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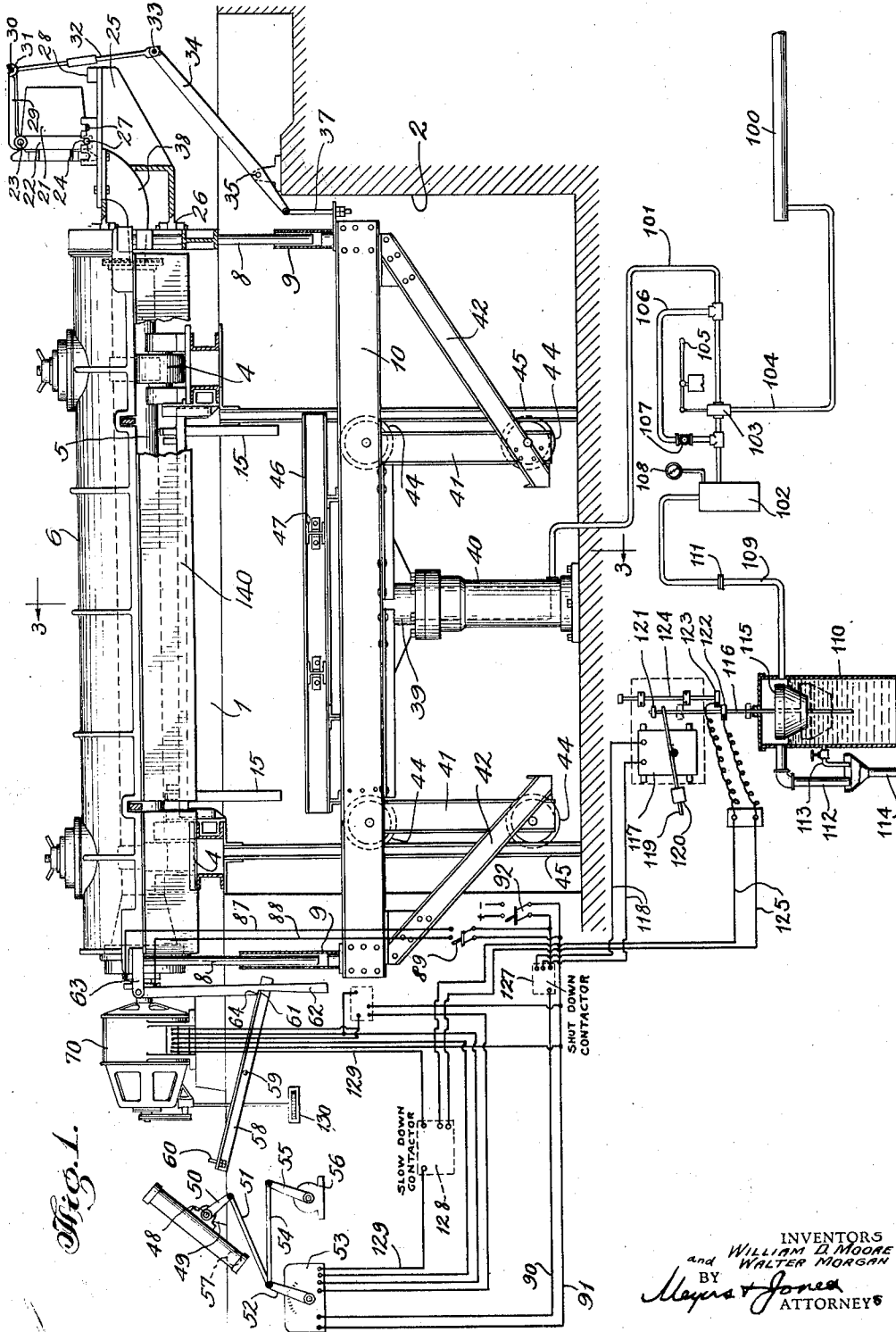
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1,783,094

CENTRIFUGAL CASTING MACHINE

Filed June 4, 1928

3 Sheets-Sheet 1



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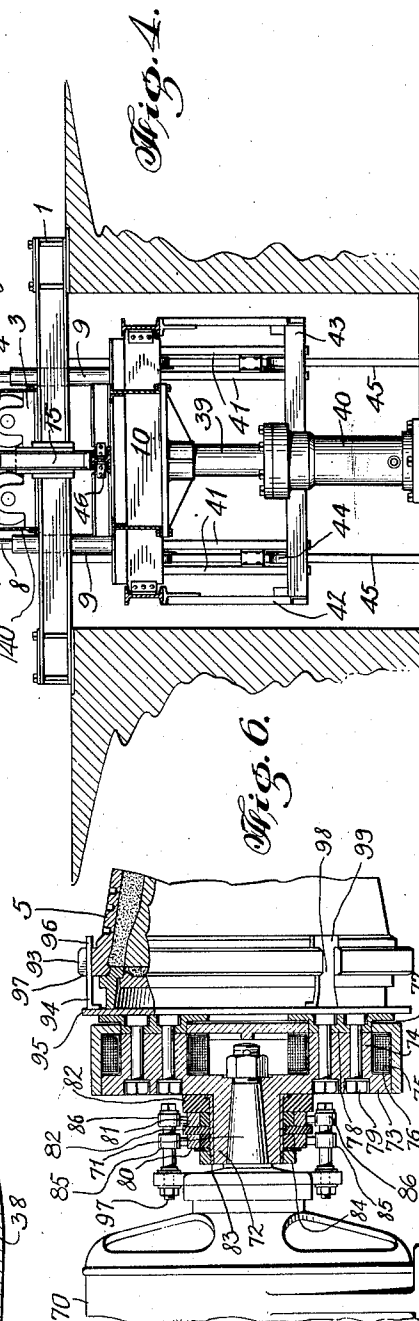
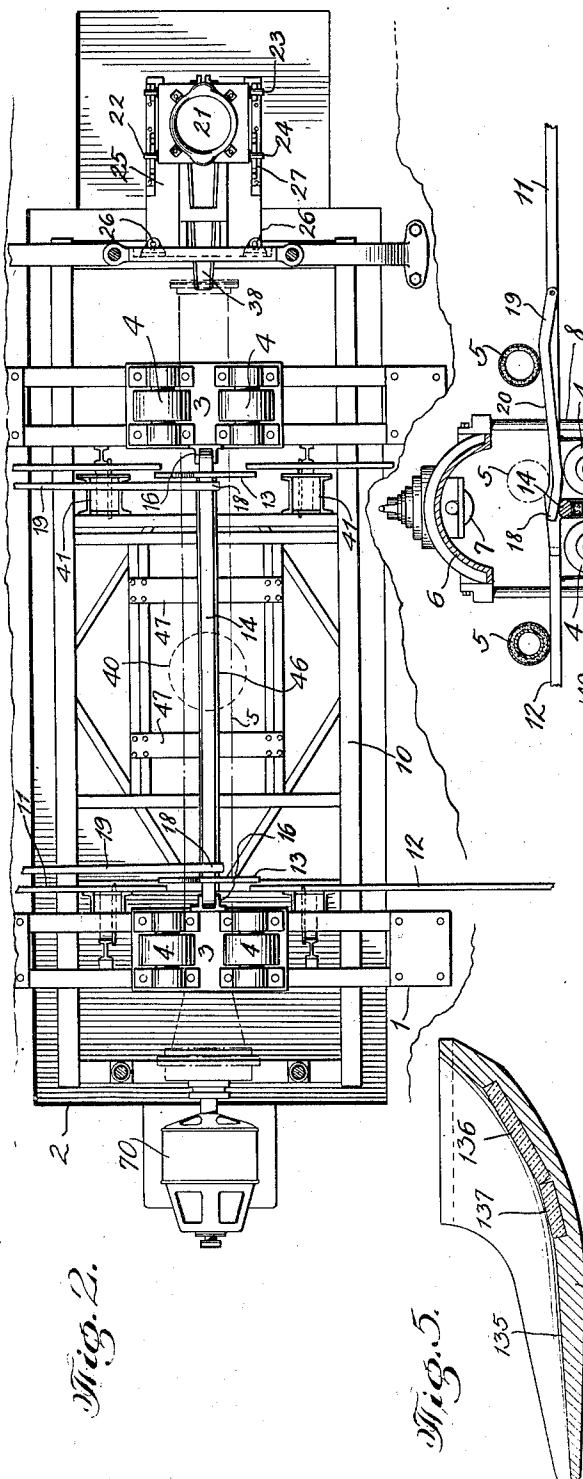
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

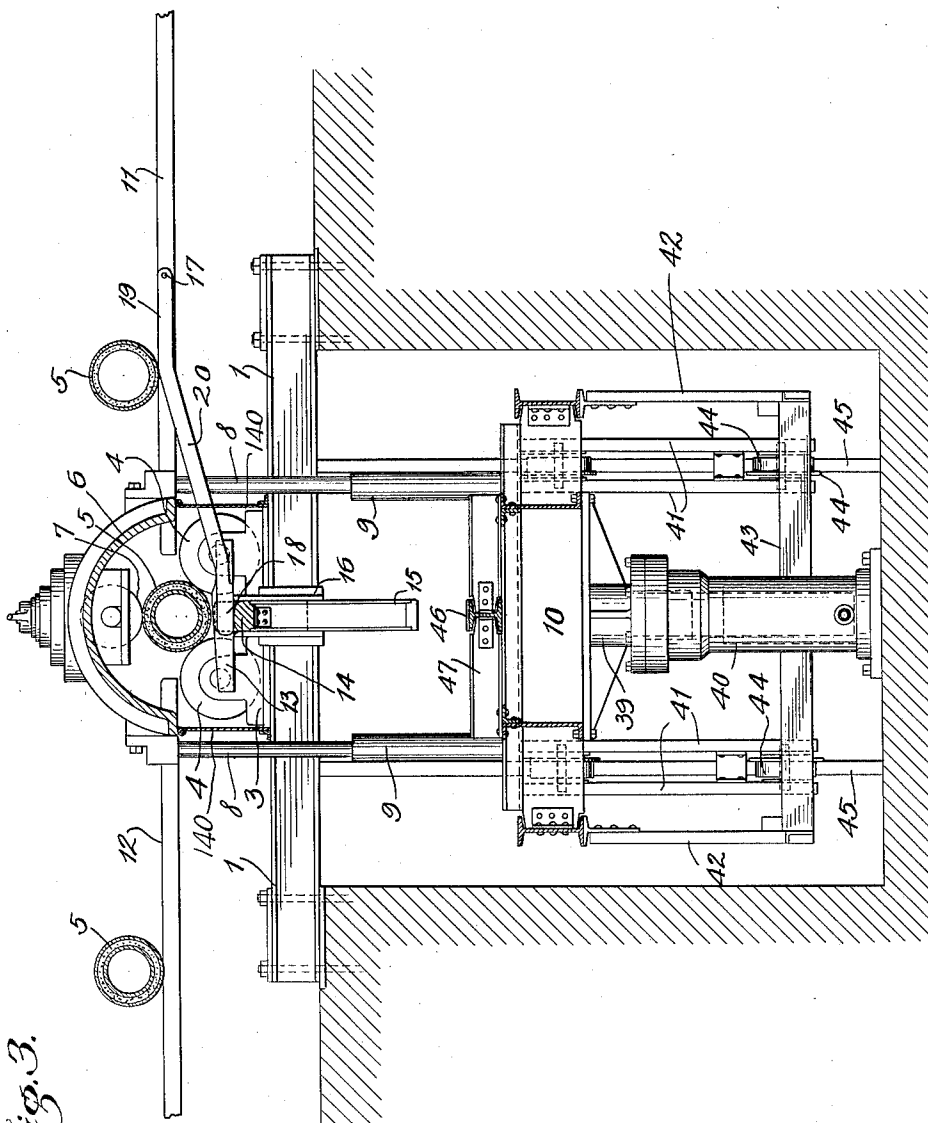


Fig. 3.

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CENTRIFUGAL CASTING MACHINE

Application filed June 4, 1928. Serial No. 282,718.

This invention relates to certain new and useful improvements in centrifugal casting machines, and more particularly to machines of the type for producing relatively long hollow castings, such as cast iron pipe, either with or without bell and spigot ends.

In order that satisfactory results may be obtained in connection with that type of centrifugal casting machine, wherein refractory lined molds or flasks are used, and wherein a freshly lined mold is used for each cast, the several operations of charging and variable rotation of the mold must be so co-ordinated that application of the metal to the mold wall will be delayed until a substantially uniform longitudinal distribution has been attained, and until the sand lining is to a certain extent skin dried, when a wet mold is used.

In order to obtain a maximum of efficiency, machines of this type should be capable of producing as many castings as possible in a given period of time, and every step in the operation must be so placed in the sequence, and so co-ordinated with the remaining steps, that the least possible time will elapse between the insertion of a mold to be cast in the machine, and the removal of the same after the casting operation.

One of the primary objects of the present invention is the provision of mechanism for rapidly charging the flasks into and out of the machine.

Another object is the provision of automatic operating means for regulating the speed of rotation of the flask in a sequence of varying speeds, whereby to effect longitudinal distribution of the molten metal throughout the length of the mold, and the application of the metal centrifugally to the inner wall of the mold.

Another object is to provide automatically operating means for properly charging the molten metal into the flask or mold.

Another object is to provide a hood or cover for the machine, with means for bodily raising and lowering the same to permit the flasks or molds to be inserted into and removed from the machine in a lateral direction.

Another object is the provision of a mag-

netic clutch interposed between an end of the flask or mold, and the motor for rotating the flask or mold to materially simplify the insertion and removal of the molds or flasks into and out of the machine.

Another and very important object is the provision of a common means for performing all of the several operations of casting in the proper order and in a minimum of time, the said means raising and lowering the hood or cover, controlling the operation of the motor which drives the flask, charging the molten metal into the mold or flask, and operating the mechanism which inserts the mold or flask into the machine and removes them therefrom.

With these and other objects in view the invention consists in the construction and novel combination of parts fully described hereinafter, illustrated in the accompanying drawings, and pointed out in the claims appended hereto, it being understood that various changes in the form, proportion, size and minor details of construction within the scope of the claims, may be resorted to without departing from the spirit of the invention.

In the drawings forming a part hereof:—

Fig. 1 is a side elevation of the improved machine with parts in section.

Fig. 2 is a plan view of the machine with the hood removed.

Fig. 3 is a section on the line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 3, showing the parts in another position.

Fig. 5 is a longitudinal section through the pouring trough.

Fig. 6 is a vertical section through the magnetic clutch.

The improvements forming the subject matter of the present invention are in connection with that type of machine wherein refractory lined molds or flasks are employed, and wherein a freshly lined mold is used for each cast. In various prior centrifugal casting machine patents, granted to us, or to some of us, the molds or flasks are supported for rotation in a tilting frame or bed, movable between inclined and horizontal positions, such movement being provided to

effect the even distribution of the molten metal throughout the length of the mold.

In the machine of the present application, the mold or flask is supported for rotation in a substantially horizontal position, a novel form of delivery spout being employed to effect the distribution of the molten metal longitudinally of the mold without requiring movement of the machine between inclined and horizontal positions, and a form of automatic controlling means shown and described in, and forming the subject matter of Patents Nos. 1,656,539 and 1,656,537, granted January 17th, 1928, to M. D. Smith, et al.

It will be understood, however, that other appropriate forms of automatic motor control may be employed in lieu of the one shown, the purpose of the showing here being merely to illustrate the manner in which the automatic control may be thrown into and out of operation from a single actuating means in association with a machine of the non-tilting type, wherein the mold or flask is always supported in a horizontal or in a substantially horizontal position.

In the present embodiment of the invention the molding machine includes a suitable frame 1, which in the present instance is composed of longitudinally extending bars, and cross bars connecting the first named bars at suitable intervals. The frame is supported above a pit 2, the cross bars of the frame resting upon the side walls of the pit, as shown in Fig. 3, and the carriage or bed 3 for supporting the flask is carried by the frame 1.

The carriage or bed has pairs of flask supporting rollers 4, which are journaled on the bed, the pairs being spaced apart longitudinally, and the members of the pairs laterally. The rollers rotate on parallel axes and they are designed to receive a flask such as that indicated at 5 in Fig. 3 to be poured.

The flask is seated upon the rollers, being rotatably mounted thereon, and a hood 6 cooperates with the bed to cover the flask, and to confine the gases discharged during pouring. This hood is curved transversely as shown, and arranged with its concave surface downward, and it carries rollers 7 which cooperate with the rollers 4 before mentioned. The rollers 7 are floating rollers, of the character shown and described in Patent No. 1,620,831 of March 15, 1927.

At each corner the hood has a depending rod 8, which is movable at its lower end in a tubular member 9 connected with a vertically movable frame or platen 10 to be described, the arrangement being such that when the platen attains a selected height in its upward movement, the lower ends of the rods will engage the bottoms of the tubular members, and the hood will be moved upward by the platen.

Runways 11 and 12 are arranged at opposite sides of the machine, the runway 11 be-

ing designed to support the flasks 5 to be poured, while the runway 12 is designed to support the flasks which have been poured. These runways are horizontal and in the same plane, the inner ends of the runways being spaced slightly above the adjacent rollers 4 as shown in Fig. 3, and it will be understood that each runway consists of two or more rails spaced apart laterally a suitable distance.

Yokes 13 are provided at each pair of rollers, the respective yokes being on the inner side of the pair as shown in Fig. 2, and the yokes are connected by a counterweight 14. The counterweight extends longitudinally of the bed, between the axes of the rollers 4, and at each end the counterweight is provided with a depending slide 15, which moves in a guide 16 secured to the frame 1. Thus the vertical movement of the counterweight is prescribed by the arrangement of the guides.

Each of the yokes as shown more clearly in Fig. 3, has the upper edge thereof of cam or wedge shape throughout approximately two-thirds of its length, the said edge inclining in the direction of the runway 12. The highest part of each cam or inclined edge is on the opposite side of the counterweight 14 or axis of the mold when in casting position, from the runway 12. The said cam or edge extends from the periphery of the roller 4 remote from the runway 12 to a little beyond the axis of the roller 4 adjacent to said runway.

The arrangement is such that when the yokes are lifted in a manner to be presently described, the flask 5 on the rollers 4 will be lifted, and because of the inclined or cam shaped edges of the yokes, the mold will be biased to roll toward the runway 12. When the yokes are lifted to their highest position they are at the level of the runways 11—12, forming in effect continuations of the runways, and with the lowest end of each cam edge in substantial register with the top of the adjacent runway rail.

A deflecting or switch rail is pivoted to each of the rails of the runway 11, as indicated at 17, the pivotal connection being at the outer end of the switch rail. Each rail, as shown in Fig. 4, consists of end portions 18 and 19, substantially parallel and offset laterally from each other, and connected by an inclined portion 20. The portion 19 of each rail is pivoted to the runway, and the portion 18 normally rests upon the counterweight as shown in Fig. 3. When the parts are in this position, the upper edge of the portion 19 of the rail is flush with the upper edge of the runway 11.

The molds to be cast are placed on the runway 11, in position such that they are at the top of the portions 20 of the switch rails, and it will be apparent that when they are lifted out of contact with the runway 11 by the switch rails, they will be biased to roll

down the inclined portions 20 of said rails to a position between the rollers 4. Thus the yokes will first lift a cast flask to the level of the runways, and near the moment when the cast flask is at the level of the runways, the mold to be cast on the runway 11 is lifted out of engagement therewith. As the cast mold reaches the level of the runways it is biased to roll toward and onto the runway 12, while at the same time the mold to be cast is biased to roll toward the rollers 4, and into place on the casting frame or bed.

The molten metal is discharged into the mold from a ladle 21 arranged in a frame 22, which has oppositely extending pairs of pins 23 and 24. A support in the nature of a bracket indicated generally at 25 is connected with the end of the frame 1, the connection being preferably a hinged connection, by means of bearings and pintle pins indicated generally at 26 in Fig. 1, in connection with the bracket and the bed, the arrangement being such that by removal of the pintle pins the bracket may be swung away from the bed.

The pins 24 of the frame 22 are adapted to engage one set of a plurality of sets of seats 27 on the upper face of the bracket 25, and the pins 23 are adapted to engage limiting blocks 28 on the bracket, when the ladle is in horizontal position. An arm 29 depends from the frame 22 at one side of the bracket, and this arm has a pin 30, which is adapted to seat in a fork 31 at one end of a strut 32, which as shown, consists of two portions connected by a turn buckle or sleeve nut, thus enabling adjustment of the length of the strut.

The lower end of the strut is forked and engages a pin 33 in one end of a lever 34, pivoted at 35 to an end wall of the pit 2 above which the casting bed is arranged. The opposite end of the lever is connected by a link 37 with the platen 10 before mentioned. The ladle normally occupies the position of Fig. 2, and it will be apparent that it is the downward movement of the platen which tilts the ladle to the position of Fig. 1, and empties the same, through the pouring trough or spout 38, to be later described in detail.

The platen 10 is a substantially rectangular frame, having connected with the center thereof a piston 39, which moves in a cylinder 40 mounted in the pit, and supplied with fluid under pressure in a manner to be presently described. The frame is provided at each side near each end with a depending bracket 41, each bracket consisting of two parallel laterally spaced and connected members, as shown in Fig. 3. An inclined brace 42 extends downwardly and inwardly from each end of the platen, and the braces are connected at the inner sides of the brackets 41 by a cross member 43. Each cross member

is also connected to the adjacent brackets 41.

A pair of wheels 44 is supported by each of the brackets 41, the wheels of each pair being journaled between the members of the bracket, and the wheels are flanged, and engage rails 45, arranged between the frame 1 and the bottom of the pit. Thus the platen has rolling engagement with the rails, and is guided in its vertical movement. The platen as before stated carries the tubular members 9 in which the rods 8 move, and the said platen also carries a longitudinally extending rail 46 on its upper side, which has its ends in position to engage the lower ends of the slides 15 at a selected moment in the upward movement of the platen. The rail 46 is braced by brace rails 47 at each side, and on each side of its center.

It will be apparent from the description that when the platen moves upward, at a selected moment, it will move the rods 8 and the hood, lifting the hood vertically. At a later selected moment, the platen will engage the slides 15, will lift the flask which has just been poured, and discharge it onto the runway 12. Movement is also imparted to the flask to be poured on the runway 11 toward the bed, and as the platen moves downward, this movement of the flask to be poured will be continued until it is seated on the bed. The hood is also lowered, and through the connection 32, 34, 37, the ladle is tilted to discharge the molten metal into the flask.

While the molten metal is being introduced into the mold, it is rotated at a relatively low speed, not sufficient to apply the molten metal to the mold wall. That is, during this period the molten metal remains in a mass on the bottom of the mold. As soon as charging is complete, and longitudinal distribution of the metal is attained, the speed of rotation is abruptly increased to a rate such as will apply the metal to the mold wall, and retain it thereon.

A motor of suitable construction, preferably an electric motor, is used to rotate the mold, the motor being connected to the flask as soon as the flask is in condition for rotation, and being detached therefrom when the casting is complete. Automatically operated mechanism is provided for controlling the motor, the said mechanism being of a nature such that and so controlled that when the mold is in position on the rollers, and the hood is properly placed with respect thereto, the relatively slow rotation commences and continues during the charging. After completion of longitudinal distribution the motor is abruptly speeded up by the same automatic mechanism.

All of these operations, namely; the lifting and lowering of the hood, the removal and insertion of a flask, the charging by means of the ladle, and the operation of the automatic control, are caused by the vertical

movement of the platen 10. As the platen moves downward after the seating of the flask, the motor is connected therewith, and the relatively slow rotation commences. At the same moment the ladle is tilted to discharge the molten metal into the mold, and further movement of the platen operates the automatic control. At the moment when the platen moves into its lowest position, the automatic control is operated. As illustrating one type of automatic control, that of the general type shown and described in Patent No. 1,656,537, January 17, 1928, Smith et al., has been selected, but it will be understood that the use of any suitable type of automatic control is contemplated. In the type shown, a tilting cylinder 48 is provided, the cylinder being pivoted intermediate its ends to a suitable bracket 49. An arm 50 is rigid with the cylinder, and this arm is connected by a link 51 with the handle 52 of a drum controller 53. A link 54 connects the handle 52 with the handle 55 of a brake, which in the present instance is a door check. A ball indicated at 57 is arranged in the cylinder, and is free to roll therein when the cylinder is tilted.

The cylinder is tilted by means of a lever 58, which is pivoted at 59, and has one end provided with an adjustable pin 60 for engaging the end of the cylinder. The lever is of angle material as shown in Fig. 1, and a portion of the horizontal part is cut away to provide a stop 61. A link 62 depends from a bracket 63 on the hood, and this link has its lower end cut away to provide a shoulder or stop 64 for engaging the lever 58.

When the hood moves upward under the influence of the platen the lever is not affected by the link 62, but returns to normal position by gravity. As the hood moves downward, the lever is swung, and at a selected moment the pin 60 engages the adjacent end of the cylinder and tilts the same. The cylinder is normally horizontal, or even slightly tilted downward at the end adjacent the lever 58, while the mold is rotating at the relatively low speed during the charging. When the pin 60 engages the cylinder, it will be moved toward level position, and as soon as it passes beyond level position, the ball 57 will commence to roll toward the opposite end, that is, away from the motor.

The movement of the ball rapidly accelerates the movement of the cylinder, and the corresponding movement of the controlling handle and the acceleration increases with much greater rapidity as the ball passes the center. The speed of the motor is rapidly increased from relatively low to relatively high, but in such manner that there is no injurious shock or jar to the parts. The brake 56 enables the time between initiation and attainment of high speed to be varied within nice limits. The brake is of the dash

pot type, such as is used for door checks, and has the usual adjusting mechanism, for varying the flow of the fluid through the same.

At the commencement of the rotation, the controller handle 52 is set at about one point, and the motor will rotate at a speed of about 50 R. P. M. At or about the moment when charging is complete, the cylinder is tilted, the ball rolls, the momentum thereof rapidly increasing, and controller shaft is advanced to speed up the motor. The movement of the controller shaft to speed up the motor is initiated by the platen, but it is completed in a variable length of time by the movement of the ball, the time required to complete the speeding up from 50 R. P. M. to 1250 R. P. M. being regulated by means of the brake 56. The moment when the cylinder begins to tilt may also be varied by means of the pin 60. The speeds of 50 R. P. M. and 1250 R. P. M. given, are only approximate, and will vary in accordance with conditions.

A clutch is provided for connecting the motor with the flask, in order to provide for rotation. Preferably a magnetic clutch is used for connecting the motor 70 with the flask 5. The motor shaft 71 is tapered as shown in Fig. 6, and upon the tapered portion is fitted the hub 72 of a clutch disk 73. Upon the opposite face of the disk from the motor there is a plurality of laterally extending integral lugs 74, four in the present instance, the said lugs being of frusto-triangular shape in cross section. Each lug is the core of a coil indicated at 75, the coils being wound upon shuttles 76, shaped to fit the lugs, and to slip thereover.

A suitable construction of coil may be composed of about 1250 turns of number 20 Del-tabeston copper wire, and the coils and shuttles are held in place on the disk by a flanged plate 77, which fits against the ends of the lugs, the flange of the plate or disk extending outside of the coils and fitting against the periphery of the disk. The plate 77 has openings at each of the lugs, and each of these openings is closed by a plate 78 having thickened portions fitting into the openings. Bolts 79 are passed through the lugs and the plates 78, and are engaged by nuts as shown to connect the parts together, countersinks being provided for the heads of the bolts and the nuts.

The plates 78 are wear plates, and are interchangeable or removable, to permit replacement when worn. The plates extend beyond the face of the cover plate 77, and may be easily removed to enable access to the coils. Their removal also enables removal of the plate 77, thus fully exposing the coils. The four coils are connected in series usually with a 220 volt direct current supply circuit, and require together about 3 amperes.

A pair of brass collecting rings 80 and 81 is mounted on the hub 72 of the disk in in-

sulated relation with respect to the hub and each other. A bushing 83 is fitted over the hub 72, and the rings are arranged on the bushing. Insulation indicated at 82, in the form of rings, is arranged between the collecting rings and the bushing, between the rings and the disk, between the rings, and between the rings and a ring nut 84 threaded onto the outer end of the bushing for clamping the parts in assembled relation.

Pairs 85 and 86 of brushes cooperate with the rings, the brushes being of standard construction and supported by bolts 97 supported from the motor casing. The pairs of brushes are oppositely arranged as shown, one pair being connected to the positive lead 87 of the circuit, and the other to the negative lead 88, and they are oppositely arranged to insure continuous contact with the rings. A switch 89 is interposed in the leads for breaking the circuit when desired, and the leads 87 and 88 are connected with the leads 90 and 91 of a supply circuit, also having a switch 92 interposed therein. If desired, a 240 volt 50 watt lamp may be arranged across the circuit 87—88 to absorb back E. M. F., caused by residual flux in the coils. It will be apparent that when the switch 89 is closed, the coils 75 will be energized and the plates 78 will become magnetic, each plate being in effect a part of the appropriate core.

The flask 5 has the usual lateral flange 93 at the bell end, and it will be noticed referring to Fig. 6, that that portion 94 of the flask which would engage the wear plates would be limited if this part only were relied upon for engagement by such surfaces. In order to provide increased contact, a plate 95 is provided, which abuts the thin edge of the flask end, and is detachably connected with the flask in a manner to cause rotation of the flask therewith, and to prevent longitudinal movement of the flask with respect thereto.

A plate 95 is provided for each size of flask, as for instance, for flasks for casting pipes of 4, 6, 8, 10 and 12 inches respectively. Each plate 95 has three arms or keys extending laterally therefrom toward the flask. In the present instance, two of the arms indicated at 96 are plain keys adapted to engage notches 97 in the flask flange. The other arm 98 engages a similar notch 97, but the said arm has a head 99 which prevents relative longitudinal movement of flask and plate.

With this type of arm or key, the plate is connected with the flask by engaging the arm 98 first, the plate being inclined at the moment. It is apparent that all of the arms might be alike if desired, since there is no tendency of the flask to move away from the clutch. The plate 95 engages the entire area of all of the wear plates, and provides a firm secure grip between the clutch elements of motor and flask. Side plates 140 extend upwardly from the frame at each side of the

bed, to near the level of the runways, and when the hood is in lowered position, the upper edges of the plates contact therewith, completely enclosing the flask upon the mold.

In operation, each flask when it is ready to be poured has a plate 95 connected thereto before the flask is rolled upon the carriage, that is, while it is upon the runway 11. When the flask is in place on the bed, the switch 89 is operated to energize the coils, and the flask is tightly locked to the motor. After casting, the switch is operated to break the circuit, immediately releasing the flask from the motor, and the clutch plate 95 may be transferred to another flask. With this arrangement, the clutch not only drives the flask but holds it from endwise movement during the spinning or rotating operation.

In practice, during the charging of the mold it is, as previously stated, rotated at a relatively low speed, about 50 R. P. M. At or near the moment when charging is completed, the speed is rapidly increased to about 1250 R. P. M. After a relatively short time, long enough for the metal to set, the speed is decreased to about 900 R. P. M. The mold continues to rotate at this intermediate speed until the metal has sufficiently set, after which the motor circuit is opened and the mold ceases to rotate.

The cylinder 40 which controls all of the operations previously described, is supplied with fluid under pressure, as for instance, water from a suitable source. A pipe 101 connects the cylinder 40 with a pressure tank 102, and a three-way valve indicated generally at 103 is interposed in the pipe 101, between the pressure tank and the cylinder. A pipe 104 leads from the source 100 to the valve, and the valve is controlled by a suitable handle 105. A by-pass 106 is provided in connection with the pipe 101 about the valve 103, and the by-pass has a valve 107 for varying the capacity thereof. The pressure tank is provided with a gauge 108.

A pipe 109 leads from the pressure tank to a float chamber 110, and this pipe is provided with a calibrating orifice 111, which is adjustable to vary the discharge capacity of the pipe. The float chamber has an overflow 112 and a valve controlled bleed or drain pipe 113, both delivering into a common drain 114. A float 115 is arranged in the float tank, and a rod or stem 116 is connected with the float, the stem having guided movement as shown.

When the three-way valve is opened to admit fluid under pressure to the cylinder 40, a part of the fluid passes through the by-pass 106 to the pressure tank 102, and from the tank by way of the pipe 109 to the float chamber. The flow of liquid is greater than can discharge through the drain pipe 113, and the level of the liquid in the chamber rises, raising the float, which through the rod

or stem operates switches controlling the motor circuit.

The operation of the machine as a whole is as follows. Starting with the platen in lower position, with a casting just complete, no rotation of the flask, the flask in the machine with its casting ready to be discharged, and another flask in position to enter the machine, the valve 103 is manipulated admitting water to the cylinder 40 and starting the platen on its upward movement. The platen first engages the rods or legs 8 on the hood, and the hood begins to lift. When the hood has completed approximately one-half of its upward movement, the platen engages the elements 15, and continued movement ejects the cast flask, and moves the flask to be cast above the bed.

A reverse movement of the valve 103 starts the platen to lowering, lowering the hood and setting the flask to be cast on the bed. This downward movement of hood and flask continues through about one-half of the downward stroke of the platen, at which time the flask has been seated on the bed, and the flask handling mechanism, that is, the elements 13 and associated parts have been lowered a sufficient distance to provide clearness, so that the flask can be rotated. At this point the downward movement of the platen is checked. The motor is put into slow motion, after the switch 89 is operated to couple the motor to the flask through the magnetic clutch.

At this time the molten metal is introduced into the individual ladle of the machine. The strut 32 is put in place, and the operation of actually casting is ready to proceed. To accomplish this, the operator once more opens the hydraulic valve 103, causing the platen to continue its lowering movement, this movement being very definitely time controlled. This movement causes the hood to come to rest upon the bed, completely covering the flask, and the hood functions as a safety device from this point on.

During the lowering movement of the platen just referred to, the ladle is tilted, and the metal is poured into the slowly revolving flask, while at the same time through the lowering movement of the platen at the psychological moment, the operation of the automatic control is initiated, throwing the motor from pouring speed into casting or high speed.

As previously pointed out, the mold in the present machine is charged while it is horizontal or substantially so, the mold being preferably tilted slightly downward at the motor end. The pouring trough or spout shown more particularly in Fig. 5, is of special construction, designed to direct the metal longitudinally of the mold to the remote end thereof within a minimum of time, and without rebound or surging. The bottom of the

spout is so inclined that just enough impetus is imparted to the flowing metal to carry it to the motor and of the flask in a stream of substantially uniform cross section, but without any marked rebound and without surging. The impetus imparted to the molten metal by the pouring spout is relied upon to attain longitudinal distribution without rebound, and the incline is calculated in accordance with several factors, such as the length of the pipe, whether or not the pipe is of the bell and spigot type, and the character and constants of the molten metal.

It has been found in practice that with a metal of certain fluidity and with a known length of pipe, the inclination of the spout may be so calculated that the inflowing stream will reach the bell or motor end of the flask within a selected time, without rebound such as would cause surging and disturbance of the longitudinal distribution. The longitudinal distribution is facilitated by so arranging the bed that the flask is slightly inclined toward the motor end, the inclination, however, being insufficient to interfere in any way with the circumferential distribution from the centrifugal motion or spinning of the flask. Referring to Fig. 5, it will be noticed that the bottom 135 of the trough or spout is provided with insets of refractory material, indicated at 136 and 137 at the point where the stream of metal from the ladle strikes. These insets are removable if desired for any purpose, and materially lengthen the life of the trough, while at the same time insuring that the inclination of the bottom will remain constant.

It will be apparent from the description that a new and improved method of casting centrifugally in refractory lined flasks or molds, is provided, wherein the charge of the molten metal is introduced at one end of the mold while it is substantially horizontal, and wherein an impetus is imparted to the metal just sufficient to cause it to flow to the opposite end of the mold and to lie on the bottom thereof in a mass of substantially uniform cross section, before the mold is rotated at a speed sufficient to apply the metal to the mold wall. The method also includes the steps of rotating the mold at a relatively low speed during the time that the charge is attaining longitudinal distribution, and at a relatively high speed after longitudinal distribution is attained, thereby to apply the metal to the mold walls, that is, to obtain circumferential distribution.

The impetus is obtained by the inclination of the bottom of the pouring spout, which inclination is calculated in accordance with the length of the mold, and the characteristics of the molten metal, an important one of which is the state of fluidity. All of

the several operations are coordinated so that by a single bodily moving member they are caused to take place in the proper sequence. The platen which is the bodily movable member referred to, moves upward to raise the hood to discharge a cast mold, and to position above the bed a mold to be cast.

The downward movement of the platen through a selected distance lowers the mold on the bed, positions the hood, and a further movement of the platen inserts the charge, and initiates the operation of the automatic control to speed up the motor. The movements of the platen are controlled by a single valve, and the motor control, which in itself is automatic, is operated by the reflux of water from the cylinder which operates the platen.

The bottom of the spout, that is, the surface over which the molten metal flows from the tilting ladle to the mold, is formed on the arc of a circle, so that the direction of the flow of the metal from the ladle is gradually changed from substantially vertical to something near horizontal, without disturbance of the even uniform flow of the metal. Furthermore, by providing a tilting ladle operated in the manner described, the metal is fed gradually and in a uniform stream to the spout, the cross section of the stream from the ladle being substantially the same from the moment when discharge begins until it is ended. The arrangement of the metal is such that the head of the metal discharged is substantially the same from the commencement to the end of the operation, and this is a feature of importance, in connection with the inclination of the spout bottom.

The impetus imparted to the molten metal is such as to cause it to reach the remote end of the mold as quickly as possible without substantial rebound, and to attain a uniform level as quickly as possible. It will be apparent that the absence of rebound and surging facilitates the attainment of a uniform depth or uniform level in the mold. Because of the slight inclination of the mold, the greatest depth of metal will be at the bell end, where it is desired.

It has been found in practice that with the character of metal, such as is usually used in our casting operations, an inclined surface for the spout formed on the arc of a circle having a two foot radius very nicely fulfills the conditions in casting pipe of sixteen foot length of the several diameters. That is, the ratio between the length of the pipe to be cast and the radius of the circle upon which the incline is formed, is eight to one. This ratio will vary slightly with the length of the pipe and with the characteristics of the metal. The more fluid the metal the less incline needed, and the greater the length of the pipe the greater the incline. Hence,

the inclination will vary inversely to length of pipe and fluidity of metal.

The method of and mechanism for introducing the charge of molten metal into the flask is described and claimed in our copending application, Serial Number 481,254, filed September 11, 1930, which is a division of the present application.

What is claimed as new is:—

1. In a centrifugal casting machine, means to support a flask for rotation about a substantially horizontal axis, means to rotate the flask, means for removing a charged flask laterally from the machine toward one side, and means for inserting a flask to be charged into the machine from the other side.

2. In a centrifugal casting machine, means to support a flask for rotation about a substantially horizontal axis, means to rotate the flask, means for removing a charged flask laterally from the machine toward one side, means for inserting a flask to be charged into the machine from the other side, and a common means for operating said flask removing and inserting means in sequence.

3. In a centrifugal casting machine, means to support a flask for rotation about a substantially horizontal axis, means to rotate the flask, means for removing a charged flask laterally from the machine toward one side, means for inserting a flask to be charged into the machine from the other side, mechanism for introducing a charge of molten metal into one end of the mold, and a common means for operating the flask removing and inserting means and the charging mechanism in sequence.

4. In a centrifugal casting machine, means to support a flask for rotation about a substantially horizontal axis, means to rotate the flask, means for removing a charged flask laterally from the machine toward one side, means for inserting a flask to be charged into the machine from the other side, mechanism for introducing a charge of molten metal into one end of the mold, and a common means for operating the flask removing and inserting means and the charging mechanism in sequence, the charging mechanism including means for imparting to the molten metal an impetus sufficient to cause it to flow to the opposite end of the flask in a mass of substantially uniform cross section.

5. In a centrifugal casting machine, means to support a flask for rotation about a substantially horizontal axis, means to rotate the flask, means for removing a charged flask laterally from the machine toward one side, means for inserting a flask to be charged into the machine from the other side, mechanism for introducing a charge of molten metal into one end of the mold, and a common means for operating the flask removing and inserting means and the charging mechanism in sequence, the charging mechanism including

- means for imparting to the molten metal an impetus sufficient to cause it to flow to the opposite end of the flask in a mass of substantially uniform cross section, said means including an inclined surface over which the metal moves into the mold, the inclination of said surface being regulated in accordance with the length of the mold and the characteristics of the molten metal.
6. In a centrifugal casting machine, means to support a flask for rotation about a substantially horizontal axis, means to rotate the flask, a vertically movable hood to cover the flask during the casting operation, means for removing a charged flask laterally from the machine at one side and for inserting a flask to be charged into the machine from the other side, and a common means for raising and lowering the hood and for operating the flask removing and inserting means in sequence.
7. In a centrifugal casting machine, means to support a flask for rotation about a substantially horizontal axis, means to rotate the flask, a vertically movable hood to cover the flask during the casting operation, means for removing a charged flask laterally from the machine at one side and for inserting a flask to be charged into the machine from the other side, mechanism for introducing a charge of molten metal into the mold at one end thereof, and a common means for operating the hood, the flask removing and inserting means and the charge introducing mechanism in sequence.
8. In a centrifugal casting machine, means to support a flask for rotation about a substantially horizontal axis, mechanism for introducing a charge of molten metal into the mold at one end, means to rotate the flask, an automatically operating device for controlling the rotating means to cause the same to rotate the flask at a relatively low speed during the operation of the charging mechanism and at a relatively high speed after the completion of the charging mechanism, and a common means for operating the flask removing and inserting means, and the charging mechanism, and for initiating the operation of the controlling device in sequence.
9. In a centrifugal casting machine, a carriage or bed having means to rotatably support a mold during casting, a hood cooperating with the bed to cover a mold thereon and mounted for bodily movement with respect thereto to enable access to the bed from either side when the hood is lifted, and means for lifting the hood.
10. In a centrifugal casting machine, a carriage or bed having means to rotatably support a mold during casting, a hood cooperating with the bed to cover a mold thereon and mounted for bodily movement with respect thereto to enable access to the bed from either side when the hood is lifted, fluid pressure controlled means for lifting the hood, and a counterweight for assisting descent thereof.
11. In a centrifugal casting machine, a carriage or bed having means to rotatably support a mold during casting, a hood cooperating with the bed to cover a mold thereon and mounted for bodily movement with respect thereto to enable access to the bed from either side when the hood is lifted, and means for lifting the hood, said means engaging the corners thereof.
12. In a centrifugal casting machine, a carriage or bed having means to rotatably support a mold during casting, a hood cooperating with the bed to cover a mold thereon and mounted for bodily movement with respect thereto to enable access to the bed from either side when the hood is lifted, means for lifting the hood, said means engaging the corners thereof, and comprising a platen having a piston, a cylinder in which the piston is movable, and means for supplying fluid under pressure to the cylinders.
13. In a centrifugal casting machine, a bed having means to rotatably support a mold to be cast, runways at opposite sides of the bed for supporting cast molds and molds to be cast respectively, means for lifting a cast mold from the bed and for imparting initial rolling movement thereto away from the bed toward one side thereof, means for lifting the mold to be cast from the runway at the other side and for imparting initial rolling movement thereto toward the bed, and a common operating mechanism for said means.
14. In a centrifugal casting machine, a bed having means to rotatably support a mold to be cast, runways at opposite sides of the bed for supporting cast molds and molds to be cast respectively, means for lifting a cast mold from the bed and for imparting initial rolling movement thereto away from the bed toward one side thereof, means for lifting the mold to be cast from the runway at the other side and for imparting initial rolling movement thereto toward the bed, a hood movable toward and from the bed, and a common means for lifting the hood and for operating the lifting means for the cast mold and the mold to be cast.
15. In a centrifugal casting machine, a carriage or bed having means to rotatably support a mold during casting, a hood cooperating with the bed to cover a mold thereon and mounted for bodily movement with respect thereto to enable access to the bed from either side when the hood is lifted, means to discharge a cast mold from the bed to one side thereof, means to position a mold in the bed from the opposite side thereof, and a common operating means for said discharging and positioning means and for moving the hood.
16. In a centrifugal casting machine, a

carriage or bed having means to rotatably support a mold during casting, a hood cooperating with the bed to cover a mold thereon and mounted for bodily movement with respect thereto to enable access to the bed from either side when the hood is lifted, means to discharge a cast mold from the bed to one side thereof, means to position a mold in the bed from the opposite side thereof, and a common operating means for said discharging and positioning means and for moving the hood, the discharging means including yokes for engaging a mold in the bed and cam shaped to impart a rolling movement to the mold toward the first named side of the bed.

17. In a centrifugal casting machine, a carriage or bed having means to rotatably support a mold during casting, a hood cooperating with the bed to cover a mold thereon and mounted for bodily movement with respect thereto to enable access to the bed from either side when the hood is lifted, means to discharge a cast mold from the bed to one side thereof, means to position a mold in the bed from the opposite side thereof, and a common operating means for said discharging and positioning means and for moving the hood, the positioning means including switch rails adapted to engage and lift a mold to be cast and shaped to impart rolling movement of the mold toward the bed.

18. In a centrifugal casting machine, a bed having means to rotatably support a mold, a hood cooperating therewith and mounted for bodily movement toward and from the bed, whereby to enable access to either side of the bed, means to remove the cast mold from the bed, means to position a mold thereon, and a common operating means for the hood, the detaching and positioning means.

19. In a centrifugal casting machine, a bed having means to rotatably support a mold, means to discharge a cast mold therefrom, means to position a mold to be cast thereon, and a common operating means for the discharging and positioning means.

20. In a centrifugal casting machine, a bed having means to rotatably support a mold, means to discharge a cast mold therefrom, means to position a mold to be cast thereon, and a common operating means for the discharging and positioning means, the discharging means including vertically movable yokes having inclined upper edges to engage the mold, and to impart rolling movement thereto in a selected direction.

21. In a centrifugal casting machine, a bed having means to rotatably support a mold, means to discharge a cast mold therefrom, means to position a mold to be cast thereon, and a common operating means for the discharging and positioning means, the posi-

tioning means including rails having inclined portions to impart rolling movement to the mold toward the carriage.

Signed at Birmingham, in the county of Jefferson and State of Alabama, this 28th day of May, A. D. 1928.

WILLIAM D. MOORE.
WALTER MORGAN.

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