No. 791,946. PATENTED JUNE 6, 1905.

F. H. RICHARDS.

APPARATUS FOR CASTING PLAYING BALLS.

APPLICATION FILED FEB. 21, 1903. RENEWED MAY 11, 1905.

7 SHEETS—SHEET 1.

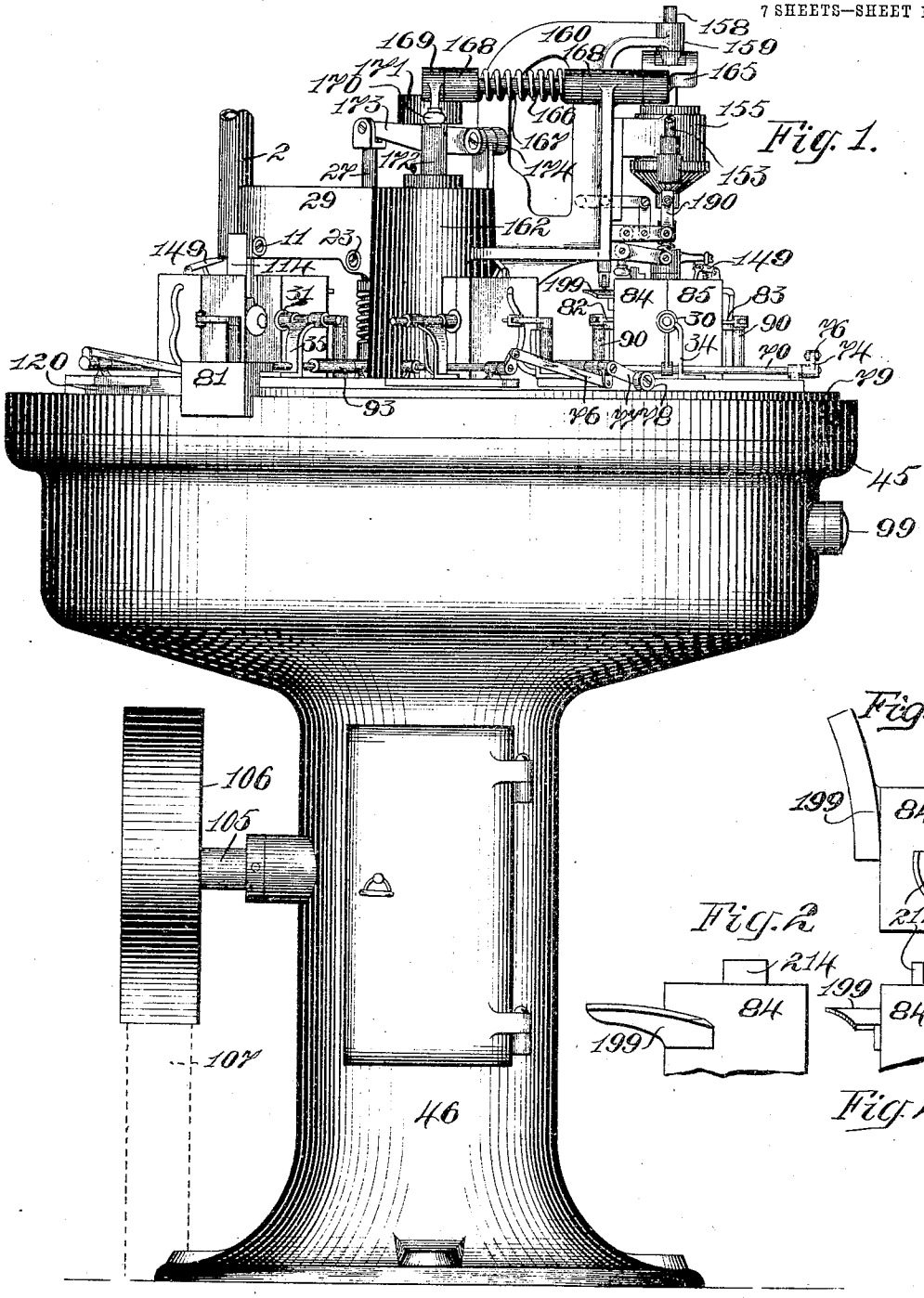


Fig. 1.

Fig. 3.

Fig. 2

Fig. 4.

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B. G. Stickney.

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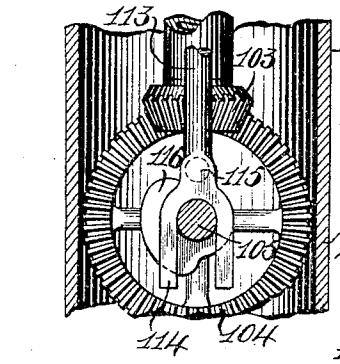


Fig. 5

Fig. 6

Fig. 7

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7 SHEETS—SHEET 3.

Fig. 8.

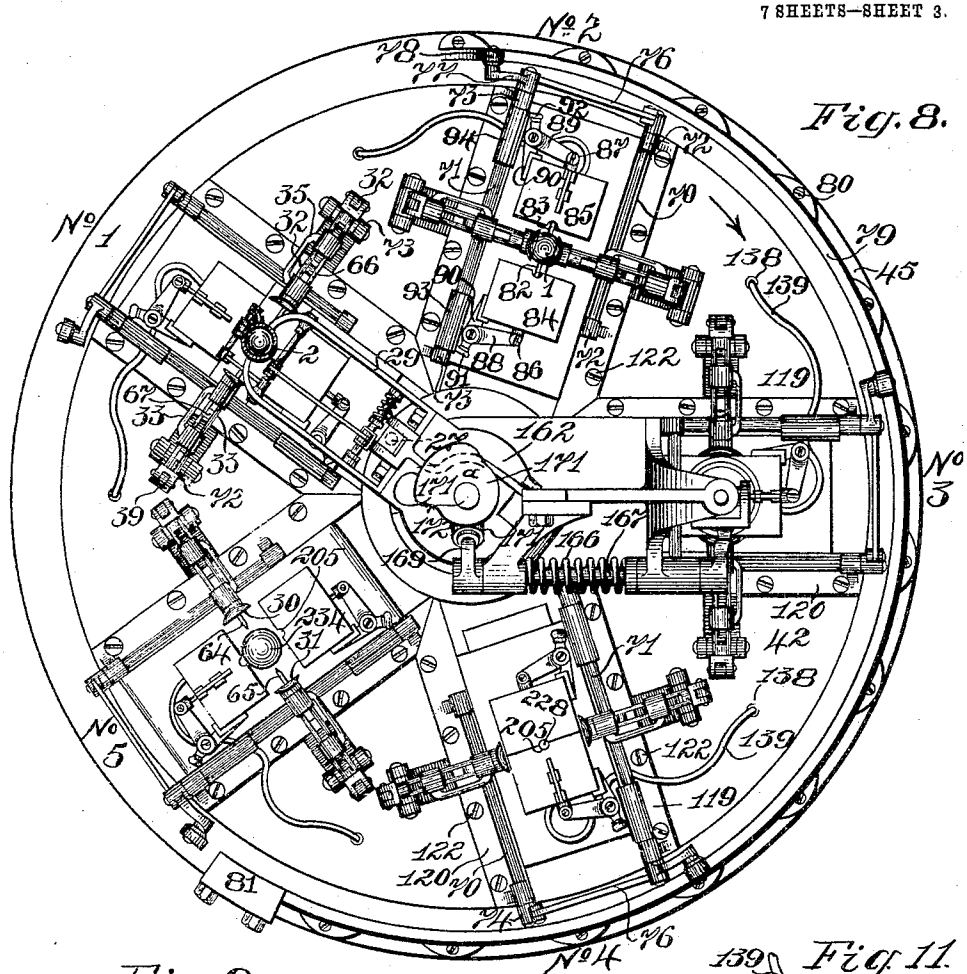


Fig. 9.

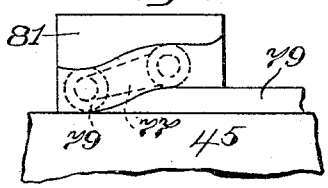


Fig. 10.

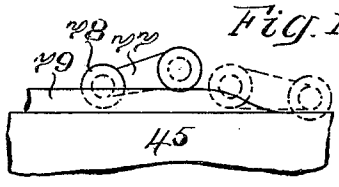


Fig. 11.

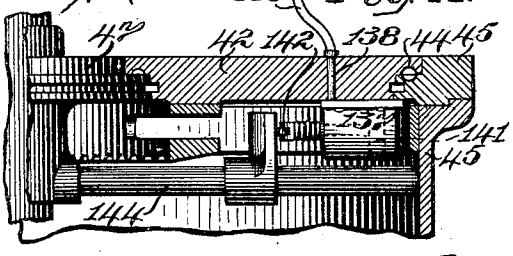
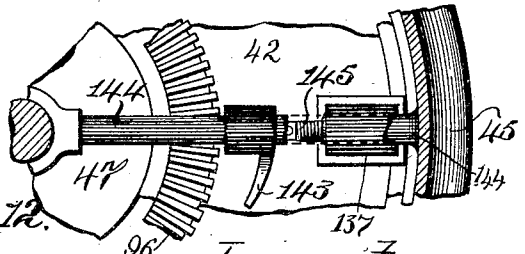


Fig. 12.



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7 SHEETS—SHEET 4.

Fig. 13.

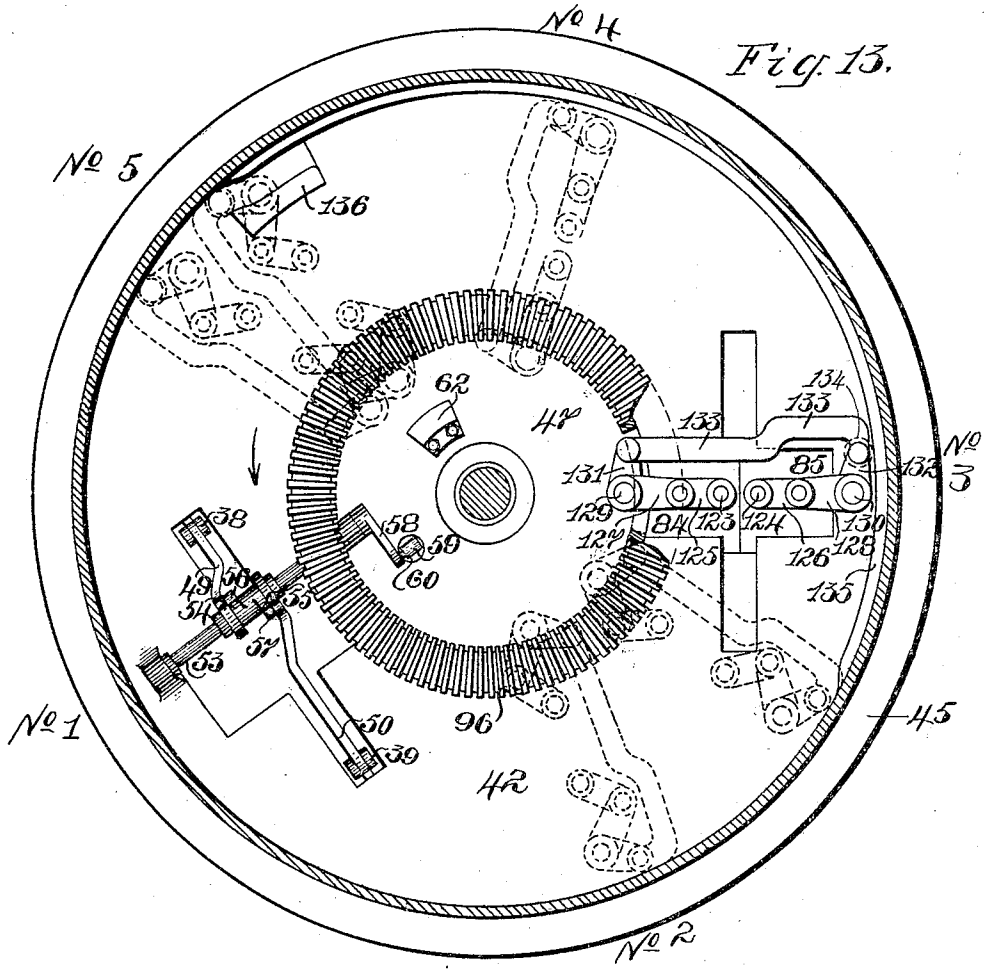
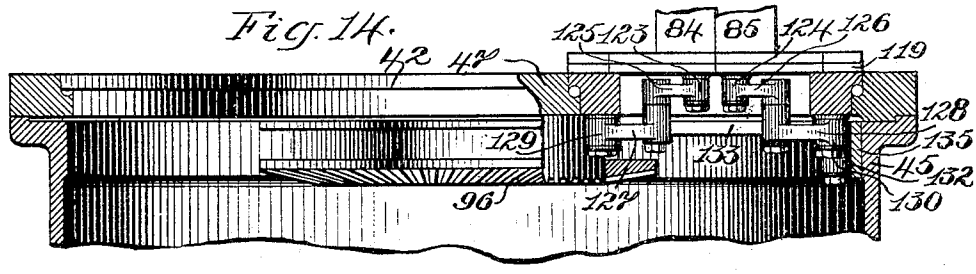


Fig. 14.



Witnesses:
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7 SHEETS—SHEET 5.

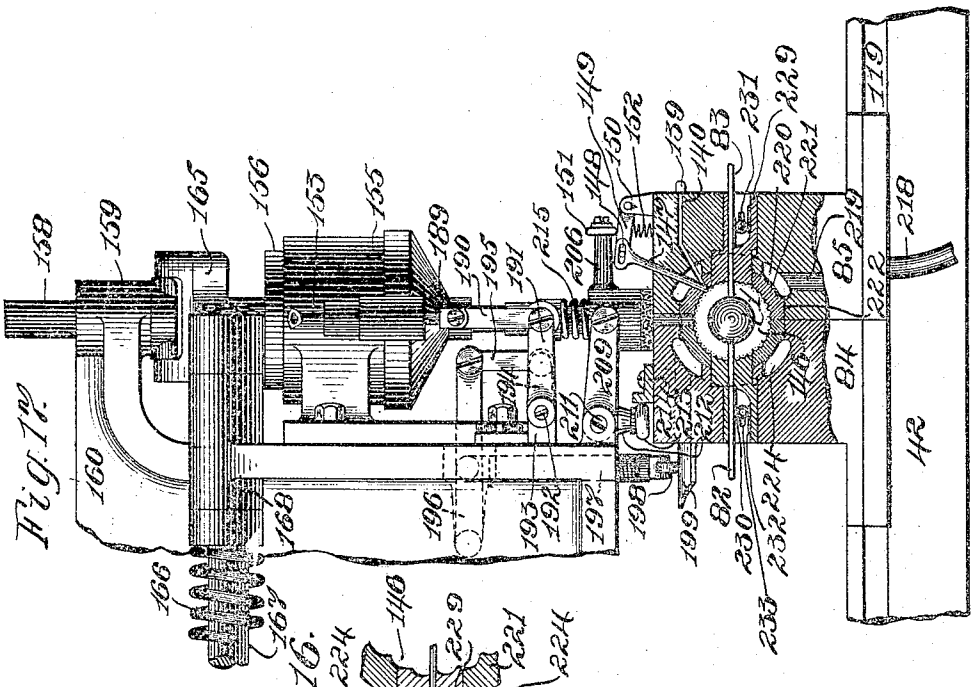


Fig. 14.

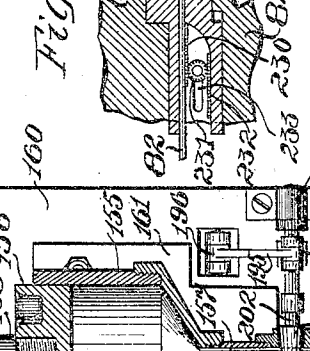


Fig. 16.

Fig. 15.

Witnesses:
C. A. Jarvis
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Inventor:
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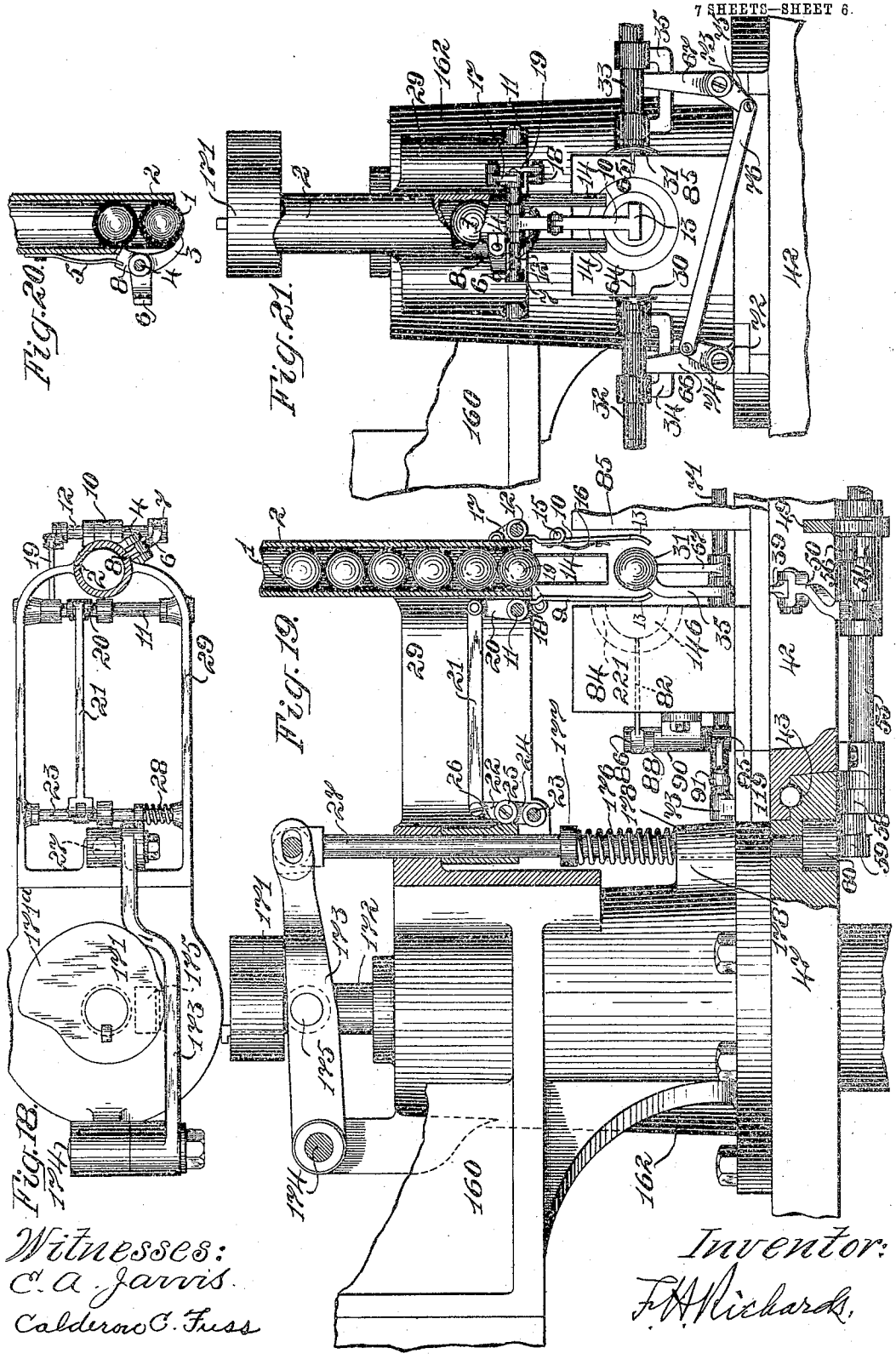
No. 791,946. PATENTED JUNE 6, 1905.

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APPARATUS FOR CASTING PLAYING BALLS.

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7 SHEETS—SHEET 6.



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Calderon C. Fuss

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7 SHEETS—SHEET 7.

Fig. 22.

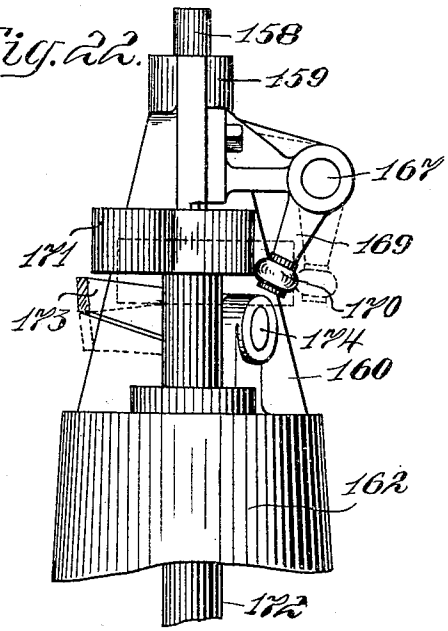
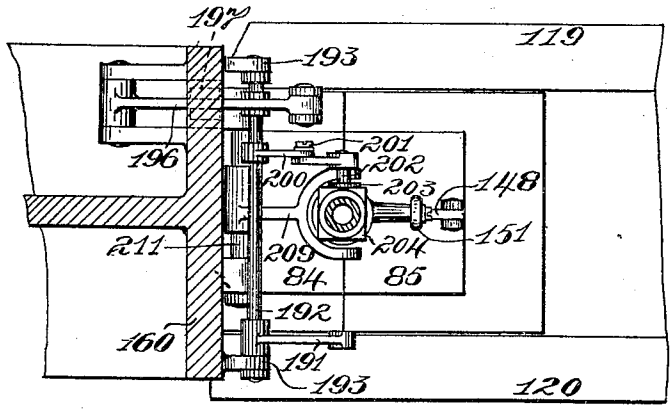


Fig. 23.



Witnesses:
C. A. Jarvis.
Calderon C. Fuss

Inventor:
F. H. Richards.

No. 791,946. Patented June 6, 1905.

UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT.

APPARATUS FOR CASTING PLAYING-BALLS.

SPECIFICATION forming part of Letters Patent No. 791,946, dated June 6, 1905.

Application filed February 21, 1903. Renewed May 11, 1905. Serial No. 259,958.

To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Apparatus for Casting Playing-Balls, of which the following is a specification.

This invention relates to an apparatus for casting shells of gutta-percha or other moldable material upon previously-formed cores, thereby forming golf or other playing balls.

In the drawings forming part of this specification, Figure 1 is an elevation of a ball-casting apparatus made in accordance with my present improvements. At this view are shown several ball-molds, which are mounted upon an intermittently-revolving table and are presented in succession to a series of devices whereby the ball-core is centered within the mold, the mold is closed, the fluent material is injected, the mold is opened, &c. Figs. 2, 3, and 4 are respectively side elevation, plan, and end elevation of certain cams used in controlling a portion of the means for forcing fluent material into the mold. Fig. 5 is a sectional detail of a part of the pedestal of the machine, showing therewithin main driving-gears and a cam-operated mechanism which controls a clutch used for automatically disconnecting from the continuously-revolving main shaft a large revolving table which forms part of the apparatus. Fig. 6 is a view similar to Fig. 1, but partly in central section and showing parts within the machine-frame, only one of the sets of molds, however, being illustrated, and this being closed. Fig. 7 is a sectional detail of the pedestal of the machine, taken transversely of the main driving-shaft, but at a different point from the section shown at Fig. 5 and showing cam connections for reciprocating vertically a rod or shaft contained within a central vertical driving-shaft, by which rod are operated several trains of mechanism, including that which forces the fluent material into the mold. Fig. 8 is a plan of the upper portion of the machine. Figs. 9 and 10 illustrate the end portions of a face cam or strip, which runs around a large portion of the revolving table, this view also showing the cam rollers and arms, which are operated by said face-cams for effecting movements of devices which center the cores within the molds. Fig. 11 is a vertical sectional detail of a portion of the revolving table, showing one of a set of five air-exhausting devices secured to the under side of said table, together with a stationary cam which causes the operation of said exhausting devices in succession at proper intervals. Fig. 12 is a bottom view of the devices shown at Fig. 11. Fig. 13 is a bottom view, and Fig. 14 a vertical section, of the revolving table, showing in full lines one of the ball-molds in a closed condition and also the means for effecting the opening and closing movements of said mold, the dotted lines at Fig. 13 showing various positions assumed by said means. Fig. 15 shows, upon a larger scale, a sectional view of means for positioning and maintaining the core of the ball within the ball-mold and for injecting fluent material into the mold to make the shell of the ball. In this figure the core is seen within the mold and transfixed by supporting-needles. The parts are in the same position as seen at Fig. 6; but the outer mold-section is omitted for the sake of clearness. Fig. 16 is a sectional detail of means for loosening or ejecting the finished ball from the mold. Fig. 17 is an elevation of parts shown at Fig. 15, the closed ball-mold being shown in section. Fig. 18 is a plan, and Fig. 19 an elevation, each partly in section, of a mass for feeding ball-cores to the ball-molds and associated parts at the upper portion of the apparatus. Fig. 20 illustrates the relation of a shutter to the cores, which are supplied by a chute from which they are fed one by one to the molds. Fig. 21 is an end elevation of parts shown at Fig. 19, all of the parts being in dormant position and the outer mold-section being omitted. Fig. 22 shows the details of the upper central portion of the machine, showing particularly means for forcing fluent material into the mold. Fig. 23 is a horizontal sectional view, on a large scale, showing certain details at the upper portion of the apparatus of means for controlling the movement of valves, &c.

In the several views similar signs denote similar parts.

One of the features of the present inven-

tion consists in the provision of means for feeding previously-formed cores automatically to a mold and then by automatic mechanism properly centering the cores within said mold, closing the mold, exhausting air therefrom forcing fluent material into the mold to form a shell on the ball, subjecting the fluent material to pressure while the ball cools and hardens, (so that the shell may hold the core under compression,) and opening the mold.

Another feature consists in mounting a succession of ball-molds, preferably five, upon a single table, and in causing said table to revolve intermittently, making one stop for each ball-mold or five stops at each revolution. Some of the operations of the several mechanisms are made during the movements of the table, while others are made while the table is stationary by means of power supplied by a continuously-revolving driving-shaft. At the first stop of the table a core is supplied to a mold and centered therein. During the next movement of the table the core is transfixed in its central position in said mold. At a succeeding stop the mold is closed and the fluent material injected thereinto. At the next stop the mold remains closed, whereby time is given for the ball to become cooler, and at the final stop the mold is opened and the finished ball is permitted to drop out. By having five sets of molds, with their associated mechanisms, it will be seen that a finished ball may be turned out at each movement of the table or five balls in a single revolution, although, if desired, a smaller or greater number of molds may be provided upon a single table or carrier. So long as a relative revolution is provided between a plurality of separate molds and an injecting apparatus the desired result may be effected whether or not it is the mold-carrier that revolves, as in the present instance.

Certain of the features of improvement herein described are also valuable in connection with other forms of machine than the one herein shown—as, for instance, the means for centering the core within the mold.

The cores 1 may be supplied to a vertical or other chute 2, Fig. 19. A shutter 3 is pivoted upon a bearing 4, carried by the chute, and is provided with a returning-spring 5, said shutter being located at the bottom of the chute and its nose projecting slightly within the latter, so as to engage the side of the lowest ball, as at Fig. 20. By the spring 5 an arm 6 upon the shutter is normally pressed against an oscillatory cam 7, Fig. 18. At the movement of the cam the arm 6 is lifted and the nose of the shutter 3 is withdrawn, permitting one ball to drop. The shutter is also provided with a detent 8, which at the release of the lowest ball moves in to engage the second ball, so that only one ball can feed at a time. The ball drops into a pocket formed by the coöperation of a pair of arms 9 and 10, depending from rock-shafts 11 and 12, said arms being shown normally separated or open at Fig. 19. Before the ball drops, however, the pocket is closed—that is, the tips of the pendent arms are swung nearly into contact. Each of the arms may be provided at its lower end with a cross-head 13, Fig. 21, to enlarge the capacity of the pocket, so that the core may not escape. The sides of the chute are continued at 14 to guide the ball as it feeds down. The outer pendent arm 10 may be formed of two parts, pivoted together at 15 and provided with a spring 16, whereby said arm is enabled to yield when other parts of the machine contact therewith during the table movements, said spring 16 serving to restore the arm to normal position. The rock-shafts 11 and 12 for said pendent arms are connected for simultaneous motion by means of arms 17 and 18 and link 19, Figs. 18 and 19. The operation of these rock-shafts and arms is effected by a train of mechanism comprising an upwardly-directed arm 20 on said shaft, a link 21, and a rock-arm 22, connected by said link to the arm 20, said rock-arm 22 being mounted upon a rock-shaft 23. The latter has an arm 24, carrying a roll 25, which bears against a cam 26, the latter being in the form of a sleeve and being fixed upon a vertical rod 27, mounted for up-and-down movement for a purpose presently to be explained. The shaft 23 is provided with a coiled spring 28, Fig. 18, for moving to effective position the shaft and connected parts, said movement being permitted by the downward movement of the cam 26, the return movement to normal position being effected by the upward movement of the cam. It will be noticed that the chute 2 is carried between arms 29 of a horizontally-extending bracket, which forms a part of the framing of the machine and affords a support for the several rock-shafts mentioned. The rock-shaft 12 carries at one end the cam 7, which controls the shutter 3, so that the shutter opens at the closing of the arms 9 and 10. At the time that the core drops into the pocket the ball-mold and connected parts are at position No. 1, Fig. 8, said mold being of course movable into and out of position for receiving the ball from the chute. The five molds are presented successively to said chute and each receives a core therefrom.

Each of the five mold mechanisms is provided with core-centering means, as seen clearly at Figs. 8, 16, 19, and 21. When the core is dropped into the pocket formed by the coöperation of the pendent arms 9 and 10, opposite cups 30 and 31 are moved simultaneously inward to grasp the ball upon opposite sides, whereby the core is accurately centered with reference to the mold. Thereupon the arms 9 and 10 relinquish the core and return to normal position, and the mold is advanced,

the parts then being in position No. 2, Fig. 8, the mold still being open. These centering-cups 30 and 31 are mounted upon the inner ends of sliding rods 32 and 33, which are carried in brackets 34 and 35, and at their outer ends have pin-and-slot connections 36 and 37, with upright levers 38 and 39, pivoted at 40 and 41 upon the revoluble table, which is designated as 42. It should here be explained that the table, as seen at Fig. 6, is of annular form and preferably by means of bearing-balls travels upon inner and outer sets of annular tracks 43 and 44, the outer tracks being formed upon the upper edge of a drum-like frame 45, cast integral with its pedestal 46, and the inner track 43 being formed upon a boss or plate portion 47, formed upon a fixed bracket 48, which projects inwardly from the side of the drum to the central portion of the frame. To the said cup-operating levers 38 and 39, Fig. 15, are pivoted at their lower ends inwardly and downwardly extending links 49 and 50, respectively, said links being forked at their inner ends, as at 51 and 52, to bestride a rock-shaft 53, having cams 54 and 55. The cams engage rolls 56 and 57, mounted upon said links, respectively, whereby the latter are simultaneously thrust out, whereby the levers 38 are vibrated and caused to thrust in the centering-cups 30 and 31 to grasp the core. The shaft and links are clearly seen from the under side at Fig. 13, the parts being shown in their dormant or open position and only one of the above mechanisms being illustrated at said figure. This shaft is rocked by means of an arm or crank 58, (shown best at Fig. 13,) which carries a roll 59, which when the table 42 stops lies just beneath a head 60, provided upon the lower end of the plunger-rod 27, hereinbefore described, which has the cam 26 for operating the core-feeding mechanism. At each operation of said plunger-rod 27, therefore, a core is released and fed into position between the mold-sections and is there grasped by the centering-cups, the core being of course held by the arms 9 and 10 until it is grasped by said cups. As soon as the core is grasped by the cups the table advances, and it will be understood that the cups are maintained in working position through the instrumentality of the cams 54 and 55, which at their crowns have dead-faces 61, which lock the links, levers, and cup-rods in effective position, where they remain temporarily. During the succeeding movement of the table the core is impaled upon needles, as will immediately be explained, and then the roll 59 upon said cup-operating crank-arm 58 contacts with and rides up over a shelf-cam 62, which is in the path of said roll, being secured upon the under side of the central fixture 47, as will be understood by reference to Fig. 13, thus returning the links and levers to normal position and withdrawing the cups, so as to permit the ball-mold to be presently closed. While the core is in the grasp of said cups it is impaled by four needles, of the kind illustrated in my pending applications Serial No. 111,264, filed June 12, 1902, and Serial No. 142,712, filed February 10, 1903. The needle-operating mechanism is best shown at Figs. 8, 15, 19, and 21. At Fig. 15 it will be noticed that the cup-carrying rods 32 and 33 are hollow and contain slides 63, from the inner ends of which project impaling-needles 64 and 65. The parts at Fig. 15 are shown in the same relation as indicated at position No. 3 in Fig. 8, the core being held by the needles and the mold being closed, (it being understood that at Fig. 15 one of the mold-sections is omitted for the sake of clearness.) The needle-slides are operated by rock-arms 66 and 67, having heads 68, which engage suitable slots 69, formed in the slides. These arms are carried by rock-shafts 70 and 71, mounted in bearings 72 and 73 and carrying at their outer ends arms 74 and 75, which are connected by a link 76 for effecting simultaneous inward and outward movement of the needle-arms 66 and 67. As seen at Fig. 8, upon the shaft 71 is mounted an operating-arm 77, which carries a roll 78, adapted to ride upon a cam 79, which is in the form of a long bent strip, and is secured by screws 80 to the top of the frame-drum 45 near the periphery thereof. Said operating-arm 77 and the needles connected thereto are hence brought into operation by the movement of the revolving table, and the needles are thereby caused to impale the core, whereupon the cups are withdrawn from the core by the engagement with the fixed cam 62, Fig. 13, of the roll 59 on the cup-operating arm 58. The needle-operating roll 78 then runs upon the level edge of the cam 79 during somewhat more than half the revolution of the table and at the proper time engages an overhanging cam 81, fixed upon the frame, whereby it is driven down to normal position, as will be understood by reference to Figs. 8 and 9, thus withdrawing the needles and permitting withdrawal of the finished ball.

Referring again to Fig. 15, it will be seen that the two needles 64 and 65 project through the center of the core-centering cups 30 and 31, which are in line, so that said needles fix the core in the position in which said cups center it. Since the relation between said needles and said cups is absolute, all liability of the core becoming uncentered within the finished ball is avoided. To further provide against inaccuracy of positioning of the core, I prefer to provide a second pair of needles 82 and 83, Figs. 8, 17, and 19, which are on a level with the needles 64 and 65 and are mounted directly in the centers of the mold-sections hereinafter referred to and designated as 84 and 85, which sections are relatively movable, as will presently be explained. These needles 82 and 83 have pin-and-slot connections at 86

and 87, Fig. 8, with bell-cranks 88 and 89, mounted upon the mold-sections 84 and 85 by means of brackets 90 and having rolls 91 and 92, which run upon eccentric cams 93 and 94, mounted upon the described needle-operating rock-shaft 71, said cams being in the form of elongated sleeves, so as to accommodate the opening and closing movements of the mold-sections whereon said bell-cranks are carried, so that the rolls 91 and 92 may always remain in engagement with the cams. The cams are so timed that the radial needles 82 and 83 are driven in at the same time as the tangential needles 64 and 65. By means of springs 95 said bell-cranks are returned to operative position at the reverse movement of the cam-carrying rock-shaft 71, so that all of the needles are withdrawn simultaneously, as seen at position No. 5, Fig. 8, the return of the needle-operating arm 77 being effected by the cam 81.

The means for effecting the revolution above referred to of the table 42 includes a bevel-gear 96, secured by bolts 97 to the under side of the table, Figs. 6 and 13, said gear being driven by a pinion 98, which is mounted upon a horizontal shaft 99, the latter being connected by bevel-pinions 100 and 101 with a vertically-mounted shaft 102, which at its lower end is connected by a bevel-pinion 103 and bevel-gear 104 with a horizontal power-shaft 105, operated by a pulley 106 and belt 107 or otherwise, so that upon revolution of the said shaft 105 power is communicated, through the gears 104, 103, 100, 101, 98, and 96, to the table. The latter, however, preferably revolves intermittently, and for this purpose the pinion 98 is loosely mounted upon the shaft 99 and has a clutching engagement with a collar 108, splined upon said shaft and provided with a spring 109 for forcing it into engagement with said pinion. The clutch is automatically operated by means of a bell-crank pivoted at 110 upon the framework and comprising an upright arm 111 and an inwardly-extending arm 112, said arm 111 having a pin 113, which engages a groove 114, formed upon said clutch-collar 108. From the arm 112 of the bell-crank depends a link 113, whose lower end is forked at 114, Fig. 5, to bestride the shaft 105. Above said shaft the link is provided with a roll 115, running upon a peripheral cam 116, fixed upon said shaft 105, Figs. 5 and 6. When the roll 115 contacts with said cam 116, the link 113 is forced up, the bell-crank is vibrated, and the collar 108 is disengaged from the pinion 98. At this time a lock 117, formed upon the upper end of the bell-crank arm 111, enters a seat formed by a pair of angle-plates 118, affixed to the under side of the revolving bed, one of said plates being shown at Fig. 6 and the other one being oppositely disposed, as will be understood. By this means the revolving bed is accurately positioned when it comes to rest, so as to insure the proper coöperation of parts of the mechanism which are mounted upon the bed with parts which are mounted upon fixed portions of the machine. It will be understood that there are five sets of the locking-plates 118, corresponding with the five sets of mold mechanism illustrated.

After the core is transfixed by the needles the mold-sections 84 and 85 are slid toward each other, being for this purpose mounted in guides 119 and 120, the mold-sections being provided with broadened base portions 121, whose edges engage said guides, and the latter being secured by screws 122 to the upper surface of the table. The mold-sections are opened and closed by the following means, viz: From the bottom portions of the mold-sections project downwardly studs at 123 and 124, Figs. 13 and 14, whereby movement is imparted to the molds, said studs being connected by links 125 and 126, respectively, to rock-arms 127 and 128, which together with the links form toggles, said rock-arms being pivoted at 129 and 130, respectively, to the under side of the revolving bed. It will be understood that there is one set of these toggles for each of the five molds. In order to secure a simultaneous movement of the mold-sections, said arms 127 and 128 are provided, respectively, with angular arms 131 and 132, connected by a link 133. Said arm 132 is provided with a roll 134, which is adapted to run upon a cam 135, having the form of a ledge curving around the interior of the frame-drum for about half of a circle, and the construction being such that when the arm 132 is forced inwardly by the rise at the beginning of the cam the toggles are straightened, thereby closing the molds, as seen in full lines at Fig. 13, (and position No. 3, Fig. 8,) the toggles having the effect of locking the molds, so that the pressure of the ball material which is injected thereinto is effectively resisted. After the ball material is injected the molds remain closed, as seen at position No. 4, Fig. 8, and then are opened by means of a terminal cam-surface 136, (shown at the upper portion of Fig. 13,) thus permitting the removal of the finished ball.

I prefer to exhaust air from the closed mold before injecting thereinto the material for the shell, and for this purpose I secure an exhaust cylinder or pump 137 to the under side of the revolving bed 42, as seen at Figs. 11 and 12, one cylinder for each mold. The pump has a port 138 extending up through the bed, which is connected by a hose 139 to the outer mold-section, where it communicates with a port 140 in said section, as clearly seen at Fig. 17. Within the cylinder is a piston 141, operated by a rod which carries at its outer end a friction-roll 142, adapted to engage with a fixed cam 143, which is supported upon a stationary radial bar 144, the latter serving as a brace between the drum 45 of the fram-

ing and the central boss portion 47. At said Figs. 11 and 12 the piston is shown as driven in by the inclined face of said cam, and it will be understood that by this movement the air is exhausted from the closed mold. A returning-spring 145 is coiled around the projecting end of the piston-rod. At Figs. 11 and 12 the parts are shown in a position corresponding to position No. 3 of Fig. 8. At Fig. 17, which also corresponds to said position No. 3, it will be seen that the communication between the port 140 and the mold-chamber 146 is closed by means of a valve-rod 147, which has a pin-and-slot connection at 148 with a lever 149, pivoted upon the framework at 150 and operated by a roll 151, which at the instant of the completion of the exhaust stroke of the piston thrusts said rod 147 to close the exhaust-port. The roll 151 is given a downward movement for this purpose by means (209) presently to be described in connection with the mechanism for injecting shell material into the mold.

The gutta-percha or other material is contained in a vat, (not shown,) in which it is kept in a fluent condition by heating means (not shown) or otherwise, said vat communicating, by means of a vertical pipe 153, Figs. 15 and 17, and an inlet 154, with a cylinder 155 of the proper capacity, which forms a portion of a forcing apparatus or pump. The cylinder contains a piston 156 and at its lower end is provided with an outlet 157, through which the gutta-percha is forced into the spherical chamber 146 of the mold. The piston is operated by a piston-rod 158, guided in a boss 159, formed upon a bracket 160, to which the cylinder 155 is secured by means of a bracket 161. The bracket 160, it will be noticed, is cast integral with a hollow pedestal 162, which is secured to the top of the fixed central boss-like member 47 of the framing. The piston-rod is provided with a cross-pin 163, which works in slots 164, formed in forked portions of an operating arm or crank 165, which is fixed upon a horizontal rock-shaft 167, mounted in bearings 168 on said bracket 160. The shaft carries at its opposite end an operating-arm 169, provided with a roll 170, which runs upon a peripheral cam 171, which rotates in unison with the central vertical driving-shaft 102. The cam 171 as it revolves rocks the arm 169 and the shaft 167 and by means of the arm 165 forces down the piston 156, which injects ball material into the mold, the parts being returned by a spring 166, coiled about said shaft 167. It may here be explained that said cam, which is fixed upon the upper end of a vertically-movable shaft 172, mounted within and splined to said shaft 102, is caused to move up and down by mechanism connected with the horizontal driving-shaft 105, said movement being effected for the purpose of vibrating an arm 173, Fig. 19, which has a pin-and-slot connection with the upper end of the vertical plunger-rod 27, heretofore referred to, which operates the means for feeding the cores to the molds, positioning the cores, &c. Said arm 173 is pivoted at 174 in a suitable fixed bearing and carries a roll 175, which runs upon the plane under side of said revolving cam 171. A returning-spring 176 for said plunger-rod 27 is coiled around said rod and works between a collar 177 thereon and a guiding-boss 178. It will be seen that the cam-face 171 is widened so as to avoid liability of the roll rolling off therefrom during the reciprocating movements of the cam-carrying central shaft 172. It should also be explained that the reciprocating movements of said shaft 172 are effected by means of a bell-crank 179, Fig. 7, which forks a collar 180 on the lower end of said shaft and has pins 181, which engage a groove 182 in said collar, the other arm 183 of said bell-crank being pivoted to an inwardly-extending link 184, which is forked at 185 to ride upon the shaft 105 and which is provided with a roll 186 to ride upon a cam 187, fixed upon said shaft 105, whereby once during each revolution said link is thrust out or to the right, as seen at Fig. 7, and the arm 179 of the bell-crank is vibrated downwardly, thus pulling down the rod 172 and operating the core-positioning mechanism already described. At the time that the piston 156 is forced down the inlet 154 is closed by means of a valve 188, the depending stem 189 whereof is connected by a link 190 to a rock-arm 191, which is fixed upon a horizontal rock-shaft 192, mounted in bearings 193 upon the bracket 160, as at Figs. 15, 17, and 23. The rock-shaft 192 is operated by means of an arm 194, which is connected by a vertical link 195 to an arm 196, pivoted upon the fixed bracket 160, said arm 196 being operated by a plunger 197, sliding within said framework and carrying at its lower end a roll 198, adapted to ride upon a cam 199, provided upon the inner mold-section 84, so that when the mold during the rotation of the table comes into position beneath the pump 155 said roller 198 rides up on the cam 199 and thrusts up the plunger 197, so that by means of the arm 196, link 195, arm 194, rock-shaft 192, arm 191, and link 190 the stem 189 is thrust up to close the valve 188, as seen in Fig. 15.

As will be seen clearly at Fig. 23, which is a section taken just below the cylinder 155 at Fig. 15, the shaft 192 carries between its ends a rock-arm 200, which has a pin-and-slot connection at 201 with a stem 202, which rotates a conical valve 203, which is inserted in a head or fitting 204, fixed to the lower end of the outlet 157 of the pump 155, whereby said valve is opened, as seen at Fig. 15, at the time that the inlet-valve 188 is closed, thereby permitting the fluent material to pass down from the pump into the mold.

As seen at Fig. 15, each mold-section is provided at its upper portion with an inlet-groove

205, the grooves taken together forming an inlet or gate, which when the traveling table is at rest is in line with the injecting apparatus just described.

In order to prevent leakage between the valve-head 204 and the closed mold, I provide a block or gland 206, having a central vertical opening therethrough at 207 in line with the mold-gate 205 and communicating at its upper end with said head 204, the lower end of the block having a pad 208, which is likewise perforated, so as to make a continuous passage for the fluent material. The object of the pad is to pack the joint between the block 206 and the top of the mold, for which purpose I compress the pad, this being effected by means of an arm 209, forking the block and pivoted thereto at 210, said arm being fulcrumed at 211 upon the fixed bracket 160 and being provided with a short depending arm 212, carrying a roll 213, which runs upon a cam 214, fixed upon the top of the inner mold-section and operating during the rotation of the table to force the arm 212 inwardly or toward the center of the machine, thereby drawing down the arm 209 and cramping the packing 208, in which position the parts are held during the injection of the mold material. These parts may be returned by draw-spring 215, coiled around the lower portion of the head 204. The hereinbefore-mentioned roll 151 is mounted upon said block 206, so that at the operation of cramping said packing the valve 147 is forced inward to close the exhaust, whereby during the final portion of each intermittent movement of the revolving table the air is exhausted from the mold, the air-exhaust is closed, communication is established between the mold and the fluent-material pump, and communication is shut off between the latter and the source of supply, thus making preparation for the descent of the piston 156 to force the material into the mold. The packing material 208 may be quite elastic, so as to permit of considerable movement of the block 206 after the joint is rendered air-tight between said block and the mold, this air-tight period being reached before the table ceases to move, so that thereafter the air may be exhausted from the mold by a quick action of the air-pump piston 141, Fig. 11, and so that after the exhaust of the air and just at the terminal portion of the movement of the table said block 206 may be forced down a little farther, so as to cause the roll 151 to operate the lever 149, and thereby push in the valve 147 to close the exhaust-port in the mold. It will be understood that the cam 214 is suitably formed for this purpose.

As seen at Fig. 8, the cam 171, which operates the force-pump, is provided with an elongated dwell portion 171^a, whereby pressure is maintained upon the fluent material after the injection thereof and for a considerable portion of the revolution of the vertical driving-shaft 172, during which time the shell material is being cooled by the circulation of water, as will presently be explained. By thus hardening the shell material under pressure it is not only solidly compacted, but the shell in the completed ball is caused to grip the core powerfully.

Any suitable circulation of water, oil, or other cooling liquid may be provided for. In the present instance I illustrate diagrammatically a watercourse 216, into which water may be forced through a supply-pipe 217, said course being partly in the revolving table and partly in the adjoining wall of the framing, as illustrated at Fig. 6. Each outer mold-section is connected by hose 218 to the watercourse 216, said hose 218 communicating with an inlet-port 219, Fig. 17, in the mold, which opens into a suitable course 220, surrounding a metal shell 221, which is formed in two hemispherical sections and threaded into the mold-blocks 84 and 85, as at 222, and is sufficiently thin to enable the cooling of the ball promptly by the circulating fluid. The courses 220 are connected by a hose 223, Fig. 6, with courses 224 in the inner mold-section, and the latter are connected by a hose 225 to an inner watercourse 226, formed partly in the innner edge of the revolving table and partly in the central portion of the framing 47, the latter being provided with an outlet-pipe 227.

In the movement of the revolving table from position No. 3, Fig. 8, to position No. 4 the plug 228, of gutta-percha, which is left within the gate or inlet 105 of the mold, is sheared off by the movement of the mold away from the injecting apparatus, and by this time the shell material is sufficiently cool to permit the separation of the mold from the injecting apparatus without danger, and it will also be understood that the water or other fluid may continue circulating while the mold remains in No. 4 position, thereby thoroughly hardening the shell. In position No. 5, Fig. 8, the mold is shown open and the needles withdrawn. Owing to the uneven contour of the surface of the finished ball, it is liable to stick to one of the mold-sections, and hence I prefer to provide means for positively ejecting the same from the mold. One form of such ejecting means is illustrated at Figs. 16 and 17, an ejector being fitted in each mold-section and having a head 229, which is shaped to conform to the wall of the mold-chamber 146. The ejectors 229 also serve as housings or bearings for the needles 82 and 83, which extend longitudinally through said ejectors. The latter are preferably moved by means of the needles, each of which is provided for this purpose with a rack 230, which meshes with a traversing pinion 231, the latter rolling along in mesh with an internal rack 232,

provided upon the ejector, so that as the needle moves in and out said pinion may run the length of the said rack 232 idly. A slot 233 is provided in the mold-section 94, within which protrudes the hub of the pinion, thereby limiting the travel of the latter. It will be understood that when the needle is withdrawn or moved to the left in Fig. 16 by the means hereinbefore described said pinion is caused to run to the left-hand end of the slot 233, where its traveling movement is stopped, while during the continued movement of the needle the pinion which now bears against the end of the slot is caused to rotate in a direction to thrust the ejector 229 inwardly, this movement being sufficient to disengage the finished ball from the mold-section. It will be understood that a similar operation is performed by the opposite needle 83 and that the ejectors remain in this protruding position until the needles are again projected for impaling the succeeding core. The first portion of the projecting movement of each needle drives the pinion to the position shown in Fig. 16, and the last portion of said projecting movement causes said pinion to rotate, and thereby withdraw the ejector 229 to the normal position shown in said figure. At position No. 5, Fig. 8, it will be understood that the ejectors have loosened the finished ball, which is designated at 234. At the next motion of the table the mold whose movements have been traced is moved to position No. 1, and the operation is repeated.

It will be seen that by having five mold mechanisms five balls may be in process of making at the same time, thereby conducing to economy and speed of manufacture. Simultaneously the core of one ball is being positioned the core of another ball is being impaled, the shell is being cast upon a third ball, the cast shell of the fourth ball is being cooled, and the fifth ball is being delivered from its mold.

Having thus described my invention, I claim—

1. A ball-casting apparatus, comprising a mold, consisting of sections and means for moving said mold, in combination with core-centering means, mold-closing means, material-injecting means, and mold-opening means, to all of which said mold is successively presented.

2. A ball-casting apparatus comprising a series of sectional molds, and means for rotating said series, in combination with core-centering means, mold-closing means, material-injecting means, and mold-opening means, to which said molds are respectively presented.

3. A ball-casting apparatus, comprising a carrier, means for moving said carrier intermittently, and a mold upon said carrier, in combination with core-centering means, mold-closing means, material-injecting means, and mold-opening means to which said mold is successively presented by the movement of said carrier.

4. A ball-casting apparatus, comprising a carrier, means for moving said carrier intermittently, and a series of sectional molds upon said carrier and automatically operable with the carrier, in combination with core-centering means, mold-closing means, material-injecting means, and mold-opening means to which said molds are simultaneously and in succession presented by the movement of said carrier.

5. A ball-casting apparatus comprising a carrier, means for moving said carrier intermittently, and a sectional mold upon said carrier, in combination with core-centering means, mold-closing means, material-injecting means, and mold-opening means to which said mold is successively presented during the movement of said carrier.

6. A ball-casting apparatus comprising a carrier, means for moving said carrier intermittently, and a series of sectional molds upon said carrier, in combination with core-centering means, mold-closing means, material-injecting means, and mold-opening means to which said molds are presented simultaneously and in succession during the movement of said carrier, and means for locking said carrier when the molds are presented to the injecting means.

7. A ball-casting apparatus comprising a table, means for revolving said table intermittently, and a sectional mold upon said table, in combination with core-centering means, mold-closing means, material-injecting means, and mold-opening means to which said mold is successively presented by the movements of said table.

8. A ball-casting apparatus comprising a table, means for revolving said table intermittently, and a series of sectional molds mounted upon said table, in combination with core-centering means, mold-closing means, material-injecting means, and mold-opening means to which said molds are simultaneously presented in succession by the movements of said table.

9. A ball-casting apparatus comprising means for injecting ball material, a series of ball-molds made of sections adapted to be automatically opened and closed, core-centering means, and means for presenting said molds in succession to said injecting means.

10. A ball-casting apparatus comprising means for injecting ball material, a series of ball-molds made of sections adapted to be automatically opened and closed, core-centering means, and means for effecting a relative step-by-step movement between said molds and said injecting means.

11. A ball-casting apparatus comprising means for injecting ball material, a series of ball-molds made of sections and adapted to be opened and closed, core-centering means,

and means for moving said mold bodily into and out of communication with said injecting means.

12. A ball-casting apparatus comprising means for injecting ball material, a series of mold-sections adapted to be automatically opened and closed, means for closing and opening said mold-sections, core-centering means, and means for moving them into and out of communication with said injecting means.

13. A ball-casting apparatus comprising a series of molds each made in sections, automatically-operating means for centering cores within said molds in succession, means for closing and opening the molds in succession, and means for injecting fluent ball material into the closed molds in succession.

14. A ball-casting apparatus comprising mold-sections, means for feeding cores to said sections, means for centering the cores within the mold, means for closing and opening the sections, and means for injecting fluent ball material into the closed mold.

15. A ball-casting apparatus comprising a series of sectional molds, means for feeding cores to said molds in succession, means for centering the cores within said molds, means for closing and opening the molds, and means for injecting fluent ball material into the molds.

16. A ball-casting apparatus comprising a sectional mold, means for feeding cores automatically to the mold, means for centering the cores within the mold, means for closing the mold, means for exhausting air from the mold, means for forcing fluent material into the mold, and subjecting said material to pressure, means for cooling the material while subjected to pressure, and means for opening the mold.

17. A ball-casting apparatus comprising a series of sectional molds, means for feeding cores automatically to the molds, means for centering the cores within the molds, means for closing the molds, means for exhausting air from the molds, means for forcing fluent material into the molds, and subjecting said material to pressure, means for cooling the ball while subjected to pressure, and means for opening the molds.

18. A ball-casting apparatus comprising a mold, means for feeding cores to the mold, means for centering the cores within the mold, means for closing the mold, and means for forcing fluent material into the mold, and subjecting said material to pressure during the hardening thereof.

19. A ball-casting apparatus comprising a revoluble series of sectional molds, means common to the molds for feeding cores to the molds, common means for centering the cores within the molds, common means for closing the molds, and common means for forcing fluent material into the molds and subjecting said material to pressure during the hardening thereof.

20. A ball-casting apparatus comprising a mold, means for feeding cores automatically to the mold, means for centering the cores within the mold, means for closing the mold, means for forcing fluent material into the mold and then maintaining pressure thereon, means for cooling the ball while subjected to pressure, and means for opening the mold.

21. A ball-casting apparatus comprising a revoluble table, a series of sectional molds thereon, means for revolving the table intermittently, means for feeding cores automatically to the molds, means for centering the cores within the molds, means for closing the molds, means for forcing fluent material into the molds and then maintaining pressure thereon, means for cooling the balls while subjected to pressure, and means for opening the molds.

22. A ball-casting apparatus comprising a plurality of molds each consisting of sections, means provided at each mold for locking the sections together, a common device for operating said locking means, and means also common to said molds for injecting fluent material thereinto, said injecting means, said common locking device, and said molds being relatively movable.

23. A ball-casting apparatus comprising a series of molds, means for centering cores in said molds, means common to said molds for injecting fluent material thereinto, and means for effecting an intermittent movement of said molds to and from said injecting means.

24. A ball-casting apparatus comprising a plurality of sectional molds, means for feeding cores automatically to the molds, means for centering the cores within the molds, means for closing the molds, and means for injecting fluent material into the molds.

25. A ball-casting apparatus comprising a plurality of sectional molds, means common to the molds for feeding cores automatically thereto, means, including a common actuating device, for centering the cores within the molds, means, including a common actuating device, for closing the molds, and means, including a common force-pump, for injecting fluent material into the molds.

26. A ball-casting apparatus comprising a mold, means for feeding cores to the mold, means for centering the cores within the mold, means for closing the mold, and means for injecting fluent material into the mold.

27. A ball-casting apparatus comprising a common driver, a mold, means actuated by said driver for feeding cores to the mold, means also actuated by said driver for centering the cores within the mold, means also actuated by said driver for closing the mold, and means also actuated by said driver for injecting fluent material into the mold.

28. A ball-casting apparatus comprising a

mold, means for feeding cores to the mold, means for centering the cores within the mold, means for closing the mold, means for injecting fluent material into the mold, and means for opening the mold.

29. A ball-casting apparatus comprising a common driver, a mold, means actuated by said driver for feeding cores to the mold, means also actuated by said driver for centering the cores within the mold, means also actuated by said driver for closing the mold, means also actuated by said driver for injecting fluent material into the mold, and means also actuated by said driver for opening the mold.

30. A ball-casting apparatus comprising a series of molds, means for centering and supporting cores within the molds, means for closing the molds, means for injecting fluent material into the molds, and means for maintaining pressure upon the fluent material while it hardens within the molds.

31. A ball-casting apparatus comprising a series of molds, means for feeding cores automatically to the molds, means for centering and supporting the cores within the molds, means for closing the molds, means for injecting fluent material into the molds, and means for maintaining pressure upon the fluent material while it hardens within the molds.

32. A ball-casting apparatus comprising a series of molds, means for feeding cores automatically to the molds, means for centering the cores within the molds, means for closing the molds, means for injecting fluent material into the molds, and means for opening the molds.

33. A ball-casting apparatus comprising a series of molds, means for supporting cores within the molds, means for closing the molds, means for injecting fluent material into the molds, and means for opening the molds and loosening the ball therefrom.

34. A ball-casting apparatus comprising a series of molds, means for centering cores within the molds, means for supporting cores within the molds, means for closing the molds, means for injecting fluent material into the molds, and means for opening the molds and loosening the ball therefrom.

35. A ball-casting apparatus comprising a series of molds, means for centering cores within the molds, means for exhausting air from the molds, and means for injecting fluent material into the molds.

36. A ball-casting apparatus comprising a series of molds, means for centering cores within the molds, means for closing the molds, means for exhausting air from the molds, and means for injecting fluent material into the molds.

37. A ball-casting apparatus comprising a plurality of molds, means for feeding cores automatically to the molds, means for centering the cores within the molds, means for closing the molds, means for exhausting air from the molds, and means for injecting fluent material into the molds.

38. A ball-casting apparatus comprising a series of molds, means for centering cores within the molds, means for closing the molds, means for injecting material into the molds, and means for cooling the molds.

39. A ball-casting apparatus comprising a series of molds means for centering cores within the molds, means for injecting ball material into the molds, and means for cooling the molds.

40. A ball-casting apparatus comprising a series of molds, means for feeding cores automatically to the molds, means for centering cores within the molds, means for injecting ball material into the molds, and means for cooling the molds.

41. In a ball-casting apparatus, the combination with a ball-mold and means for injecting fluent material thereinto, of means for feeding a core to said mold, said feeding means including a chute, a shutter, and means for operating the shutter.

42. In a ball-casting apparatus, the combination with a sectional ball-mold and means for injecting fluent material thereinto, of means for feeding a core to said mold, said feeding means including a chute, a shutter, means for operating the shutter, a pocket into which the core may drop after it is released by the shutter, and means for transferring the core from the pocket to the mold and supporting it therein.

43. In a ball-casting apparatus, the combination with a ball-mold and means for injecting fluent material thereinto, of means for feeding a core to said mold, and means for moving said mold from said feeding means to said injecting means.

44. In a ball-casting apparatus, the combination with a series of ball-molds and means for injecting fluent material thereinto, of means for feeding cores to said molds, and means for moving said molds successively from said feeding means to said injecting means, the construction and operation being such that the injecting means and feeding means may operate simultaneously upon different molds.

45. In a ball-casting apparatus, the combination with a ball-mold and means for injecting fluent material thereinto, of means for feeding a core to said mold, said means including a chute, a shutter having a part for engaging the lowermost ball, and also a part for engaging the next ball, and a device for operating said shutter.

46. In a ball-casting apparatus, the combination with a series of ball-molds and means common thereto for injecting fluent material thereinto, of means also common to said molds for feeding cores thereto, said means including a chute, a shutter having a part for engaging the lowermost ball, and also a part for

engaging the next ball, and a device for operating said shutter.

47. In a ball-casting apparatus, the combination with a ball-mold and means for injecting fluent material thereinto, of means for feeding a core to said mold, said means including a chute, a shutter, devices which may move toward each other to form a pocket for the ball, and means for effecting movement of said pocket devices.

48. In a ball-casting apparatus, the combination with a ball-mold and means for injecting fluent material thereinto, of means for feeding a core to said mold; said means including a chute, a shutter, devices which may move toward each other to form a pocket for the ball, and means for effecting movement of said pocket devices; and means for transferring the core from said pocket to the mold and centering and supporting the core within the mold.

49. In a ball-casting apparatus, the combination with a series of ball-molds and means for injecting fluent material thereinto, of means for centering cores within the molds, and means for maintaining the cores in their central position and closing the molds.

50. In a ball-casting apparatus, the combination with a ball-mold and means for injecting fluent material thereinto, of means for feeding cores to the mold, and means for centering the cores within the mold.

51. In a ball-casting apparatus, the combination with a series of ball-molds and means for injecting fluent material into one mold at a time, of means for feeding cores to the molds, and means for centering and supporting the cores within the molds.

52. In a ball-casting apparatus comprising a series of molds, means for centering cores within the molds, means for transfixing the cores within the molds, means for closing the molds, means for injecting fluent material into the molds, and means for opening the molds.

53. In a ball-casting apparatus, the combination with an actuator, of a series of ball-molds, means connected to said actuator for moving said series together, means also connected to said actuator for injecting fluent material into the molds in succession, means also connected to said actuator for feeding cores to the molds, and means also connected to said actuator for centering and transfixing the cores within the molds.

54. In a ball-casting apparatus, the combination with a ball-mold and means for injecting fluent material thereinto, of means for feeding cores to the mold, and means for centering and transfixing the cores within the mold.

55. In a ball-casting apparatus, the combination of a series of molds, a chute, a shutter, a pocket below the shutter, ball-centering means, ball-transfixing means, mold-moving means, and means for supplying fluent ball material to the molds.

56. In a ball-casting apparatus, the combination of a chute, a shutter, a mold, a pocket below the shutter, ball-centering means, ball-transfixing means, and means for supplying fluent ball material.

57. In a ball-casting machine, the combination with a revoluble table of a series of molds mounted thereon, core-supplying means mounted upon the framing of the machine, core-centering means mounted upon said table, and means also upon the framing for supplying fluent material to the molds in succession.

58. In a ball-casting machine, the combination with a revoluble table of a mold mounted thereon, core-supplying means mounted upon the framing of the machine, core-centering means mounted upon said table, and means also upon the framing for supplying fluent material to the mold.

59. In a ball-casting apparatus, the combination with a mold of means for centering a core within said mold, said centering means comprising a pair of cups.

60. In a ball-casting apparatus, the combination with a mold of means for centering a core within said mold, said centering means comprising a pair of cups, sliding rods whereon said cups are mounted, and means for operating said rods.

61. In a ball-casting apparatus, the combination with a mold of means for centering a core within said mold, said centering means comprising a pair of cups, sliding rods whereon said cups are mounted, means for operating said rods, levers for operating said rods, and cams for operating said levers.

62. In a ball-casting apparatus, the combination with a series of molds of means for centering a core within each of said molds, said centering means comprising a pair of cups for each mold, rods whereon said cups are mounted, and means for operating said rods.

63. In a ball-casting apparatus, the combination with a mold of means for supplying cores thereto, means for centering the cores, means for impaling the cores, and means for supplying ball material.

64. In a ball-casting apparatus, the combination with a series of molds of means for supplying cores thereto in succession, means for centering the cores, means for impaling the cores, and means for supplying ball material.

65. In a ball-casting apparatus, the combination with a mold of core-centering cups, and a set of needles.

66. In a ball-casting apparatus, the combination with a mold made in sections, of means for opening and closing said sections, core-centering cups, means for operating said cups, a set of needles, and means for operating said needles.

67. In a ball-casting apparatus, the combination with a mold of core-centering cups, needles projecting from said cups, and means for effecting independent movements of the needles and cups.

68. In a ball-casting apparatus, the combination with a mold made in sections, of core-centering cups, needles projecting from said cups, needles projecting from the mold-sections, and means for effecting independent movements of the needles, cups and mold-sections.

69. In a ball-casting apparatus, the combination with a mold of core-centering cups, needles projecting from said cups, means for effecting independent movements of the needles and cups, and coöperating needles at right angles to the first-mentioned needles.

70. In a ball-casting apparatus, the combination with a mold of core-centering cups, needles projecting from said cups, means for effecting independent movements of the needles and cups, and coöperating needles at right angles to the first-mentioned needles, and means for moving said coöperating needles; all of said needles lying substantially in a single plane.

71. In a ball-casting apparatus, the combination with a mold of core-centering devices, means for operating them, core-impaling needles, and independent means for operating the needles.

72. In a ball-casting apparatus, the combination with a series of molds of a series of core-centering devices, common means for operating them, a series of sets of core-impaling needles, and common means for operating the needles.

73. In a ball-casting apparatus, the combination with a mold of core-centering devices, means for operating them, core-impaling needles within said centering devices, and means for operating the needles.

74. In a ball-casting apparatus, the combination with a mold of two core-centering devices, means for operating them a core-impaling needle mounted centrally within each of said centering devices, independent means for operating said needles, and a coöperating needle.

75. In a ball-casting apparatus, the combination of a revolving table, a sectional mold thereon, needles mounted in the mold-sections, means for moving the needles, and means for injecting ball material into the mold.

76. In a ball-casting apparatus, the combination of a revolving table, a sectional mold thereon, needles mounted in the mold-sections, means for moving the needles, a pair of coöperating needles, and means for injecting material into the mold.

77. In a ball-casting apparatus, the combination of a revolving table, a mold thereon, needles mounted in the mold, rock-shafts upon the table for operating the needles, and means, including a fixed cam, for operating the rock-shafts during the table movement.

78. In a ball-casting apparatus, the combination of a revolving table, a mold thereon, a pair of needles mounted in the mold, rock-shafts upon the table for operating the needles, a coöperating pair of needles, rock-shafts for operating them, and a fixed cam for operating all of said rock-shafts during the table movement.

79. In a ball-casting machine, the combination of a mold, means for feeding a core to the mold, means for centering the core within the mold, means for transfixing the core within the mold, means for closing the mold, means for injecting ball material into the mold, means for withdrawing the transfixing means, and means for opening the mold.

80. In a ball-casting machine, the combination of a series of molds, means for feeding a core to one of the molds, means for simultaneously centering and transfixing a core within another mold, means for simultaneously closing and injecting ball material into another mold, and means for simultaneously opening another mold.

81. In a ball-casting apparatus, the combination with a mold of means for centering a core within the mold, needles projecting through said centering means and movable toward each other independently thereof, and means coöperating with said needles for supporting the core after the withdrawal of said centering means.

82. In a ball-casting apparatus, the combination with a mold of automatically-operating means for centering a core within the mold, needles projecting through said centering means and automatically movable toward each other independently thereof, and automatically-movable coöperating needles extending transversely to said needles.

83. In a ball-casting apparatus, the combination with a mold, of means for centering a core within a mold, needles projecting through said centering means and movable toward each other independently thereof, and coöperating means for supporting the core after the withdrawal of the centering means; said coöperating means including a pair of needles mounted in the mold-sections centrally thereof, and means for moving the last-mentioned needles independently of said sections.

84. In a ball-casting apparatus, the combination with a mold, of means for feeding a core to the mold, means for centering the core within the mold, needles projecting through said centering means and movable toward each other independently thereof, and coöperating means for supporting the core after the withdrawal of the centering means; said coöperating means including a pair of needles mounted in the mold-sections centrally thereof, and about at right angles to the first-mentioned needles, means for moving said coöperating last-mentioned needles independently of said sections, and means for opening and closing said sections.

85. In a ball-casting machine, the combination of a plurality of molds and means for clos-

ing them, of means common to said molds for injecting ball material thereinto, and an air-pump connected to each mold.

86. In a ball-casting machine, the combination of a plurality of molds and means for closing them, of means common to said molds for injecting ball material thereinto, an air-pump connected to each mold, and means common to said pumps for operating them.

87. In a ball-casting machine, the combination with a mold and an injecting-pump of means for connecting said mold to said pump, said means including a yielding packing, and means for compressing said packing.

88. In a ball-casting machine, the combination with a series of molds, and an injecting-pump, of means for connecting said molds in succession to said pump, said means including a yielding packing, and means for compressing said packing.

89. In a ball-casting machine, the combination with a mold and an injecting-pump of means for presenting and connecting said mold to said pump, said connecting means including a yielding packing, and automatically-operating means for compressing said packing.

90. In a ball-casting machine, the combination with a series of molds, and an injecting-pump, of inlet and outlet valves for said pump, means for connecting said molds in succession to said pump, said means including a yielding packing, and automatically-operating means for compressing said packing.

91. In a ball-casting machine, the combination with an injecting-pump and a mold, of means for moving the mold to and from said pump, and means for connecting the pump to the mold, said connecting means including a yielding packing, and means operating during the movement of the mold for compressing said packing.

92. In a ball-casting apparatus, the combination with a mold and means for injecting fluent material thereinto, of means for supporting a core within the mold, and means for ejecting the finished ball from the mold, said ejecting means including an ejector mounted within one of the mold-sections, and means for operating said ejector.

93. In a ball-casting apparatus, the combination with a mold and means for injecting fluent material thereinto, of means, including a needle, for supporting a core within the mold, and an ejector mounted in the mold; said needle being mounted within said ejector.

94. In a ball-casting apparatus, the combination with a mold and means for injecting fluent material thereinto, of means, including a pair of needles, for supporting a core within the mold, and a pair of ejectors mounted in the mold; said needles being mounted within said ejectors and operatively connected thereto; and means for operating the needles and ejectors.

95. In a ball-casting apparatus, the combination with a mold and means for injecting fluent material thereinto, of means, including a needle for supporting a core within the mold, and an ejector mounted in the mold; said needle being mounted in said ejector; means for moving said needle, and means operated by the needle for moving the ejector.

96. In a ball-casting apparatus, the combination with a mold and means for injecting fluent material thereinto, of means, including four needles disposed at about right angles, for supporting a core within the mold, and an ejector mounted in the mold; at least one of said needles being mounted in said ejector; means for moving said needles, and means for moving the ejector.

97. In a ball-casting apparatus, the combination with a ball-mold of means for centering a core within the mold, means for injecting ball material into the mold, means for supporting the core within the mold during the casting operation, and means for ejecting the ball from the mold.

98. In a ball-casting apparatus, the combination with a series of ball-molds of means for centering cores within the molds, means for injecting ball material into the mold, means for supporting the cores within the molds during the casting operation, and means for ejecting the balls from the molds.

99. In a ball-casting apparatus, the combination with a ball-mold of means for centering a core within the mold, means for injecting ball material, means for supporting the core within the mold during the casting operation, and means for ejecting the ball from the mold; said supporting means including a needle which has a bearing within said ejecting means.

Signed at Nos. 9 to 15 Murray street, New York, N. Y., this 20th day of February, 1903.

FRANCIS H. RICHARDS.

Witnesses:

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JOHN O. SEIFERT.