted to be pre-set and instantly released for action. This impelling device includes driving and driven members. In the particular arrangement illustrated in the drawings, the shaft 11 and gears 24 and 25 are driven members of this impelling device and the driving mechanism is as follows:

Extended transversely of and rigidly secured within the box 9 is a horizontal guide bar 26^1 formed in its upper edge with a channel in which slides an impelling bar 27 that is held against rising movements by a retaining plate 28 shown as rigidly secured at one end to one side of the box 9. On its upper edge, the impelling bar 27 is provided with rack teeth 29 and, on its under edge, it is provided with ratchet teeth 30. In the normal position of the impelling bar 27 shown in Fig. 6, the rack teeth 29 are just out of mesh with the teeth of the gear 35, but slight movement of said bar toward the left will engage said rack teeth with said gear.

Rigidly secured to the inner or left-hand end of the impelling bar 27 and projecting on opposite sides thereof is a pin 31, and rigidly secured to the left-hand end of the guide bar 26 is a similar pin 32. The corresponding ends of the pins 31 and 32 are connected by strong coiled springs 33, which constitute the primary impelling means, or, otherwise stated, the motor springs. These springs impel the bar 27 toward the right in respect to Fig. 6 and normally hold the same in the position shown in said view.

For moving the impelling bar 27 toward the left in respect to Fig. 6, to thereby stretch the impelling springs 33, we provide an impeller-setting device, which, as shown, includes a depressible key-like setting lever 34 pivoted on a bearing shaft 35 supported within the box 9. The lever 34 is yieldingly retracted or pressed upward by a slight coiled spring 34^a. The free end of this lever 34 works through a slot 36 in the box 9, so that the head, at its outer end, may be readily engaged and depressed. The pivoted end of the lever 34 is provided with a short depending arm 34^b, which, by a twin link 37, is connected to the intermediate portion of a twin or two-part setting arm 38, the lower ends of the members of which are pivoted on a rod 39 secured within the box 9. The members of this two-part setting arm are spaced on opposite sides of the guide bar 26 and their free upper ends are engageable with the opposite ends of the pin 31, which, as above noted, is carried by the impelling bar 27.

For holding the impelling bar set variable distances toward the left in respect to Fig. 6, we provide a latch dog 40 that works vertically through the bottom of the guide bar 26 and through a guide bracket 41 rigidly secured within the box 9. This latch dog 40 is yieldingly pressed upward by a coiled spring 42 and its lower end is connected by a short link 43 to one end of a rocker 44, which, as shown, is rigidly secured to the intermediate portion of a shaft 45 journaled in the box 9. The other end of the rocker 45 is connected by a link 46 to the short end of a trip lever 47, which, as shown, is pivoted on the shaft 35. The free end of the trip lever 47 is connected to the lower end of the stem of a depressible trip key 48 that works through the top of the box 9.

For indicating the depressed position of the setting lever 34, the box 9 is shown as provided, adjacent to the slot 36, with a graduated indicator 49. The graduations indicated at 49 correspond to the ratchet teeth 30 of the impelling bar 27 and the numerals 5, 7, 9 and 12, marked on said graduations, indicate the impelling tension under which the springs 33 will be set for different positions of the setting lever 34.

Operation.

For illustration, we will assume that the object to be cast is a dental inlay and that the wax duplicate or form of the inlay is indicated at *a*, Fig. 5. This wax form is imbedded in investing material *b* contained within the casting ring 19.

In accordance with our invention, the fusing cavity *c* is formed directly in the investing material 20 and is connected to the mold a^1 that is produced by the wax model *a* by a sprue or small passage c^1. Also, as a highly important feature, a small air-venting passage *d* is formed in the investing material 20 and is extended from the mold a^1 to the inner face of the investing material.

For the production of the fusing cavity *c* and for forming the inner face of the investing material, we provide a sprue base form 49^1 having a shallow boss 50 that will slightly telescope into the casting 19; and on this boss is a crucible-forming lug 51 that is preferably one-quarter or quadrant of a sphere and is arranged with one flat wall in a radial plane that includes or approximately includes the axis of the casting ring. The investing material will be molded into the casting ring 19 while the latter is set on the sprue base as shown in Fig. 5. The sprue c^1 may be formed by a removable

pin 52 or by a wax cord positioned as shown in Fig. 5. The venting passage d will preferably be formed by a waxed cord d^1 inserted as shown in Fig. 5 and extended from that portion of the mold cavity a^1 that is radially innermost in respect to the casting ring and investing material positioned as shown in Fig. 1.

The investing material inserted as shown in Fig. 5 will quickly harden and then the spru base, together with the sprue-forming pin 52, may be removed. Then, by applying heat to the casting ring and investing material, the wax of the model a and the waxed cord d^1 may be quickly melted so that it will run out, leaving the investing material with the hollow or open mold cavity a^1, open sprue c^1 and open air venting passage d, as shown in Fig. 4. The parts shown in Fig. 4 are then inverted and applied in the clamp or vise 21—22, with the flat wall of the fusing cavity c located in a plane that radiates from the axis of the shaft 11. When the arm 13 is set substantially as shown in Fig. 1, the fusing cavity c will be in the best position for the fusing of the gold or other metal that is to form the inlay, and such metal may then be readily fused within said cavity by the use of a blow torch or flame and blow pipe. The metal fused in the cavity c will, by molecular action, be held in mass and will not, under the action of gravity, run through the sprue c^1 into the mold cavity a^1, but will be caused to run into said mold cavity under the action of centrifugal force when the shaft 11 and arm 13 are caused to rapidly rotate.

The speed at which the shaft 11 will be rotated will, as already stated, depend on the tension under which the impelling springs 33 are set and, of course, the farther the impelling bar 27 is set toward the left in respect to Fig. 6, the greater will be the tension under which the said springs will be set. The force under which the springs 33 are to be caused to act will be determined in advance by the ratchet tooth 30 with which the latch dog 40 is engaged and the arrangement is such that the first of the said teeth toward the left engaged with said dog will set said springs for five pounds pressure, the second tooth for seven pounds pressure, the third tooth for nine pounds pressure and the fourth tooth for twelve pounds pressure. Moreover, it is desirable that the casting ring 19 be substantially in the position shown in Fig. 1 when the springs are set for any of the several tensions above stated. With the arrangement described, this may be easily accomplished as follows: Say, for example, that the springs 33 are to be set under seven pounds pressure—then, while the impelling bar 27 is still in its inoperative position toward the right and its teeth 29 free from the gear 25, the arm 17 is moved until the oil on the washer 16 is aligned with the seven mark on the annular dial 18; the setting lever 34 will then be depressed to the seven mark on the scale 49, which will cause the second ratchet tooth 30 to be engaged by the latch dog 40. This movement of the impelling bar 27 just noted will engage the rack teeth 29 with the gear 25 and, acting through the gears 25 and 24, will rotate the arm 13 back to its initial position shown in Fig. 1, and the latch dog will then hold the impelling bar, the gears, and the arm 13 locked in such position until tripped, but the setting lever 34 and arms 38 will, upon being released, immediately go back to normal positions shown in Fig. 6. This immediate return of the arms 38 is important because it brings them back where they will not impede the movement of the impelling bar 27 under the action of the impelling springs 33 when said bar is released.

While the parts are set as just stated, the melting of the metal in the fusing cavity c should take place, and when it is brought to proper fluid condition, the operator depresses the trip key 48, thereby releasing the latch dog 40 and permitting the impelling springs 33 to quickly throw the impelling bar 27 back to its normal position. As said impelling bar moves back to normal position, it acts through the gears 25 and 24 to rotate the shaft 11 and arm 13, but just as said impelling bar approximately reaches its normal position, its rack teeth 29 go out of mesh with the teeth of the gear 25, thereby permitting the shaft 11 and parts carried thereby to be rotated under the action of momentum and such rotation, with anti-friction bearings, will continue for several minutes and long enough to permit the molten metal to solidify or cool off to form retaining condition.

Under the action of centrifugal force produced by the above noted rotation, the molten metal will be caused to run through the spruce c^1 into the mold cavities a^1 and will fill the latter. The flat radial wall of the fusing cavity c prevents the molten metal from slushing back out of the cavity under the initial forward rotation. The vent passage d permits the air to escape from the mold cavity a so that the molten metal may completely fill said cavity, and inasmuch as said vent cavity is extended from the inner portion of the mold cavity in a general direction toward or nearer and nearer to the axis of rotation, it is evident that no metal can possibly enter said vent cavity at least until after the mold cavity has been completely filled with metal.

By arranging the arm and mold to rotate in a vertical plane, not only is a more

convenient arrangement provided than if arranged to rotate in a horizontal plane, but under initial rotary motion, the molten metal in the mold is raised against the action of gravity so that gravity assists centrifugal force in accomplishing the initial flow of the molten metal from the fusing cavity into the mold cavity.

Obviously, the invention is capable of very considerable modification. For example, while the impelling spring is preferably a duplicate or twin spring, various other arrangements thereof may be employed. The impelling bar 27 is shown as in the form of a sliding rack, but this rack is really an incomplete gear of infinite diameter and, from a broad point of view, is the vibratory driving member of the impelling mechanism, which is arranged to go into and out of action on the driven member of such impelling mechanism.

The device has been particularly described in its use for casting dental inlays, but, of course, it can be used for very many other purposes, both within the dental art and in other arts. In the dental art, it is admirably adapted for use in casting crowns, bridges and the like.

What I claim is:

1. In a casting apparatus, a rotatable arm, a mold and a fusing cavity carried by said arm, the latter being radially inward of said mold and arranged to deliver thereinto under the action of centrifugal force, and means for rotating said arm comprising separable driving and driven members engageable to impart rotative momentum to said arm but disengageable to permit said arm to continue its rotation under the action of momentum, and means for completely separating said members when the impelling force has been exerted.

2. In a casting apparatus, a rotatable arm, a mold and a fusing cavity carried by said arm, the latter being radially inward of said mold and arranged to deliver thereinto under the action of centrifugal force, means for rotating said arm comprising separable driving and driven members engageable to impart rotative momentum to said arm but disengageable to permit said arm to continue its rotation under the action of momentum, and a resilient impelling device operative on said driving member, and means for completely separating said members when the impelling force has been exerted.

3. In a casting apparatus, a rotatable arm, a mold and a fusing cavity carried by said arm, the latter being radially inward of said mold and arranged to deliver thereinto under the action of centrifugal force, means for rotating said arm comprising separable driving and driven members engageable to impart rotative momentum to said arm but disengageable to permit said arm to continue its rotation under the action of momentum, and an impelling spring tending to move said driving member out of engagement with the said driven member, and means for completely separating said members when the impelling force has been exerted.

4. In a casting apparatus, a rotatable arm, a mold and a fusing cavity carried by said arm, the latter being radially inward of said mold and arranged to deliver thereinto under the action of centrifugal force, means for rotating said arm comprising separable driving and driven members engageable to impart rotative momentum to said arm but disengageable to permit said arm to continue its rotation under the action of momentum, an impelling spring serving to move said driving member completely out of engagement with the said driven member, and a latch operative to hold said driving member engaged with said driven member and said impelling spring set under strain.

5. The structure defined in claim 3 combined with means for varying the impelling tension under which said impelling spring may be set.

6. The structure defined in claim 4 in which there is a variable engagement between said latch and driving member for setting said impelling spring under varying impelling tension.

7. The structure defined in claim 4 in further combination with a tripping device for radially releasing said latch to instantly release said impelling spring and throw said driving member into action while the latter is engaged with said driven member.

8. The structure defined in claim 4 in which said latch is operative to set said driving member in different positions and said impelling spring under varying impelling tension, and in further combination with a lever for setting said driving member, the said lever being returnable to normal position in advance of the release of the set driving member.

9. The structure defined in claim 4 in which said latch is operative to set said driving member in different positions and said impelling spring under varying impelling tension, and in further combination with a lever for setting said driving member, the said lever being returnable to normal position in advance of the release of the set driving member, and in further combination with means cooperating with indicating means serving to indicate the position of the said setting lever for different tensions of said impelling spring.

10. The structure defined in claim 4 in which said latch is operative to set said driving member in different positions and said impelling spring under varying impel-

ling tension, and in further combination with a lever for setting said driving member, the said lever being returnable to normal position in advance of the release of the set driving member, and in further combination with means cooperating with indicating means serving to indicate the position of the said setting lever for different tensions of said impelling spring, and in still further combination with indicating means for indicating the position in which said arm should be set while released in order that it will be returned to its predetermined normal position when said driving member is moved to set said impelling spring under predetermined impelling tension.

11. The structure defined in claim 3 in which said driven member is a gear and said driving member is a vibratory toothed member.

12. The structure defined in claim 4 in which said driven member is a gear and said driving member is a vibratory toothed member, and in which said driving member has ratchet teeth with which said latch is engageable to set the same in different positions and said impelling spring under varying impelling tension.

13. In a casting apparatus, a rotatable arm, a mold carried by said arm and having a fusing cavity, the latter being radially inward of said mold and having a sprue arranged to deliver into said mold under the action of centrifugal force, said mold having a vent that is distinct from said sprue and extends from the inner portion of said mold to a point outside of said fusing cavity.

14. In a casting apparatus, a rotatable arm, investing material and a holder therefor carried at the free end of said arm, said investing material having formed therein a mold and a fusing cavity, the latter being radially inward of said mold and having a sprue arranged to deliver into said mold under the action of centrifugal force, and a vent passage independent of said sprue and extended from the radially inner portion of said mold through said investing material to the atmosphere in a general direction toward the axis of rotation of said arm.

In testimony whereof we affix our signatures.

CHARLES E. LARSON.
MERRILL G. SWENSON.