G. A. WETTENGEL.

LADLE STOPPER OPERATING MECHANISM.

APPLICATION FILED OCT. 28, 1915.

1,212,860. Patented Jan. 16, 1917.

3 SHEETS—SHEET 1.

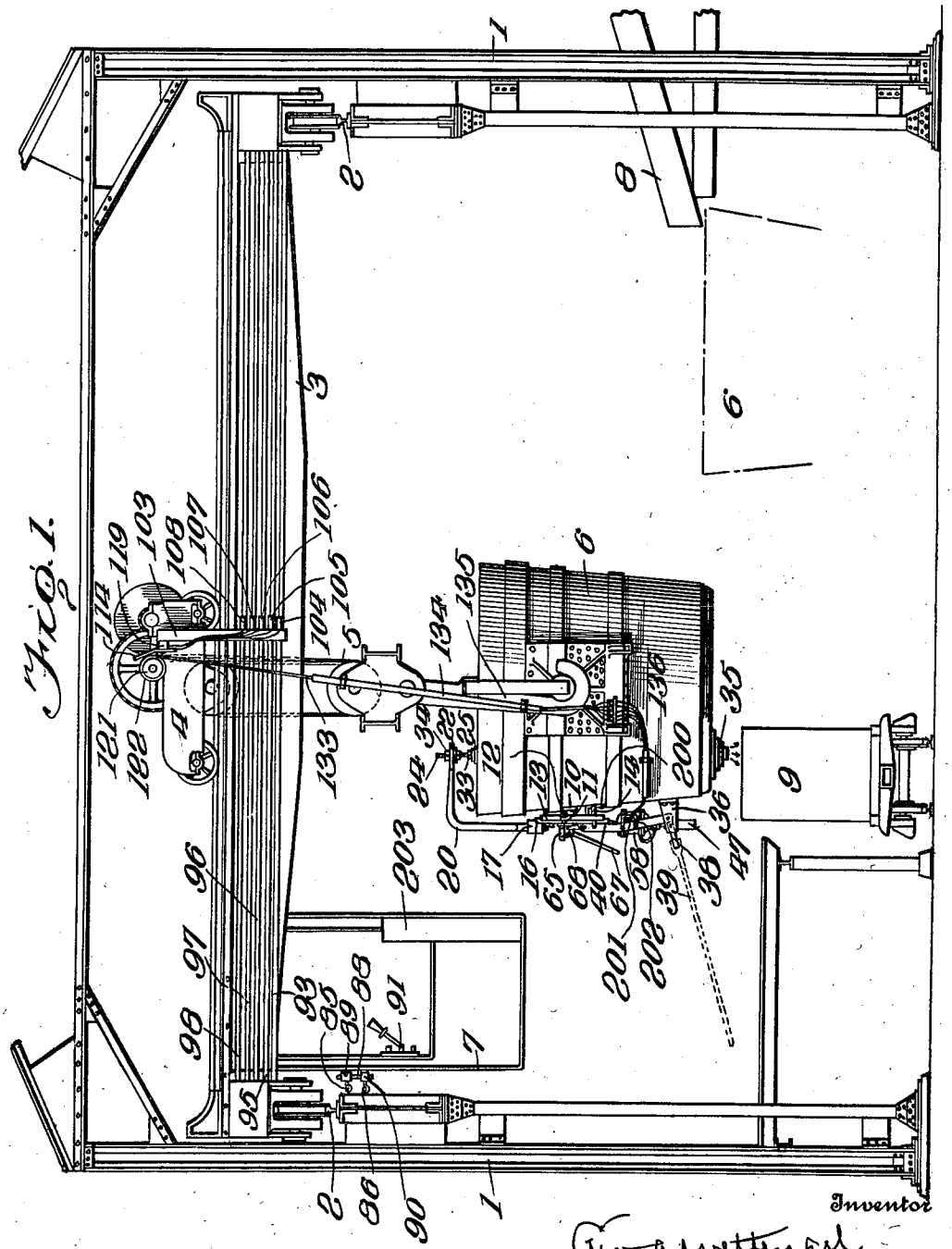


Fig. 1.

Witnesses

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3 SHEETS—SHEET 2.

Fig. 2.

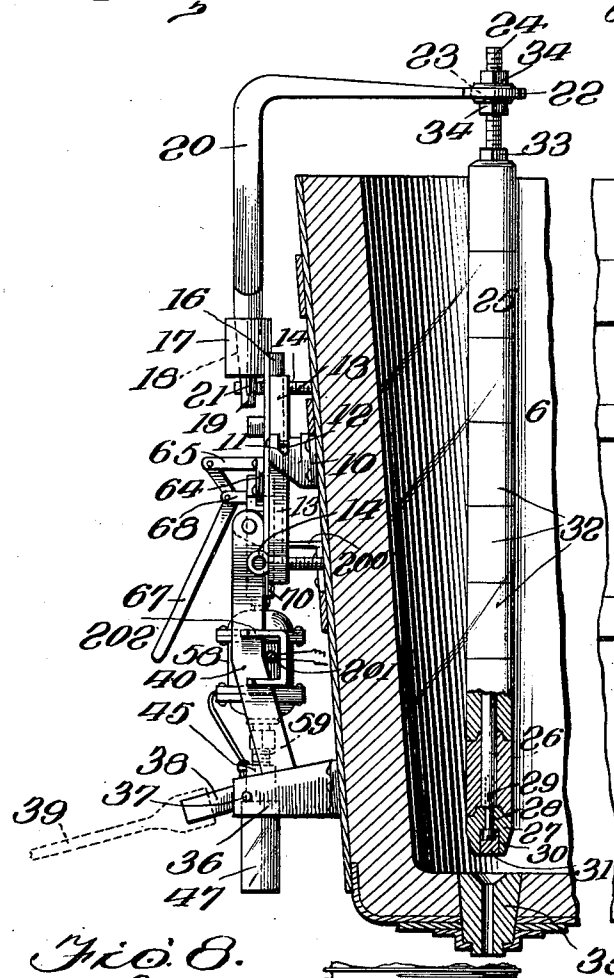


Fig. 10.

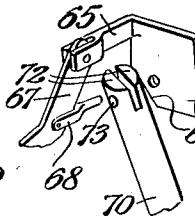
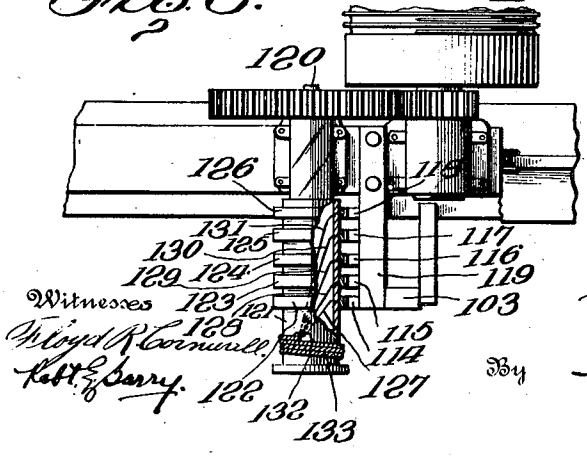


Fig. 3.

Fig. 8.



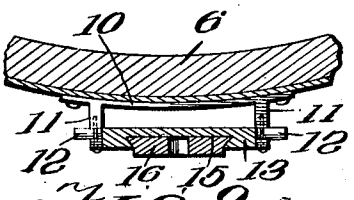


Fig. 9.

Witnesses
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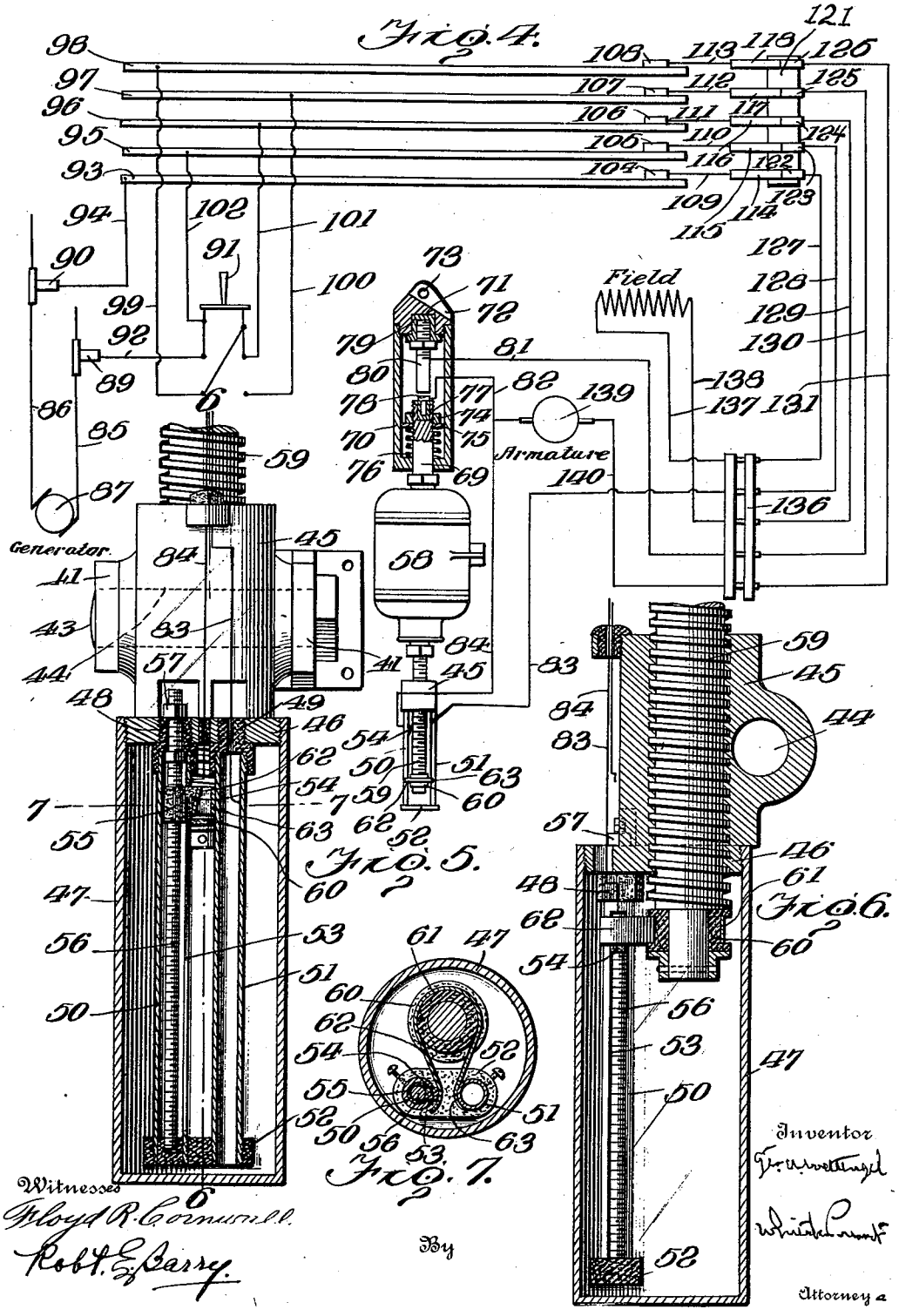
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3 SHEETS—SHEET 3.



UNITED STATES PATENT OFFICE.

GEORGE ALEXANDER WETTENGEL, OF ST. LOUIS, MISSOURI.

LADLE-STOPPER-OPERATING MECHANISM.

1,212,860. Specification of Letters Patent. Patented Jan. 16, 1917.

Application filed October 28, 1915. Serial No. 58,402.

To all whom it may concern:

Be it known that I, GEORGE A. WETTENGEL, citizen of the United States, residing at St. Louis, State of Missouri, have invented certain new and useful Improvements in Ladle-Stopper-Operating Mechanisms; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention consists in the novel features hereinafter described, reference being had to the accompanying drawings in which I have illustrated one form of my invention selected by me for purposes of illustration, and the said invention is fully disclosed in the following description and more particularly pointed out in the appended claims.

Referring to the said drawings, Figure 1 is a diagrammatic view of the interior of a portion of a steel mill showing in elevation my ladle and improved electrical means for operating the stopper of the same. Fig. 2 is a vertical sectional view of a portion of the ladle and stopper, the stopper operating means being in elevation. Fig. 3 is a front view of a portion of the ladle and the mechanism for operating the stopper of the same. Fig. 4 is a diagrammatic view of the electric wiring and an elevation of the motor, one of the motor switches being shown in section. Fig. 5 is a transverse vertical sectional view of one of the motor limit switches and an elevation of the motor screw and nut. Fig. 6 is a vertical sectional view of said limit switch, screw and nut taken on line 6—6 of Fig. 5. Fig. 7 is a horizontal sectional view of said switch taken on line 7—7 of Fig. 5. Fig. 8 is a detail showing a portion of the crane trolley and the winding mechanism for the wire cable which carries the current from the source of power to the motor. Fig. 9 is a view taken on line 9—9 of Fig. 3. Fig. 10 is a detail showing a portion of the mechanism for connecting the upper end of the motor to the arm which raises and lowers the ladle stopper.

In order that my invention may be clearly understood, I deem it desirable to briefly describe the present manual means and method of operating the stopper of a ladle for molten steel. In teeming, say a sixty ton ladle of molten steel, the ladle which is provided with a refractory lining, stopper and stopper operating mechanism, is supported and conveyed from the furnace to the molds, and from mold to mold by a crane, which is provided with a trolley and by which the ladle is carried and also raised or lowered as required. The ladle which has previously been internally heated, is placed under the tapping spout of the furnace by the crane, and the furnace is then tapped, the molten metal flowing out and filling the ladle. The ladle is then raised and carried over one of a series of cast iron molds and the ladleman standing on a platform adjacent the molds, operates a lever while his helper removes a key which clamps the stopper mechanism in its closed position and which key has been placed in position prior to tapping the furnace to prevent the surging metal from opening the stopper. The ladleman lowers the lever controlling the stopper mechanism, thereby raising the stopper allowing the metal to enter the mold, until the latter is filled and he then raises the lever and lowers the stopper to close the ladle aperture when the mold is filled. The ladle is then conveyed from mold to mold which are filled consecutively until the ladle is empty. This method is known as top casting and while other methods have been used, they need not be described. It has been found in practice that the disadvantages of operating a ladle stopper in the manner above described, are numerous, owing to the extreme heat of the molten metal and its liability to erupt and scatter over the operators. It will therefore be apparent, that ladleman and his helper standing on the platform adjacent the molds occupy very dangerous positions, owing to the fact that the gases escaping from the metal while the mold is filling, keeps the metal in violent motion and eruption, and frequently causes a spray of hot metal to fall upon and burn the operators. It also occasionally happens, after partly emptying the ladle, that the metal will violently react, the escaping gases throwing liquid metal to the roof of the building, often burning off the trolley wires, destroying the trolley motor and rendering it extremely dangerous for the operators, it being necessary to cover them with wet sacks to keep their clothes from igniting. A further and very serious objection resides in the fact that not infrequently the stopper

will only partially close the nozzle opening, due to imperfect construction, thereby allowing a stream of metal to escape when the nozzle is supposed to have been closed. Again the nozzle occasionally breaks, owing to the sudden expansion, when the hot metal strikes it, thereby causing a leak, so that while the ladle is being conveyed from mold to mold, the liquid metal from a leaky nozzle striking the top edges of the molds, splashes upon the operators and frequently burns them seriously.

It is to overcome these objections and obviate the necessity of employing ladlemen and their assistants, that I have devised my improved stopper operating mechanism. With my improvements, the operation of the ladle stopper is entirely under the control of the craneman, who is always a sufficient distance away from the ladle and molds to insure his safety.

Referring more particularly to the drawings, 1 represents the side walls of a portion of a steel mill; 2 the crane tracks; 3 the crane; 4 the crane trolley; 5 the ladle cable; 6 the ladle and 7 the crane cage, all of which are of the usual construction and form no part of my present invention.

In teeming, the ladle 6, which has previously been internally heated, is placed under the tapping spout 8 of the furnace (not shown) by the crane 3. The furnace is then tapped, allowing the molten metal to flow out of the spout and fill the ladle. The ladle is now carried by the crane trolley over one of a series of cast iron molds 9 and the ladle stopper, hereinafter described, is raised to permit the molten metal to flow from the ladle and fill said mold.

My improvements consist in electrically operated means for raising and lowering the ladle stopper to fill the molds 9 and to this end my invention comprises a bracket 10, secured to the exterior of the ladle by any suitable means and provided with hook-shaped members 11, in which are swiveled trunnions 12 of a guide plate 13. The guide plate is adjusted to a desirable position relative to said ladle by screws 14, one of which is placed at each end of said plate, and in a dovetailed guide 15 of said plate, a sliding plate 16 is mounted for vertical reciprocation. A socket 17 having a tapered aperture 18 is rigid with the upper end of the sliding plate 16 and the tapered lower end 19 of an angular rod 20 is passed through said aperture and secured to said socket by a wedge key 21. The horizontal portion of said angular rod 20 terminates in an enlargement 22 having an elongated vertical slot 23 extending in the direction of the horizontal portion of the rod 20, through which passes the upper end 24 of the ladle stopper 25, which will now be described.

The ladle stopper comprises a metal rod 26 which is provided at its lower end with a refractory plug 27 secured to the rod by a pin 28, which enters a recess in the lower end of said rod and is secured therein by a key 29 which passes through transverse slots in the rod and pin, and the lower end of said plug is provided with a counter sunk hole 30, for the reception of the head of the pin 28, the hole being closed by refractory paste 31. Mounted on the rod, for the purpose of protecting the same against the intense heat, are a series of sleeves 32, which are of refractory material and are clamped together by a nut 33, screwed on the upper end of the rod 26. Nuts 34 engaging the upper end 24 of the stopper adjustably secure the same on the horizontal portion of the angular rod 20, and the plug 27 of the stopper is adapted to engage a nozzle or spout 35 in the bottom of the ladle for the purpose of closing said nozzle.

Mounted on the exterior of the ladle 6 below the bracket 10 are a plurality of arms 36 carrying a fulcrum 37 on which is pivoted a short lever 38, which when the stopper is to be raised and lowered by manual power, is adapted to be engaged by a long lever 39, shown in dotted lines in Fig. 1. The inner end of the lever 38 is pivotally connected to the lower end of a link 40, the upper end of which is pivotally connected to the sliding plate 16, and when the stopper is manually operated, as it might be in case of damage to the stopper operating mechanism, hereinafter described, the link 40 moves the sliding plate 16 either up or down as the case may be.

The electrically operating means for raising and lowering the plate 16 will now be described. Secured to the exterior of the ladle and positioned at one side of the arms 36 is a support 41 having an aperture 42, and a pin 43 is adapted to pass through said aperture and also through an aperture 44 in a nut 45 for the purpose of removably securing said nut to said support. The nut 45 is provided at its lower end with an integral screw threaded projection 46 upon which is screwed a casing 47. Mounted in the forward portion of said projection are a plurality of hollow fiber plugs 48 and 49 to which are screwed a plurality of brass conducting tubes 50 and 51, the tubes being connected at their lower ends by a non-conducting member 52. The tube 50 has a longitudinal slot 53 through which extends a non-conducting projection 54, which is integral with a non-conducting nut 55. The nut 55 is mounted on a screw 56 which is rotatably mounted in the tube 50 and the upper end of which extends above the projection 46 and is provided with a nut 57 by which said screw may be turned for raising and lowering the nut 55 on the same. A motor 58 has a screw 59 movable with the armature

139 of the motor and said screw engages the nut 45 for the purpose of moving said motor toward and away from said nut 45, when the motor is operating. The screw 59 is provided at its lower end with a non-conducting collar or spool 60, which carries a brass conducting brush 61, having forwardly extending arms 62 and 63 which normally slide on the tubes 50 and 51 and electrically connect the same.

Rigidly secured to the plate 16 is an arm 64 which is provided at its outer end with a forwardly extending bracket 65 and a diagonally cut portion 66 having an aperture as best shown in Fig. 10. A lever 67 is pivotally secured to said bracket 65 and carries a pivotally connected pin 68 for a purpose hereinafter described. Mounted upon the upper end of the motor 58 is a rod 69 which enters a casing 70, the casing being provided at its upper end with a diagonally cut portion 71 and vertical arms 72 having apertures 73. In mounting the motor upon the ladle, the arms 72 embrace the diagonal portion 66 of the arm 64 and the pin 68 secures said parts together by passing through the aperture in the part 66 and the apertures 73 in the arms 72. By reason of the diagonally cut portions on the arm 64 and casing 70, should the motor become inoperative and the pin 68 be withdrawn by operating the lever 67, the weight of the stopper and its connected parts will cause the diagonal surface of the arm 64 to ride down on the surface 71 and force the motor out of operating position. This feature has been incorporated in my present device in order to allow the stopper to be raised or lowered by the lever 38, if the motor should become inoperative by reason of any defect.

As best shown in Fig. 4, the upper end of the rod 69 of the motor is screw threaded and provided with a nut 74 and a washer 75, and a spring 76 is located between said washer and the lower end of the casing 70. The nut 74 is for the purpose of adjusting the tension of said spring. Located in a recess in the top of the rod 69 is a non-conducting plug 77 which carries a conducting pin 78 and a similar plug 79 is mounted in the top of the casing and carries a suspended conducting pin 80 which is adapted normally to be out of contact with the pin 78. Wires 81 and 82 connect the pins 78 and 80 with the motor and wires 83 and 84 connect the motor with the tubes 50 and 51.

Suitably supported upon one of the walls 1 of the steel mill are a plurality of wires 85 and 86 which are connected to the brushes of a generator 87 and mounted on an insulated bracket 88 carried by the crane cage 7 are a plurality of conductor slides 89 and 90, which slide on said wires 85 and 86 when the crane cage is moved from place to place. As shown in Fig. 4, conductor slide 89 is connected to a switch 91 in the crane cage by a wire 92 and the conductor slide 90 is connected to a trolley bar 93 carried by the crane, by a wire 94. The crane also carries four other trolley bars designated respectively 95, 96, 97 and 98 on Figs. 1 and 4 of the drawings and wires 99, 100, 101 and 102 connect the trolley bars 95, 96, 97 and 98 with the switch 91.

The crane trolley 4 carries a downwardly extending bar 103 provided with a series of trolley shoes 104, 105, 106, 107 and 108 which slide along the bars 93, 95, 96, 97 and 98 of the crane when said trolley traverses said crane and said trolley shoes are always in electrical contact with said trolley bars. These trolley shoes are connected by wires 109, 110, 111, 112 and 113 with brushes 114, 115, 116, 117 and 118 carried by a bar 119 extending horizontally from said crane trolley 4. Mounted on a shaft 120 which is rotated through a train of gears from the crane cable raising and lowering means, as best shown in Fig. 8, is a hollow drum 121 carrying on its periphery a series of collector rings 122, 123, 124, 125 and 126 which are engaged by the brushes 114, 115, 116, 117 and 118. Wires 127, 128, 129, 130 and 131 extend from said collector rings through the interior of said drum 121 and out through an aperture 132 in the same, where they are twisted into a cable 133, which winds and unwinds on the drum 121 when the ladle is raised or lowered. The cable 133 extends from the drum 121 down through a flexible tube 134 secured to the ladle hook 135 for the purpose of protecting the cable from the heat and the wires 127, 128, 129, 130 and 131 at the lower end of the cable, are each secured to a plug of a plug switch 136, which is secured upon the exterior of the ladle 6 and the plugs of which are so placed that they cannot be reversed. Wires 137 and 138 connect the plug switch with the field windings of the motor 58; wires 81 and 83 connect the switch 136 with the pin 80 and the tube 51; wires 82 and 84 connect the pin 78 and tube 50 with the armature 139 of the motor, and wire 140 connects the armature with the switch 136.

The operation of the above described mechanism is as follows: Assuming that the ladle 6 is in position over a mold 9 the craneman raises the switch 91 closing the circuit and the electric current from the generator 87 is conducted along the wire 86, conductor slide 90, wire 94, trolley bar 93, trolley shoe 104, wire 109, brush 114, collector ring 122, wire 127, switch 136, wire 137, field coils of the motor, wire 138, plug switch 136, wire 129, collector ring 124, brush 116, wire 111, trolley shoe 106, trolley bar 96, wire 101, switch 91, wire 99, trolley bar 98, trolley shoe 108, wire 113, brush 118, collector ring 126, wire 131, switch 136, wire 140, armature 139, wire 84,

tube 50, brush 61, tube 51, wire 83, plug switch 136, wire 128, collector ring 123, brush 115, wire 110, trolley shoe 105, trolley bar 95, wire 102, switch 91, wire 92, conductor slide 89, trolley wire 85 and back to the generator 87. This closes the circuit through the motor and causes the armature 139 of the same to revolve the screw 59, and as said screw moves in the nut 45 it will raise the motor 58, arm 64, sliding plate 16, angular rod 20, and stopper 25, thereby permitting the molten metal in the ladle to escape through the nozzle 35 into the mold 9, which is in position under said ladle. The motor 58 continues to rotate and raise the stopper 25 until the circuit is broken by the arm 62 of the brush 61, passing off of the tube 50 and onto the projection 54 of the fiber nut 55. By adjusting the nut 55 the travel of the stopper upwardly can be increased or decreased as desired, and this will regulate the velocity of the flow of metal through the nozzle 35. When the proper rate of flow has been determined, the nut 55 is clamped fast so that the motor 58 will always stop at this predetermined point while the mold is being filled.

When the mold 9 is full, and it is desirable to stop the flow of metal from the ladle 6, the craneman lowers the switch 91, thereby closing the circuit through the generator 87, trolley wire 86, conductor slide 90, wire 94, trolley bar 93, trolley shoe 104, wire 109, brush 114, collector ring 122, wire 127, plug switch 136, wire 137, the field coils of the motor 58, wire 138, switch 136, wire 129, collector ring 124, brush 116, wire 111, trolley shoe 106, trolley bar 96, wire 101, switch 91, wire 100, trolley bar 97, trolley shoe 107, wire 112, brush 117, collector ring 125, wire 130, plug switch 136, wire 81, pins 80 and 78, wire 82, armature 139, wire 140, switch 136, wire 131, ring 126, brush 118, wire 113, trolley shoe 108, bar 98, wire 99, switch 91, wire 92, slide 89, wire 85 and the generator 87. This closes a different circuit and reverses the polarity of the armature connection and thereby reverses the armature 139, which causes the screw 59 to turn in the opposite direction and lower in the nut 45 and draw down the motor 58, the arm 64, sliding plate 16, angular rod 20 and the stopper, which closes the nozzle 35 thus stopping the flow of metal. When the stopper has been closed, the casing 70 is brought to a stationary position but the screw 59 and motor continue to descend and the rod 69 through its washer 75, compresses the spring 76 and causes the pins 78 and 80 to separate, thus breaking the circuit and stopping the motor. The spring 76 acts as a safeguard against breaking the operating mechanism. When the switch 91 is again raised, the pins 78 and 80 will be brought together and the operation may be repeated as desired. It is also desirable to fill the casings 47 and 70 with oil for the purposes of smothering arcs when the contacts in the same are broken.

As incidentally mentioned before, the circuit is occasionally broken from the generator, due to an overload releasing the circuit breaker or by accident to the machinery and should this happen while the stopper 25 is in raised position, there is no means of operating the motor 58 to close the same. To guard against such accidents I have provided the diagonal surfaces on the arm 64 and the casing 70 which when disconnected by operating the lever 67, throws the motor to one side against a stop 200 and the stopper can then be lowered by manipulating the mechanism manually through the lever 39, in the ordinary manner.

In order that the motor may be easily detached from the ladle and attached to another, to obviate the necessity of equipping each ladle with a separate motor, I have provided the pins 43 and 68, heretofore described, which may be quickly inserted or removed.

It is very important that all molds should be filled at a uniform predetermined rate of speed, for if the molds are filled too rapidly, the gases will be entrapped, causing "piping" or unsound ingots. In the methods heretofore employed, the ladleman guesses at the rate of speed with which each mold is filled, while with my improved mechanism each mold is filled at the same uniform speed, thereby making a more homogeneous ingot.

To prevent the motor casing from turning with the armature, I have provided a hollow sleeve 201 upon the same, which enters a yoke 202 upon the link 40 and this arm also acts as a conduit for the wires from the plug switch 136.

In some cases the ladle obstructs the craneman's view so that he cannot see the stream of metal and to obviate this defect, I have provided the crane cage with a periscope 203 having mirrors placed at such angles that the image will be reflected to the operator, thus giving him a full view of the flowing metal and the filling mold.

What I claim and desire to secure by Letters Patent is:—

1. The combination with a portable ladle having a nozzle and a stopper for closing said nozzle, of electrical power operated means carried by said ladle for actuating said stopper.

2. The combination with a portable ladle having a nozzle and a stopper for closing said nozzle, of electrical power operated means carried by said ladle for raising and lowering said stopper.

3. The combination with a ladle having a nozzle and a stopper for closing said nozzle, of a sliding plate arranged on said ladle, means connecting said plate and said stop-

per, and electrical power operated means for raising and lowering said plate.

4. The combination with a ladle having a nozzle and a stopper for closing the same, of electrical power operated means for raising and lowering said stopper, and means connecting said operating means and said stopper, said operating means comprising a motor, a nut secured to said ladle, and a screw passing through said nut and operable by said motor for raising and lowering said connecting means.

5. The combination with a ladle having a nozzle and a stopper for closing the same, of electrical power operated means for raising and lowering said stopper, and means connecting said operating means and said stopper, said operating means comprising a motor having a screw, a nut secured to said ladle and engaging said screw, a plurality of conductor tubes carried by said nut and one of which is provided with a non-conducting projection, and a brush carried by said screw and adapted to electrically connect said tubes when not engaged by said projection.

6. The combination with a ladle having a nozzle and a stopper for closing the same, of electrical power operated means for raising and lowering said stopper, and means connecting said operating means and said stopper, said operating means comprising a motor having a screw, a nut secured to said ladle and engaging said screw, a plurality of conductor tubes carried by said nut and one of which is provided with an adjustable non-conducting projection, and a brush carried by said screw and adapted to electrically connect said tubes when not engaged by said projection.

7. The combination with a ladle having a nozzle and a stopper for closing the same, of electrical power operated means for raising and lowering said stopper, said power operated means consisting of a motor having a screw, a nut secured to said ladle and engaging said screw, a plurality of conductor tubes carried by said nut and one of which is provided with a slot, a screw rotatably mounted in said slotted tube, a non-conducting nut mounted on said tube screw and provided with a projection which extends through said slot, and a brush carried by said screw and adapted to electrically connect said tubes when not engaged by said projection.

8. The combination with a ladle having a nozzle and a stopper for closing the same, of electrical power operated means for raising and lowering said stopper, and means connecting said operating means and said stopper, said operating means comprising a motor having a screw, a nut secured to said ladle and engaging said screw, a plurality of conductor tubes carried by said nut and one of which is provided with a non-conducting projection, a brush carried by said screw and adapted to electrically connect said tubes when not engaged by said projection, and a casing inclosing said tubes and the end of said screw.

9. The combination with a ladle having a nozzle and a stopper for closing the same, of electrical power operated means for raising and lowering said stopper, means connecting said power operated means and said stopper, an arm included in said connecting means and provided with a diagonal surface, a member projecting from said power operated means and provided with a diagonal surface which engages the diagonal surface of the arm, and a pin connecting said arm and said member, the diagonal face of the arm being adapted to force said member away from said arm when the pin is withdrawn.

10. The combination with a ladle having a nozzle and a stopper for closing the same, of an electrical motor for raising and lowering said stopper, means connecting said motor and said stopper, a casing secured to said connecting means and carrying a conductor pin and a conductor rod secured to said motor and entering said casing.

11. A ladle having a nozzle, a stopper for closing said nozzle, a nut secured to the exterior of said casing, a plurality of conductor tubes carried by said nut, one of said tubes being provided with a non-conducting part, a motor, a screw operated by said motor and engaging said nut, a brush carried by said screw and engaging said tubes, wires connecting said tubes with the motor wires, a rod extending from said motor, a casing inclosing said rod, a conductor pin carried by said rod, another conductor pin carried by said casing with which said first named pin is normally out of contact, wires connecting said pins with the motor wires, means for operating said motor, and means connecting said casing and said stopper.

12. The combination with a crane carrying a crane cage and a ladle provided with a nozzle, a stopper for closing said nozzle, of electric power operated means secured to the exterior of said ladle for raising and lowering said stopper, automatic controlling means for said power operated means carried by said ladle, manual controlling means for said power operated means provided in said crane cage, and means connecting said controlling means and said power operated means.

13. The combination with a crane carrying a crane cage and a ladle provided with a nozzle, a stopper for closing said nozzle, of electrical power operated means for raising and lowering said stopper, said power operated means comprising a generator, a plurality of trolley wires taking power from

said generator, a plurality of conductor slides carried by said crane cage and engaging said wires, a switch carried by said crane cage, a wire connecting said switch and one of said conductor slides, a series of conductor bars carried by said crane, a wire connecting the other of said conductor slides with one of said trolley bars, wires connecting said switch with the other trolley bars, a series of trolley shoes carried by the crane trolley and engaging said trolley bars, a switch having a series of plugs mounted upon said ladle, means connecting said trolley shoes and said switch, a nut secured to said ladle, a motor having a screw which engages said nut, wires connecting said motor and said plug switch and means connecting said motor and said stopper.

In testimony whereof I affix my signature.

GEORGE ALEXANDER WETTENGEL.