

Dec. 26, 1950

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2,535,335

APPARATUS FOR CHILL-CASTING

Filed March 19, 1948

5 Sheets-Sheet 1

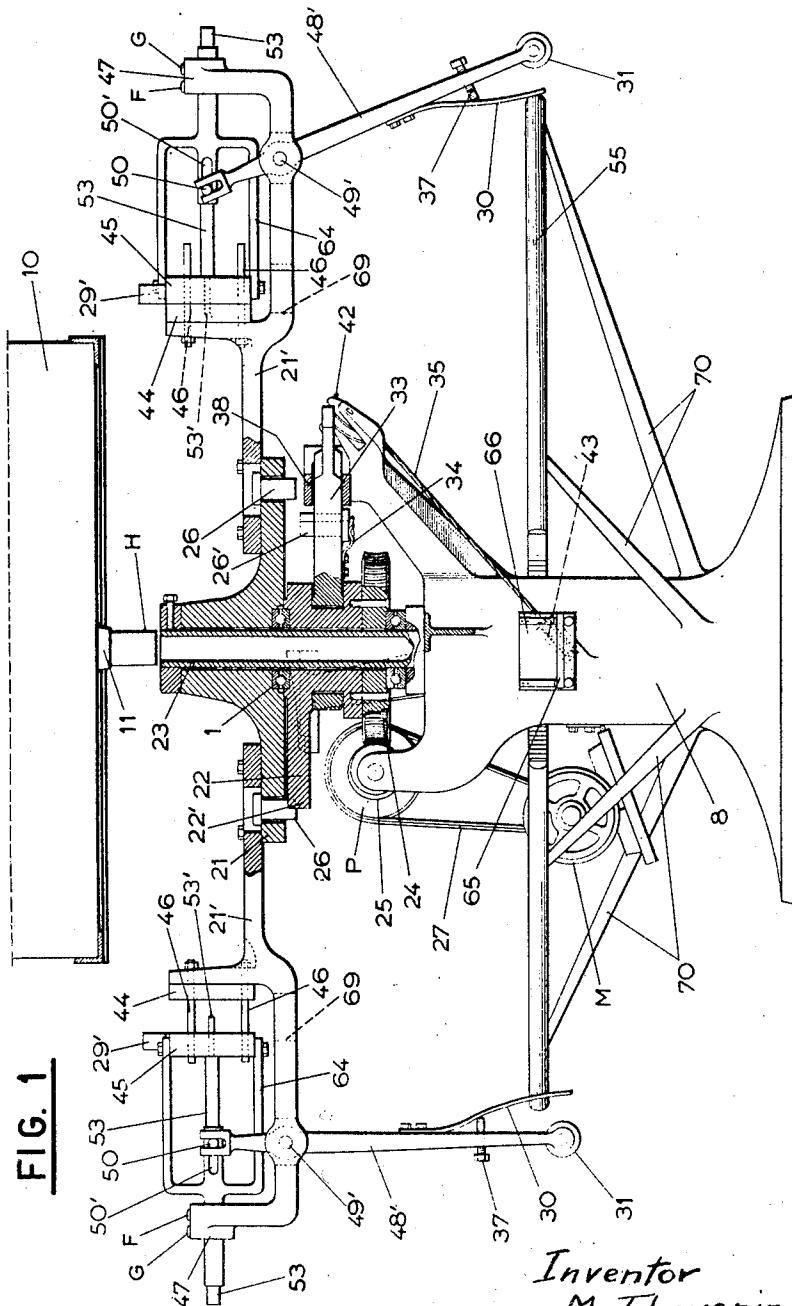


FIG. 1

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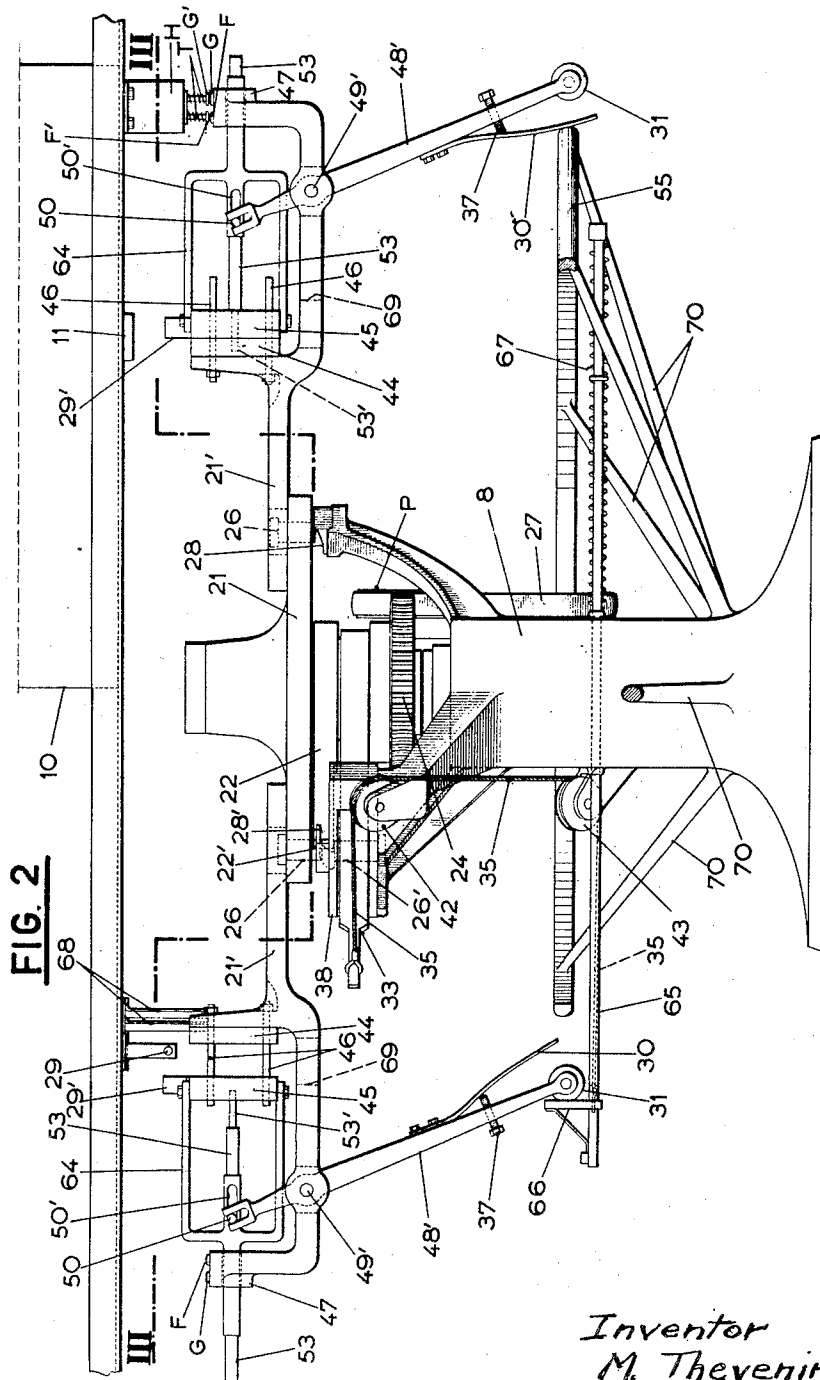
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Filed March 19, 1948

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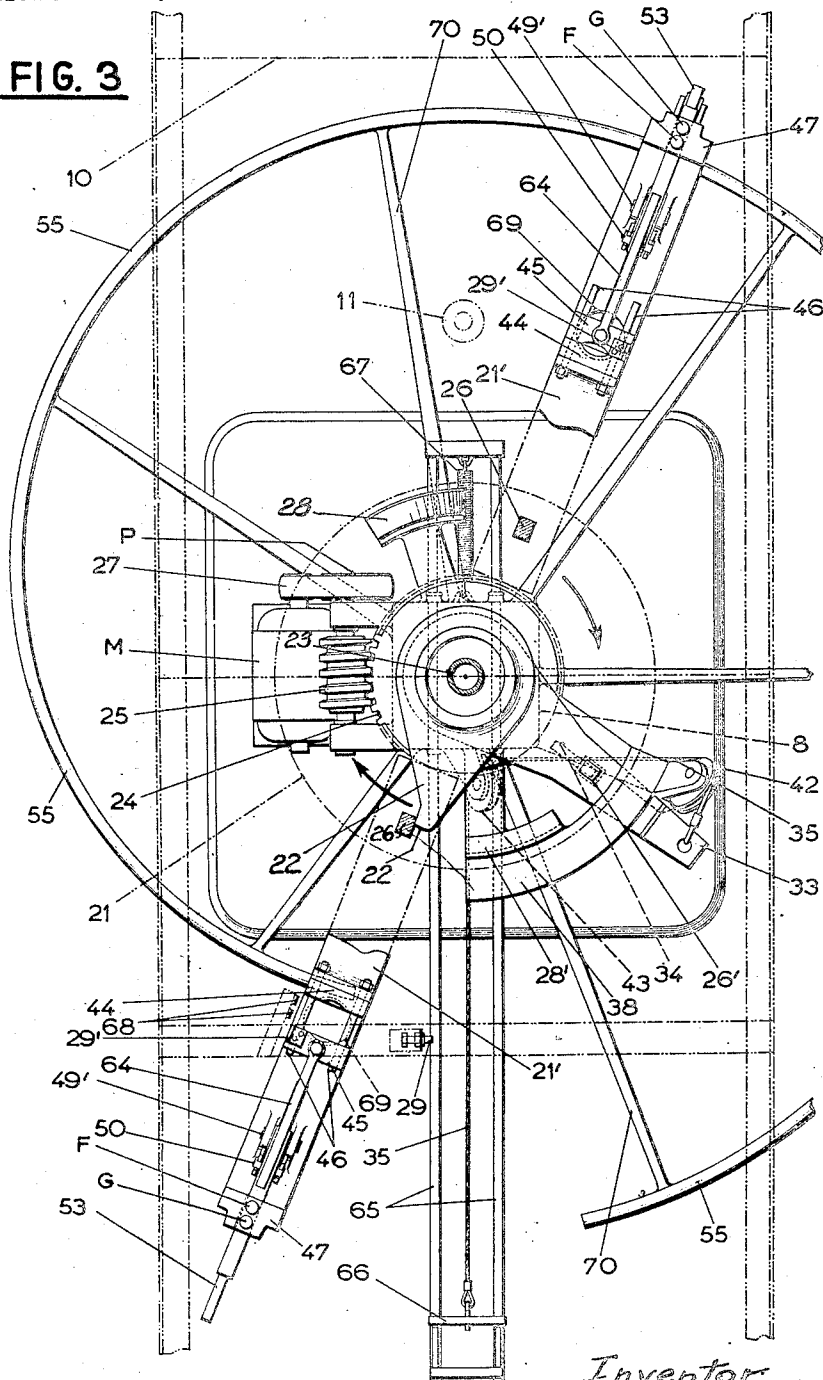
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Filed March 19, 1948

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FIG. 3



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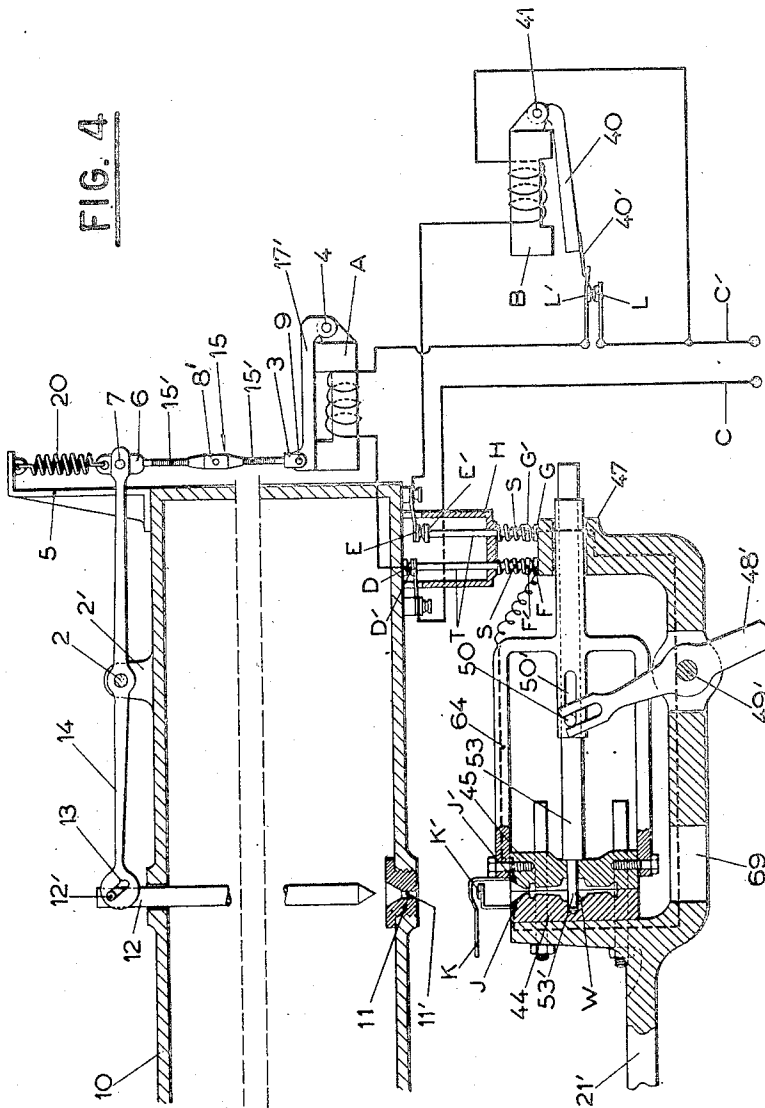
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APPARATUS FOR CHILL-CASTING

Filed March 19, 1948

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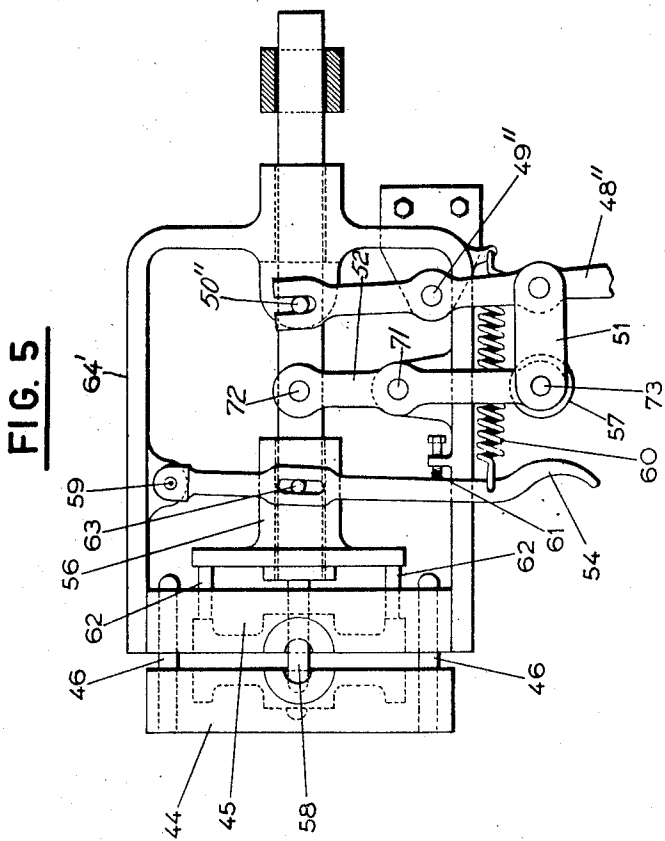
Dec. 26, 1950

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2,535,335

Filed March 19, 1948

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UNITED STATES PATENT OFFICE

2,535,335

APPARATUS FOR CHILL CASTING

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Application March 19, 1948, Serial No. 15,902
In France March 21, 1947

6 Claims. (Cl. 22-77)

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The present invention relates to an improved apparatus for casting wherein the molten metal is cast in a series of molds intermittently moved so as to position each mold successively below a tap-hole which is opened and closed for the time necessary for a casting operation. The opening of the mold for discharge of the finished casting is determined in synchronous timed relationship to the intermittent movements of the molds and the closure of a mold prior to casting is similarly determined.

An object of the invention is to provide an apparatus so that a continuous operation of the furnace may be secured so that losses in heat are reduced to a minimum thereby economizing on fuel or electricity.

A further object of the invention is to make the operations entirely automatically thereby securing a substantial saving in labor.

A further object of the invention is to provide a casting apparatus which is highly advantageous for the lighter alloys but is also advantageous in connection with other metals and other alloys.

With the above and other objects in view which will appear from the following detailed description a preferred embodiment of the invention is shown in the drawings in which:

Fig. 1 is a front view with parts in cross-section of an apparatus according to the invention comprising two molds;

Fig. 2 is a front view of the apparatus according to Fig. 1 with one of the molds located in casting position under the tap-hole of the furnace;

Fig. 3 is a cross-sectional view taken on section line III-III of Fig. 2;

Fig. 4 is a partial diagrammatic view with certain elements in cross-section showing the electromagnetic means for opening and closing the tap-hole; and

Fig. 5 is a detailed view illustrating a modified construction for opening and closing a separable mold.

In the various figures similar reference characters indicate like parts.

A melting furnace is shown at 10 for the alloy or metal to be cast which is provided with a casting jet or nozzle 11. Under the furnace 10 there is located a circular plate 21 rotatable about a vertical tubular shaft 23 secured to the frame 8.

On the plate 21 are secured projecting arms 21' which support separable molds formed of two sections 44 and 45. The section 44 is fixed in position on the arm 21' while the cooperating section 45 is movable. In the construction shown there are only two molds shown as supported by

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the plate 21 but it is obvious that any number of molds may be provided as desired.

The plate 21 is supported on a ball bearing thrust bearing 1 which is in turn supported on a plate 22 having a laterally extending projection 22'.

The plate 22 has fixed thereto a helical gear 24 which is concentric with the tube 23 and meshes with a worm gear 25. The worm gear 25 is fixed to a pulley P which is driven by a motor M through the transmission belt 27.

The plate 21 is intermittently driven by means of the lugs 26 which are slidable within a slot formed in the plate 21 and in which such lugs are supported. The lugs 26 cooperate with the projection 22' upon the plate 22 in order to drive the plate 21 with the plate 22 until the driving lug is removed from contact with the nose 22' by a cam 28 supported on arms fixed to the frame 8. When a driving lug 26 is removed from contact with the plate 22 then the drive of the plate 21 is only resumed after the plate 22 has made a half revolution when the projection 22' contacts the other lug 26.

The means for opening and closing the separable molds will now be described. This comprises a lever 33 freely rotatable upon the plate 22. The lever 33 is also adapted to be driven by the projection 22' through a drive lug 25' which is mounted vertically slidable in the lever 33. The lug 26' is urged upwardly by a spring 34 and is moved away from the path of the projection 22' when acted upon by a cam 28' mounted upon a slideway 38 having two arms between which the lever 33 may freely move.

The lever 33 is retained in or restored to its initial position when not driven by means of a cable 35 having one end attached thereto. The cable 35 passes over rollers 42 and 43 which are rotatably mounted on the frame 8. The other end of the cable 35 is attached to a member 66 supported on a carriage 65 which is horizontally slidable in a slideway formed in the frame 8. The carriage 65 is returned to initial position by a return spring 67 having one end secured to the frame 8 and the other end to the carriage 65.

The closing of a mold is effected by a mechanism including a cam 55 of spiral form, see Fig. 3, which is supported by brackets 70 secured to the frame 8.

The movable section 45 of the mold is slidable upon horizontally extending rods 46 and is supported on a fork 64 slidable in a support 47 provided at the free end of the arm 21'. A rod 53 is in turn slidable axially of the fork 64. The rod 53 has mounted thereon a stub shaft or pin 50 cooperating with the fork of a lever 48' pivoted on a shaft 49'. The opposite end of the lever

48' has mounted thereon a freely rotatable roller 31. There is also mounted on the lever 48' a leaf spring 30 which can be adjusted by means of a set screw 37.

The means for opening and closing the tap-hole 11 is preferably accomplished by electromagnetic means will now be described.

Above the furnace 10, see Fig. 4, there is arranged a substantially horizontal balance lever 14 pivoted on a shaft 2 mounted upon a fixed support 2'. At one end the lever 14 is provided with a helical groove 13 into which a pin 12' upon the rod 12 projects. At its opposite end the lever 14 coacts with a pin 7 mounted on a part 6 which forms the end of a vertical arm 15 comprising a pair of threaded rods 15' which are interconnected by means of a turn buckle 8'. The arm 15 at its lower end carries a member 3 pivoted upon a pivot pin 9 mounted upon the armature 17' of an electromagnet A. The armature 17' is pivoted at one end at 4.

Normally when the tap-hole 11 is closed by the rod 12 when no current flows through the winding of the electromagnet A a spring 20 secured at one end to the part 6 and at the other end to a bracket 5 secured to the furnace maintains the armature 17' away from the electromagnet A by pivoting the armature 17' about pivot 4. Fig. 4 shows the position of the parts when casting is taking place and the spring 20 is in extended condition.

In order to close the tap-hole 11 a second electromagnet B having a movable armature 40 pivoted at one end on a pivot 41 is used. The current for both electromagnets A and B is supplied through the lines C and C'.

During rotation of the plate 21 carrying the molds the current is normally broken.

Mounted upon the furnace 10 as shown particularly in Fig. 4 is a casing H constructed of insulating material having therein fixed contacts D and E. Cooperating therewith are the movable contacts D' and E' mounted on the rods T slidably mounted in the casing H. The opposite ends of the rods T are provided with the contacts F' and G'. The springs S normally maintain the contacts D, D' and E, E' disengaged as long as the conductive plates F and G upon the arm 21' are not in contact with the contacts F' and G'. Such contact however is made as soon as the plate 21 is stopped with a mold located under tap-hole 11.

The contact plates F and G are connected to a suitably insulated circuit shown in dotted lines to the terminals J and J' located at a predetermined level upon each mold so that when the molten metal reaches such level a circuit is established between J and J'.

The terminals J and J' are furthermore electrically connected to a pair of contacts K and K' which are located rearwardly of the plane shown in Fig. 4. The contacts K and K' will engage one another in case the mold for any reason is imperfectly closed.

The line C' is provided with a pair of contacts L and L' which are in contact with one another only when the armature 40 having an extension 40' exerts pressure upon contact L' in order to maintain it in contact with the contact L. Therefore the contacts L and L' in the line C' are only in contact when no current is flowing through the winding of the electromagnet B.

The operation is as follows:

When the plate 21 has come to rest with a

mold accurately positioned under the tap-hole 11 the contact plates F and G will move the contacts F' and G' upwardly and close contacts D, D' and E, E'.

The winding of the electromagnet A will then be energized and the armature 17' attracted which will pivot the balance lever 14 thereby raising the rod 12 which is also subjected to a slight rocking movement because of the helical form of the groove 13. When the mold is filled and the molten metal has reached the level of the terminals J, J' then the current is established through the terminals J, J' and the contacts E, E' energizing the winding of the electromagnet B which attracts its armature 40 thereby breaking the current through the line C' which deenergizes the winding of electromagnet A and allows the spring 20 to come into action to rock the lever 14 counterclockwise as shown in Fig. 4 thereby closing the tap-hole 11 upon downward movement of the rod 12. In such downward movement the rod 12 is also subjected to a slight angular rotation which facilitates a tight sealing engagement with the tap-hole.

If the mold should be imperfectly brought together in casting position then the contacts K and K' would be brought into engagement and since these contacts are electrically connected with the terminals J and J' the effect is the same as set forth above. The electromagnet B will be energized and the current broken at L, L' to deenergize the electromagnet A.

Relative movement between the sections 44 and 45 of each mold may be made in various ways. Fig. 4 shows a preferable embodiment applicable for instance in casting a wheel W. The pin 50 on the rod 53 slides within a slot 50' provided in the fork 64. The end 53' of the pin 53 serves as a core for the hub of the wheel when the mold is closed for a casting operation. When the lever 48' is rotated clockwise about its pivot 49' the extension 53' is moved before the fork 64 and the movable section 45 is withdrawn.

In Fig. 5 a modified construction for opening a mold is shown. The shaft or pin 59'' is fixed to the fork 64' and rotation of the lever 48'' about the fixed pivot 49'' directly moves the section 45 along the rods 46. The lever 48'' is arranged horizontally and the mold shown in Fig. 5 is a plan view thereof. A second lever 52 is coupled through a pivoted link 51 to the lever 42''. The lever 52 is pivoted on a pin 71 mounted upon the fork 64 and cooperates with a pin 72 provided on the rod 53.

A clockwise movement of the lever 48'' directly moves the fork 64 with the mold section 45. The ensuing pivoted movement of the lever 52 moves the pin 72 towards the right and thereby disengages the central extension 53. Upon continuation of the movement of the lever 48'' the roller 57 mounted freely rotatable on the pivotal shaft 73 engages a lever 54 pivoted at 59 and the lever 54 moves a pin 63 fixed to a bushing 56 slidably mounted on the rod 53. The bushing 56 has mounted thereon spaced pins 62 which are operative to positively eject the casting. A return spring 60 restores the lever 54 to its initial position upon closing of the mold and a set screw 61 permits adjustment of the position of the lever 54.

Also a stop 29, see Fig. 2, may be provided upon the furnace 10 to cooperate with a counterstop 29' provided upon each movable section 45 of the mold. The counterstop 29' will engage the stop 29 when the mold is closed and when the

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molds are in open position the counterstop 29' will avoid the stop 29. Furthermore vertically extending spring plates 68 are positioned so as to pass between the sections 44 and 45 of an open mold to positively eject any casting which might have remained wedged across the mold into an aperture 69 located beneath the mold.

The above described apparatus generally operates as follows:

Assuming the apparatus to be in the position shown in Fig. 3 and the motor started the projection 22' will drive the lug 26 with which it is in engagement. Thereupon the plates 21 and 22 will move in unison in the direction indicated by the arrow. The rotation of the plate 21 is continued until the lug 26 has been raised by the cam 28 sufficiently to remove it from the projection 22'.

During this movement the mold associated with the lug 26 in engagement with the projection 22' will have been moved from its open to its closed position. This takes place because the related spring 30 frictionally engages the cam 55. At the end of the movement the position of the parts are as shown in Fig. 2 at the right thereof.

When the mold therefore reaches a position opposite the tap-hole 11 it is in closed position and also the oppositely located mold is closed so that the stop 29' engages the fixed stop 29 to accurately position the mold in casting position.

As soon as a mold is in casting position the rod 12 is raised by the electromagnet arrangement above described. When the molten metal reaches the level of the terminals J and J' the rod 12 is moved to close the tap-hole 11. During this entire casting operation the plate 21 remains stationary since the projection 22' must travel a half revolution before it will encounter the other lug 26 and the return of rotation of the plate 22 has been predetermined to secure a sufficient dwell period for the mold carrying plate.

During the time the plate 21 is stationary the driving plate 22 continues rotating. The projection 22' engages the lug 26' upon the arm 33. The arm 33 is therefore driven and the cable 35 is pulled to move the carriage 65 with the member 66 in a direction against the spring 67. This movement continues until the lug 26' is removed by the cam 28' from contact with the projection 22'. The member 66 cooperates with the roller 31 and thereby rocks the lever 48 of the mold which is opposite the one being filled from the tap-hole. This position of the parts is shown for the mold at the left in Fig. 2.

As soon as the opposite mold from the one being filled has been opened the stops 29 and 29' are disengaged and therefore movement of the plate 21 may be resumed when the projection 22' meets the lug 26 diametrically opposite the one which it has just left. When the plate 21 resumes its rotation the mold which has just been filled with molten metal is positively maintained closed as long as the associated spring 30 remains in frictional contact with the cam 55.

As indicated above the mold carrying plate makes one half revolution for each revolution of the driving plate. Immediately after a mold has been opened and during the initial phase of its rotational movement such mold will encounter the spring blades 68 which will eject any casting wedged therein.

The apparatus described is entirely automatic in its operation and the carriage may be arranged in any suitable manner other than that shown and in particular may be arranged so as to be

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capable of operating the lever 48' when such lever is in horizontal position as shown in Fig. 5.

Where the apparatus of the invention is used for the casting of aluminum or aluminum alloys, the rod serving to close the tap-hole may be made of cast-iron protected with a special surface-coating suitably comprising sodium silicate, whitening and graphite. Care should be taken not to put it to use until the coating is perfectly dry. The rod rests on a graphite seating surface.

The open period of a mold may be put to use for cleaning and cooling it with a jet of compressed air or a liquid spray, depending on the size of the casting.

It will, of course, be understood that modifications may be made in the above-described apparatus and means therein may be replaced by equivalent means without exceeding the scope of the invention as defined in the ensuing claims. Thus for instance in order to obtain a smoother drive for the mold carrier plate 21 means may be used for exerting a slight braking action on said plate. Moreover it will be understood that depending on the size of the foundry plant, all of the individual operations or any number of them may be effected automatically.

The essential feature of the invention primarily resides in the general organization of the casting operation as described above. It will be understood, for example, that this feature will be preserved if in the case of an assembly including two molds rectilinear reciprocation rather than a circular movement is imparted to said assembly so as successively to bring them beneath the tap-hole of the furnace.

What I claim is:

1. In a casting apparatus comprising a rotating support carrying a plurality of separable molds and adapted to successively position each of said molds under a tap-hole, the combination with said support of means for moving said support intermittently comprising a continuously rotating member coaxial with said rotating support and having a radial projection, lugs slidably mounted in said support and normally projecting into the path of said radial projection, there being a lug for each mold on the support and a fixed cam in the path of travel of said lugs to force said lugs out of engagement with said radial projection, said tap-hole and said cam being so positioned with respect to each other that said cam is operative to disconnect a lug from driven engagement with the said projection when its related mold reaches a position under said tap-hole.

2. In a casting apparatus comprising a moving support carrying a plurality of separable molds and adapted to successively position each of said molds under a tap-hole, the combination with said support of means for moving said support intermittently comprising a continually moving member associated with said moving support and having a projection, lugs slidably mounted in said support and normally projecting into the path of said projection, there being a lug for each mold on the support and a fixed cam in the path of travel of said lugs out of engagement with said projection, said tap-hole and said cam being so positioned with respect to each other that said cam is operative to disconnect a lug from driven engagement with the said projection when its related mold reaches a position under said tap-hole.

3. In a casting apparatus comprising a rotating support carrying a plurality of separable

molds and adapted to successively position each of said molds under a tap-hole, the combination with said support of means for moving said support intermittently comprising a continuously rotating member coaxial with said rotating support and having a radial projection, lugs slidably mounted in said support and normally projecting into the path of said radial projection, there being a lug for each mold on the support and a fixed cam in the path of travel of said lugs to force said lugs out of engagement with said radial projection, said tap-hole and said cam being so positioned with respect to each other that said cam is operative to disconnect a lug from driven engagement with the said projection when its related mold reaches a position under said tap-hole, a lever pivoted on said rotating member, a flexible connection attached to the free end of said lever; a sliding block controlled by said flexible connection; return spring means associated with said block, a second lever for each mold pivotally attached to said rotating support, having one end pivoted to one portion of a separable mold and having its free end in engagement with said block when a mold is in mold opening position; a spiral cam extending in a plane substantially parallel to the plane of rotation of said rotating support, having its maximum radius extending in the general direction from said rotating support axis to said tap-hole; and a resilient member associated with each second lever engaging said spiral cam.

4. In a casting apparatus comprising a rotating support carrying a plurality of separable molds and adapted to successively position each of said molds under a tap-hole, the combination with said support of means for moving said support intermittently comprising a continuously rotating member coaxial with said rotating support and having a radial projection, lugs slidably mounted in said support and normally projecting into the path of said radial projection, there being a lug for each mold on the support and a fixed cam in the path of travel of said lugs to force said lugs out of engagement with said radial projection, said tap-hole and said cam being so positioned with respect to each other that said cam is operative to disconnect a lug from driven engagement with the said projection when its related mold reaches a position under said tap-hole, a first lever pivoted about the axis of said rotating member; a second slidable lug in said first lever also arranged in the path of said radial projection; a second fixed cam in the path of travel of said second lug to force said second lug out of engagement with said radial projection; a flexible connection attached to the free end of said first lever; a sliding stop block for each mold controlled by said flexible connection; return spring means associated with said stop block, a second lever for each mold pivotally attached to said rotating support, having one end pivoted to one portion of each separable mold and having its free end in engagement with said stop block when a mold is in mold opening position; a spiral cam extending in a plane substantially parallel to the plane of rotation of said rotating support, having its maximum radius substantially parallel to the radius from said rotating support axis to said tap-hole; and a resilient member attached to each of said second levers engaging said spiral cam.

5. In a casting apparatus comprising a rotating support carrying a plurality of separable molds and adapted to successively position each

of said molds under a tap-hole, the combination with said support of means for moving said support intermittently comprising a continuously rotating member coaxial with said rotating support and having a radial projection, lugs slidably mounted in said support and normally projecting into the path of said radial projection, there being a lug for each mold on the support and a fixed cam in the path of travel of said lugs to force said lugs out of engagement with said radial projection, said tap-hole and said cam being so positioned with respect to each other that said cam is operative to disconnect a lug from driven engagement with the said projection when its related mold reaches a position under said tap-hole, electromechanical means for controlling said tap-hole comprising in combination; a plugging member for said tap-hole; a first electromagnet having an armature; an energizing circuit for said electromagnet; a first pair of normally open contacts in said electrical circuit fixedly positioned with respect to said apparatus; contact plates on said rotating support, each associated with a related mold to close said first contacts upon the associated mold being positioned under said tap-hole; a second pair of normally open contacts in said energizing circuit; a second electromagnet having an armature; a mechanical connection connecting said second armature with said second contacts, and adapted to close said contacts when said second electromagnet is de-energized; a second energizing circuit for said second electromagnet connected to said first energizing circuit at one end; a third pair of normally open contacts in said second energizing circuit fixedly positioned with respect to said apparatus and adapted to be closed by said contact plates upon the associated mold being positioned under said tap-hole; and a fourth pair of fixed, spaced contacts in each mold near the upper end thereof and connected respectively to one of said first contacts and to one of said third contacts, adapted to be bridged by the metal in the mold when said metal reaches a predetermined level, thus energizing said second electromagnet and opening said second contacts to break said first energizing circuit.

6. In a casting apparatus, as set forth in claim 5, wherein said electromechanical means further comprise a pair of conductive strips for each mold assembly, each strip being electrically connected with a related one of said fourth contacts and said strips being so shaped as to engage each other when said mold portions are not applied tightly against each other.

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