May 9, 1944. F. E. BELLOWS 2,348,322

CENTRIFUGAL ELECTRIC CASTING AND MOLDING MACHINE

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Fig. 1.

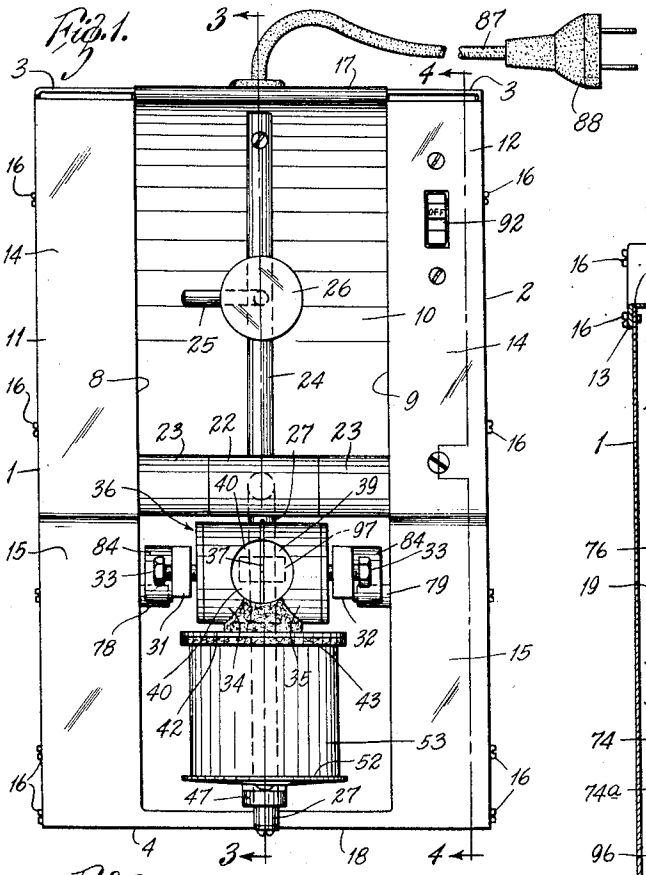


Fig. 2.

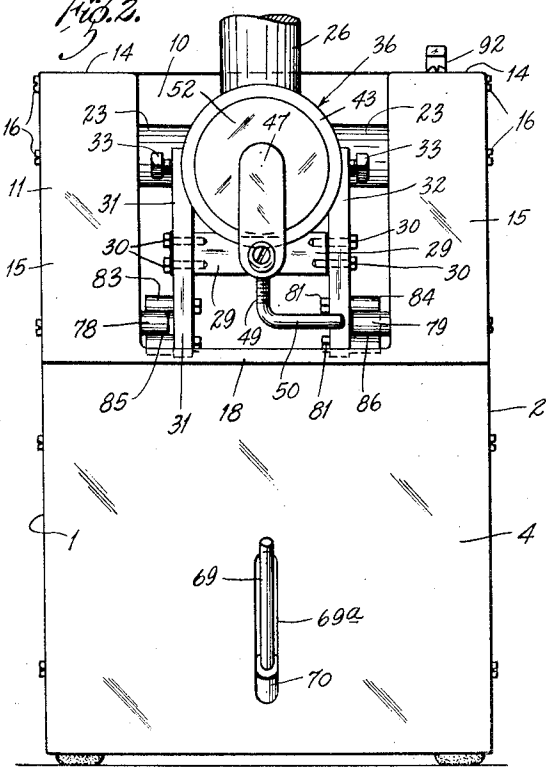


Fig. 5.

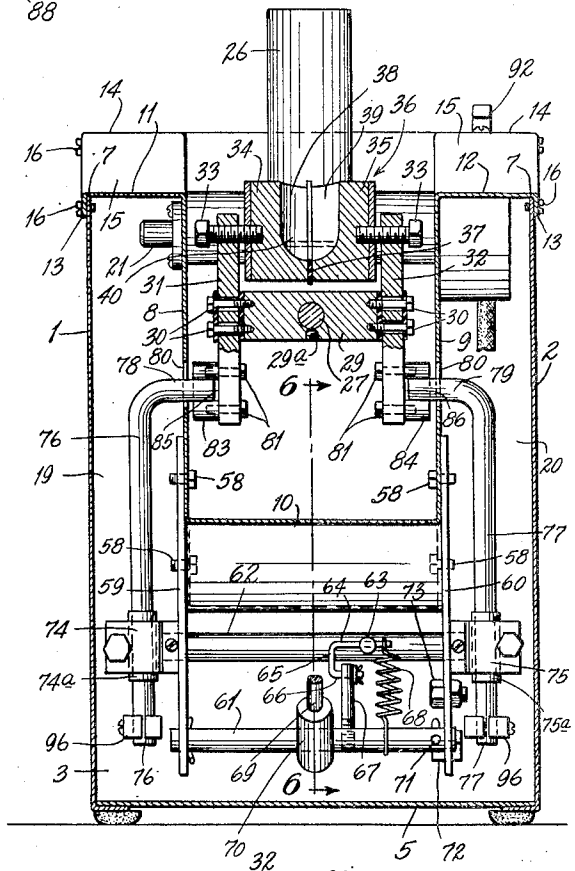
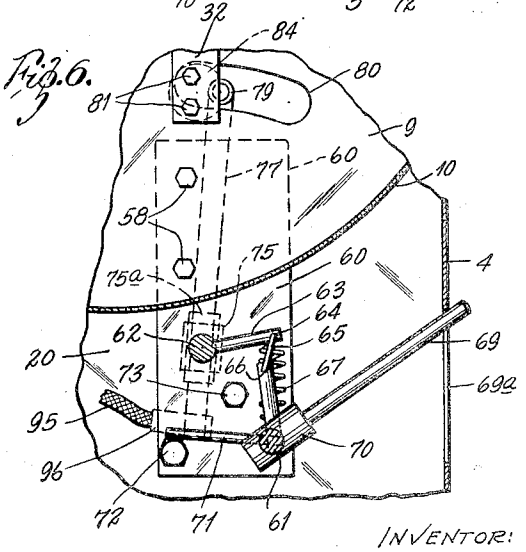


Fig. 6.



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CENTRIFUGAL ELECTRIC CASTING AND MOLDING MACHINE

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Fig. 3.

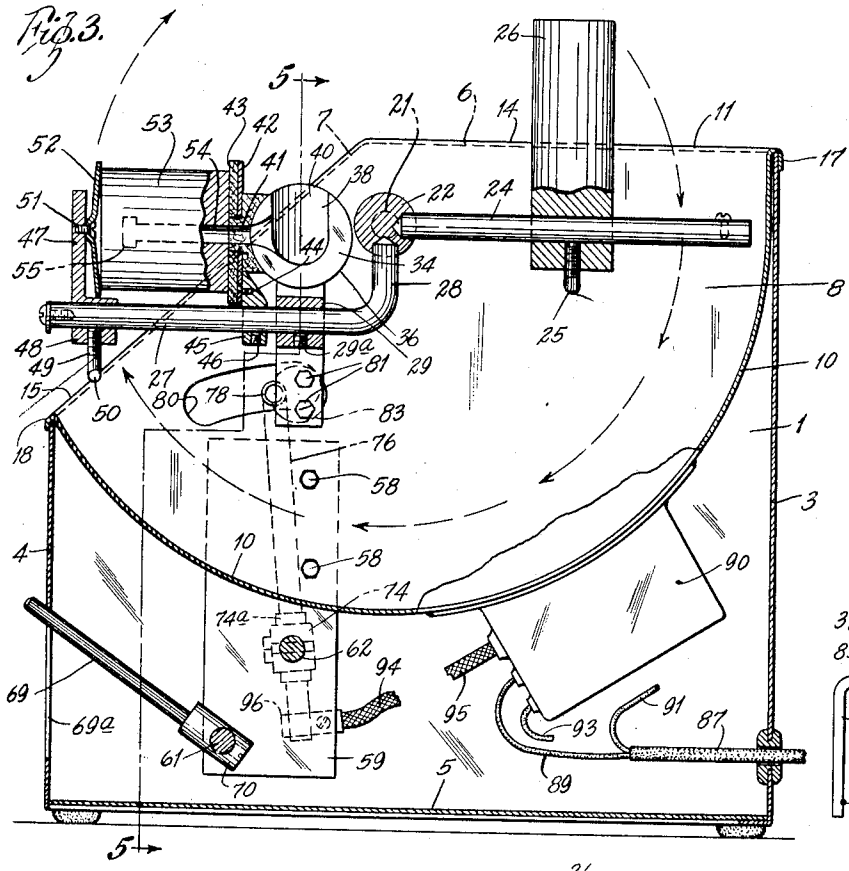


Fig. 4.

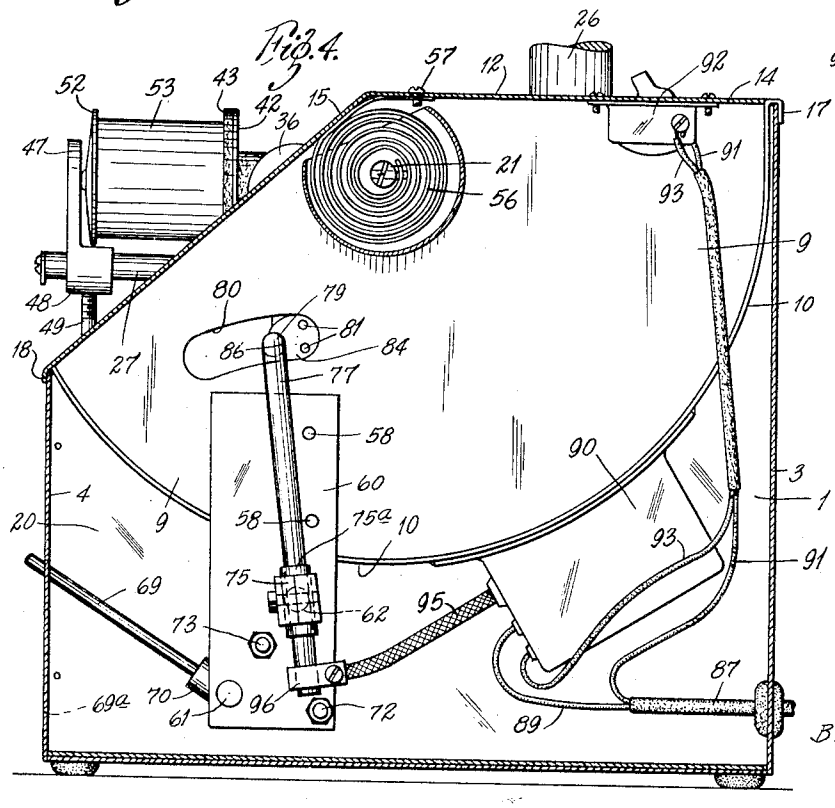
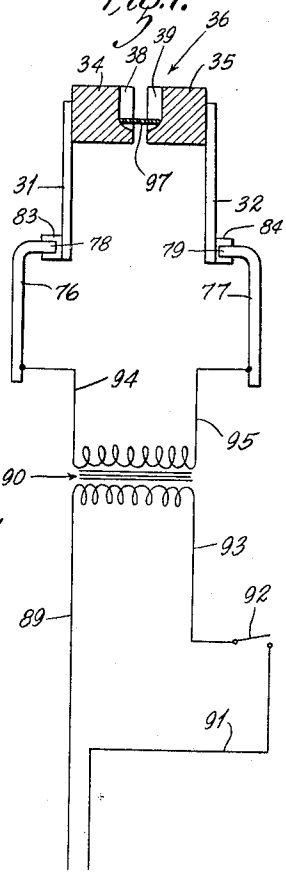


Fig. 7.



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UNITED STATES PATENT OFFICE

2,348,322

CENTRIFUGAL ELECTRIC CASTING AND MOLDING MACHINE

Foy E. Bellows, Van Alstyne, Tex.

Application June 15, 1942, Serial No. 447,028

5 Claims. (Cl. 22—65.1)

The general object of this invention is to provide a novel centrifugal electric casting and molding machine, and particularly a machine of this character which shall embody certain improvements in the operation and construction of the machine forming the subject-matter of my prior patent, No. 1,944,163, dated January 23, 1934.

In the machine of my prior patent, two crucible sections of carbon interposed in an electric circuit were employed and arranged to be separated from each other a sufficient distance so that when a current of sufficient voltage was cut into the circuit, a flaming arc would be formed by the current jumping the air gap between the adjoining ends of the crucible sections and the heat of this arc was relied on to melt a piece of precious metal, gold or silver, placed in the crucible. The mold of this machine was mounted on the end of a rotatable arm and was in two separable sections communicating with each other, one of these sections being located directly under the space between the two crucible sections to receive the molten metal flowing through such space from the crucible. The machine was spring powered for centrifugal action, and after the receiving section of the mold had received the molten metal, the mold sections were rapidly revolved by releasing said arm and the metal thrown by centrifugal force into the second mold section and cast therein to the desired shape.

In the use of this patented machine, several objections were noted. In the first place, it was necessary to employ a high-voltage current to jump the air gap between the crucible sections, which it was found produced oxidation of the metal, which materially affects the strength, the ductility and the density of the finished casting. As a result, pitting and porosity of the castings were of frequent occurrence. Again, the construction of the machine was such that much valuable time was required to prepare for and produce a casting, and then to remove the casting from the mold, and only a person skilled in the use of the machine could operate it with any degree of efficiency.

The present machine embodies the electric arc principle in obtaining a melt, but a low-voltage current is employed, i. e., a current of from 8 to 12 volts, which is not strong enough to jump the gap between the two sections of the crucible. In practice, this gap is bridged by the piece of precious metal placed in the crucible, and the current then passes directly through this metal, which is quickly melted, thus avoiding a lengthy process of waiting for the gold, or other precious metal, to reach a state sufficiently molten to make a good casting. Actually, the cold metal is converted into a perfect state of casting in a matter of a few seconds, and all the disadvantages incident to the use of a high-voltage current are eliminated. Furthermore, the machine is greatly simplified in construction as compared with my prior patented machine, so that the necessary skill for operating the same can be acquired by the dentist, or his technician in a very short time.

Another advantageous feature of the present invention is the fact that in place of an air gap between the two sections of the crucible, through which the molten metal will of course run out, necessitating the provision of a receiving chamber in the mold for catching it, as explained with reference to my prior construction, the gap between the two sections of the carbon crucible is filled with mica, or other insulating material, and the crucible communicates directly with the mold, and is adapted to be revolved therewith, so that the metal may be thrown by centrifugal force into the mold for casting immediately upon being reduced to the molten state.

In the drawings—

Fig. 1 is a plan view of the machine;

Fig. 2 is a view in front elevation thereof;

Fig. 3 is a central longitudinal section, taken on the line 3—3 of Fig. 1, a transformer being shown in end elevation;

Fig. 4 is a longitudinal section, taken on the line 4—4 of Fig. 1;

Fig. 5 is a cross-section, taken on the staggered section, line 5—5 of Fig. 3;

Fig. 6 is a fragmentary section, taken on the line 6—6 of Fig. 5; and

Fig. 7 is a diagrammatic view of the electrical arrangement.

Referring now to the drawings, the numerals 1, 2, indicate, respectively, the side walls of an outer casing, generally rectangular in shape, having a back wall 3, a relatively low front wall 4 and a supporting bottom 5. Each of the side walls 1, 2, has a horizontal upper edge portion 6 (Fig. 3) and a downwardly-inclined front edge portion 7. Inclosed by and supported on the walls of the outer casing is a housing having side walls 8, 9, respectively, circular in shape on their under side and connected by a circular bottom 10 (Figs. 3, 4 and 5). The side walls 8, 9 are bent outward at their upper side to provide lateral supports 11 and 12, respectively, which supports are bent downwards at right angles at their

outer sides to provide narrow flanges 13 provided at intervals with screw holes. The supports 11, and 12 are shaped to provide horizontal portions 14 at the top of the machine and inclined portions 15 at the front of the machine, which are designed to rest upon the upper edges of the side walls 1 and 2 of the casing and to be secured thereon by screws 16 inserted in the holes in flanges 13 and screwed into the side walls of the casing. The bottom 10 is provided at its upper and lower edge with retaining flanges 17, 18 (Figs. 3 and 4), respectively, the flange 18 being continued along the lower edges of the supports 11 and 12. In securing the inner housing on the outer casing, as described above, the flanges 17 and 18 engage over the top edges of the walls 3 and 4 of the casing, and thus the housing is securely supported on said casing. The inner housing is of less width than the outer casing, and its side walls are parallel with the side walls of the latter, providing working spaces 19 and 20, respectively, for certain operating parts to be hereinafter referred to.

Mounted at its ends in the side walls 8, 9 of the housing is a shaft 21 (Fig. 3) having a central hub 22 (Fig. 1) which is held centered in the machine by spacers 23 located between its ends and the side walls of the housing. Secured at its inner end in one side of the hub 22 in an arm 24 which, relative to the "cocked" position of the machine shown in Fig. 3, extends rearwardly in a horizontal direction and has adjustably mounted thereon by means of a binding screw 25 a cylindrical weight 26, which is vertically disposed and of a height extending well above the top of the machine, so that, relative to its mass, said weight occupies only a small part of the arm 24, and in the revolution of the arm its total power is exerted at a greater distance from the hub 22 than if said weight occupied a greater part of the arm, as would be the case, for example, if it were round or square. The numeral 27 indicates a second arm extending forwardly in a horizontal direction and its inner end portion being bent upwardly at right angles, as indicated at 28, and secured in the hub 22 to extend at right angles to the arm 24, so that the latter and arm 27 are in line with each other in parallel planes. Secured at its center on the arm 27 by a set screw 29a is a rectangular cross-bar 29, on the opposite ends of which are centrally secured by screws 30 two arms 31, 32, respectively (Fig. 5). Mounted in the upper ends of these arms are two adjusting contact screws 33, on the inner end of which are secured the two halves, or sections, 34, 35, respectively, of a circular crucible 36. As shown in Figs. 1 and 5, the ends of the two sections of the crucible are separated from each other a suitable distance and a piece of insulating material 37, such as mica, inserted in the gap between them, after which the screws 33 are turned to cause the ends of the crucible sections to firmly grip the insulating material between them. This arrangement is to prevent current applied to the crucible from passing from one section thereof to the other except when a piece of precious metal to be melted is placed in the crucible in a manner to bridge the gap between the crucible sections 34 and 35, and thus act as a conductor for the current. At the same time, the closed gap prevents the molten metal from running out of the crucible. As shown by said Figs. 1 and 5, the inner ends of the crucible sections are recessed, as indicated at 38 and 39, respectively, so that when they are forced against the interposed insulating material, as described above, they provide a crucible chamber 40 (Fig. 3) for receiving the piece of metal to be melted. Extending through the outer wall of the crucible from near the bottom of chamber 40 is a conduit 41, common to the two sections. In the present form of the invention, the mold communicates directly with the crucible through the conduit 41, as will now be described.

Mounted on the outer side of the crucible 36 is a disk 42, provided on its outer face with a layer of insulating material 43, both the disk and insulating material being centrally apertured to surround the conduit 41. Disk 42 is secured at its lower side by means of one or more screws 44 to a supporting bracket 45, which in turn is secured on the horizontal portion of arm 27 by a screw 46. The numeral 47 (Figs. 3 and 4) indicates an arm having at its lower end an apertured boss 48 which is slidably mounted on the arm 27 and adapted to be secured in fixed position thereon by means of a clamping screw 49 having a handle 50 for turning it. Loosely mounted for pivotal movement on a pivot screw 51 toward the upper end of arm 47 is a clamping disk 52. The numeral 53 indicates the mold, made of material commonly used in making dental castings and preferably cylindrical in shape, having approximately the circumferenence of the two disks 42 and 52. Located centrally of the mold and opening from the inner end thereof is a passage 54 which terminates near the opposite end of the mold in a cavity 55 having the configuration of the casting to be made. To place the mold in position for use, it is inserted in the space between the two disks 42, 52, and the passage 54 aligned with the conduit 41; arm 47 is then pushed inward to cause disk 52 to firmly engage the outer end of the mold and force its inner end into equally firm engagement with the insulated disk 42. Handle 50 is then turned to cause the end of screw 49 to engage the under side of arm 27 and thus hold the mold clamped between the two disks on said arm, as clearly shown in Figs. 1, 3 and 4. The mold is, of course, made separately to suit the particular casting desired.

For rotating shaft 21, I employ an ordinary clock spring 56, (Fig. 4) one end of which is secured in the end of the shaft, and the other to the under side of the horizontal part of support 12 by a screw 57. The spring is wound up by the operator grasping alternately the ends of arms 24 and 27 and pulling them toward himself, thereby turning shaft 21 in an anticlockwise direction, usually for two complete revolutions, stopping the winding with the arms in the horizontal position shown in Fig. 3. To hold the machine in this cocked position until it is to be operated, the following lock and release mechanism is employed.

Secured at their upper ends by screws 58 to the side walls 8, 9 of the housing are two rectangular plates 59, 60, which extend some distance below the bottom of the housing. Mounted near the lower end of these plates is a rock-shaft 61; and similarly mounted in these plates above and to the rear of rock-shaft 61 is a second rock-shaft 62. Secured in and near one end of the rock-shaft 61 and projecting forwardly therefrom is a lever arm 63 (Figs. 5 and 6) in the outer end of which is pivotally mounted one horizontal member 64 of a bent lever 65, having a second horizontal member 66 extending parallel to the horizontal member 64 and pivotally mounted in the upper end of an arm 67 which is secured at its lower end in the rock-

shaft 61 and projects upwardly therefrom. Secured on the end of the horizontal member 64 is one end of a pull spring 68, the other end of which is secured to the rock-shaft 61. The numeral 69 indicates an operating handle which at its lower end is provided with an enlarged portion 70 secured on the rock-shaft 61. This operating handle extends through, and works in, a vertical slot 69a in the front wall 4 of the casing (Figs. 2 and 3). Secured at one end in, and projecting rearwardly from the rock-shaft 61 is a stop-arm 71, which in the locking position of the operating handle 69 engages a stop 72, and in the release position of said arm engages a stop 73. Secured on opposite ends of the rock-shaft 62 are two clamps 74, 75, respectively, which embrace and securely hold two throw-levers, 76, 77, respectively, but are insulated therefrom by sleeves of mica, or similar material, 74a and 75a. Each of these throw-levers is bent inwardly at right angles at its upper end to provide two engaging members 78, 79, respectively, which work through corresponding curved slots 80 provided in the side walls 8, 9, of the housing. The throw-levers 76, 77 work in the spaces 19 and 20 (Fig. 5) previously referred to. Secured by means of screws 81 on the lower end of the arms 31 and 32 previously referred to, are two circular bosses 83, 84, respectively (Figs. 2 and 5), located within the housing, and each of which is provided with a longitudinal groove 85, 86, respectively, which in the cocked position of the machine are adapted to receive the engaging members 78 and 79 of the throw levers 76 and 77, and thus prevent the arms 24 and 27 from revolving, as will be apparent from an inspection of Figs. 4 and 5 and the dotted positions shown in Figs. 3 and 6. This locked position is secured by moving the operating handle 69 upward to the position shown in Fig. 6. In this movement, the arm 67, through the bent lever 65, moves the lever-arm 63 upward, turning rock-shaft 62 and causing the engaging members 78 and 79 to engage in the slots 85 and 86. Continued upward movement of operating handle 69 carries the lower end 66 of bent lever 65 inward beyond the center of gravity, in which position it is held by the pull of spring 68. To release the engaging members 78 and 79 from the slots 85 and 86, the operating handle 69 is turned downward until the stop-arm 71 engages stop 73 and arrests its movement. In this downward movement of the operating handle, the arm 67 first turns the bent lever 65 outward, or to the right in Fig. 6, beyond the center of gravity, and the power of spring 68 is then exerted to pull lever arm 63 downward, turning rock-shaft 62, which causes throw-arms 76 and 77 to be moved toward the operator and move engaging members 78 and 79 out of the slots 85 and 86. The clock spring 56 may now exert its power to rotate shaft 21 and rapidly revolve arms 24 and 27 in the direction shown by the arrows in Fig. 3. The electrical arrangement for furnishing current to the crucible to melt a piece of metal placed therein will now be described, referring particularly to Figs. 1, 3, 4 and 7.

The numeral 87 indicates an ordinary insulated conductor leading into the machine, and provided with a plug 88 by means of which the machine may be connected with the usual 110-volt lighting circuit. One wire, 89, of this conductor leads into a transformer 90 mounted on the bottom 10 of the housing, and another wire 91 leads to a switch 92 located on the top of the machine. A wire 93 leads from the switch to the transformer. Leading out of the transformer are two conductors 94 and 95 which are, respectively, connected to the lower ends of the throw-arms 76 and 77 by means of clamps 96. When the engaging members 78 and 79 are in contact with the bosses 83 and 84, as shown in Fig. 5, electrical connection with the two sections 34, 35 of the crucible will be established through the contact screws 33 whenever the switch 92 is closed. The voltage of the current is reduced by the transformer down to from 8 to 12 volts, such current being of insufficient strength to jump the gap between the two sections of the crucible.

In using the apparatus, with the spring 56 wound up and the machine in the locked position shown by Figs. 3, 5 and 6, a piece of metal, such as gold, or silver, indicated by the numeral 97 in the diagrammatic view, Fig. 7, is placed in the carbon crucible and may be pressed firmly against the bottom thereof by a stick of carbon held by the operator. Switch 92 is then closed and the current, being unable to jump the gap between the two sections of the crucible, or being prevented from doing so by the use of insulating material inserted in said gap, as described, will pass through the piece of precious metal, and the resistance offered by the metal to the passage of the current produces sufficient heat to rapidly melt the piece of gold or silver. As soon as this occurs, the operator turns the handle 69 downwardly, which operates to throw the arms 76 and 77 forwardly and thereby carry the engaging members 78 and 79 out of contact with the bosses 83 and 84, breaking the circuit to the crucible and permitting spring 56 to exert its power to rotate shaft 21 and cause arms 24 and 27 to revolve with great rapidity, the initial momentum being furnished by weight 26, which may be adjusted on arm 24 to overbalance the weight of arm 27 and the mountings thereon to the desired extent. The rotation of the arms is both sudden and rapid on release of the lock, with the result that the molten metal in the crucible is almost instantly thrown by centrifugal force through conduit 41 and passage 54 into the mold cavity 55, where it is cast into the desired shape.

I claim:

1. In a centrifugal casting and molding machine, a rotatable shaft, a coil spring anchored at one end and having its other end secured to said shaft, a pair of arms rigid with said shaft and projecting in opposite directions therefrom, a weight adjustably mounted on one of said arms, a crucible operatively mounted on the other arm, an electric circuit including said crucible but which will be closed through the crucible only when a piece of metal to be melted is placed in the crucible, a mold detachably clamped on the latter arm and having a molding cavity communicating with said crucible, said spring being wound by turning said arms through one or more complete revolutions, a pair of contact members electrically connected with opposite sides of said crucible, a pair of movable locking members forming conductors in said circuit and movable into and out of engagement with said contact members to close the circuit to said crucible and prevent rotation of said shaft, and to break said circuit and permit rotation of the shaft by its spring, respectively, and means for actuating said locking members.

2. In a centrifugal casting and molding machine, a rotatable shaft, a coil spring anchored

at one end and having its other end secured to said shaft, a pair of arms rigid with said shaft and projecting in opposite directions therefrom, a weight adjustably mounted on one of said arms, a crucible operatively mounted on the other arm, an electric circuit including said crucible which will be closed through the crucible only when a piece of metal to be melted is placed in the crucible, a mold detachably clamped on the latter arm and having a molding cavity communicating with said crucible, said spring being wound by rotating said shaft by turning said arms through one or more complete revolutions, a pair of contact members electrically connected with opposite sides of said crucible, a pair of movable locking members forming conductors in said circuit and movable into and out of engagement with said contact members to close the circuit to said crucible and prevent rotation of said shaft, and to break said circuit and permit rotation of the shaft by its spring, respectively, and manual means for actuating said locking members and for holding the same in either their locked or released position.

3. In a mechanism of the kind described, a base, a crucible comprising two electrical conducting elements, insulated from each other, and adapted to be electrically joined by the material therein, means supporting the crucible for rotation on the base, a mold adjacent the crucible on the supporting means, a passage between the mold and the crucible whereby melted material may flow from the crucible to the mold under centrifugal force, rotating means for the support, normally urging it in one direction of rotation, latch means to hold the supporting means against rotation, said latch means including engaging elements on the base, and engaged elements on the supporting means, both being electrical conductors, and means establishing a circuit from the crucible elements to said engaged elements, means to move the engaging elements to release the support for rotation and to break the circuit through the crucible.

4. In a centrifugal casting and molding machine, a rotatable shaft, an electric crucible and a molding device on said shaft, means for rotating said shaft to force molten metal from the crucible to the molding device, an electric circuit through said crucible with metal therein, means for opening and closing said circuit and for locking said shaft against rotation and releasing said shaft to rotate comprising a pair of contact members connected to opposite sides of said crucible, a pair of movable locking members forming conductors in said circuit and movable into and out of engagement with said contact members to close the circuit to said crucible and prevent rotation of said shaft, and to break said circuit and permit rotation of said shaft, respectively, manual means for actuating said locking members and for holding the same in either locked or released position comprising a first rock arm, said locking members being fixed to the ends of said first rock arm, a second rock arm, a lever pivoted to and extending from each of said rock arms, a spring between one of said levers and said second rock arm, a U-shaped member pivotally connecting the ends of said levers, whereby an over-center device is created, and an arm extending from said second rock arm for manipulating said locking members into and out of locking position.

5. In a casting and molding machine, an electric crucible and a molding device contiguous thereto, means for forcing molten metal from said crucible to said molding device, an electric circuit through said crucible with metal therein, means for opening and closing said circuit and for locking and releasing said means for forcing molten metal from said crucible to said molding device comprising a pair of contact members connected to opposite sides of said crucible, a pair of movable locking members forming conductors in said circuit and movable into and out of engagement with said contact members to close the circuit to said crucible and to prevent the operation of said means for forcing molten metal from said crucible to said molding device, and to break said circuit and permit the operation of said means for forcing molten metal from said crucible to said molding device, respectively, manual means for actuating said locking members and for holding the same in either locked or released position comprising a first rock arm, said locking members being fixed to the ends of said first rock arm, a second rock arm, a lever pivoted to and extending from each of said rock arms, a spring between one of said levers and said second rock arm, a U-shaped member pivotally connecting the ends of said levers, whereby an over-center device is created, and an arm extending from said second rock arm for manipulating said locking members into and out of locking position.

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