May 9, 1933. H. R. HOKIN 1,908,607

CENTRIFUGAL CASTING MACHINE

Filed Jan. 25, 1930 3 Sheets-Sheet 1

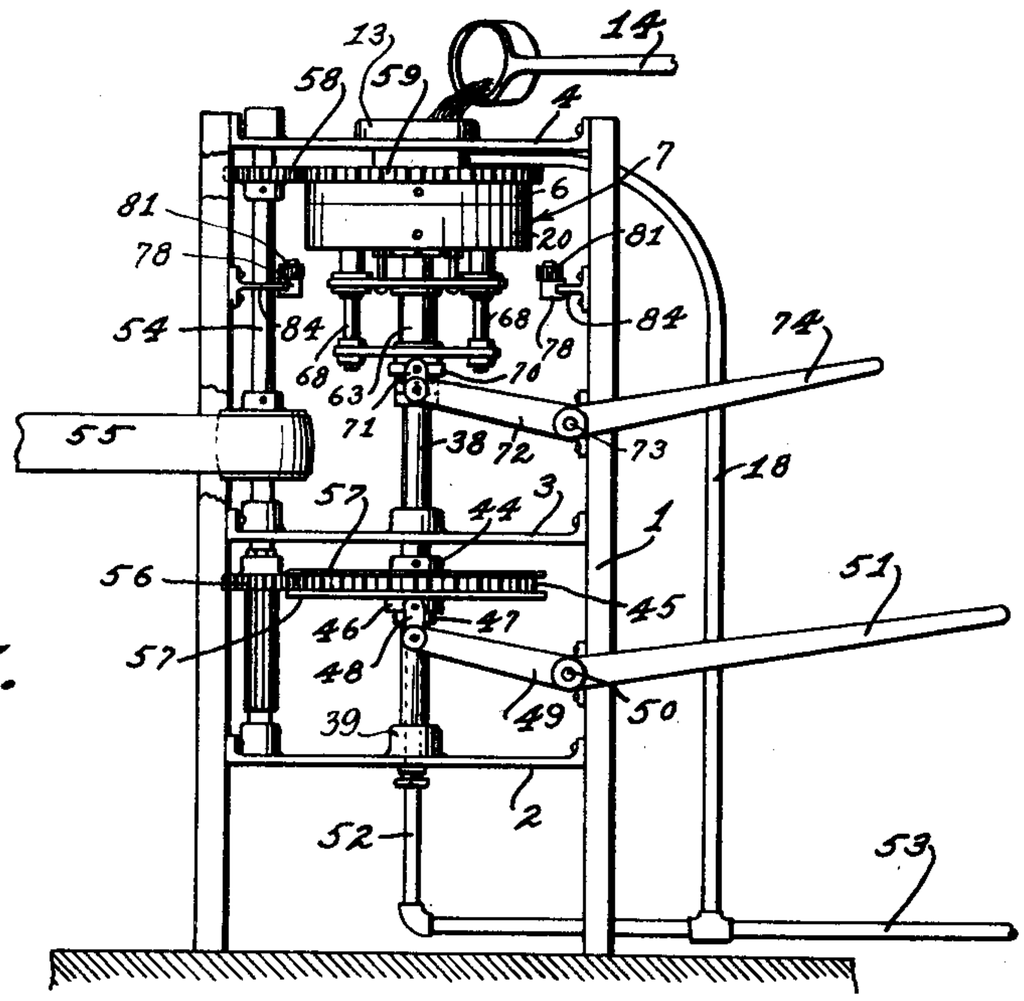

Fig. 1.

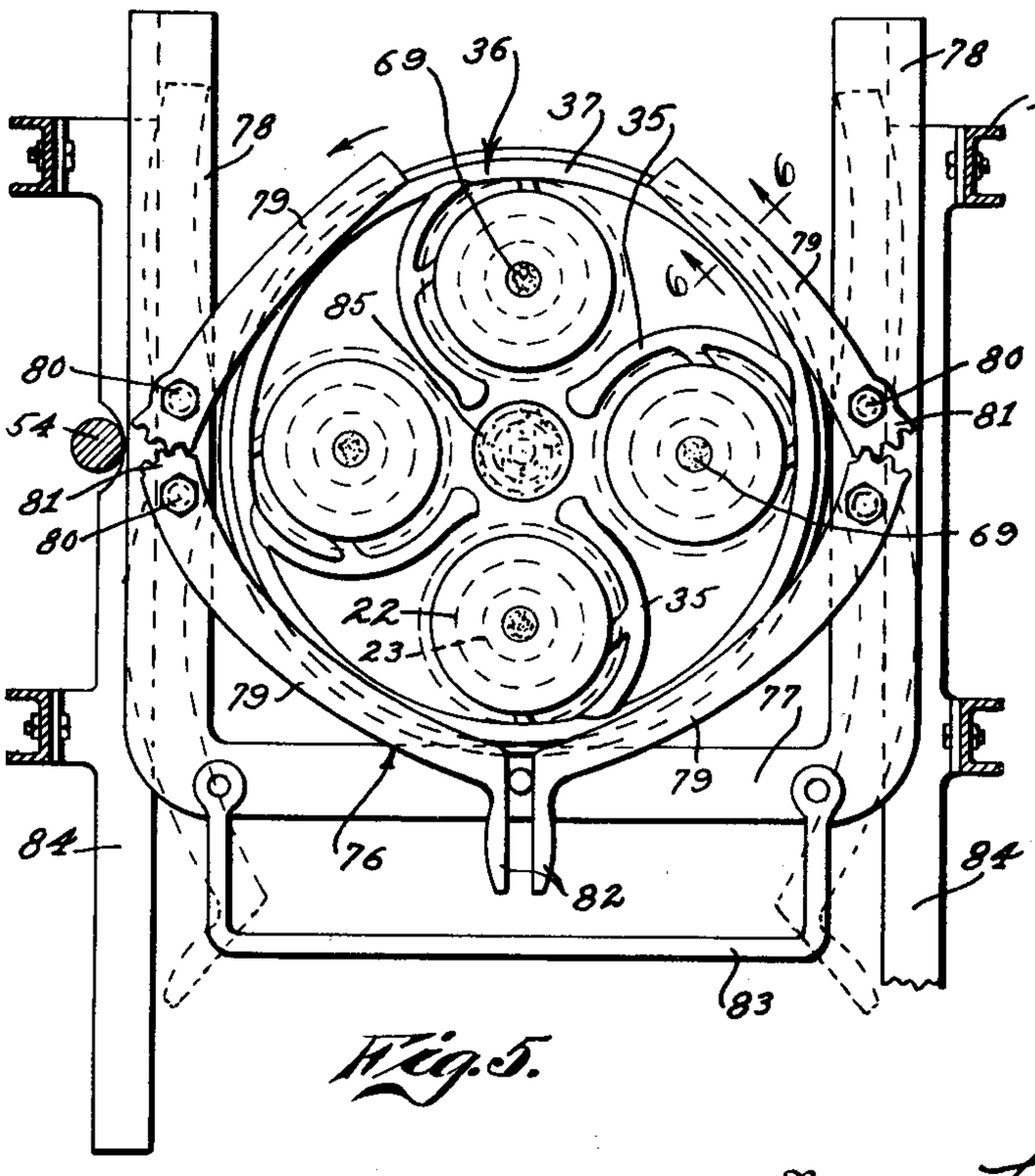

Fig. 5.

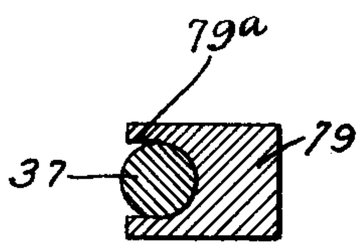

Fig. 6.

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CENTRIFUGAL CASTING MACHINE

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Fig. 2.

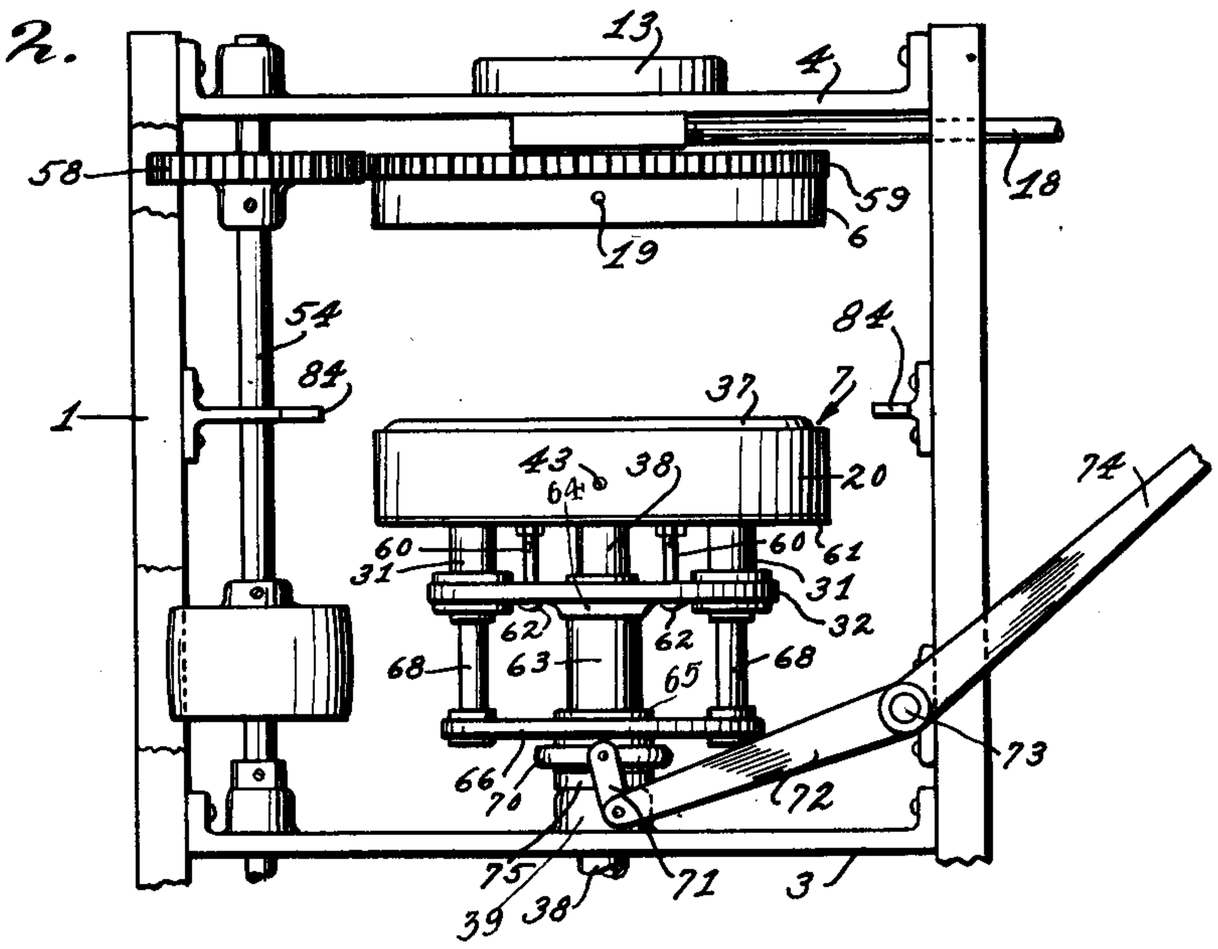
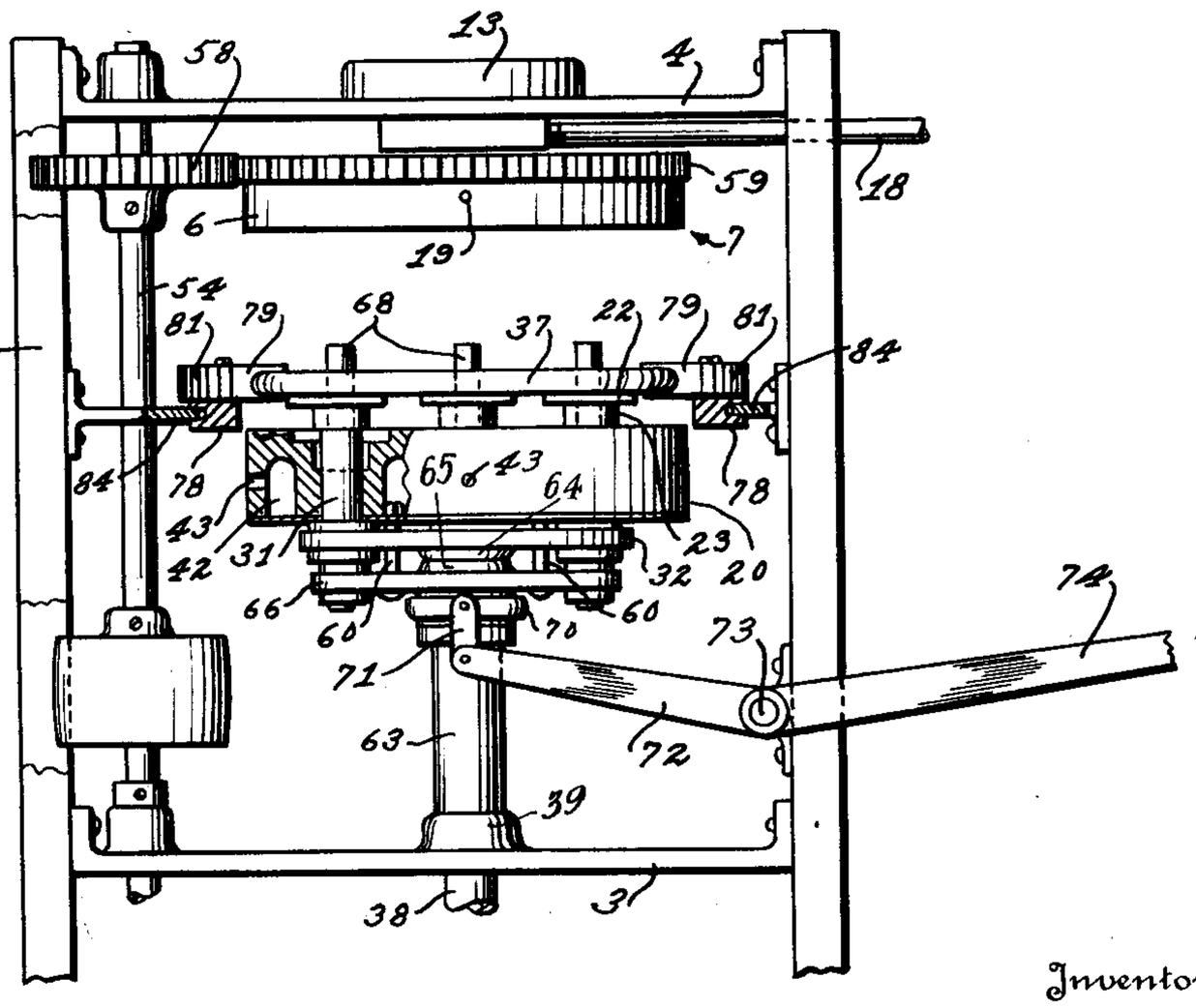


Fig. 3.



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CENTRIFUGAL CASTING MACHINE

Filed Jan. 25, 1930 3 Sheets-Sheet 3

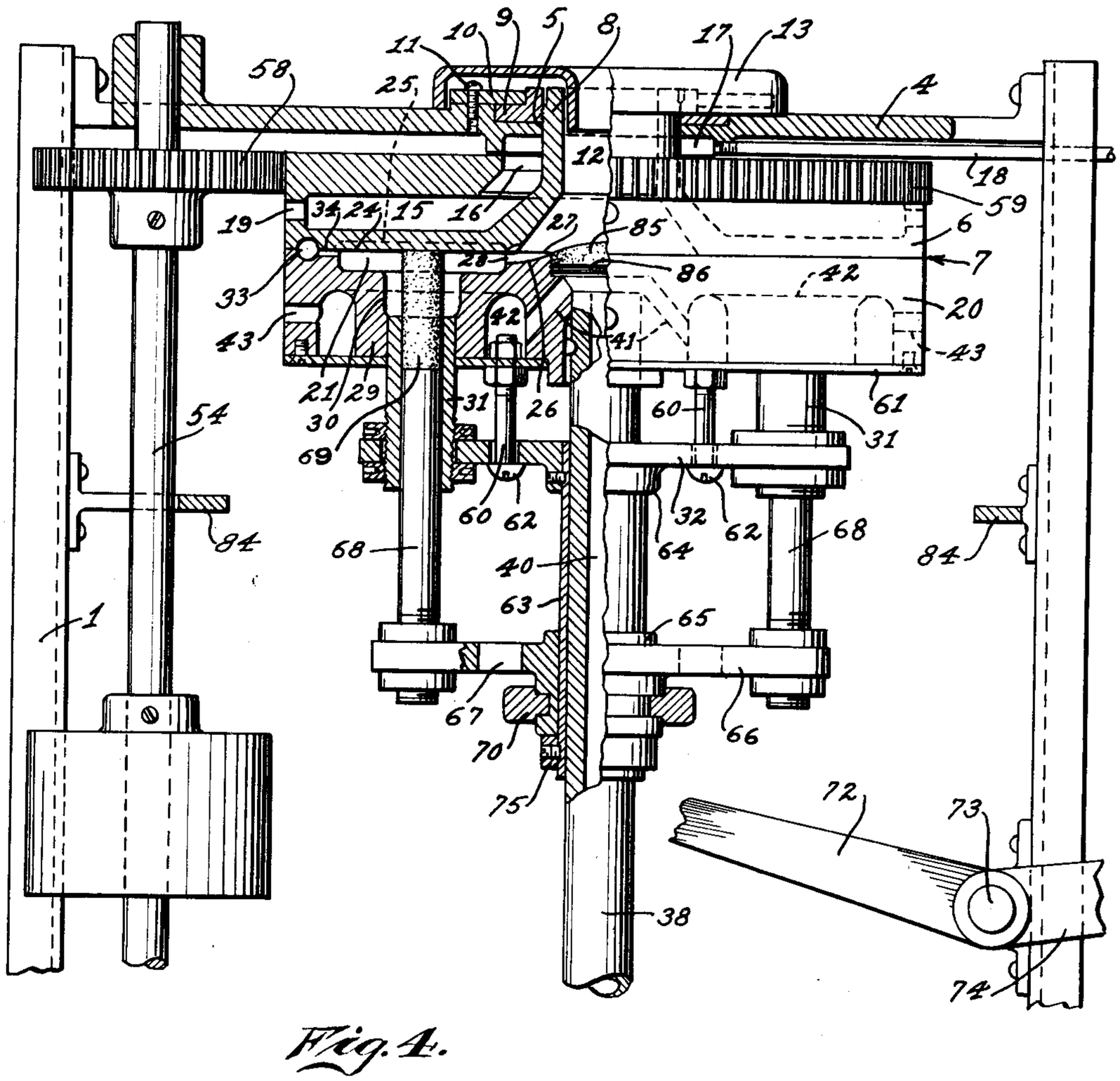

Fig. 4.

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UNITED STATES PATENT OFFICE

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CENTRIFUGAL CASTING MACHINE

Application filed January 25, 1930. Serial No. 423,398.

This invention relates to casting machines, and the general object of the invention is to produce a machine of simple construction which can be operated to cast small articles in large quantities and with a minimum of hand labor. While the invention may be employed in casting articles of any shape, it is particularly adaptable for casting articles of simple form and is also especially adapted for use in a machine of centrifugal type in which the metal poured into the mold is forced outwardly by centrifugal force into the mold compartments. This is advantageous because it insures perfect filling of the mold chambers and consequently enables a high percentage of perfect castings to be produced.

One of the objects of the invention is to provide a construction which will facilitate the opening and closing of the mold and the removal of the cast articles. In the present embodiment of the invention I propose to produce a connected casting in which all of the molded articles are connected together, and this method is utilized to facilitate the removal of the molded articles simultaneously from the mold; one of the objects of the invention is to provide simple means to cooperate with such a mold to effect this mode of operation.

One of the objects of the invention is to provide simple means for effecting circulation of a cooling fluid through the mold to insure immediate cooling of the molded articles so that they can be removed from the mold without delay. This enables the mold to be filled and emptied at a rapid rate, thereby giving a large casting capacity for the machine.

A further object of the invention is to provide a construction for the parts of the mold which will enable the mold to operate effectively as a centrifugal mold and at the same time to avoid the necessity for providing matching elements, such as dowel pins and dowel sockets, to insure proper registering or alignment of the cope and drag of the mold when the same are brought together to close the mold.

Further objects of the invention will appear hereinafter.

The invention consists in the novel parts and combinations of parts to be described hereinafter, all of which contribute to produce an efficient centrifugal casting machine.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawings:

Figure 1 is a side elevation of a casting machine embodying my invention and showing a portion of the drive belt broken away.

Figure 2 is a front elevation of the upper portion of the machine shown in Figure 1 upon an enlarged scale and showing the mold in an open condition, certain parts being broken away.

Figure 3 is a view similar to Figure 2 showing the mold open and showing the parts in a second stage in the process of removing the casting made in the mold. This view shows a portion of the mold in cross section and also shows a portion of the handling device for handling the whole casting, or "spider" when the same is ejected from the mold.

Figure 4 is a side elevation in partial section of the upper portion of the machine, certain parts being broken away, and illustrating the mold in its closed condition, also further illustrating the means for supporting and operating the ejectors for the molded articles and the means for supporting and operating the cores.

Figure 5 is a horizontal section taken about on the line 5—5 of Figure 3 and particularly illustrating the handling device, together with the means for operating it to effect the removal of the entire casting or "spider" from the mold.

Figure 6 is a cross section taken about on the line 6—6 of Figure 5 but upon an enlarged scale.

Before proceeding to a detailed description of the invention, it should be understood that the construction of the apparatus is such as to enable the cast articles to cool very quickly. For this purpose, and also to enable large quantities of the articles to be produced rapidly with this mold, I construct the mold as

a gang mold, that is to say, the mold has a plurality of molding chambers into which the metal is run. The use of a gang mold of this kind lends itself very readily to the quick cooling feature because it facilitates the formation of a cooling chamber enveloping parts of the individual molds. This, of course, enhances the cooling effect and chills the metal very quickly. On this account the mold can be very quickly filled and the solidified casting ejected from the mold.

The mold of course is constructed so that access can readily be had to the interior of the mold to enable the cast metal to be removed.

One of the difficulties in producing castings with chilled molds is that unless the metal flows very quickly into the mold, it will become chilled, and the chilled metal may interfere with the complete filling of the mold. For this reason the use of chilled molds in a centrifugal type casting machine is particularly advantageous because by reason of the centrifugal force the mold fills instantly with the molten metal. In this way there is not sufficient time for the metal to chill while passing into the mold, but it does chill immediately after the mold is filled, and the casting can then be ejected.

It is usually necessary in the construction of molds to provide some means for insuring that the mold sections register properly together, and this is particularly necessary where a portion of the molded article is cast in the cope and a portion in the drag. In a centrifugal molding machine, if only the drag is rotated, or if only the cope is rotated, the torque that drives the part there is not driven directly must be imparted through dowel pins or other connections insuring proper alignment or orientation of the drag and cope.

One of the novel features of my improvement is that I eliminate the necessity for the use of dowel pins or other connections between the drag and cope by rotating the cope and the drag independently but at the same speed of revolution so that they always maintain the same relative alignment, that is to say, the same orientation, with respect to each other.

In a centrifugal type of machine such as described in the following specification, I prefer to rotatably support the cope in a relatively fixed position and provide it with a central filling gate for the mold located on the axis of rotation. The drag is mounted below the cope and I provide means for effecting relative movement between the cope and drag so as to open the mold. This is preferably effected by maintaining the cope in a relatively fixed position and then dropping the drag to open the mold.

According to my invention, I provide means when the drag is dropped to eject the molded articles. Furthermore, in order to facilitate the quick removal of the casting from the mold, I prefer to provide the mold with a marginal chamber which is filled with the metal at each casting operation, and which is gated to the cast articles. In this way at each casting operation I cast a "spider" carrying the molded articles all connected up to an outer member which may be of circular form when the mold has that shape. This is the preferable shape in centrifugal molding. This outer cast member or ring is employed to facilitate the removal of the entire "spider" when it is ejected from the open mold.

In order to accomplish this effect I provide a frame 1, which may be constructed of light angle iron comprising posts connected by horizontal bars 2, 3 and 4, the upper bar 4 being in the form of a head having a central opening 5 (see Fig. 4), in which the cope 6 of the mold 7 is mounted. This cope is of circular form and is provided with an upwardly extending neck 8 that is supported on the upper face of the head 4 by means of a ring 9 that is threaded to the outer side of the neck. If desired, this ring 9 may be covered by a ring 10 held down by machine screws 11. The opening 12 through the tubular neck 8 operates as a gate through which the molten metal may be poured, and if desired, a collar 13 may be permitted to rest on the upper side of the head 4 to operate as guide for pouring in the metal. The metal may be poured if desired from a ladle 14, such as indicated in Figure 1. In order to chill the cope 6, it is formed with a cooling chamber 15 having an inlet opening 16 located around the neck 8 and communicating with a shallow inverted dish-shape chamber 17 in the under side of the head 4. This chamber is supplied with a chilling fluid, such as cold air, through a supply pipe 18. The chilled air flows out from the cope through a plurality of air vents 19. It is obvious that if desired a liquid could be used instead of air, in which case a single outlet would be employed instead of the outlets 19, and the same would be connected to a return flow pipe for carrying the liquid back to a refrigerating coil.

The mold 7 includes a drag 20 that is located below the cope and mounted so that it can be shoved up against the under side of the cope or dropped down from it to open the mold. It is most practical to construct the mold so that the principal part of the molding chamber for the article or articles to be molded is located in the drag.

While articles of any shape can be produced in this mold, in the present instance, by way of example, I have illustrated the mold as constructed to produce a plurality of bushings of the form illustrated by the mold chamber 21, illustrated in Figure 4. These bushings 22 are illustrated in Figure 5.

They have bodies of disk form with tubular extensions 23, which are cast below the disks in the drag. If desired, the upper face of each molded article may be chilled against a plain bottom face 24 of the cope, but if desired, the upper portion of the cast article may be cast in the cope as indicated by the dotted line 25 in Figure 4. These mold chambers 21 are disposed circumferentially around in the mold and in the present instance I illustrate four such chambers. Their inner portions are all gated by suitable gate openings 26 to the flared mouth 27, which is formed at the lower end of the tubular gate 12 (see Fig. 4). At the periphery of the flared mouth 27 gutters 28 may be formed in the face of the cope opposite the gate openings 26 to facilitate the flow of metal by centrifugal force outwardly from the gate opening 12 into the individual molds or mold chambers 21.

Each mold chamber 21 is preferably formed with a downwardly extending annular wall 29 that surrounds the tubular extension 30 of the mold chamber that is to form the tubular portion 23 of the bushing. The bottom of this portion of the mold is formed by an ejector 31 which corresponds to each mold chamber 21, and these ejectors are preferably of tubular form and are all carried adjustably in an upper cross-head 32 so that they can be moved up or down in unison.

Extending around the interior of the mold I provide a mold channel 33 which is gated as indicated at 34 to the individual molding chambers 21. In addition to this, in order to insure ample supply of the molten metal, I prefer to provide the mold with arcuate canals, the result of which is that when the metal is cast, curved extensions 35 of the cast metal are produced which extend around portions of the periphery of the individual mold chambers 21 (see Fig. 5). In this way it will be evident that at each casting operation a "spider" 36 is formed which consists of the molded articles or bushings 22 connected up to an outer ring 37. This ring facilitates the removal of the "spider" from the open mold as will be described hereinafter.

The drag 20 is carried on a central vertical shaft 38 which is mounted for rotation in bearings 39 formed on the cross bars 2 and 3 (see Fig. 1). This shaft 38 is formed with central duct 40 to carry in the cooling fluid to the interior of the drag 20.

For this purpose the shaft 38 is of tubular form and its open upper end communicates by radial ducts 41 (see Fig. 4) with a cooling chamber 42 that is formed in the drag and which surrounds the walls 29 of the individual mold chambers. The periphery of the drag may be provided with air vents 43 through which this cooling air may escape in the atmosphere.

The upper end of the shaft 38 is rigidly secured to the drag 20 so that when this shaft is permitted to drop, it will carry down the drag and thereby open the mold. Any suitable means may be employed for accomplishing this. In the present instance I provide a collar 44 which is rigidly secured to the shaft 38 above a gear wheel 45 that is keyed to the shaft (see Fig. 1), and below the gear wheel 45 I provide a slip ring 46 carried on a collar 47 which is rigidly secured to the tubular shaft 38. This slip ring 46 is connected by links 48 to arms 49 secured on a rock shaft 50 that is mounted on the frame and operated by an actuating lever 51. With this arrangement of parts it will be evident that by pulling up on the lever 51 the shaft 38 will be pulled in a downward direction, that is to say, the shaft will slide down through its bearings 39, thereby depressing the drag 20 and opening the mold. The lower end of the shaft 38 makes a sliding connection with a vertical piece, 52, of pipe, that is connected to a supply pipe 53 that supplies the cooling air to the mold.

The gear wheel 45 is provided so as to enable rotation to be imparted to the shaft 38. In order to accomplish this, and also to rotate the cope of the mold in unison with the drag, I provide a vertical countershaft 54 that may be driven by a belt 55, and the lower end of this shaft is fluted to carry a driving pinion 56. This driving pinion engages the teeth of the gear 45 and is slid up and down with the gear 45 by reason of flanges 57 on the gear wheel that project over the upper and lower faces of the pinion.

The upper end of the shaft 54 carries a pinion 58 of the same diameter as the pinion 56, and this pinion meshes with gear teeth 59 formed around the margin and upper portion of the cope; in other words, these teeth 59 form a gear wheel around the cope.

Any suitable means may be employed for producing a relative upward movement of the ejectors 31 when the mold is open. However, I accomplish this in a simple manner by suspending their cross-head 32 from the under side of the drag and permitting the cross-head to have a relative upward movement by reason of the downward movement of the shaft 38. For this purpose I suspend the cross-head 32 on a plurality of long adjustable bolts 60. The upper ends of these bolts are adjustably mounted in a bottom plate 61 secured to the under face of the drag 20 and operating to close the underside of its cooling chamber 42.

When the mold is in its closed condition the cross-head 32 is supported on the lower heads 62 of the suspending bolts 60. The cross-head 32 is rigidly secured to a sliding sleeve 63 on the shaft 38, and when the shaft

38 is let down all the way to open the mold, the hub 64 of the cross-head 32 seats on corresponding hub 65 on a lower cross-head 66. This cross-head 66 stops the downward movement of the cross-head 32 but permits the continued downward movement of the drag 20 (see Fig. 3).

If desired, clearance openings 67 may be provided in the lower cross-head 66 to permit this mode of operation. The lower cross-head 66 may carry cores 68 to move up through the tubular ejectors 31 in the interior of the mold so as to produce cored openings in the molded articles. If desired, the upper ends 69 of these bars may be formed of baked core sand, or other refractory material may be used. Furthermore, the ejectors 31, as they come in contact with the metal may, if desired, also be formed of some refractory material.

The lower cross-head 66 is mounted so that it can be slid up and down on the sleeve 63, for which purpose it is provided with a slip collar 70 connected by links 71 with arms 72 actuated by a rock shaft 73 and operating lever 74 (see Fig. 3). When the mold is in its open condition, as illustrated in Figure 3, the upper faces of the core bars 68 are flush with the upper face of the drag 20 so as to permit the sand cores 69 to slide off of the bars 68 when the "spider" 36 is removed from the mold (see Fig. 3).

The lower end of the sleeve 63 is provided with a fixed collar 75 that limits the downward movement of the cross-head 66 on this sleeve. When the mold is closed the slip collar 70 is located near the upper face of the collar 75.

When the mold is in its open condition, as illustrated in Figure 3, in order to seize the "spider" 36 and pull it away from the mold to permit the mold to be reclosed, I provide a carrier 76 (see Fig. 5). This carrier consists of a three-sided frame having a cross bar 77 and side bars 78, the latter of which are provided with arms 79 pivoted on pivot bolts 80 and capable of swinging inwardly so as to engage the ring member 37 of the "spider". For this purpose the inner faces of the arms 79 are formed with half round grooves 79ª (see Fig. 6). These arms 79 are disposed in pairs, each pair corresponding to one of the side bars 78, and each pair of arms is provided at the inner end with segments 81, the teeth of which mesh together so that the arms swing in and out in unison. The arms 79 that are disposed toward the front side of the frame are provided with handles 82 for operating them. Their movement is of course imparted through the segments 81 to the rear arms. As soon as the arms 79 have seized the ring 37, the operator of the machine pulls the carrier frame outwardly by means of a handle bar 83 that is attached to the cross bar 77 of this frame.

The frame of the carrier is mounted to slide on guiding means in the form of two rails 84 that are parallel with each other, and which extend in a front and rear direction on the frame, being supported on the sides of the frame (see Fig. 3).

Immediately under the filling gate of the cope the drag is provided with a spatter plate 85 that is seated in a recess on the upper face of the drag. This spatter plate is preferably convex on its upper face and is formed of refractory material capable of withstanding the contact with the hot poured metal. This plate may seat on its under side on a disk 86 screwed into a recess in the drag. This plate 86 operates to close off the upper end of the duct 40 so as to facilitate directing the air that comes up this duct, over into the air chamber 42. This spatter plate 85 may be renewed from time to time if that is necessary.

A mode of operation of the machine is substantially as follows:

The mold is filled as indicated in Figure 1 by pouring the molten metal into the cope at the point 12 (see Fig. 4). While this is taking place, the mold is being rotated at a high velocity on its longitudinal axis by rotating the shaft 38 that carries the drag and by rotating the cope 6 through the medium of pinion 58 that engages the teeth 59 on the cope.

The pinion 56 is mounted on flutes on the countershaft 54 so that it can slide up and down when the shaft 38 is raised to close the mold, or lowered to open the mold, by means of the levers 49 and 51. The metal 40 in the mold immediately comes under the influence of the centrifugal force and is thrown outwardly through the openings 26 radially into the mold chambers 21. At the same time the metal passes into curved canals located between the mold chambers 21 which produce the curved extensions 35 of the complete casting or "spider" 36. These canals communicate with the mold spaces or chambers by gates so that the metal flows from each curved canal into its corresponding mold chamber, thereby connecting the metal flowing in the canals with the metal that forms the cast articles 22. The outer ends of the curved channels communicate with the annular channel 33 through gates 34 (see Fig. 4), and the metal flowing in this annular channel produces a ring 37 forming the outer portion of the entire casting or "spider".

The direction of rotation of the mold is preferably left-hand, as indicated by the arrow in Figure 5, to correspond with a backward curving of the extensions 35 toward the margin of the mold. The connection between the curved canals that produce the extensions 35 are preferably substantially tangent to the mold chambers (see Fig. 5). This results in ejecting the metal into the

molds with a centrifugal action and assists in completely filling the mold.

After sufficient metal has been poured in to fill the mold spaces 21 and to form the complete "spider" 36, the mold may be immediately opened. In order to do this, the levers 74 and 51 are pulled upwardly. This opens the mold as indicated in Figure 3, and causes the ejectors 31 to eject the "spider" from the mold, bringing it up to an elevated position, such as that indicated in Figure 3. Before this occurs, however, the operator of the mold positions the carrier device illustrated in Figure 5 so that its arms 79 lie open and near the periphery of the outer ring 37 of the "spider". After the mold has been opened in this way, the handles 82 of the carrier device are pulled inwardly, thereby operating all of the arms 79 to make them seize the ring 37. The operator then seizes the handle 83 and pulls the carrier frame outwardly. This will pull the "spider" or complete casting free of the mold and after the "spider" is out of alignment with the mold, the carrier can be opened so as to drop the "spider" onto a conveyor or onto the sand of the foundry floor.

While the casting operation is going on, cold air is being supplied to the mold through the supply pipe 53 (see Fig. 1).

It is understood that the embodiment of the invention described herein is only one of the many embodiments this invention may take, and I do not wish to be limited in the practice of the invention, nor in the claims, to the particular embodiment set forth.

What I claim is:

1. In a casting machine, the combination of a mold having a drag and a cope, a frame supporting the same and having means for separating the drag and cope to open the mold, said mold having a gang of mold chambers for molding a gang of articles simultaneously, and having a mold channel extending around on the interior of the mold connecting with the mold chambers, said mold channel operating to produce an extension of the casting to facilitate the removal of the gang of molded articles, means for raising the molded articles and the said molded extension relatively to the drag when opening the mold, and means for engaging the molded extension for removing the same and the molded articles in a general horizontal direction simultaneously from the mold.

2. In a casting machine, the combination of a mold having a drag and a cope, a frame supporting the same and having means for separating the drag and cope to open the mold, said mold having a gang of mold chambers for molding a gang of articles simultaneously, and having a mold channel extending around on the interior of the mold connecting with the mold chambers, said mold channel operating to produce an extension of the casting to facilitate the removal of the gang of molded articles, means for raising the molded articles and the said molded extension relatively to the drag when opening the mold, guides mounted on the frame, and means mounted on the guides for engaging the molded extension for removing the same and the molded articles simultaneously from the mold.

3. In a casting machine, the combination of a mold having a drag and a cope, a frame supporting the same and having means for separating the drag and cope, said mold having a central filling gate and a plurality of mold chambers connecting to the gate to mold a gang of articles simultaneously, and having an outer mold channel extending around the periphery of the mold beyond the mold chambers and gated into the mold chambers, said channel having extensions corresponding to the mold chambers and gated thereto, and means for rotating the mold on a central axis.

4. In a centrifugal casting machine, the combination of a frame, a mold having a drag and a cope supported on the frame, means for raising and lowering the drag relatively to the cope to open the mold, means for ejecting the casting of molded articles from the drag when the same is in a lowered position, and means supported on the frame for engaging the ejected casting and moving the same in a general horizontal direction out of line with the open mold.

5. In a casting machine, the combination of a frame, a cope supported on the frame and having a filling gate, a drag supported on the frame under the cope and having means for lowering the same to open the mold, means associated with the drag for raising the casting out of the lowered drag, and means mounted on the frame for engaging the casting when the mold is open and for guiding the casting out of line with the open mold.

6. In a centrifugal casting machine, the combination of a frame, a mold having a cope supported on the frame for rotation on a vertical axis, and having a filling gate located on said axis, a drag supported on the frame under the cope, said drag and said cope being relatively movable and having means for separating the same to open the mold, said cope and said drag cooperating to form a gang of molding chambers for molding a gang of articles, said molding chambers communicating with said filling gate, and means for rotating the mold on said axis.

7. In a centrifugal casting machine, the combination of a frame, a mold having a cope supported in the frame for rotation on a vertical axis, a drag below the cope having means for lowering the same to open the mold, said drag and said cope cooperating to form a gang of mold chambers to mold a gang of ar-

ticles, said cope having a filling gate on said axis communicating with said molding chambers, a cross-head guided to move vertically with ejectors passing through the drag to eject the gang of molded articles, and means for rotating the mold.

8. In a casting machine for molding gangs of cored articles, the combination of a fixed frame, a mold having a cope supported in the frame and a drag below the cope, means for guiding the drag for vertical movement on the frame, with means for raising and lowering the drag to close and open the mold, said drag having a cross-head with means for suspending the same on the underside of the drag, a plurality of tubular ejectors carried by the cross-head for ejecting the molded articles from the open mold, a second cross-head below the first named cross-head and movable up and down relative to the same, and a plurality of cores carried by the last named cross-head mounted to slide through the ejectors and into the mold.

9. In a centrifugal casting machine, the combination of a frame, a mold having a cope rotatably supported in the frame, means for rotating the cope on its central axis, a drag below the cope, said drag and cope having a plurality of mold spaces formed partly in the drag and partly in the cope, a vertical shaft mounted on the axis of the cope carrying the drag, means for raising and lowering the said shaft to close and open the mold, and means for rotating the shaft to rotate the drag at the same angular velocity as the cope and thereby maintaining the said parts of the mold spaces in the cope in register with respect to the cope, said cope having a filling gate on its central axis.

10. In a centrifugal casting machine, the combination of a frame, a mold having a cope rotatably supported in the frame, means for rotating the cope on its central axis, a drag below the cope, a vertical shaft mounted on the axis of the cope carrying the drag, means for raising and lowering the said shaft to close and open the mold, means for rotating the shaft to rotate the drag in unison with the cope, said cope having a filling gate on its central axis, said shaft being of tubular form and said drag having a cooling chamber within it communicating with the interior of the tubular shaft to enable a cooling fluid to be circulated up the shaft and through the drag.

11. In a centrifugal casting machine, the combination of a frame, a mold having a cope rotatably supported in the frame, said cope having a plurality of mold spaces formed therein, means for rotating the cope on its central axis, a drag below the cope, a plurality of mold spaces formed partly, in the drag and partly in the cope, a vertical shaft mounted on the axis of the cope, and carrying the drag, means for raising and lowering the said shaft to close and open the mold, and means for rotating the shaft to rotate the drag at the same angular velocity as the cope to maintain the parts of the mold spaces in the cope and in the drag in register with each other, said cope having a filling gate on its central axis, and a spatter plate of refractory material carried by the upper side of the drag under the said gate, for receiving the metal when poured down the said gate.

12. In a centrifugal casting machine, the combination of a frame, a mold having a cope supported in the frame for rotation on its central vertical axis, said cope having a cooling chamber therein with means for conducting a cooling fluid through the same, a drag below the cope with means for raising and lowering the same to close and open the mold, said drag having a plurality of molding chambers therein, and having a cooling chamber, a vertical shaft on the said central axis of the cope supporting the drag and having a duct through the same communicating with the cooling chamber of the drag for circulating the cooling fluid therethrough.

13. In a centrifugal casting machine, the combination of a frame, a mold having a cope supported in the frame for rotating on its central vertical axis, said cope having a cooling chamber therein with means for conducting a cooling fluid through the same, a drag below the cope with means for raising and lowering the same to close and open the mold, said drag having a plurality of molding chambers therein, and having a cooling chamber, a vertical shaft on the said central axis of the cope supporting the drag and having a duct through the same communicating with the cooling chamber of the drag for circulating the cooling fluid therethrough, means for rotating the cope on its central axis, and means for rotating the said shaft on its central axis to revolve the drag in unison with the cope.

Signed at Los Angeles, Cal., this 20th day of January 1930.

HARRY R. HOKIN.