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Huppert et al.

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[54] CENTRIFUGAL CASTING MACHINE

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[52] **U.S. Cl.** **164/250**, 164/240

[51] **Int. Cl.** **B22d 13/06**

[58] **Field of Search** 164/289, 290, 287, 164/292, 250; 222/504; 219/421

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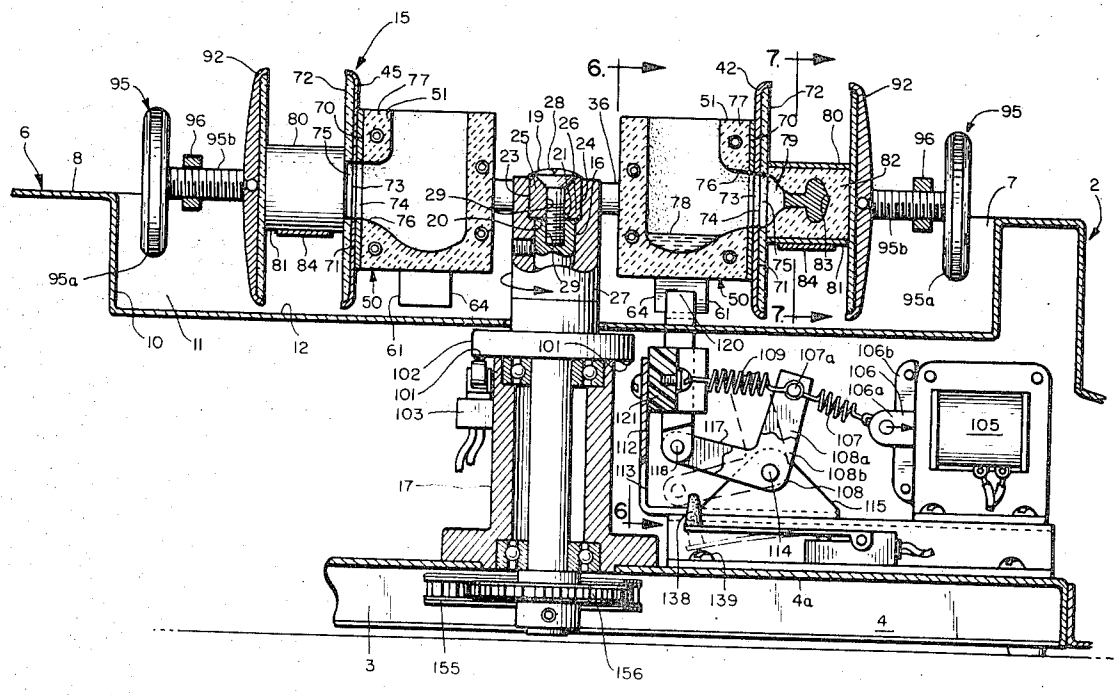
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[57] **ABSTRACT**

A casting machine having a casting arm rotatable about a vertical axis and mounting a pair of opposed graphite crucibles and held casting rings thereon with one crucible casting ring in opposition to the other crucible ring wherein electrode contact fingers are positioned below crucible contact blocks on the casting arm for movement into electrical contact with one of the crucibles during the melting cycle and wherein the contact fingers are retracted during the spin cycle at which time the melt is thrown horizontally and radially outwardly in centrifugal action through a gate in the side of the appropriate crucible into the investment cavity of the associated casting ring abutted against the outer side of the respective crucible. The interlocking of the electrical contact fingers and blocks prevents rotation of the casting arm. Interlocking electrical components in an electrical circuit are employed to prevent rotation of the casting arm when the electrode contact fingers are engaged with the crucible contact blocks and the components permit the rotation when the electrodes are withdrawn.

10 Claims, 9 Drawing Figures



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SHEET 1 OF 4

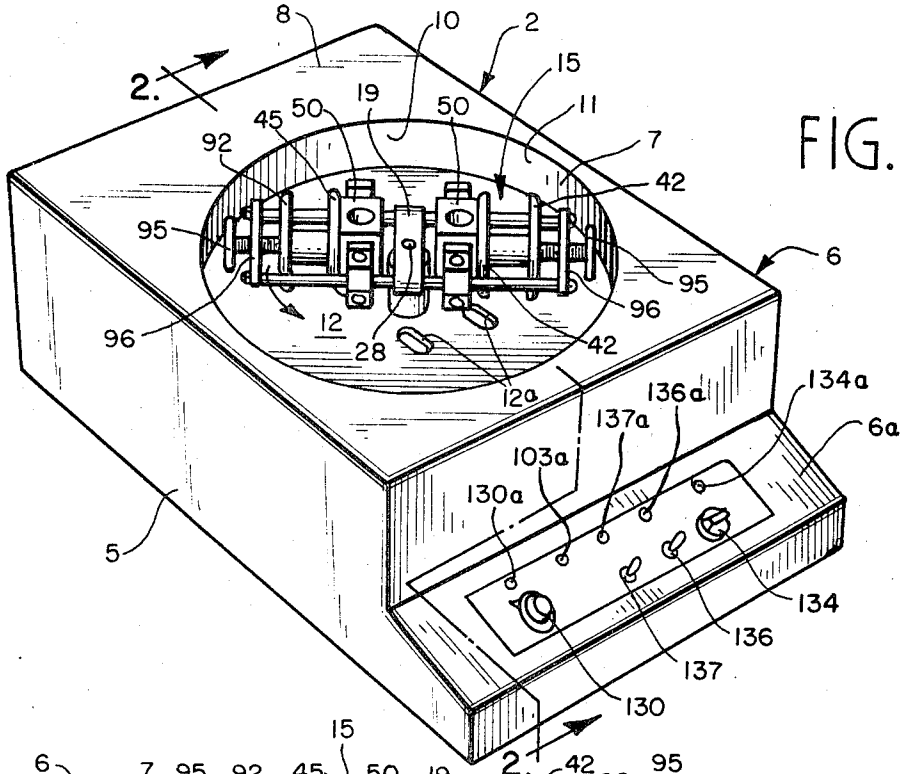


FIG. 1

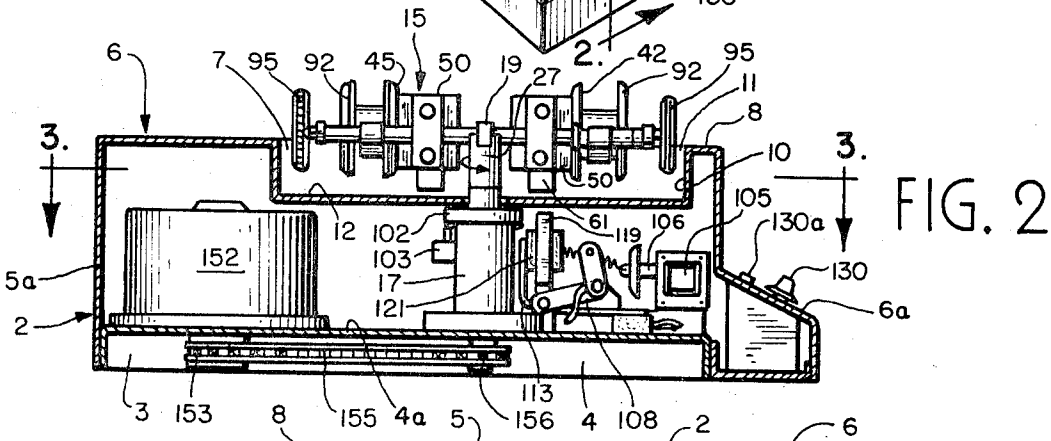


FIG. 2

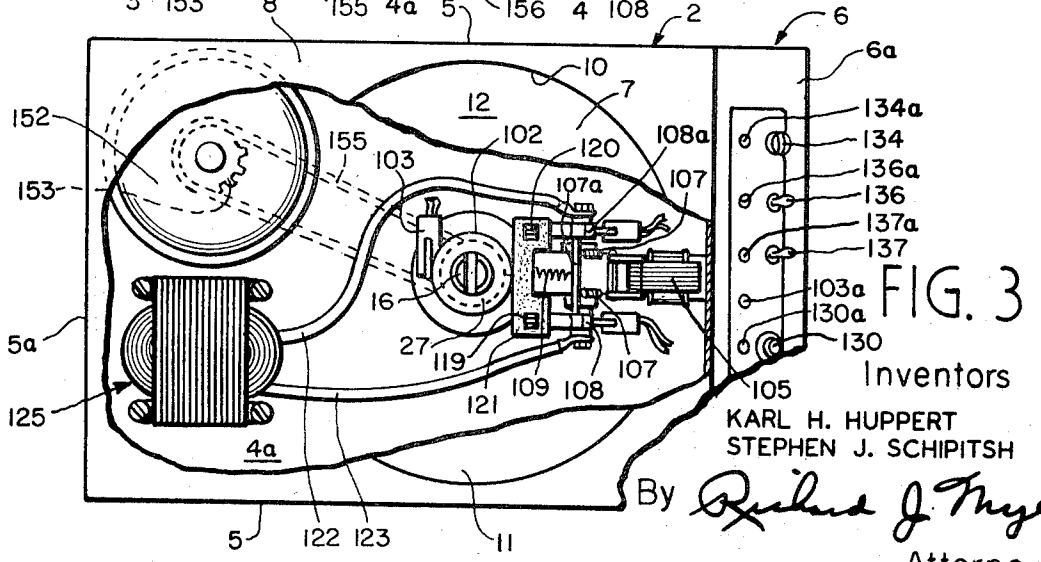


FIG. 3

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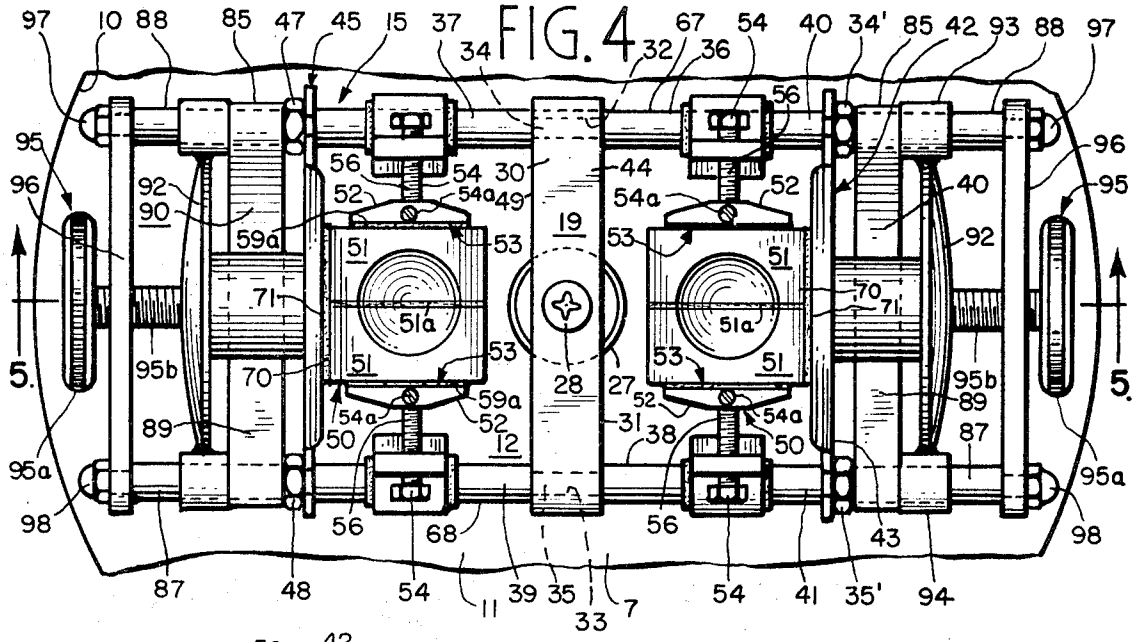
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FIG. 4



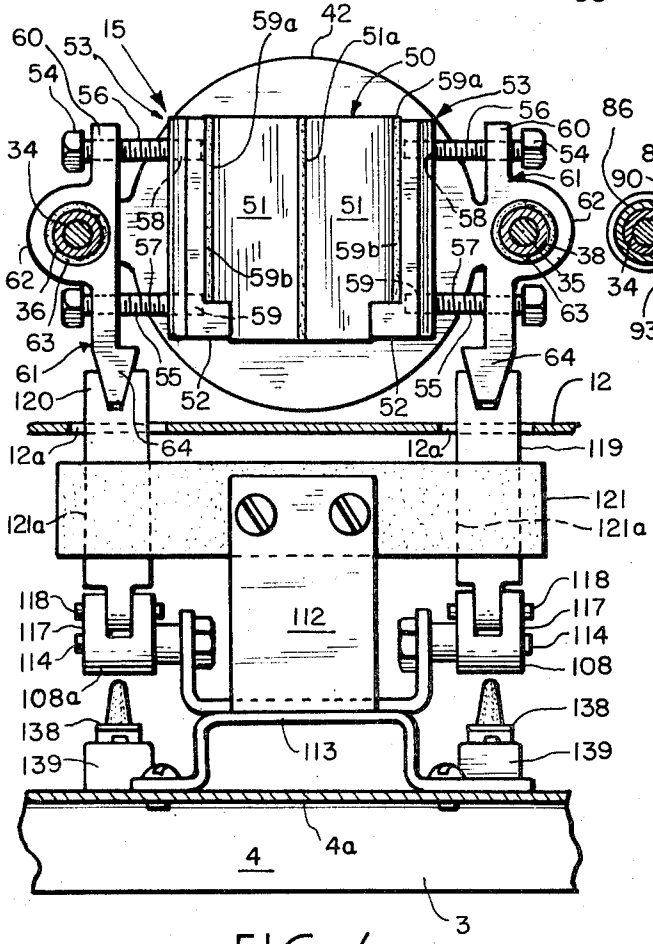


FIG. 6

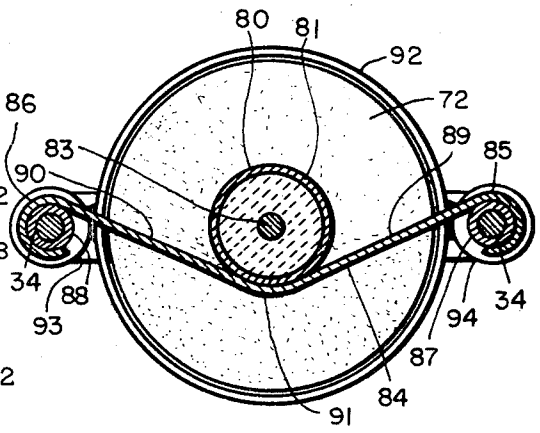


FIG. 7

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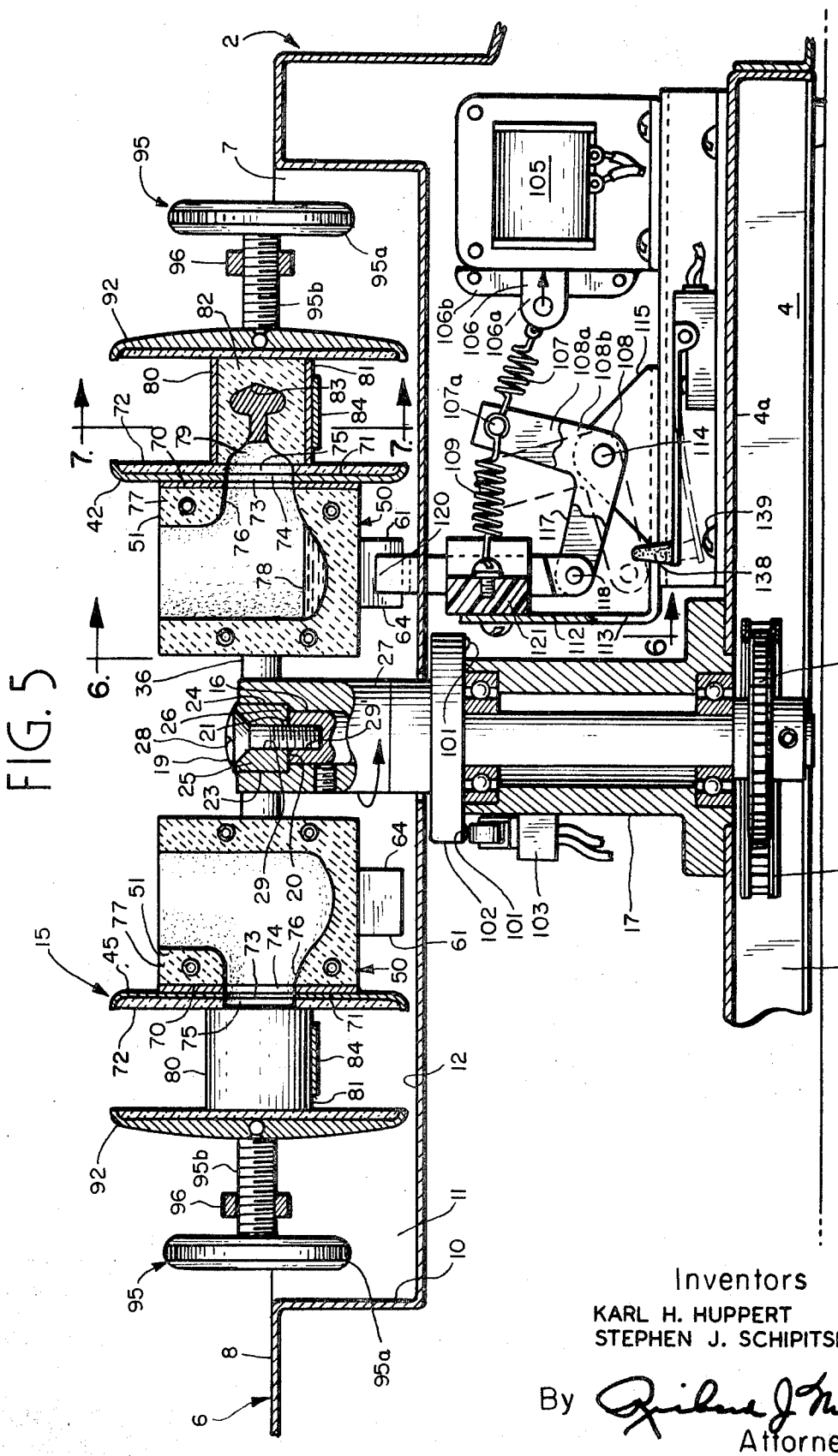
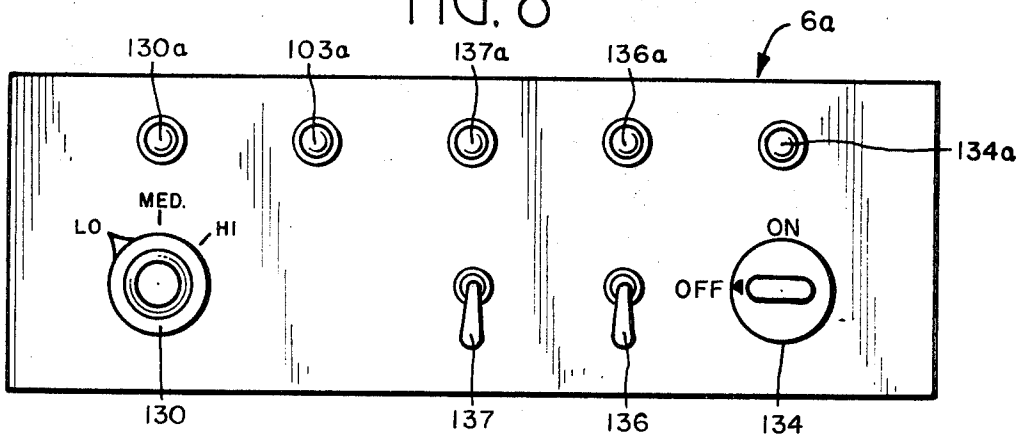


FIG. 5

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FIG. 8



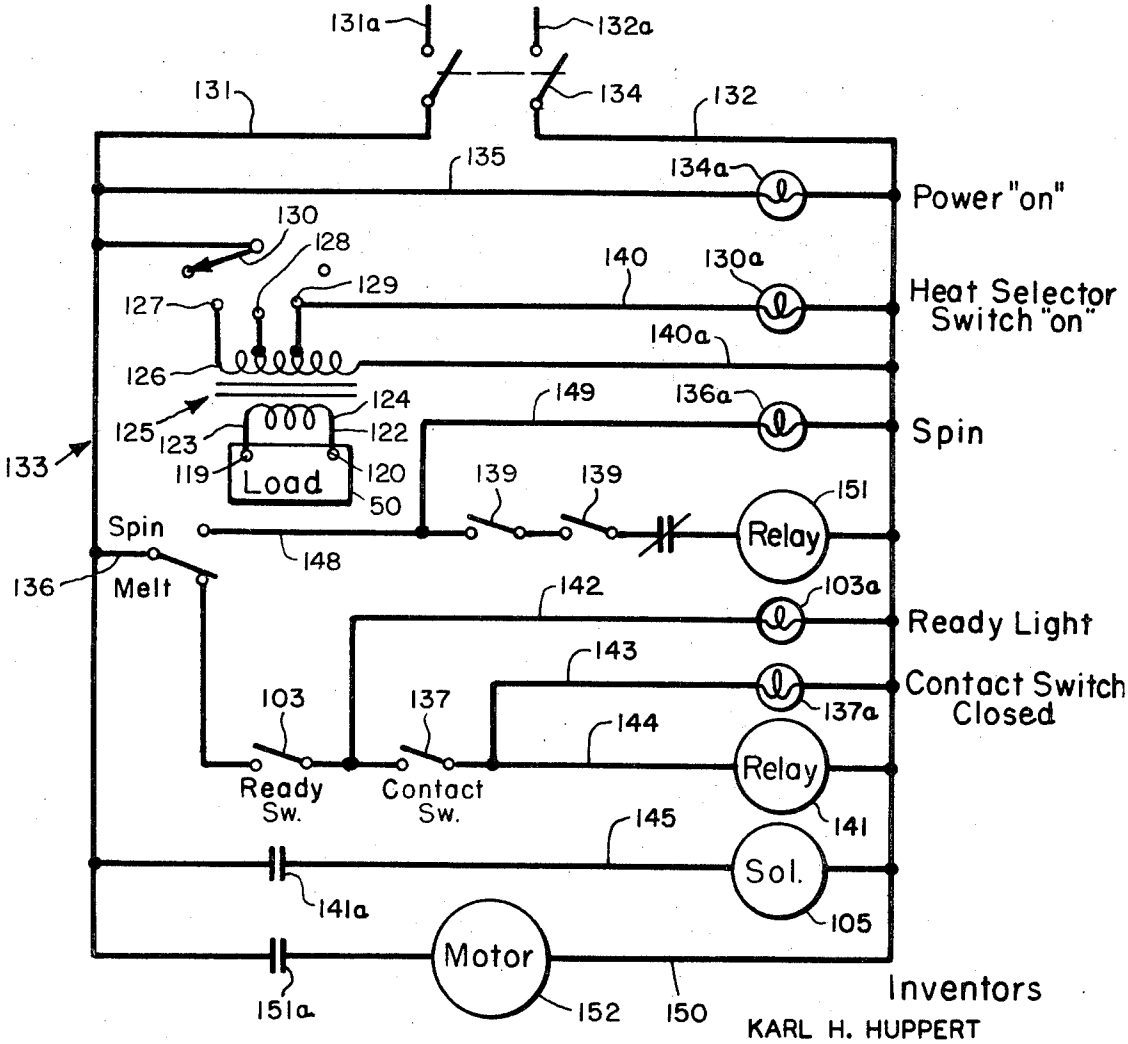


FIG. 9

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CENTRIFUGAL CASTING MACHINE

The instant apparatus is particularly, but not exclusively, useful in the lost wax art and is primarily intended for use in casting small objects such as gold dental fillings, jewelry and the like.

Centrifugal casting devices to my knowledge have been heretofore cumbersome to use. Many require precise balance and a sequence of operation which the operator cannot accidentally change without destroying the equipment. In some such devices, the transfer of the melt to the mold takes too long so that some solidification takes place. Devices which rotate on a horizontal axis require instant acceleration to prevent spilling of the melt or must be capped.

The instant invention is directed to a novel casting machine which is facile to use and requires minimum adjustment.

A general object of the invention is to provide novel casting apparatus in which the investment casting ring or mold is coupled to the melt crucible in direct horizontal transfer relation.

A further object is to provide in such apparatus a casting arm structure rotatable about a vertical axis and carrying a crucible at each end and held casting rings with investment material outwardly thereof, which casting arm structure is simply and effectively connected electrically with electrical heating means for melting of metal in the crucible by a quick release contact bellcrank arm means.

Another object is to provide for a centrifugal casting machine which employs a casting arm carrying opposed crucible and investment casting rings and ring holders wherein the casting arm is powered rotatably in a horizontal plane about a vertical axis during a spin cycle after a melt cycle involving current contact finger means moving upwardly from the casting machine base to have an electric mechanical interlock with casting arm mounted crucible contact blocks to prevent rotation of the casting arm and to liquify metal by electrical resistance heating.

Another object is to provide a novel electrical arrangement in a novel circuit for such apparatus which prevents rotation of the casting arm which supports the crucibles which are connected to the heating current.

A still further object is to provide a novel, rugged, efficient and compact casting device in which expendable parts can be quickly removed and properly replaced and readily adjusted for optimum performance and wherein the service components are readily accessible.

These and other objects and advantages inherent in and encompassed by the invention will become more readily apparent from the specifications and the drawings, wherein:

FIG. 1 is a perspective view of my novel casting apparatus;

FIG. 2 is a sectional view taken essentially in line 2—2 of FIG. 1;

FIG. 3 is a fragmentary top plan view with parts broken away to show the interior thereof;

FIG. 4 is an enlarged top plan view of the casting arm;

FIG. 5 is an enlarged longitudinal elevational section of the casting arm taken substantially on line 5—5 of FIG. 4;

FIG. 6 is a cross sectional view taken substantially on line 6—6 of FIG. 5;

FIG. 7 is a cross sectional view taken substantially on line 7—7 of FIG. 5;

FIG. 8 is a top view of the control console; and

FIG. 9 is a schematic view of the control circuit.

DESCRIPTION OF THE INVENTION

Having particular reference to the drawings, the casting device 2 comprises a base 3 with a peripheral vertical flange 4 over which extend the upright side and back wall structures 5 and 5*a* of a removable cover 6 which has a well 7 in its top wall 8 (FIGS. 1–3, 5). The well 7 is defined by an annular vertical wall 19 coextensive with the opening 11 in the top wall and a bottom wall 12 joins the bottom edge of the peripheral wall 10. A rotary crucible casting support structure or casting arm generally designated 15 is positioned within the well 7 (FIGS. 1, 2, 4, 5) and is rotatably mounted on a vertical axis at the center of the well to an upright shaft 16 within the casting machine bearing 17 which is suitably secured to the top side 4*a* of the base 3. The connection of the upper end of shaft 16 to the casting arm comprises a casting arm center cross-piece or bar 19 of preferably square cross-section which on its bottom side 20 seats upon the upper end 21 of the shaft 16 (see FIG. 5) and at its sides 23, 24 fits between furcations 25, 26 at the upper end of casting arm collar 27 which is fixedly mounted on shaft 16. A screw 28 is passed through an opening 29 in the center of cross-piece 19 and threaded into a threaded bore 29′ in the upper end of shaft 16.

The opposite ends 30, 31 (see FIG. 4) of the center bar 19 of the casting arm are provided with horizontal apertures 32, 33 through which extend casting arm longitudinal frame support arms or bolts 34, 35 respectively. Tubular guides or spacers 36, 37, 38, 39 which are sleeved onto bolts 34, 35 at opposite sides of the middle cross bar or element 19 and at adjacent ends abut thereagainst. The remote ends 40, 41 of sleeves 36, 38 abut against the interior of inner casting ring holder or abutment plate 42 through opposite ends of which extend the bolts 34 and 35. Locking nuts 34′, 35′ are threaded on bolts 34 and 35 and are tightened against the outer side 43 of the plate 42 at said ends thereof, thus fixedly clamping the inner side of holder 42 against the spacers 36, 38 and the latter against the side 44 of the center cross bar 19. An abutment plate or second inner casting ring holder 45 is mounted on the bolts 34, 35 outwardly of sleeves 37, 39 and nuts 47, 48 are threaded on the bolts outwardly of holder 45 and draw the holder 45 against the spacers 37, 39 and the latter against side 49 of the cross bar or driven element 19.

Identical crucibles 50 and 50 are positioned between the holder plates 42 and 45 at opposite sides of the cross-piece 19 (FIGS. 4,6). Each crucible comprises a pair of complementary halves 51, 51 which are made of graphite with a ceramic clay electrical resistant adhesive insulator binding 51*a* therebetween and each crucible 50 is held between the L-shaped jaws 52, 52 of crucible holders or clamps 53, 53. Each holder 53 comprises, in addition to the jaw or support bracket 52, upper and lower adjusting crucible holder bolts or screws 54, 55 which have threaded shanks 56, 57 extending through threaded holes 58 and 59 in the upper and lower parts of the related jaw for engagement and electrical contact with the outside metallic shims 59*a* which abut and have good electrical contact with the

outsides 59*b* of the respective crucibles **50, 50.** The shank **56** is threaded through an upper flange **60** (see FIG. 6) of a mounting bracket or electrical contact block **61** of a clamp **53** which block **61** has an intermediate sleeve portion **62** sleeved on the related spacer **36, 37, 38** or **39** by an electrically insulative tubular bearing **63.** The shank **57** of the lower adjusting bolt or contact screw **55** is threaded through a lower flange **64** of the respective contact block **61.** The lower flange **64** of each contact block **61** has a lower wedge shaped end for dovetailing contact with upwardly extending contact arms to be later explained. Contact screws **54, 55** have heads for engagement by a suitable wrench tool and are held against rotation by set screw **54***a* (see FIG. 4) in the top of the crucible holder jaws **52.** The spacers **36, 37, 38, 39** and the bolts **34, 35** together form the casting arm side rails **67, 68** (see FIG. 4).

The outer end face **70** (FIGS. 4 and 5) of each crucible **50** abuts against a dielectric, preferably an asbestos wafer or gasket **71** which is secured to the inner face of the associated inner fixed casting ring holder **42** or **45.** The inner ring holders **42** and **45** are outer-faced each with an outer gasket **72** of dielectric material preferably incorporating asbestos. Each inner ring holder and the gaskets **71** and **72** thereon have aligned openings **73, 74** and **75** therethrough communicating with an opening or spout **76** in the outer side wall **77** of the related crucible. These openings **73–76** form a gate or passageway for the melt or molten metal **78** (FIG. 5) in the bottom of the right crucible and which, upon rotation of the carriage or casting arm **19** as hereinafter described, is thrown centrifugally through the related passageway **73–76** into the gate or passageway **79** of a mold or casting ring **80** which is a rigid tubular housing **81** encompassing the mold material or investment **82** in which the mold or investment cavity **83** is formed.

The housing **81** is preferably of cylindrical form so that it may be placed on the casting ring candle **84** (FIGS. 4 and 7) which is in the form of a flat metal strap having hook ends **85** and **86** respectively wrapped about the spacers **87** and **88** of side rails **67, 68** which are mounted on the ends of the bolts **34** and **35** outwardly of the respective nuts **34', 35'** and **47, 48.** Each cradle **84** has downwardly converging portions **89, 90** which form an apex **91** in which the cylindrical periphery of the respective casting ring housing **80** nests in alignment with the passageway in the related inner ring holder, gaskets and crucible. Outwardly of each mold there is provided a clamp or outer ring holder **92** having a pair of sleeves **93, 94** slidable on the associated spacers **87, 88.** At each end of the casting arm, a bolt type clamp assembly **95** is fixed on each outer ring holder and includes a hand wheel **95***a* and screw **95***b* which is threadably mounted to a respective end cross bar **96** (FIGS. 4 and 5) each of which is fixed at its ends to the bolts **34,35** by end nuts **97** and **98** which draw up the end cross bar **96** against spacers **87** and **88** and the latter against the respective nuts **34', 35'** or **47** and **48.** The inner ring holder **42** at one end with its outer ring holder **92** form holding means for one casting ring and the other inner ring holder **45** on the other side of the center cross bar **19** forms another holding means for another casting ring. It will be appreciated that by loosening the set screws **54***a* and contact screws **54** the crucibles **50** may be removed and by loosening the clamp assembly **95** the casting rings are withdrawn and reinserted and clamped in place.

Referring to FIGS. **3, 5** and **6,** the casting arm **15,** as heretofore stated, is connected to collar **27** which is secured by a locking screw **28** to the drive shaft **16.** The bottom end of the rotatable collar **27** is provided with a pair of cam lobes **101, 101** spaced 180° from one another on the underside of its bottom flange **102.** Each lobe **101** when in position indicates by tripping switch **103** and lighting pilot **103***a*, alignment of a particular right or left crucible for contact with contact arms **108, 108***a*. Either lobe **101** serves to close "ready" microswitch **103** for positioning the casting arm **15** which switch **103,** as hereinafter explained, permits energizing of the solenoid unit **105** by contact switch **137** (for positioning contact arms **108, 108***a* to the casting arm **15**) which solenoid unit **105** draws its core **106** inwardly. The solenoid core **106** has a limit stop or arm **106***b* to limit inward travel of the core **106.** The solenoid core **106** has an end transverse rod **106** *a* that is connected through a pair of resilient link means or springs **107, 107** to a dielectric transverse arm **107***a* to the legs **108***b* of the pair of electrical current carrying bell crank levers or contact arms **108, 108***a* and arm **107***a* is connected to opposing resilient link means or return spring **109,** which is connected to a dielectric cross bar **121** connected to a standard or upright bracket element **112** of a mounting bracket **113** securely fastened to the base **3.** The levers or contact arms **108, 108***a* are pivoted at their elbows at pivots **114** to lugs **115** upstanding from a base **116** of bracket **113.** The other legs **117** of lever or contact arms **108, 108***a* are pivotally connected at pivot **118** to contact bars or fingers **119** and **120** which guidingly slide through the slotted ends of the dielectric bar **121.** Unless solenoid **105** is energized springs **107, 107** and **109** keep contact arms **108, 108***a* and fingers **119** and **120** down and out of contact with blocks **61.** The contact arms **108, 108***a* are electrically wired into an electrical circuit for conducting electrical current to the crucibles **50.**

The electrical circuit **133** and the various electrical components for melting the gold in the crucibles and rotation of the casting arm pursuant to casting of the gold is shown by FIGS. **2, 3, 5, 6** and **8** as well as in the circuit diagram of FIG. **9.** The control console panel portion **6***a* of the cover **6** with the control console and switches and pilot lights is shown by FIG. **8.** These electrical contact fingers or means **119, 120** that are connected with a crucible or load **50,** are connected to output electrical leads **122, 123** of the secondary winding **124** of a step down transformer **125,** the primary windings **126** of which have a plurality of taps **127, 128, 129** which are selectively connected by a selector switch **130** to the circuit line lead **131** of the electrical circuit **133** which has its other circuit lead **132** connected to the end of the primary winding **126** (see FIGS. **8, 9**). The three taps or fixed power settings provide a low, medium and high heat for regulating the melt rate depending on what is being melted and the melting time needed. The power is turned "on" or "off" by a switch **134** which is connected to lines **131, 132** and to power lines **131***a*, **132***a*. A "Power on" indicating light **134***a* bridges leads **131, 132** by line **135** to indicate if power is on or off and the heating cycle is initiated by placing the "melt spin" switch **136** in the lower or "melt" position as shown in FIGS. **8** and **9.** The casting arm **19** must be positioned as shown in FIG. **5** with the crucible **50** on the right half of the casting arm **19** vertically po-

sitioned over the contact fingers **119, 120** in which position the "ready switch" **103** is closed and the switch **136** which controls the spin is open to the spin circuit. When the contact switch **137** is raised upwardly (see FIG. **8**) the solenoid **105** is energized to raise contact fingers into engagement with contact blocks, the upward swinging of contact arms **108, 108***a* releasing the switch opening arms **138** which are mounted on the base thereunder and simultaneously microswitches **139, 139** are opened to prevent accidental actuation of the spin cycle when the contact fingers **119** and **120** have their tapered slotted ends in engagement with the lower flanges **64, 64** of contact blocks **60, 61.** Closing of the ready switch **103** and contact switch **137** allows current to flow through line **144** and the relay **141** having contacts **141***a* which via line **145** energize the solenoid **105** thus pulling the core inwardly and forcing the contact fingers **119** and **120** to close with the contact blocks **60, 61.** This, in turn, runs current from the transformer **125** through the crucible halves **51, 51** of the right crucible **50** (see FIG. **5**), heating and melting the gold or other metal. Pilot lights **137***a* and **103***a* are lighted at this time with current flowing through lines **143** and **142** since switches **103, 137** are closed and switch **136** is in the melt position. At this time the "heat on" pilot light **130a** lights by current flowing through selector switch **130** and one of the resistance selector lines or taps **127–129** and lines **140** and **140***a* thus connecting lines **131, 132.**

After the metal is melted the contact switch or melt switch **137** is turned "off." This causes the solenoid to be de-energized and the return spring **109** pulls the contact fingers **119** and **120** down through the apertures **12***a* in the cover bottom wall and the apertures **121***a* in the dielectric guide bar **121.** The lowering of the contact arms **108, 108** *a* closes microswitches **139, 139** and by putting the melt-spin switch **136** to the raised or spin position, current flows through lines **148, 149** to light "spin on" pilot light **136***a* and energize the relay **151** having contacts **151***a* which closes to pass current therethrough to line **150** to actuate motor **152** which is mounted on the top plate **4***a* base **3** and has a sprocket **153** on the output shaft **154.** The sprocket **153** drives chain **155** which drives a sprocket **156** on the lower end of shaft **16** thus rotating the casting arm **15.** The molten metal is then transferred from the right crucible **50** into the investemnt material **82** of the mold **83** in the right casting ring **80** (see FIG. **5**).

In order to stop the casting arm, the main switch **134** is turned "off" and the casting arm stops. The mold is then removed preparatory to making another casting. The unused crucible is, however, ready and may be placed in the position of FIG. **5,** that is, the left hand crucible may be placed at the right and the right one at the left and the procedure then would be followed to again perform the melt and spin cycles of the casting machine on gold placed in the left hand crucible.

The foregoing description and drawings merely explain and illustrate the invention and the invention is not limited thereto, except insofar as the appended claims are so limited, as those skilled in the art who have the disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention.

What is claimed is:

1. A casting machine comprising:

a base,

generally vertically extending shaft means mounted on said bare for rotation about a generally vertical axis,

a casting arm fixedly attached on said shaft means and extending in a generally horizontal plane for rotation about such vertical axis and in such horizontal plane,

a pair of crucibles mounted on said casting arm for rotation in generally a horizontal plane, one crucible being on each opposite side of said vertical shaft means and acting as a centrifuge counterweight to the other upon rotation of said shaft means about said axis,

a pair of mold means on said casting arm each being outwardly of a respective crucible and in fluid communication therewith,

said casting arm including a frame having a pair of longitudinally extending support arms and a center crossarm connecting with said support arms and with said shaft means, one crucible and one mold means being on each opposite side of said crossarm,

electrical means for melting material within one of said crucibles during the melt cycle of the casting machine and including a pair of vertically movable base mounted electrical contact arms on one side of said shaft means and adapted for electrical engagement with one of said crucibles for supplying heat thereto for melting, each contact arm being disposed adjacent a respective support arm of the casting arm,

electrical motor means for rotating said shaft means about said vertical axis during the spin cycle of the casting arm for transfer of the molten material from the crucible to the mold means,

selective means for alternate operation of said electrical means for melting in said crucible and said electrical motor means for rotating said casting arm,

a pair of crucible support means one on each side of the crossarm carrying a respective crucible between the support arms of the casting arm,

each crucible support means including a pair of electric current conducting elements each mounted on a respective support arm and engageable with a respective contact arm in preventing rotation of the appropriately positioned crucible during the melt cycle and each conducting element of a pair of conducting elements electrically connectible with a respective of the electrical contact arms and with a crucible associated therewith,

each crucible including a pair of crucible parts and electrical insulation means between each crucible part, each crucible part being supported by and in electrical contact with a respective conducting element of an associated pair of conducting elements whereby each contact arm has electrical connection with a respective crucible part and the material to be melted extending into each part of the crucible is melted by electrical resistance,

said electrical means for melting further including a solenoid means connecting with the contact arms and in the energized position placing each contact arm in electrical engagement with the apropriate conducting element for melting the material in the crucible, and

spin melt switch means having electrical connection with said electrical motor means for rotating and with said means for melting and having closed circuit position for melting of the material in the crucible and a closed circuit position for spinning the casting arm about said vertical axis.

2. The invention according to claim 1, and

mold supporting means on said casting arm for carrying each of said mold means and releasable clamp means on said casting arm for fixedly holding said mold means against movement during rotation of the casting arm.

3. The invention according to claim 2, and

said supporting means including a generally V-shaped cradle means supporting each of said mold means in the trough thereof.

4. The invention according to claim 1, and

casting arm alignment means associated with said fixed base and said rotatable shaft means and indicating the proper aligned rotative position of the current conducting elements on casting arm with the contact arms on the base.

5. The invention according to claim 1, and

said electrical means for melting including a pivotal bellcrank arm means on the base,

said contact arms connecting with the bellcrank arm means and including finger means being raised into contact with said appropriate crucible by said bellcrank arm means in the energized position of the solenoid means,

biasing means connecting with the bellcrank arm means and solenoid means and urging said bellcrank arm means and lowering the finger means out of engagement with said appropriate crucible in the de-energized position of the solenoid means.

6. The invention according to claim 1, and

said electrical means for melting including a heat selector switch means having a plurality of electrical resistance means of different electrical resistance values to provide for different rates of heating.

7. The invention according to claim 1, and

said selective means including switch means de-activating said means for rotating said shaft means when said contact arms are placed in engagement with the conducting elements of one of said crucibles.

8. The invention according to claim 7, and

said switch means being acted upon by movement of said contact arms de-activating said electric motor means for rotating in the energized position of the solenoid means.

9. The invention according to claim 1, and

each conducting element having an electrical contact member engaging a respective crucible part in supportive and electrical conductive relation therewith.

10. The invention according to claim 9, and

each electrical contact member including an adjustable threadable screw means mounted in each conducting element.

* * * * *