

Sept. 19, 1933.

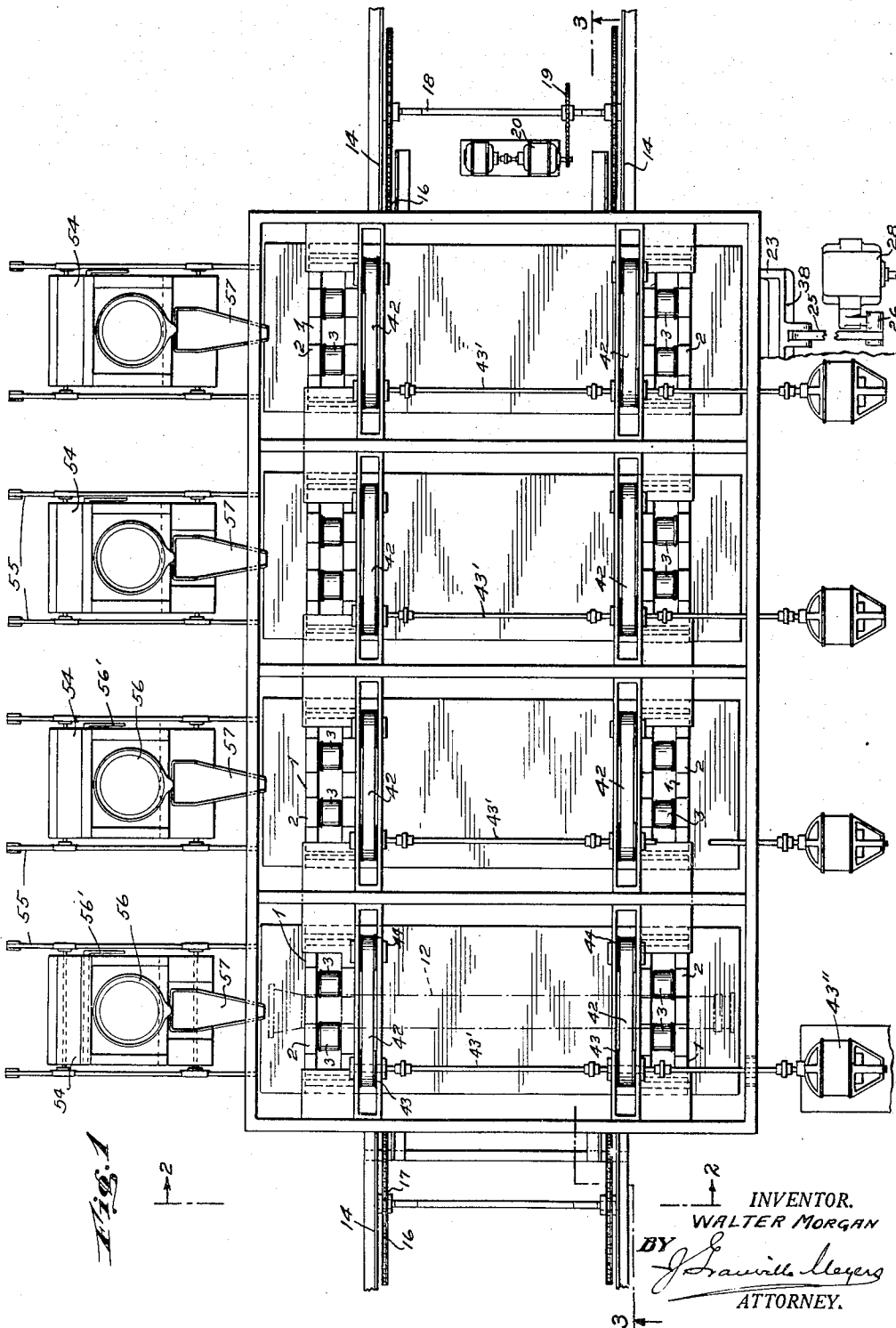
W. MORGAN

1,927,467

CENTRIFUGAL CASTING MACHINE

Filed Aug. 2, 1932

4 Sheets-Sheet 1



Sept. 19, 1933.

W. MORGAN

1,927,467

CENTRIFUGAL CASTING MACHINE

Filed Aug. 2, 1932

4 Sheets-Sheet 2

Fig. 2

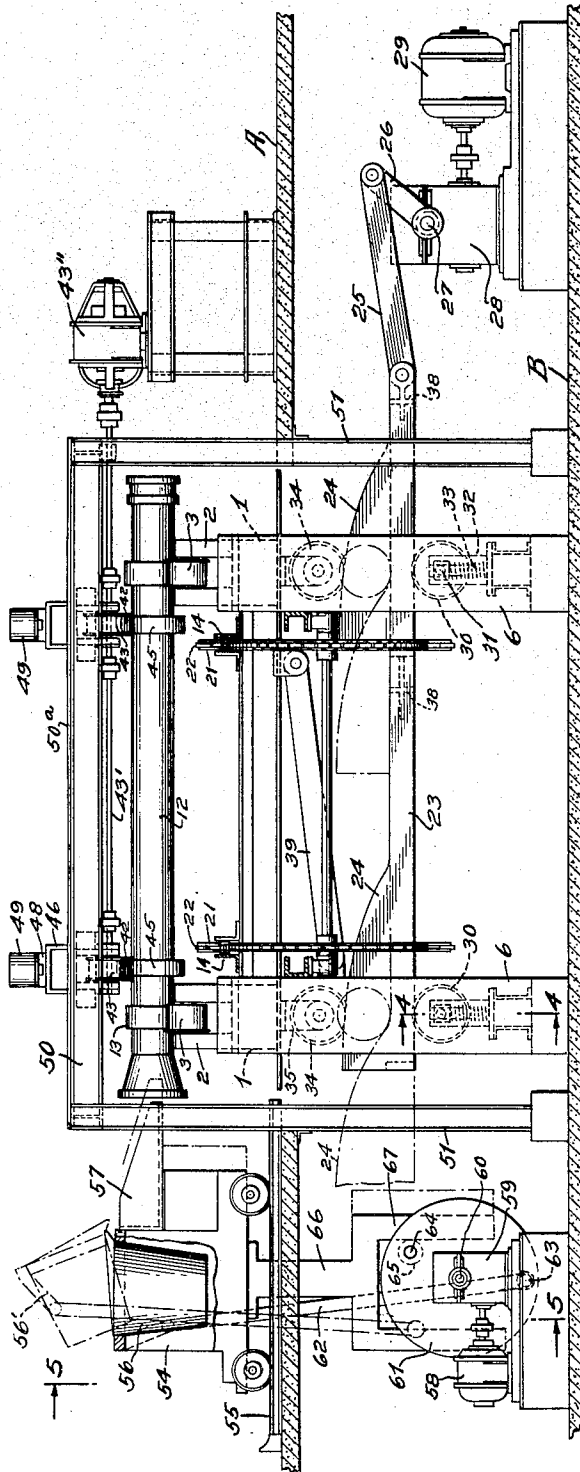
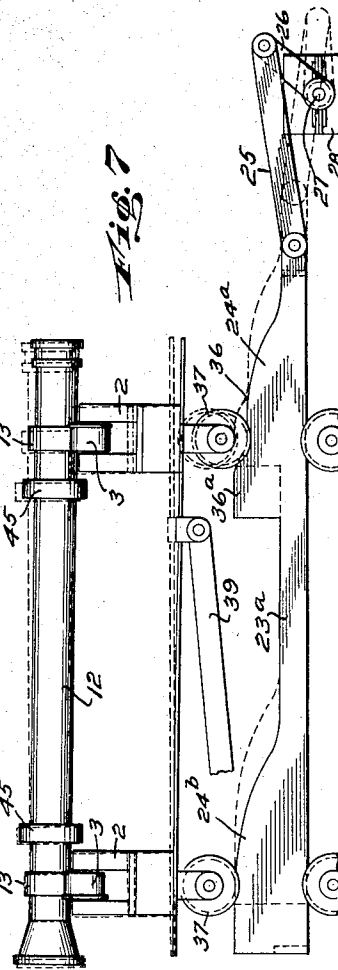


Fig. 7



INVENTOR.
WALTER MORGAN
BY *J. Lawrence Meyers*
ATTORNEY.

Sept. 19, 1933.

W. MORGAN

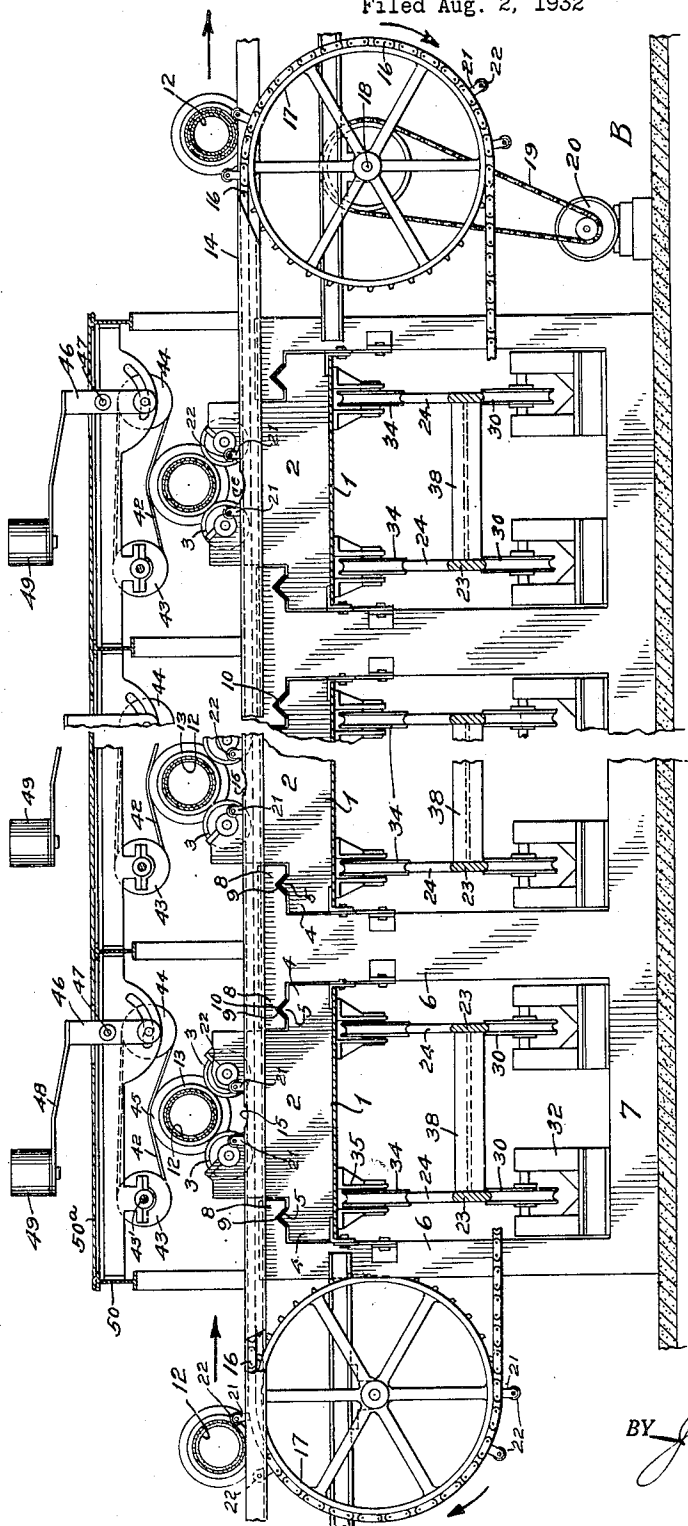
1,927,467

CENTRIFUGAL CASTING MACHINE

Filed Aug. 2, 1932

4 Sheets-Sheet 3

Fig. 3



INVENTOR.
WALTER MORGAN

BY *J. Lawrence Rogers*
ATTORNEY.

Sept. 19, 1933.

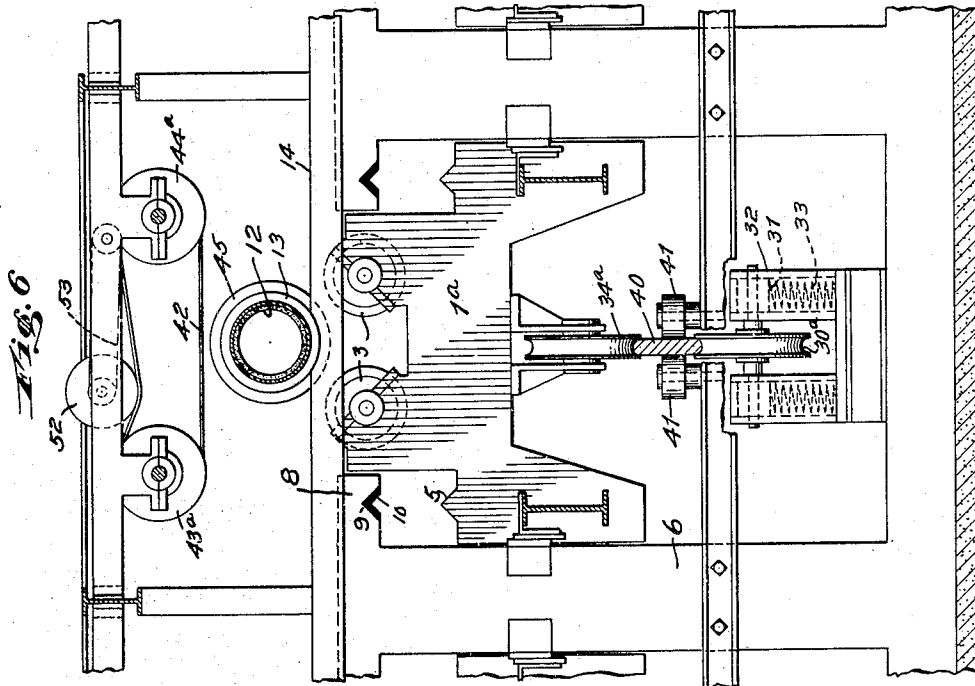
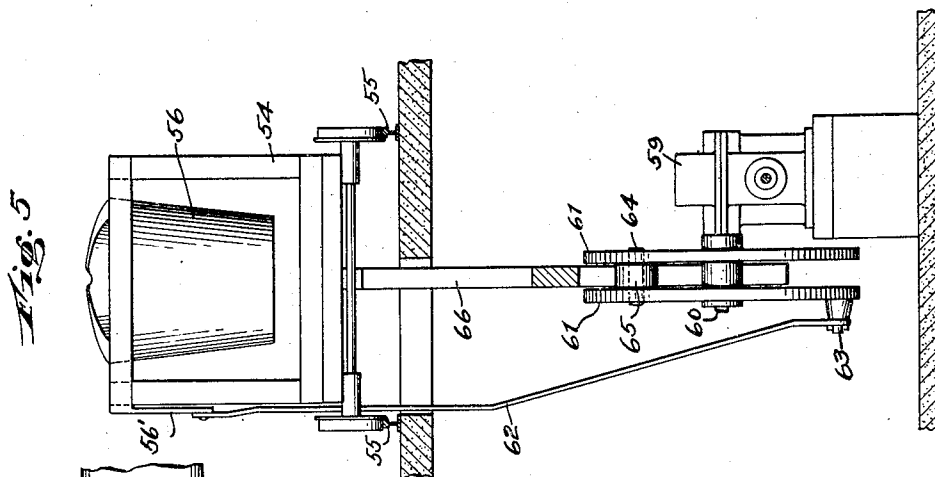
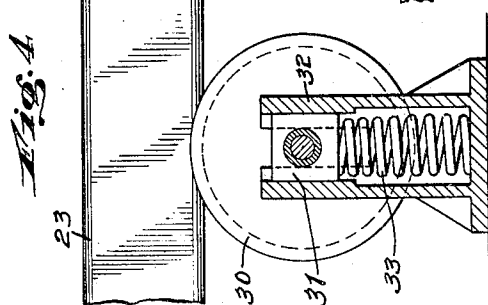
W. MORGAN

1,927,467

CENTRIFUGAL CASTING MACHINE

Filed Aug. 2, 1932

4 Sheets-Sheet 4



INVENTOR.
WALTER MORGAN
BY *J. Lawrence Leary*
ATTORNEY.

UNITED STATES PATENT OFFICE

1,927,467

CENTRIFUGAL CASTING MACHINE

Walter Morgan, Birmingham, Ala., assignor, by
mesne assignments, to Sand Spun Patents Cor-
poration, New York, N. Y., a corporation of
Delaware

Application August 2, 1932. Serial No. 627,282

20 Claims. (Cl. 22—65)

My present invention relates to centrifugal casting apparatus for the manufacture of hollow cylindrical bodies, such as cast iron pipe, and more particularly to that type of apparatus wherein a separate refractory-lined flask is employed in each casting operation.

An important object of the invention is to provide an apparatus of the class referred to, with means for conveying the flasks to and from and through the machine without requiring the use of an overhead crane, such as is now generally employed for this purpose.

Another object of the invention is to provide a centrifugal casting apparatus, the construction of which is such that it lends itself admirably to a "battery" arrangement wherein one or more casting units may be located side-by-side for the simultaneous production of a plurality of pipes or other hollow bodies.

Another object of the invention is to provide a novel charging means for introducing the molten metal into the flask when the latter is in casting position, said means including a pivoted ladle and a pouring spout, with means for automatically advancing and retracting the spout into and out of the flask during the tilting movement of the ladle.

Other features of the invention will hereafter appear in the detailed description to follow, taken in connection with the appended drawings.

Briefly and generally stated, the invention includes among other things, a vertically movable member carrying a plurality of spaced flask-supporting rollers for supporting the flask during the casting operation; flask-transporting means, such as a runway extending transversely of the supporting rollers, and means for raising and lowering the said vertically-movable member with its flask-supporting rollers from a flask-receiving and discharging position below the plane of the transporting means or flask runway to a spinning or rotating position above the plane of the transporting means or runway, combined with means for rapidly rotating the flask when the latter is in its elevated or casting position.

In order to enable others to understand, build and use my said invention I will now proceed to describe the same in detail, reference being had for this purpose to the accompanying drawings, wherein—

Fig. 1 is a plan view showing a plurality of my improved casting units arranged in battery formation.

Fig. 2 is an end elevation, certain parts being shown in section.

Fig. 3 is a vertical sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is a detail, partly in section, of the parts shown in dotted lines at 4—4 of Fig. 2, illustrating the roller cushioning means for the cam bar.

Fig. 5 is an end elevation of the charging ladle and its carriage and the operating mechanism therefor, looking in the direction of the arrows 5—5 of Fig. 2.

Fig. 6 is an end elevation, partly in section, of a slightly modified form of apparatus, the flask-supporting rollers and the carrier member being shown in lowermost position, with the flask resting upon the runway.

Fig. 7 is an end elevation showing one means for raising and lowering the flask-supporting rollers and for supporting the flask at a slight angle during the charging operation.

In the present application I have elected to show a plurality of the casting units in battery formation, four of such units being shown in Fig. 1, but I wish it to be understood that the showing is by way of illustration only and that the invention may be employed as a single unit or in battery formation comprising two or more units.

In the practice of the invention I prefer to locate certain parts of the apparatus above the main floor A of the foundry, and other parts upon a sub-floor B located in a basement below the main floor. As each of the casting units are alike in construction, a description of one will suffice for all.

Each casting unit includes a vertically-movable member 1, upon which is mounted two spaced apart upstanding bifurcated bracket-castings 2, each carrying a pair of spaced flask-supporting rollers 3 mounted upon journals supported in anti-friction bearings (not shown) located at the upper bifurcated portion of each bracket casting 2, each of which has a laterally-extending portion 4 at each side, provided with an upwardly-extending ridge or projection 5 on its upper face for a purpose presently to be described.

The vertically-movable member 1 with its flask-supporting rollers 3, is mounted for movement between vertically-extending columns 6 rising from a transverse bed-casting 7 supported upon the floor B, each column having an integral inwardly-extending portion 8 at its upper end, provided with a groove or depression 9 corresponding with the projections 5 upon the extensions 4, and between each depression 9 and projection 5 is located a yielding buffer or cushion 10 of rubber or other suitable cushioning material for a purpose hereafter to be described.

The flask-supporting rollers 3 are so constructed and arranged as to support the refractory-lined flasks 12, each of which is provided with a pair of supporting bands or tracks 13 which rest upon the rollers 3 to rotatably support the flasks during the spinning or casting operation, and the rollers are peripherally flanged at one side to prevent endwise movements of the supported flask during the casting or spinning operation.

Suitable means is preferably provided for transporting the flasks horizontally into and out of the machine, whether a single or a battery of units are employed. This means, in the instance shown, consists of a runway comprising a pair of spaced rails 14 extending transversely of the machine units, each rail being preferably but not necessarily provided with a curved seat or depression 15 located at a point between each pair of flask-supporting rollers 3, so that when the flask or flasks are rolled over the rails 14 they will come to rest in one of the seats or depressions 15, and thus be properly positioned to be engaged and lifted by the supporting rollers 3 when the vertically-movable member 1 is moved upward, it being understood that during the operation of transporting the flasks into position, the vertically-movable member is in its lowermost position, at which time the flask-supporting rollers 3 are below the plane of the upper surface of the tracks 14.

In order positively to advance the flasks along the tracks 14 and bring them to proper position above the supporting rollers 3, I provide an endless chain carrier 16 mounted upon sprocket wheels 17, located at opposite ends of the machine, one of said sprocket wheels, namely, that one to the right in Fig. 3, being mounted upon a shaft 18, which is driven by sprocket chain 19 from the motor 20, which motor will of course be provided with a suitable manual control means (not shown) for stopping and starting the same at will. The sprocket chain carries a plurality of pairs of spaced lugs 21, in each of which is journaled a roller 22, the rollers of each pair being spaced apart a distance sufficient to engage opposite sides of a flask and roll it over the tracks to position in the seats 15 thereof, it being understood of course that the endless chain 16 will carry as many pairs of rollers 22 as may be necessary to transport and properly position a flask in each casting unit of the battery, the pairs of rollers being accurately spaced on the chains 16 for the purpose specified. The track-way 14 at one end of the machine, as, for instance, the left-hand end of Fig. 3, preferably leads from the sand-ramming station of the foundry where the flasks are prepared with a refractory lining, so that no overhead crane is required to carry the flasks to the machine or battery of machines, it being necessary only to roll the flasks over the track-way to a position to be automatically moved by the endless chain in proper spaced relation, one by one, into the machine or battery of machines where they will be engaged and lifted by the supporting rollers 3. At the other end of the machine, namely, the right-hand end as shown in Fig. 3, the track-way will extend to a point for a subsequent operation, as, for instance, to the ejecting mechanism for removing the casting from the flasks as they are delivered thereto.

Any suitable mechanism may be employed for elevating and lowering the vertically-movable member 1. This mechanism in the instance shown, comprises a horizontally-reciprocating cam-bar 23, as more clearly shown in Fig. 2, upon

which is mounted a pair of spaced upstanding cam-plates 24, said bar 23 being pivoted at one end to a link 25, the other end of the link being pivoted to a crank 26 mounted upon the shaft 27 of a speed-reducer mechanism 28, which is driven by a motor 29, the construction and arrangement of the parts being such that the bar 23 with its cam 24 will make one complete back-and-forth movement during each complete revolution of the crank 26.

The cam-bar 23 is supported near its opposite ends upon grooved rollers 30, each of which is journaled in bearings carried by a vertically-movable block 31 supported for movement between flanged upstanding brackets 32, each block being supported upon a coiled spring 33 to yieldably support the rollers 30. The upper active face of each cam 24 is rounded and bears upon a correspondingly-grooved roller 34 journaled in brackets 35 secured to the under-face of the vertically-movable member 1, so that when the bar 23 with its cams 24 is moved to the left as shown in dotted lines in Fig. 2, the vertically-movable member 1 will move downwardly by gravity to bring its flask-supporting rollers 3 below the plane of the upper face of the tracks 14, and when said bar 23 with its cams 24 is moved to the full-line position shown in Fig. 2, the vertically-movable member 1 with its flask-supporting rollers 3 will be brought to a position above the plane of the upper face of the tracks 14, as more clearly shown in Fig. 3, and when in this position the projections 5 upon the upper faces of the extensions 4 of the vertically-movable member 1, will be yieldably pressed against the rubber blocks or cushions 10 to firmly support the member 1 against undue vibration during the casting operation, the cushioning effect being materially aided by the springs 33 upon which the rollers 30 are supported.

It is sometimes desirable, especially in the manufacture of pipes of small diameter, to tilt the flask slightly at the time the molten metal is charged therein, as such tilting assists in more rapidly and uniformly distributing the metal. To effect such tilting of the flask when desired, I have provided a slightly modified construction of cam which operates to move one side of the vertically-movable member 1, and its flask-supporting rollers, as more clearly shown in Fig. 7.

In said Figure the cam 24^a of the cam-bar 23^a has a portion of its active face 36 on a lower plane than the highest portion of the cam face 24^b of the other cam, so that when the rollers 37 ride upon the portion 36, of the cam, the flask-supporting rollers which support that end of the flask opposite the end in which the metal is poured, will likewise be on a plane lower than the other flask-supporting rollers; hence the supported flask will be inclined downwardly from the pouring end to the other end, as shown in dotted lines in Figure 7. Thus when the metal is poured into the bell end of the flask, due to the inclination of the latter, it will more quickly distribute itself throughout the length of the flask. If desired, the entire spinning operation may be carried on while the flask is slightly tilted, or the flask may be brought to a true horizontal position by a further longitudinal shifting movement of the cam-bar 23^a to bring the rollers 37 onto the highest portion 36^a of the face of the cam.

In the mechanism illustrated in Figs. 2 and 3, for raising and lowering the vertically-movable member I have shown two horizontally-reciprocating cam-bars 23 for each unit, said cam-bars

being connected together by a cross-brace 38, as more clearly shown in Fig. 2, and I also prefer to employ pivoted stabilizing bars 39 each connected at one end to the vertically-movable member 1, and at its opposite end to the fixed part of the machine frame, as more clearly shown in Fig. 2, said bars operating to prevent endwise movement of the vertically-movable member during the raising and lowering position.

Instead of employing two cam-bars 23 for each unit as shown in Fig. 2, I may employ only a single cam bar 40, as shown in Fig. 6, the said bar being guided in its reciprocating movements by rollers 41 bearing upon the opposite faces thereof. In this arrangement the cam-bar is supported on its under edge upon the yieldably-mounted flanged rollers 30^a and its upper edge acts upon a flanged roller 34^a supported upon the underside of the vertically-movable members 1^a.

Any suitable mechanism may be employed for rotating the flask 12 when the vertically-movable member and its flask-supporting rollers is moved upward to bring the flask to the spinning or casting position. In the instance shown in Figs. 1, 2 and 3, this flask-rotating or driving means consists of an endless belt 42 mounted upon a flanged driven pulley 43, and a flanged idler pulley 44, an intermediate run or portion of the belt being positioned to make friction driving contact with a cylindrical ring or band 45 carried by the flask 12. I prefer to employ two such drives for each flask as clearly shown in Fig. 2, but this may not be necessary in every installation. The driven roller or rollers 43 of each unit are mounted upon a shaft 43' coupled to an electric motor 43'', which motor may be of the variable speed type, in which case its speed is suitably controlled by an automatic or manually-controlled means as is common in the art, depending upon whether the molten metal is poured into the flask while the latter is rotating at a high speed, or whether the charging is effected while the flask is rotating at a slow speed and thereafter speeded up to what may be termed "the centrifugal casting speed".

Each idler roller 44 as shown in Fig. 3, is preferably mounted upon a bracket 46, pivoted at 47, which bracket carries an arm 48, upon which a weight 49 is mounted, the weight normally tending to tilt the bracket 46 outward, and thus maintain the endless belt taut so as to increase its friction contact, and therefore its driving action against the flask.

As more clearly shown in Fig. 3, the driving run of the belt 42 is located above and transversely of the flask 13, and is so positioned that when the vertically-movable member is moved to its uppermost position, the driving ring 45 of the flask will be pressed firmly against its driving belt 42. The driving belt 42, may be composed of any material suitable for the purpose, namely, leather, canvas, composition material or metal, either in the form of a band or endless chain of links.

The rollers 43 and 44 constituting the driving means for the flask, may be mounted upon an overhead frame-work 50 supported upon uprights 51, the lower ends of which rest upon the floor B. Obviously, the driving means may be supported in any other approved way. The frame-work 50, may have a cover plate 50^a to cover the machine unit.

Instead of employing the idler roller 44, as the tightening means for the driving belt 42, as shown in Fig. 3, I may employ any other belt-tightening means, as for instance the belt-tight-

ener roller 52 mounted upon a pivoted link 53, as shown in Fig. 6, in which arrangement both the driven roller 43^a and its companion roller 44^a are mounted in fixed bearings as shown.

I do not wish to be understood as limiting myself to the cam-means shown for raising and lowering the vertically-movable member as obviously these members could be raised and lowered by any other suitable power-operated means without departing from the spirit of the invention. If either of the methods shown is employed it will be understood that only a single shaft 27 and a single motor 29 may be employed to impart reciprocating movements to the several cam-bars 23, irrespective of the number of machine units contained in a battery of machines, if a battery arrangement is used. In this instance the shaft 27 will carry as many crank arms as there are units in the battery, and obviously all of the cam-bars will then be operated simultaneously to raise and lower all of the vertically-movable members with their supporting rollers at one and the same time.

Any suitable charging mechanism may be employed to charge molten metal into the flasks 12. In the present instance, the charging mechanism is shown as consisting of a wheeled carriage 54 mounted to move toward and from the flasks upon tracks 55. A tilting ladle 56 is pivotally supported at its front end to the carriage 54, so that its charge of molten metal may be caused to flow into a trough 57, also mounted upon the carriage, the end of the trough being shaped and positioned to enter an end of the flask, as shown in dotted lines in Fig. 2. The ladle 56 is tilted and the carriage is at the same time caused to move forward to bring the discharge end of the spout into the flask by a motor mechanism now to be described. This mechanism consists of a motor 58 which drives a speed-reducing mechanism 59, to the shaft 60 of which is attached a disk 61. A ladle tilting link 62 is pivoted at 63 to a face of the disk near its periphery, the other end of the link being connected to a crank 56' attached to the ladle 56. I preferably employ two disks 61 arranged in spaced parallel relation and between them on a pin 64, I mount a roller 65. Depending from the bottom of the carriage 54 is a bracket arm 66, the lower end of which is forked as at 67, the opposed forked portions being normally disposed between the two disks 61 and arranged so that as the disks rotate in a clock-wise direction, the roller 65 will engage one arm of the fork 67 to shift the carriage 54 to move its spout 57 into one end of the flask, so that as the ladle is tilted through continued movement of the disks, the molten metal will be discharged into the trough and thence directly into the flask. Continued movement of the disks will restore the ladle to normal position and at the same time move the ladle-carrying truck rearwardly to withdraw the spout 57 from the flask due to the roller 65 thereafter making contact with the other fork of the bracket 66, as more clearly shown in full and in dotted lines in Fig. 2.

Obviously if a battery of casting-machine units is employed a single motor 58 and speed-reducer shaft 60 may be employed, the shaft carrying as many disks or sets of disks and ladle-tilting links as there are corresponding carriages and casting units, the arrangement being such that all of the ladles will be tilted simultaneously. Obviously, I do not wish to be understood as lim-

iting myself to the exact ladle-tilting and spout-advancing mechanism shown, as changes or modifications may be made without departing from the spirit of the invention.

5 In the event it becomes desirable for any reason to operate less than the entire number of machine units of a given battery of machines, it is only necessary to detach the link or links 25 from the crank-arms 26, thus throwing out
10 of operation the cam bars 23 which operate the vertically-movable member or members 1. As to such inoperative machines obviously the motors 43" which drive the friction driving belts, will likewise be thrown out of operation and the links
15 62, which tilt the metal pouring ladles, will also be disconnected from their disks 61. By making the simple alterations described it is obvious that power will be saved when some of the machines only of the battery are in use.

20 A centrifugal casting machine unit or a battery of such units embodying the novel features of my invention have many advantages over all other constructions with which I am familiar, and among these advantages the following may be referred to specifically:

25 The freshly-prepared refractory lined flasks are brought to and moved into the machine on smooth runs so that there is little or no likelihood of the refractory lining becoming damaged, as in cases where overhead cranes are employed
30 for carrying the prepared flasks to the machine, the use of overhead cranes being unnecessary with my arrangement.

35 It is not necessary with my invention to make changes in a given machine when changing the size of the flasks to be cast. This is true within certain ranges, as the spinning rollers are so positioned and mounted suitable for several sizes of flasks.

40 The rollers on which the cam-bars are supported are mounted upon springs or some other cushioning material, and such mounting along with the yieldable pads 10 tend to make the flask run smoother during the casting operation,
45 and the ability of the whole machine to give or yield slightly due to any eccentric tendencies of the flask, in an oscillatory motion, and also tends for smoothness of operation, and hence the abuse of improperly balanced flasks is materially reduced, it being understood that smoothness of
50 operation lengthens the life of the machine and reduces repair and maintenance costs.

55 The flask-driving belt or belts 42 serve to hold the flask upon its supporting rollers during the spinning or casting operation, and this makes for smoother running of the flask. The driving arrangement also compensates for and adjusts itself to any differences in sizes of spinning bands or flasks that may be out of balance.

60 The flask-driving means employed permits both ends of the flask to remain open during the charging and casting operation, which allows for free escape of the generated gases, thus less drying of the refractory lining in the flask is required.

65 Due to the facilities for spinning the flask while in an inclined position and for then quickly returning the flask to horizontal position during the spinning operation, the machine is particularly adapted for casting pipes of long length. This is because of the tendency of the inclined flask to assist in the distribution of the metal during pouring and casting.

70 There is not the necessity for alining the flask so accurately with respect to its supporting rollers

ers or to aline it endwise to suit the driving mechanism, such as a clutch as used in other machines.

Smaller driving motors with more simple controls may be used, because there are no external
80 forces acting upon the motor shafts, due to misalignments such as occur with a clutch-driven machine. Obviously constant speed motors may be effectively used.

85 Practically all of the parts going to make up an individual machine may be duplicated to provide a battery arrangement of machines, so that a layout or installation may be added to or deducted from conveniently and economically without substantially disturbing the original installation. Obviously, any number of machines may
90 constitute a battery lay-out.

The automatic pouring or charging mechanism requires practically no attention and performs its various operations with little manual help.
95 Power interruption would cause comparatively little damage, as the motor would stop and the position of the ladle would be fixed instantly when such interruptions occur. This is likewise true of the mechanism for raising and lowering the
100 vertically-movable members, as the entire machine would come to rest in the position at which the interruption occurred.

The battery arrangement of machine units is more economical of construction than that of
105 a single machine of the types now known, and requires less floor space, and in addition to this, the elimination of overhead cranes and other flask-handling mechanisms also tends to materially reduce the initial cost of constructing a
110 plant.

With my improved battery arrangement of machine units the labor cost per machine is considerably less than the labor cost of operation of a single machine of known types.
115

What is claimed is:—

1. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation in a substantially horizontal plane, a
120 flask-driving member located above the flask-supporting rollers and adapted to make driving contact with the flask, and means for elevating and lowering the vertically-movable member to bring a supported flask into and out of driving
125 engagement with the driving member.

2. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation in a substantially horizontal plane, an
130 endless flask-driving belt located above and transversely of the flask-supporting rollers, and means for elevating and lowering the vertically-movable member to bring a supported flask into and out of driving engagement with a run of
135 said belt.

3. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation about its longitudinal axes, a pair of
140 driving belts arranged above and transversely of the said vertically-movable member, and means for elevating and lowering said member to bring a supported flask into and out of engagement with both of said driving belts.
145

4. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation about its longitudinal axes, a flask-driving member located above the flask-support-
150

ing rollers and adapted to make driving contact with the flask, and means for elevating and lowering the vertically-movable member to bring a supported flask into and out of driving engagement with the driving member, said means including mechanism for supporting the flask at an inclination from one end toward the other.

5. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation in a substantially horizontal plane, a flask-driving member located above the flask-supporting rollers and adapted to make driving contact with the flask, means for elevating and lowering said member to bring a supported flask into and out of driving engagement with the driving member, and means for supporting a flask to be rolled into the machine from one side when the vertically-movable member is lowered below the supporting means.

6. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation about its horizontal axes, a flask-driving member located above the flask-supporting rollers and adapted to make friction driving contact with the flask, means for elevating and lowering the vertically-movable member to bring a supported flask into and out of driving engagement with the driving member, and means extending transversely through the machine for supporting a flask rolled into the machine from one side while the flask-supporting rollers are in depressed position and for supporting the flask when rolled out of the machine from the opposite side.

7. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation about its horizontal axes, a flask-driving member located above the flask-supporting rollers and adapted to make friction driving contact with the flask, means for elevating and lowering the said first-named member to bring a supported flask into and out of driving engagement with the said driving member, and a flask runway extending transversely through the machine and adapted to support flasks rolled into the machine from one side and out of the machine from the other side, and to support a flask in the path of upward movement of the flask-supporting rollers, whereby the supported flask may be lifted by the upward movement of the vertically-movable member and brought into driven contact with the driving means.

8. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers, a flask runway extending across the path of movement of the vertically-movable member, means for raising and lowering said member to bring its supporting rollers to positions above and below the runway, and a friction drive located above the vertically-movable member and with which a supported flask makes driving contact when the vertically-movable member is in its elevated position.

9. A centrifugal casting machine comprising a battery of machine units arranged side by side and each including a vertically-movable member carrying a plurality of flask-supporting rollers, a flask runway extending across the path of movement of all the vertically-movable members of the battery of machines, means for raising and lowering each of said members to bring their respective supporting rollers to positions above and

below the said runway, and means for rotating flasks supported upon said rollers when the vertically-movable members are in positions above the runway.

10. In a centrifugal casting machine, a vertically-movable member carrying a plurality of spaced flask-supporting rollers, means extending across the path of movement of said vertically-movable member to transport a flask in position to rest horizontally upon the supporting rollers, means for raising and lowering said vertically-movable member to positions above and below the plane of the flask transporting means, and means for rotating a flask supported upon said rollers when the vertically-movable member is in elevated position.

11. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers, a flask runway extending across the path of movement of the vertically-movable member, means for raising and lowering the said member to bring its supporting rollers to positions above and below the flask runway, and means for rotating a flask supported upon said rollers.

12. A centrifugal casting machine comprising a vertically-movable member having means for supporting a flask for rotation about its longitudinal axes, a flask runway extending across the path of movement of the vertically-movable member, means for raising and lowering the said member to bring its flask-supporting means to positions above and below the runway, means for rotating a supported flask when the vertically-movable member is in its raised position, and means for advancing a flask along the runway.

13. A centrifugal casting machine comprising a vertically-movable member having means for supporting a flask for rotation about its longitudinal axes, a flask runway extending across the path of movement of the vertically-movable member, means for raising and lowering the said member to bring its flask-supporting means to positions above and below the runway, means for rotating a supported flask when the vertically-movable member is in its raised position, and an endless carrier having a run thereof movable parallel with the runway for engaging and advancing a flask into the machine along said runway.

14. A centrifugal casting machine comprising a battery of machine units arranged side by side and each including a vertically-movable member carrying a plurality of flask-supporting rollers, a flask runway extending through the machine across the path of movement of all the vertically-movable members of the battery, means for raising and lowering all the said members to bring their respective supporting rollers to positions above and below the runway, means for rotating the flasks supported upon the said rollers when the vertically-movable members are in elevated position above the runway, and means for advancing a plurality of flasks over said runway and for positioning them in the respective machine units.

15. A centrifugal casting machine comprising a battery of machine units arranged side by side and each including a vertically-movable member carrying a plurality of flask-supporting rollers, a flask runway extending through the machine across the path of movement of all the vertically-movable members of the battery, means for raising and lowering all the said members to bring their respective supporting rollers to positions above and below the runway, means for rotating flasks supported upon the said rollers when the

vertically-movable members are in elevated position above the runway, and an endless propelling means for advancing a plurality of flasks along said runway into the battery of machines.

5 16. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation about its longitudinal axes, a flask-driving member located above the flask-supporting rollers and adapted to make driving contact with the flask, and a longitudinally-reciprocating cam bar for elevating and lowering the vertically-movable member to bring a supported flask into and out of driving engagement with the driving means.

15 17. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation about its longitudinal axes, a flask-driving member located above the flask-supporting rollers and adapted to make driving contact with a flask supported thereon, a horizontally-reciprocating cam bar for elevating and lowering the vertically-movable member to bring a supported flask into and out of driving engagement with the driving member, and cushioning rollers for supporting the cam bar in its back and forth movements.

20 18. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation about its longitudinal axes, a flask driving member located above the flask-supporting

rollers and adapted to make driving contact with the flask, means for elevating and lowering the vertically-movable member to bring a supported flask into and out of driving engagement with the driving member, and cushioning means for the vertically-movable member. 80

19. A centrifugal casting apparatus comprising a battery of machine units arranged side by side and each including a vertically-movable member carrying a plurality of flask-supporting rollers, a flask runway extending across the path of movement of all said members of the battery, means for raising and lowering said members to bring their respective supporting rollers to a position above the runway, means for rotating flasks supported upon said rollers, and means for simultaneously charging molten metal into all the supported flasks when the vertically-movable members are in elevated position. 85 90

20. A centrifugal casting machine including a vertically-movable member carrying a plurality of flask-supporting rollers to support a flask for rotation about its horizontal axes, a flask driving member located above the flask-supporting rollers and adapted to make driving contact with a flask supported thereon, and a horizontally reciprocating bar having cam portions for engaging and elevating the vertically-movable member, one of said cam portions being constructed to raise one end of said member to a higher plane than the other end whereby to support a flask on an incline. 95 100 105

WALTER MORGAN.

35 110

40 115

45 120

50 125

55 130

60 135

65 140

70 145

75 150