F. N. CLINE.

CASTING MACHINE.

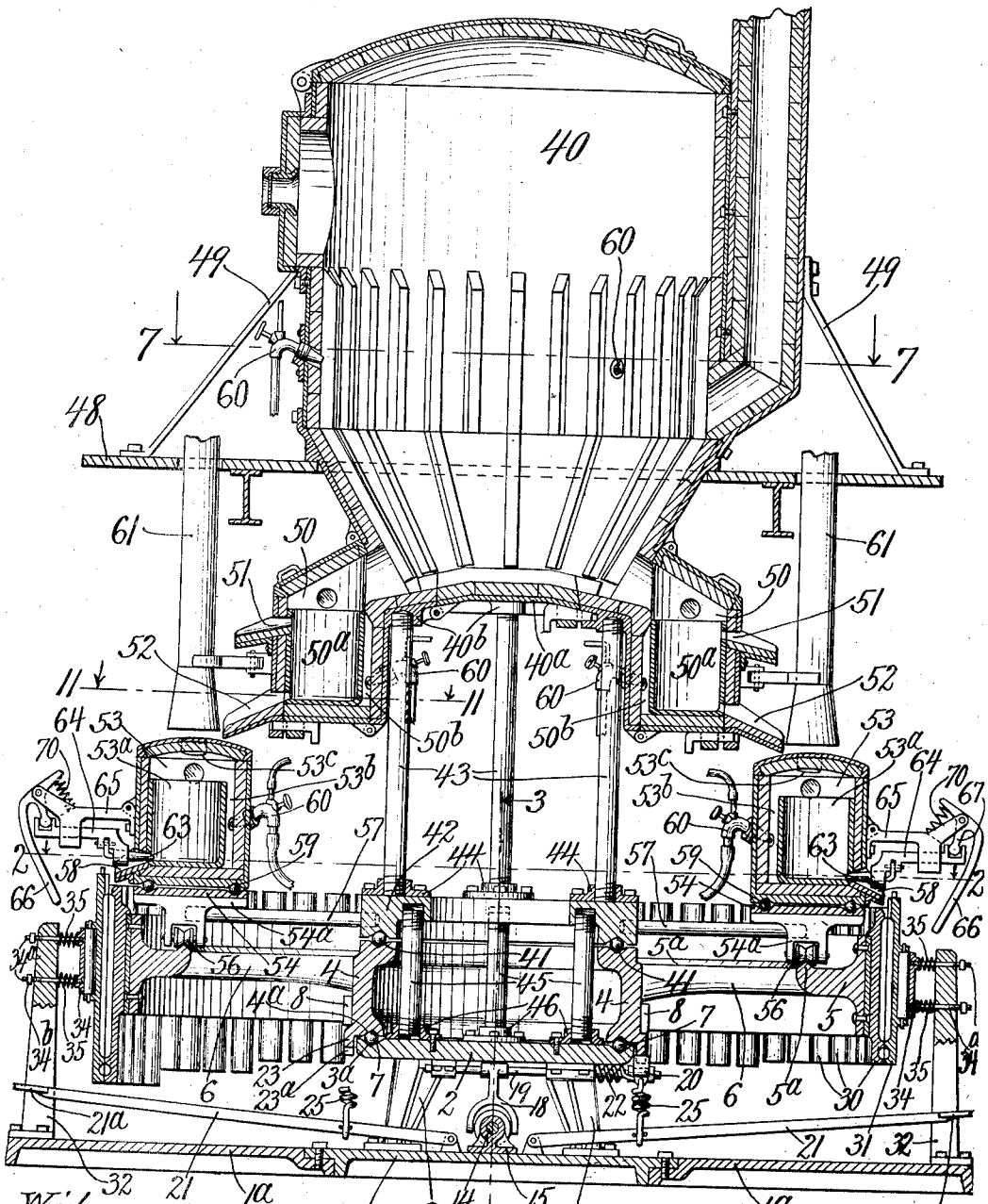
APPLICATION FILED SEPT. 2, 1908.

928,246.

Patented July 20, 1909.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
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by Burton & Burton
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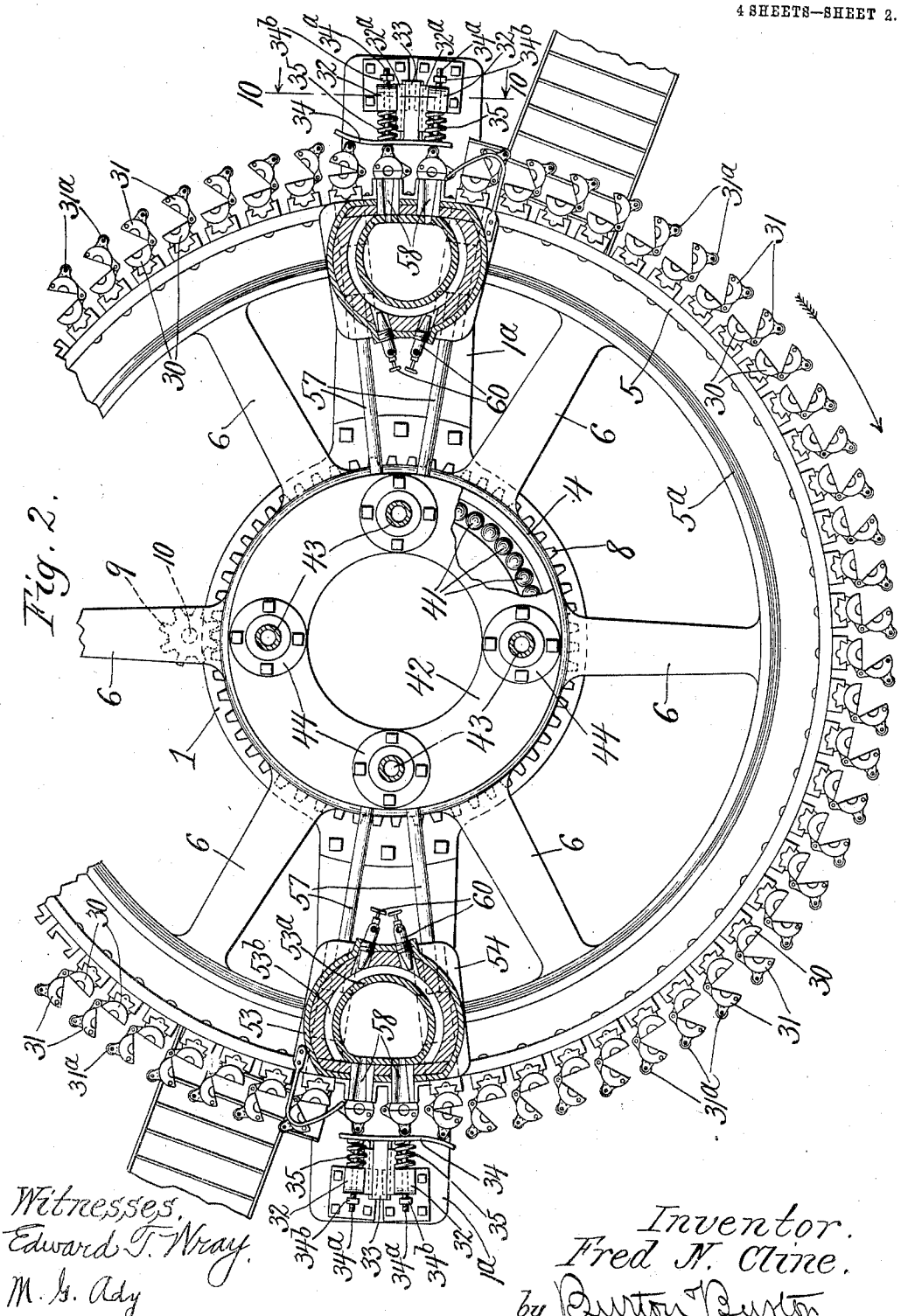


Fig. 2.

Witnesses.
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4 SHEETS—SHEET 3.

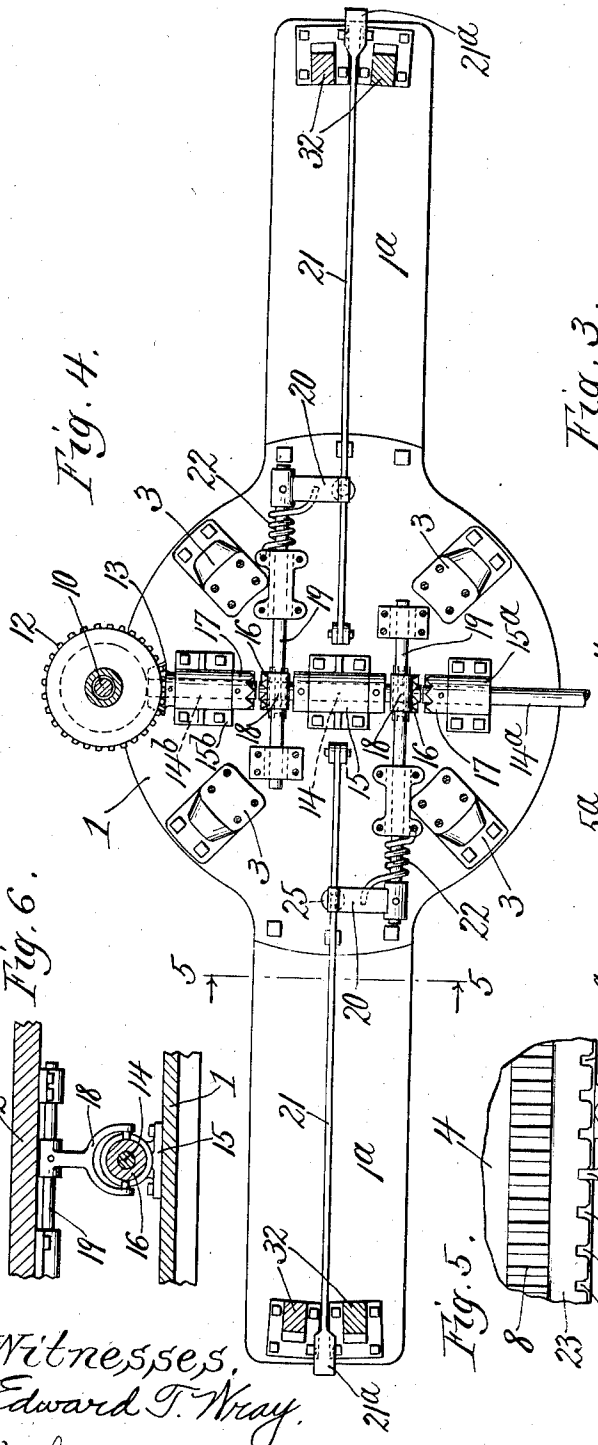


Fig. 4.

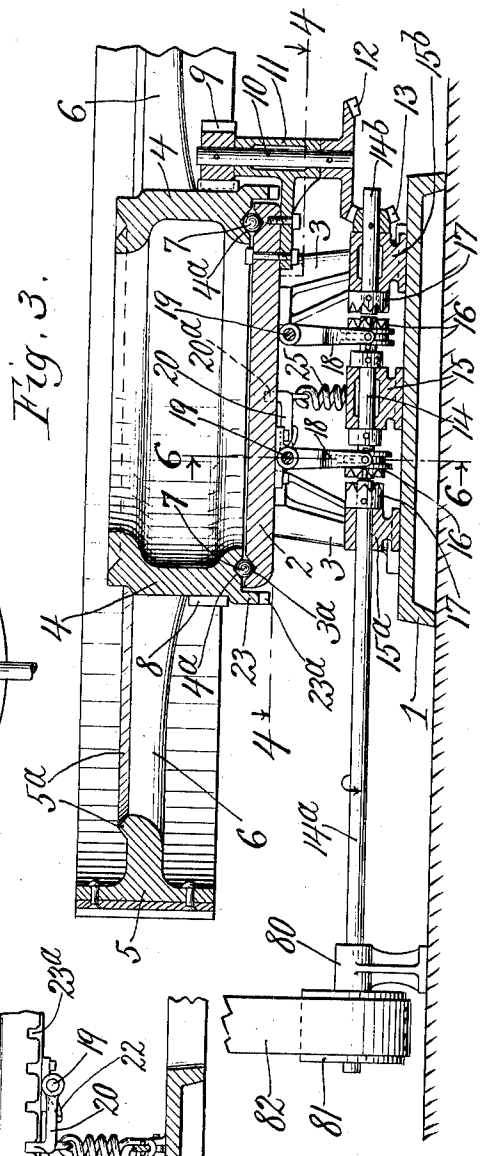


Fig. 3.

Fig. 6.

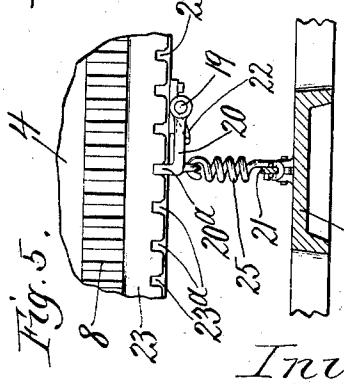


Fig. 5.

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4 SHEETS—SHEET 4.

Fig. 7.

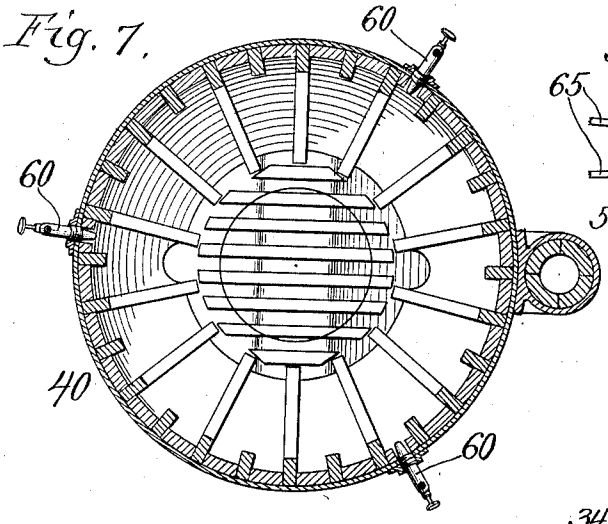


Fig. 11.

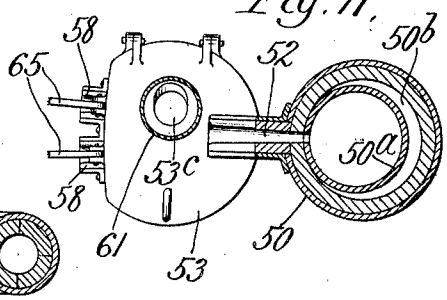


Fig. 10.

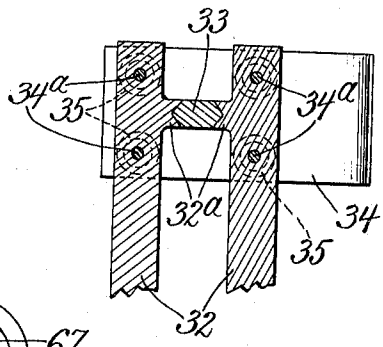


Fig. 8.

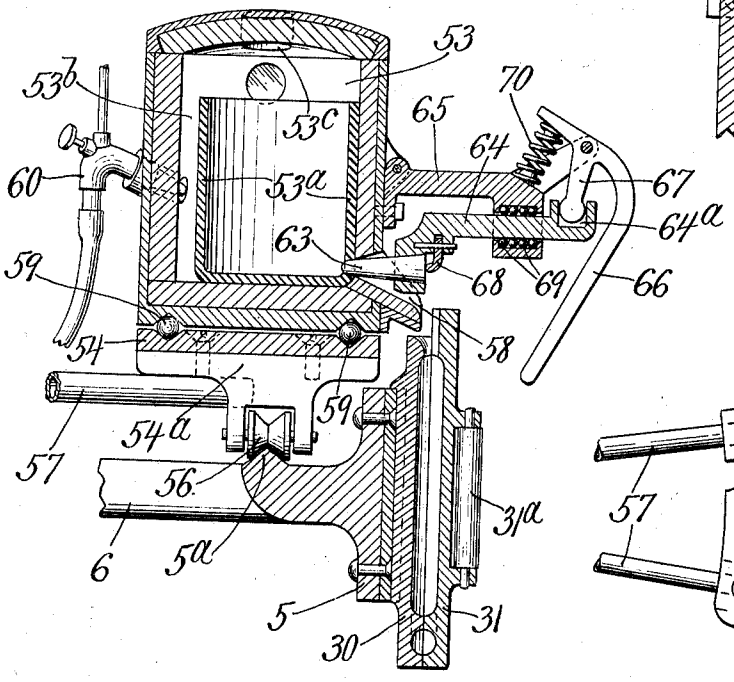
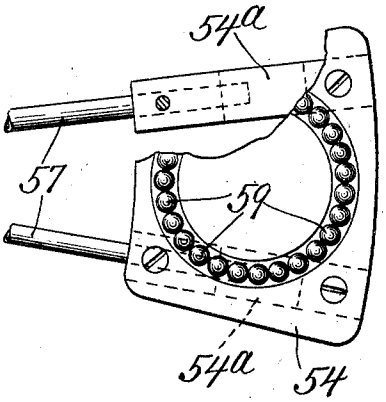


Fig. 9.



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UNITED STATES PATENT OFFICE.

FRED N. CLINE, OF CHICAGO, ILLINOIS.

CASTING-MACHINE.

No. 928,246. Specification of Letters Patent. Patented July 20, 1909.

Application filed September 2, 1908. Serial No. 451,431.

To all whom it may concern:

Be it known that I, FRED N. CLINE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Casting-Machines, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved construction for casting machines of the type or class in which a cupola for supplying the molten metal is permanently associated with the machine which carries the molds, and in which the molds are carried in circuit to the position or positions for filling, the casting being discharged and the mold being cooled in the intervals between such filling positions. It consists of the features and elements of construction and their combinations shown and described as indicated in the claims.

In the drawings:—Figure 1 is a vertical axial section of a structure embodying this invention at plane cutting through two opposite stations at which the molds are filled. Fig. 2 is a section at the line 2—2 on Fig. 1. Fig. 3 is a section at the line 3—3 on Fig. 1. Fig. 4 is a section at the line 4—4 on Fig. 3, being a plan view of the operating mechanism. Fig. 5 is a detail section at the line 5—5 showing in edge elevation a portion of the main gear and locking flange of the mold carrier and the locking device. Fig. 6 is a detail section at the line 6—6 on Fig. 3. Fig. 7 is a section through the cupola at the plane of the line 7—7 on Fig. 1. Fig. 8 is a section axial with respect to one of the pourers through the same and a mold shown in conjunction therewith for pouring. Fig. 9 is a detail plan view of the pourer-ball-bearing table. Fig. 10 is a section at the line 10—10 on Fig. 2. Fig. 11 is a section at the line 11—11 on Fig. 1.

For the purpose of this machine, there is preferably provided a base plate, 1, forming part of the base or fundamental support of the machine which comprises in addition a ball-bearing table, 2, and rigid legs, 3, by which the table is supported on the base plate. Upon the ball-bearing table of the base there is lodged a carrier, which is in the form of a large horizontal wheel comprising an annular hub, 4, and mold-carrying rim, 5, and spokes, 6, connecting the hub and rim. The ball-bearing table, 2, has upon its upper surface the lower track, 3^a, of the ball race whose upper track, 4^a, is formed in the lower end of the hub, 4, of the wheel, steel balls, 7, being interposed between the two members of the ball race for easing the rotation of the horizontal wheel upon the base. This mold carrier is rotated about its vertical axis, and for that purpose is provided with a gear rim, 8, below the spokes, 6.

For communicating rotary motion, there is provided a train which consists of a pinion, 9, on the upper end of a shaft, 10, which is journaled in a bearing, 11, bolted rigidly to the table, 2, (see Fig. 3) said shaft, 10, having at its lower end a beveled gear, 12. This beveled gear meshes with the pinion, 13, on one end of a shaft comprising three members, 14, 14^a and 14^b, which are alined so as to operate as a single shaft, journaled respectively in standards, 15, 15^a and 15^b, mounted on the base plate, 1. These three shaft members are connected by two clutches, each comprising a moving element, 16, mounted for sliding on the middle element, 14, of the shaft and adapted to engage a counterpart element, 17, mounted facing it on the adjacent shaft member. The shaft member, 14^a, has an additional journal bearing, 80, at any convenient point, preferably outside the path of the molds carried by the mold carrier so as to be adjacent to a pulley, 81, on said shaft through which power is communicated by a belt, 82, from any convenient point. The sole reason for extending the shaft member, 14^a, so as to require the bearing, 80, beyond the path of the molds is to permit the belt, 82, to come from overhead. It will be observed that the interposition of two clutches in the shaft, 14, 14^a, 14^b, affords opportunity for arresting the train which the shaft drives by disconnecting either of the clutches, and requires that both shall be connected in order to drive the train. The purpose of this is to enable two operators who may be stationed at different points along the mold path at which provision may be made for pouring the metal for filling the molds to operate independently, but so that they shall not interfere with each other in respect to starting the carrier after it has halted for filling, as will more fully appear from the following description.

The movable members, 16, 16, of the

clutches are operated by a fork arm, 18, of a rock shaft, 19, the two rock shafts being journaled upon the under side of the table, 2, extending parallel to each other, each having a second lever arm, 20, connected by a link, 25, with a pedal lever, 21, the two pedal levers extending in opposite directions from the shaft member, 14, and having their respective terminal pedals, 21ª, in positions to be reached by the feet of two operators standing at opposite sides of the machine. Each rock shaft is provided with a spring, 22, coiled about it and reacting on the lever arm, 20, for yieldingly resisting the rocking of the shaft in the direction caused by depressing the pedal, which is the direction for causing the fork lever arm, 18, to shift the movable clutch member into engagement with its counterpart member. Whenever either operator is ready to start the carrier (after having filled a mold or molds at any given halt of the carrier) he will depress the pedal lever under his control, thereby connecting one of the two clutches. This, however, will not cause the carrier to start, but when the other operator, being also ready, depresses his pedal and connects the other clutch, the movement will be communicated from the shaft member, 14ª, to the member, 14ᵇ, for driving the train and rotating the carrier. Both operators will release the pedal immediately after the carrier starts, and this would cause the clutches to be immediately disengaged but for the provisions which will now be described. The hub, 4, has a downwardly projecting rim or flange, 23, having notches, 23ª, one for each halt which the carrier is designed to make in its rotation. The lever arm, 20, has an upturned terminal lug or tooth, 20ª, adapted to engage these notches, and in the interval between them, to ride on the downwardly facing edge of the rim or flange, 23.

When the pedal is depressed for engaging the clutch as above described, the tooth, 20ª, is disengaged from a notch of the rim, 23, and as soon as the carrier starts, the notch moving away from the tooth prevents reëngagement, and when the operator releases the pedal, the spring, 22, tending to rock the shaft presses said tooth up against the edge of the rim which resists the rocking and causes the clutch to remain engaged until in the rotation of the carrier the next notch reaches the tooth, whereupon the spring causes the tooth to engage the notch, simultaneously arresting the carrier and disengaging the clutch. When the pedal is depressed for engaging the clutch, it may happen that the teeth of the two members may meet point to point, and to provide for this contingency and permit the operator to depress the pedal to its full limit without straining the parts, the link, 25, which connects the pedal lever to the lever arm, 22, is an extensible spring which yields when the pedal is depressed unless the clutch member, 16, can move freely into engagement with the clutch member, 17. The spring link, 25, is necessarily adapted to require more pressure to stretch it than is required to rock the rock shaft, 19, against the tension of the spring, 22.

The structure thus far described comprises, it will be seen, a carrier for molds and mechanism for rotating it with step-by-step movement and intervening halts at positions determined as to frequency in the rotation by the number of notches, 23ª. Upon this carrier there are mounted two-part molds, 30—31, which are designed to be filled in couples at each halting, and for filling which, there are provided, as hereinafter described, two pouring stations and pouring devices at opposite sides of the carrier. The number of molds is therefore twice the number of notches, 23ª. The member, 30, of each mold is fixed rigidly at the outer circumference of the rim, 5, of the carrier, and the member, 31, is hinged to the member, 30, at a vertical hinge line, said hinge lines of the several molds being all at the same side, which is the forward or advanced side in the direction of rotation of the carrier, so that the molds will be closed by any obstruction encountered by the hinged member as the carrier rotates. The molds are designed to be closed just prior to the position at which they are to be filled, and for that purpose the base plate, 1, has at opposite sides the extensions, 1ª, 1ª, reaching toward the mold path. At the end of each extension, 1ª, there are located a pair of standards, 32, having at their proximate sides facing each other near the upper end bosses, 32ª, provided with V-shaped horizontal grooves and affording thereby slide bearing for the stem, 33, of a mold-inclosing cam plate, 34. This cam plate has in addition to its main stem, 33, four lighter stems, 34ª, projecting from the four corners of the square and projecting from four apertures, two in each of the standards, springs, 35, being retained by these stems respectively between the cam plate and the standards and check nuts, 34ᵇ, being provided upon the outer protruding ends of the stems to limit the action of the springs which tend yieldingly to thrust the plate away from the standards and to resist its movement back toward the standards. The cam plate, 34, is bent or deflected outward,—that is, away from the center of the carrier at the end extending in the direction from which the molds advance in the rotation of the carrier. Upon the back of each hinged mold member, 31, there is mounted a vertical roller, 31ª, which is in position to encounter the inner face of the deflected end of the cam plate, 34, as the mold advances

toward the plate, and thereby ease the friction of the plate pressed upon the mold for closing it and holding it closed as the mold travels past the plate. The halting position of the carrier as determined by the location of the notches, 23[a], is preferably with two molds in radial line with the plunger stem and springs respectively, so that the full tension of the springs is exerted for pressure to hold the molds closed while they are being filled.

For supplying and filling the molds, there is provided a cupola, 40, the detail structure of which will be hereinafter briefly described, although any specific detail structure is not essential to the present invention, which, so far as the cupola is concerned, has to do only with the location of the cupola and its relation to the mold-carrier and molds. In order to perform the designed service, it is desirable that the cupola should be located above the area encompassed by the mold path,—that is, substantially or approximately over the center of the carrier,—and in order to support the cupola stably in this position, the structure is designed in the form which will now be described.

Upon the upper side of the hub, 4, there is lodged an annular cupola-supporting element, 42, ball bearings, 41, being interposed between said annulus, 42, and the hub, corresponding tracks making a ball-race being formed in the upper end of the hub and lower side of the annulus. Legs or standards, 43, are extended rigidly from the upper side of the annulus, 42, and connected rigidly to the bottom of the cupola. As illustrated, these legs consist of pipe, and their connection with the annulus, 42, at the lower end is made by means of pipe flanges, 44. The outer metallic shell or casing, 40[a], of the cupola is provided with threaded bosses, 40[b], into which the upper ends of the legs, 43, are screwed. By this means, the cupola is in a manner supported directly upon the carrier and indirectly upon the base which supports the carrier. But since the carrier is to be rotated while the cupola as well as the base remains stationary, means must be provided for preventing the rotation of the cupola with the carrier and preferably this is accomplished by staying the cupola upon the base. For this purpose it is necessary that the carrier should have an open center that the supports or staying means may be extended from the base to the cupola-supporting annulus, 42, and for this purpose there are provided pipe lugs, 45, 45, secured to the base by pipe flanges, 46, and at their upper ends screwed into the annulus, 42. It is desirable also in part to take the weight of the cupola off the ball bearings and off the carrier; and to effect this purpose at the same time with the purpose of staying the cupola against rotation, the pipe legs, 45, are preferably oppositely threaded at their opposite ends so that they may serve as a means of adjusting the cupola-supporting annulus, 42, with respect to the base to ease the pressure upon the ball bearings and transfer the load of the cupola to any desired extent directly to the base. The adjustment will be made in such manner as to leave the carrier hub exposed only to so much of the load as will be sufficient to effectively steady it. The cupola may be further steadied, and if desired, the weight may be carried in part by connection with the annular platform, 48, which it is necessary to provide extending around the cupola to facilitate charging the latter with metal and otherwise caring for its operation. It will be understood that this platform will be permanently supported from the ground or from the walls of the building in which the structure may be located, representation of such support being deemed unnecessary.

49, 49, represent braces extending from the platform to the upper part of the cupola for staying it and transmitting any desired portion of the load to the platform and thence to the ground or walls.

The cupola illustrated is provided with one or more slag-separating receptacles, 50, 50. Preferably, the number of these will correspond to the number of pouring stations or points in the circumference of the carrier at which operators may stand for filling the molds. The molten metal flowing from the cupola into the slag-separating receptacles is there afforded an opportunity for becoming cleared of the slag which arises to the top and may be raked out through slag holes, 51, 51. From these slag-separating receptacles molten metal is designed to be drawn through a spout, 52, at the bottom of such receptacle into a crucible from which it is poured into the molds. There are provided as many of these crucibles or pourers distributed at equal intervals about the circumference of the carrier as will allow sufficient interval between them for the molds to be discharged and cooled. As illustrated, two such pourers 53 are provided at diametrically opposite positions. For supporting them above the carrier, there are provided pourer stands or tablets, 54, 54, which have short stems or standards, 54[a], projecting from their lower side, provided with grooved pulleys, 56, and the carrier rim is provided with a track, 5[a], upon which these pulleys ride. The carrier thus affords support for the pourer stands or tables and thereby for the pourers. But the pourers obviously must be prevented from rotating with the carrier, and for that purpose, stay arms, 57, 57, are extended from the cupola-supporting annulus, 42, above the carrier spokes, 6, two such arms being provided for each pourer stand or tablet engaged rigidly

therewith. Since it is designed to fill two molds at once at each halt and at each pouring station, each of the pourers is provided with two discharge spouts, 58, 58, positioned for overhanging respectively two adjacent molds when the carrier is halted in position for filling, as seen in Fig. 2. In order to provide for adjusting the pourers so that the spouts may register as accurately as possible with the molds in case of any slight inaccuracy in the position at which the carrier halts which may occur from a variety of causes, each pourer is preferably mounted for rotation upon its stand or table and is not rigidly connected therewith but is centered thereon by ball-bearings, 59, in counterpart grooves in the table and bottom of the pourer forming a circular ball-race (see Figs. 1 and 9). The weight of the pourer is sufficient to dispense with any other means of securing it to the table when it is centered thereon by means of the ball bearings described.

The heat for melting the metal in the cupola is designed to be provided by means of oil burners represented conventionally at 60, 60, and by similar burners similarly indicated, the slag-separating receptacles are heated and maintained at temperature to prevent the metal from cooling therein. For the purpose of melting the metal in the cupola, the flame over the burners is discharged directly into the metal chamber and is designed to impinge against the metal fragments therein; but for maintaining the molten metal in molten condition, the slag receptacles are constructed in crucible form,—that is, having an interior crucible lining, 50^a, between which and the outer wall of the receptacle there is a flame cavity, 50^b, in which the flames of the burners are discharged for maintaining the crucible lining at proper temperature. The pourers are of similar construction, comprising an interior crucible, 53^a, with the flame space, 53^b, outside of it. The pourers are filled through an aperture, 53^c, in the top, which is in position to be overhung by the spout, 52, of the slag-separating receptacle when the pourer is rotated on its ball bearings some distance from the position for filling the molds. As illustrated, the filling aperture, 53^c, (see Fig. 11) is about ninety degrees around from the spout, 52, when the spout, 58, of the pourer is in position for filling the molds. The purpose of this arrangement arises from the fact that the gases from the heating flame of the burners must escape through this filling aperture and should not be allowed to escape continuously against the spout, 52, partly because they will be thereby deflected in all directions to the inconvenience of the operators, and partly because the spout will thereby become unduly heated and the outer metal wall thereof would be melted; to conduct the gases away harmlessly,—that is, so as to cause the operator no inconvenience,—there is suspended above each pourer a draft pipe, 61, having its lower funnel-shaped end in position to overhang the filling aperture, 53^c, when the pourer is in mold-filling position,—that is, swung around ninety degrees from the spout, 52, of the receptacle, 50.

Certain details of construction for operating these molds are of practical importance, particularly the device for closing the discharge spouts of the pourer in the intervals of the pouring. It is well understood that metal plugs cannot be used for such purpose, and plugs of graphite and other material not liable to combustion and to which the metal will not stick are commonly employed for similar purposes but are liable to rapid deterioration causing leakage of metal around them and also to rapidly wearing away and enlarging the discharge aperture of the crucible. I have found that a wooden plug thrust into the discharge aperture will burn but slightly, no air being accessible to it at the area at which it is in contact with the molten metal, and wood being a poor conductor, it does not rapidly become heated at the outer portion exposed to the air sufficiently for combustion. Moreover, wooden plugs are easily replaced, and even soft wood answers the purpose. I provide, therefore, for closing the discharge apertures of the pourers wooden plugs, 63, 63, carried in holders, 64, from which they may be readily disengaged for replacing with new ones when they become burned or worn to a point of unserviceability. The holder, 64, is a slide bar mounted for sliding in a bracket, 65, which is rigid with the pourer's outer casing. A hand lever, 66, fulcrumed on the bracket, 65, has a finger or arm, 67, engaging in a notch, 64^a, of the slide bar, 64, for operating it to thrust the plug in and withdraw it as the handle of the lever, 66, is swung in or out. The wooden plugs, 63, are turned conical, as seen clearly in Fig. 8, and the slide bar, 64, has its downwardly offset terminal provided with a conical bore whose axis is parallel with the slide bearing of the bar and through which the plug may be driven in from the outer or back side until it is tight, a latch, 68, being provided to swing in behind it and secure it. The latch being knocked aside, the plug may be driven out by a blow from the forward end when it is to be replaced by a new one. To render the sliding movement of the slide bar, 64, easy, and especially to prevent it becoming tight by heating of the parts, ball-bearings, 69, are provided for it in the brackets, 65, as seen in Fig. 8. A spring, 70, reacting between the bracket and the tool's handle tends to thrust the plug in whenever the operator

releases the handle, but the operator may apply additional pressure to force the plug in more tightly when necessary.

I claim:—

1. In combination with a mold carrier mounted for horizontal rotation and molds thereon in a circular series above the axis of rotation; a cupola positioned above the area encompassed by the mold path; a plurality of pourers, each having a supply connection with the cupola and terminals positioned respectively for discharge above the mold path at different stations along said path; means for rotating the carrier; disengageable connections in such rotating means corresponding in number to such stations; automatic means for disengaging such connections, and separate means for engaging the same respectively at will positioned for operation at the pouring stations respectively.

2. In combination with a mold carrier comprising a wheel having a centrally apertured hub; a mold carrying rim and rigid connections between said hub and rim; a base upon which said hub is mounted for rotation of the carrier; an element superposed upon the carrier hub; and connections therefrom extending through the hub tying said superposed element to the base; a cupola positioned above the area encompassed by the mold path and supported upon said superposed element, and means for conducting the metal from the cupola for discharge above the mold path.

3. In combination with a mold carrier mounted for horizontal rotation and molds thereon in a circular series about the axis of rotation; a cupola positioned above the area encompassed by the mold path; a base upon which such carrier is mounted for rotation; supports for the cupola extending to such base within the bearing of the carrier on the base; a pourer supported on the carrier and means connecting it with the base for staying it against rotation with the carrier.

4. In combination with a mold carrier comprising a wheel having a centrally apertured hub, a mold carrying rim and rigid connections between said hub and rim; a base upon which such hub is mounted for rotation of the carrier; an element mounted upon the carrier hub and connections therefrom extending through the hub tying said element to the base.

5. In combination with a mold carrier mounted for horizontal rotation, a base upon which such carrier is thus mounted; a support for the cupola extending to such base within the bearing of the carrier on the base; a pourer supported on the carrier having a supply connection with the cupola and a discharge terminal positioned for discharge above the mold path, and an arm for holding the pourer extending from the cupola support above the carrier.

6. In combination with a mold carrier comprising a wheel having a centrally apertured hub, a mold carrying rim and rigid connections between said hub and rim; a base upon which said hub is mounted for rotation of the carrier; an annular element mounted upon the carrier hub and connections from said annular element extending through the central aperture of the hub tying said annular element to the base, said connections being disengageable and accessible for such disengagement through the central opening in said annular element.

7. In combination with a cupola, a central support for the same; a mold carrier on such central support for horizontal rotation thereabout; molds on the carrier in a circular series about the axis of rotation; means for conducting the cupola contents for discharge above the mold path, the carrier having ball bearings below and overhanging it on the cupola support.

8. In combination with a base and a cupola supported above it, a mold carrier interposed between the base and the cupola support, the carrier resting on the base and the cupola support resting on the carrier; means for rotating the carrier on the base; means for staying the cupola against rotation; a pourer positioned for discharge above the path of the carrier having supply connection with the cupola, the carrier having a circular track inside the mold path, the pourer having a support on such track, and means connecting it with the cupola support for staying it against rotation with said track.

9. In a casting machine, in combination with a rotating mold carrier; a train by which such carrier is rotated; a disengageable clutch in such train, the carrier having a notched rim; a rock shaft having a lever arm bearing on such rim adapted to engage the notches for arresting the carrier, such shaft having another lever arm operatively connected with the movable member of the clutch; a spring operating on the rock shaft for rocking it in the direction to disengage the clutch and arrest the carrier, and means for operating the rock shaft at will in opposition to the spring for releasing the carrier and engaging the clutch.

10. In a casting machine, in combination with a rotating mold carrier; a cupola having a slag-separating receptacle into which the metal flows when melted, provided with a bottom discharge spout; a pourer positioned for receiving metal at the top from the spout of the slag-separating receptacle, said pourer having a spout for discharging above the mold path, and means for heating the slag receptacle and the pourer.

11. In a casting machine, in combination with a horizontally rotating mold carrier, a cupola positioned above the area encom-

passed by the mold path having a slag-separating receptacle into which the metal flows when melted, provided with a bottom discharge spout; a pourer positioned for receiving metal at the top having a spout for discharge above the mold path; a support for the cupola extending within the path of rotation of the molds, the pourer being lodged for support upon the carrier, and an arm extending from the cupola support to the pourer to stay the latter against rotation with the carrier.

12. In a casting machine, in combination with a base, a cupola supported thereon; a pourer apertured for filling and positioned for receiving the cupola contents through such aperture and provided with a discharge spout; means for heating the pourer; a mold carrier and means for actuating it with step-by-step movement to bring the molds successively into position to receive the discharge from the pourer spout, and a draft pipe provided at its lower end with a receiving funnel overhanging the pourer filling aperture, at the mold filling position of the pourer to conduct the fumes of the metal and heating flame away from the vicinity of the halting position of the molds.

13. In a casting machine, in combination with a cupola provided with a spout for discharging the molten metal, a pourer having a receiving mouth at the top and a discharge mouth at the lower part and mounted for oscillation about a vertical axis from a position at which the receiving mouth is overhung by the cupola discharge spout to a position at which said mouth is not so overhung; a draft pipe having a receiving funnel at its lower end mounted in position to overhang the receiving mouth of the pourer at the last-mentioned position of the latter; a mold carrier and means for actuating it to carry the molds with step-by-step movement successively into position for receiving the discharge from the pourer spouts at said last mentioned position of the pourer.

14. In combination with a mold carrier comprising a wheel having a centrally apertured hub, a mold carrying rim and rigid connections between said hub and rim; a base on which such hub is mounted for rotation of the carrier; an annular element mounted upon the carrier hub and connections from such annular element extending through the central aperture of the hub tying said annular element to the base, said connections being disengageable and accessible for such disengagement through the central opening in said annular element; a cupola positioned above the area encompassed by the mold path and supported upon said annular element, and means for conducting the metal from the cupola for discharge above the mold path.

15. In combination with a mold carrier mounted for horizontal rotation and molds thereon in a circular series about the axis of rotation, a cupola positioned above the area encompassed by the mold path; a plurality of pourers each having a supply connection with the cupola, and terminals positioned respectively for discharge above the mold path at different stations along said path; a power-transmitting train; clutches in such train equal in number to such stations, and operating means for said clutches respectively positioned for operation at the pouring stations respectively.

16. In combination with a mold carrier comprising a wheel having a centrally apertured hub, a mold-carrying rim and rigid connections between said hub and rim; a base upon which such hub is mounted; a gear rim on said hub; a sectional shaft, one of the extreme sections having power-receiving means, the other extreme section having a power-transmitting wheel; clutches successively connecting said sections, and power-transmitting connections from said wheel to said gear rim.

17. An annular mold carrier mounted for horizontal rotation; a base upon which such carrier is thus mounted; a cupola support extending up from the base within the annular carrier; a cupola on such support; a pourer lodged on the annular mold carrier, and an arm extending off from the portion of the cupola support within the annular carrier positioned above the latter and engaging the pourer for staying it against rotation with the carrier.

18. In combination with a cupola, a central support for the same; a mold carrier mounted on such central support for rotation thereabout, the support having a circular track at which such carrier is thus mounted for rotation, and ball bearings interposed on such track between the same and the carrier.

19. In combination with a cupola, a central support for the same, a mold carrier mounted on such central support for rotation thereabout, the support having two horizontal circular tracks facing each other, the carrier being engaged between such tracks and stopped vertically thereby.

20. In combination with a cupola, a central support for the same, a mold carrier mounted on such central support for rotation thereabout, the support comprising a base having a circular track on which the carrier is thus mounted, and a rigid member connected with the base by means extending up within the circular track and annular carrier, overhanging the latter and vertically stopping the same.

21. In combination with a cupola, a central support for the same, an annular mold carrier mounted on such support for rotation below the level of the cupola; molds

in a circular series carried by the carrier; a pourer lodged upon the carrier and positioned for discharging into the molds on the latter, and an arm extending off from the central support above the annular carrier and engaging the pourer against rotation with the carrier.

In testimony whereof, I have hereunto set my hand at Chicago, Illinois, this 19th day of August, 1908.

FRED N. CLINE.

Witnesses:
CHAS. S. BURTON,
M. GERTRUDE ADY.