

June 9, 1931.

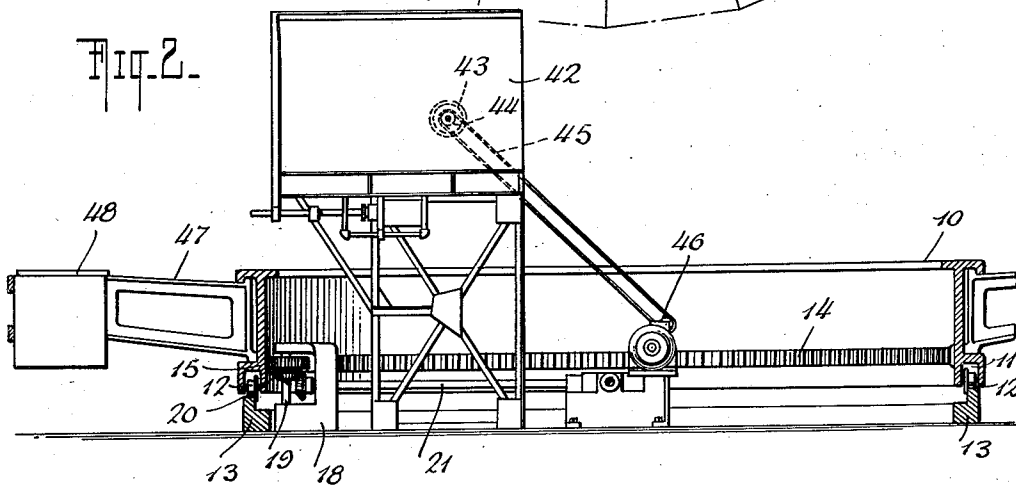
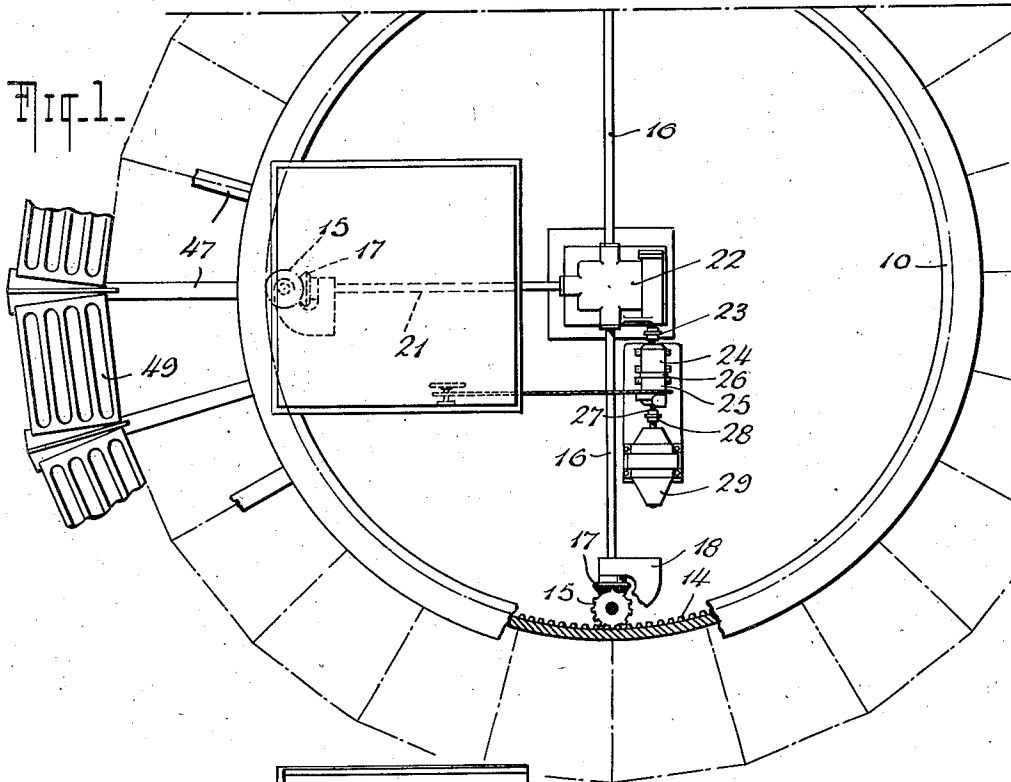
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APPARATUS FOR CASTING COPPER INGOTS AND OTHER ARTICLES

Filed Nov. 30, 1929

2 Sheets-Sheet 1



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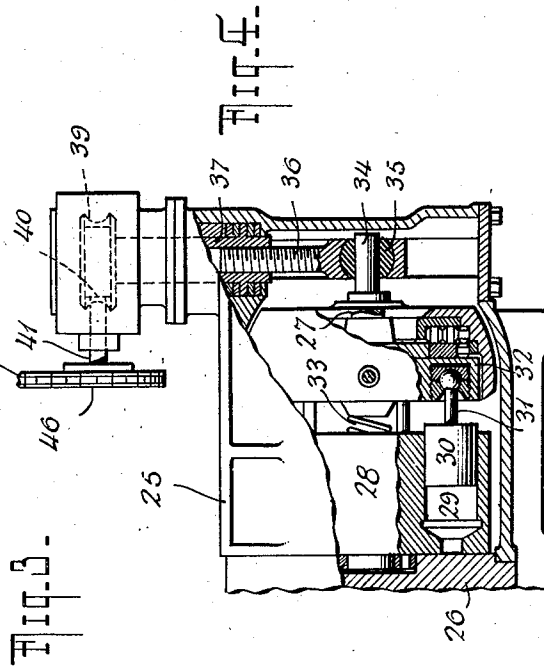
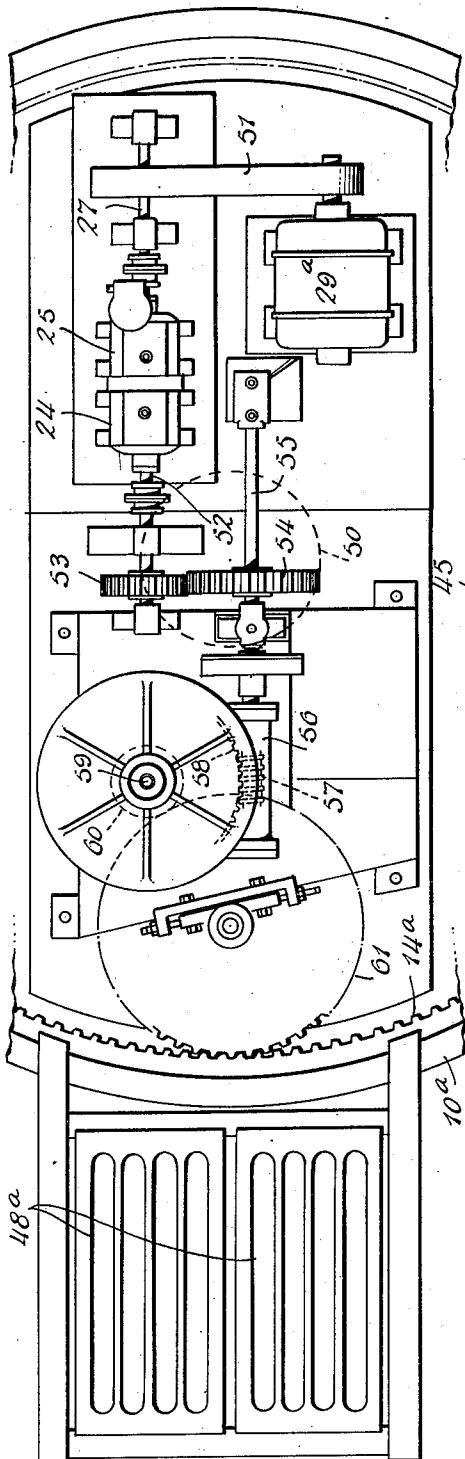
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UNITED STATES PATENT OFFICE

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APPARATUS FOR CASTING COPPER INGOTS AND OTHER ARTICLES

Application filed November 30, 1929. Serial No. 410,667.

This invention relates to apparatus for casting copper ingots, wire bars, cakes, etc., and particularly to that type of apparatus in which a plurality of casting molds are arranged about the periphery of a large wheel, which is slowly rotated during the pouring of the molten metal into the molds, and is speeded up as soon as one mold is filled until the next mold is in position to receive the metal, after which the speed is again cut down as the molding operation proceeds. While machinery of the type above described has gone into extensive use, great difficulty has heretofore been experienced in providing such machines with a driving apparatus that would enable the alternate speeding and slowing down of the speed of rotation of the casting wheel to be accomplished without shock or jerk. It has been the practice heretofore to employ electric motors for driving these wheels, the speed of the motor being regulated in any usual or well known manner to produce the desired speed changes, but it has not been possible with the use of such motors to avoid the production of a slight jerk, especially when the wheel is accelerated. This jerking action referred to is a most serious objection, because it sets up ripples on the surface of the molten metal which it has been found impossible to remove, even by machining.

The principal object of the present invention is to provide a new and improved construction for actuating casting wheels of the type above described, by means of which the driving of the wheel will be rendered smooth, the acceleration thereof even and steady, and jerking of the wheel absolutely eliminated, with the consequent avoidance of the production of ripples on the surface of the molten metal, which characterizes the action of such machines as heretofore constructed.

Another object is to provide a compact, sturdy, efficient and reliable driving apparatus for casting wheel machinery that will operate satisfactorily and successfully over long periods of time, with a minimum amount of attention.

The above and other objects will appear more fully from the following more detailed

description and by reference to the accompanying drawings forming a part hereof, wherein Fig. 1 is a plan view of a casting wheel having a driving gear constructed in accordance with the principles of the present invention; Fig. 2 is a central vertical section through the machine shown in Fig. 1; Fig. 3 is a view similar to Fig. 1 of a somewhat modified form of construction, and Fig. 4 is a view partly in section and partly in side elevation on one of the driving units employed for driving the machines shown in Figs. 1 to 3.

As shown in Fig. 1 of the drawings, the casting wheel indicated by the reference character 10 is in the form of a large, hollow, cylindrical drum, the bottom edge of which is flanged to provide an inverted U-shaped channel, as indicated by the reference character 11, which channel extends about the entire circumferential lower edge of the drum. Mounted within the channel 11 is a plurality of flanged supporting wheels or runners 12, which, it will be understood, are arranged in spaced relationship around the entire bottom of the drum. These rollers 12 rest upon an annular track 13, about which the drum is adapted to be rotated by means of the driving mechanism to be described. Secured to the inner wall of the drum adjacent to the bottom thereof is an annular, internal gear 14, with which is adapted to mesh one or more driving pinions 15. In Fig. 1 of the drawings the wheel shown is of the type wherein three of such pinions 15 are provided. Two of such pinions are located at the ends of a diametrically extending shaft 16 having secured to the ends thereof bevel gears 17, the upper end of the shaft 16 and bevel gear, however, not being shown in the drawings. The ends of the shaft 16 are supported in bearings formed in brackets 18; said brackets 18 also include bearings for a counter shaft 19, to which the pinions 15 are keyed. Each shaft 19 has also fixedly secured thereto a bevel gear 20, which meshes with the co-operating bevel gear 17, on the end of the shaft 16. In the example shown, a radial shaft 21 extends perpendicular to the shaft 16 and is provided at its end with a bevel gear

17, which meshes with a co-operating gear 20 and drives the third pinion 15. The shafts 16 and 21 extend at their inner ends into a reduction gear box 22, which may be of any suitable construction. The gear box 22 is provided with an input shaft to which, in the constructional example illustrated, is connected, by means of a coupling 23, the driving shaft of a hydraulic gear of the well known Waterbury type, which consists of a hydraulic motor 24 and a pump 25 associated together to form a unitary structure and separated by a valve plate 26. The driving shaft 27 of the hydraulic pump is connected by means of a coupling 28 to the armature shaft of an electric motor 29.

In order that the construction and operation of the hydraulic gear unit may be thoroughly understood, reference may be had to Fig. 4 of the drawings, which shows the main constructional details of such a gear. As shown in Fig. 4, which is a partial section and partial elevation of the pump unit 25 of the hydraulic gear, said gear consists of a driving shaft 27, to which is secured a cylinder barrel 28. The cylinder barrel 28 is provided with a plurality of cylinders 29. Mounted within each cylinder 29 is a piston 30, connected by a piston rod 31 with a swash plate 32. The swash plate 32 is connected to the driving shaft 27 for rotation therewith by a universal joint 33, which permits said swash plate to be tilted angularly to the driving shaft without interrupting the driving connection. The plate is rotatably mounted within a tilting box 33 having secured thereto, or having formed integral therewith, a stub shaft 34. The stub shaft 34 projects into a rocking bearing 35, seated in the lower end of a control shaft 36, which at its upper end is threaded for engagement with a control shaft nut 37. The latter is mounted for rotation within the casing of the pump 25, but is held against longitudinal movement relatively thereto. In the constructional example disclosed, the control shaft nut has integrally associated therewith a worm wheel 39, with which is engaged a worm 40 carried by a worm shaft 41. When the driving shaft 27 is rotated, the cylinder barrel 28 and swash plate 32 are carried along with it. If the tilting box 33 and swash plate 32 are adjusted to a position perpendicular to the axis of rotation of the driving shaft 27, the pistons 30 will have no stroke and no fluid will be pumped by the pump. When, however, the swash plate and tilting box are adjusted by means of the control shaft 36 to extend at an angle to the axis of the driving shaft, the pistons will be reciprocated and fluid will be pumped by the pump, the direction of flow of the fluid and the volume of such flow depending upon the direction in which the swash plate is inclined and the extent of its inclination.

In accordance with the usual construction of Waterbury type gears, the mid, or valve, plate 26 is provided with a pair of arcuate ports (not shown), through which the fluid is circulated to and from the motor by the action of the pump. The pump is similar in construction to the motor, and includes a cylinder barrel with cylinders, pistons, piston rods, swash plate, and tilting box, as just described. In the motor, however, the swash plate and tilting box are usually held at a fixed angle of inclination. Fluid pumped to the cylinders of the motor by the pump will produce, through the reaction of the pistons on the swash plate, a rotation of the driving shaft of the motor, in accordance with the volume of fluid delivered by the pump. The change in the angle of inclination of the swash plate and tilting box of the pump by adjustment of the control shaft 36 will produce, through the variation of the output of the pump, a variation of the speed of rotation of the motor's driving shaft.

In the constructional example shown in Figs. 1 and 2, adjustment of the control shaft of the pump may be effected by an operator in the platform or stand 42. A hand wheel 43 is provided in such platform at a conveniently accessible point. The hand wheel 43 has associated with it a sprocket wheel 44 connected by means of a chain 45 with a sprocket wheel 46, the latter being connected by suitable gearing with the worm shaft 41.

Mounted on suitable brackets 47, arranged at spaced intervals about the outer periphery of the drum 10 and extending radially thereof, are a plurality of casting molds 48, which, in the constructional example disclosed, are provided with cavities or recesses 49 for the reception of the molten metal.

The operation of the apparatus shown in Figs. 1-3, as will be readily understood, is as follows: The motor 29 being placed in rotation, the operator stationed on the platform 42 will manipulate the hand wheel 43 so as to cause the wheel 10 to be rotated slowly as the molten metal is poured into the molds 48, the speed of rotation of the wheel being adjusted so as to secure a proper distribution of the molten metal into the cavities 49. As soon as a mold is properly filled, the hand wheel 43 is turned to cause the speed of the hydraulic gear 24, 25, to be increased, and, as soon as the next mold 48 comes into position to receive the molten metal, the speed is then cut down until the next pouring operation is completed. It makes no difference how fast the operator may turn the wheel 43 to bring about the speeding up of the wheel to bring each successive mold into position for the pouring of the metal, because as the longitudinal movement of the control shaft which brings about the change in the angle of inclination of the plate and tilting

box of the pump is produced by rotation of the control shaft nut 37, an abrupt change of speed of the motor cannot possibly be secured, the speed of the motor changing gradually not only because of the fact that the movement of the control shaft is produced by a nut and screw connection, but also because the driving effect of the motor 29 is communicated from the pump 25 to the hydraulic motor 24 through a column of liquid under pressure. The hydrostatic properties of such column completely absorbs any shocks, and jerking of the wheel 10 is therefore entirely obviated.

In Fig. 3 of the drawings is shown a wheel of the type wherein the molds 48^a extend radially of the wheel 10^a, the wheel 10^a in this constructional example being supported at its center upon a trunnion 50, indicated in dotted lines in said figure. The driving mechanism shown in Fig. 3 operates upon the same principles as that shown in Figs. 1 and 2, with the exception that the gearing connections are somewhat different. The wheel 10^a is also driven by a hydraulic gear consisting of a pump 25 and motor 24. The driving shaft 27 of the pump is driven by a chain or rope drive 51 from the electric motor 29^a. Connected to the driving shaft 52 of the hydraulic motor 24 is a spur pinion 53, which meshes with a spur gear 54 secured to a counter shaft 55. One end of the counter shaft 55 projects into a gear housing 56 and has secured to it a worm 57, which meshes with a worm wheel 58, the latter being secured to a jack shaft 59. Mounted upon the lower end of the jack shaft 59 is a gear wheel 60, which meshes with a large spur gear 61. The latter meshes in turn with the internal gear 14^a of the casting wheel 10^a.

The manner of operation and adjustment of the installation shown in Fig. 3 is similar to that described in connection with Figs. 1 and 2, the control shaft of the pump being connected by any suitable means (not shown) with a manually operable control located at the operator's platform. While the installations herein described and shown form satisfactory constructional examples of successful commercial installations, it will be understood that the invention is not limited in its application to all of the constructional details shown in the drawings, and that, for example, many changes in the connecting gearing arrangements could be employed, that the means for actuating the control shafts of the pumps may likewise be varied, in accordance with the requirements of each particular installation, and that many other changes, variations and modifications may be resorted to without departing from the principles of the invention.

I claim:—

1. The combination with a casting wheel for casting metallic ingots, bars, or the like,

and having a plurality of casting molds arranged at spaced intervals about said wheel and adapted to be successively brought to a charging position, of means for driving said wheel continuously at varying speeds without the production of shocks or jerks during an operative period consisting of successive mold charging intervals of relatively slow wheel travelling speeds and mold shifting intervals of relatively higher wheel travelling speeds, said means comprising a hydraulic pump and a hydraulic motor, the latter having a driving shaft, and gearing connecting the driving shaft of said motor with said casting wheel.

2. The combination with a casting wheel for casting metallic ingots, bars, or the like, and having a plurality of casting molds arranged at spaced intervals about said wheel and adapted to be successively brought to a charging position, of means for driving said wheel continuously at varying speeds without the production of shocks or jerks during an operative period consisting of successive mold charging intervals of relatively slow wheel travelling speeds and mold shifting intervals of relatively higher wheel travelling speeds, said means comprising a hydraulic pump and a hydraulic motor, the latter having a driving shaft, gearing connecting the driving shaft of said motor with said casting wheel, said pump being provided with an adjustable control shaft, by means of which the output of said pump may be varied to produce a corresponding variation in the speed of rotation of the driving shaft of said motor, and manually operable means for changing the adjusted position of said control shaft.

3. The combination with a casting wheel for casting metallic ingots, bars, or the like, and having a plurality of casting molds arranged at spaced intervals about said wheel and adapted to be successively brought to a charging position, of means for driving said wheel continuously at varying speeds without the production of shocks or jerks during an operative period consisting of successive mold charging intervals of relatively slow wheel travelling speeds and mold shifting intervals of relatively higher wheel travelling speeds, said means comprising a hydraulic pump and a hydraulic motor, the latter having a driving shaft, gearing connecting the driving shaft of said motor with said casting wheel, said pump being provided with an adjustable control shaft by means of which the output of said pump may be varied to produce a corresponding variation in the speed of rotation of the driving shaft of said motor, and manually operable means for changing the adjusted position of said control shaft, said manually operable means including a screwthreaded shaft and nut, and gearing interposed between said shaft

and nut and said manually operable control.

4. Apparatus for casting ingots, bars, etc., comprising a rotatable drum-like wheel, and means for supporting a plurality of casting molds at spaced intervals about said wheel adapted to be successively brought to a charging position, said wheel having an annular driving rack secured to it, pinions meshing with said driving rack, and means for driving said pinions continuously at varying speeds during an operative period consisting of successive mold charging intervals of relatively slow wheel travelling speeds and mold shifting intervals of relatively higher wheel travelling speeds, said driving means including an electric motor, a hydraulic gear consisting of a hydraulic pump and motor, said pump being connected with and driven by said electric motor, said hydraulic motor having a driving shaft, gearing connecting said driving shaft and said pinions and said pump being provided with means for varying its output and thereby the speed of the driving shaft of said hydraulic motor, and said hydraulic pump and motor including a confined column of liquid under pressure, which serves to absorb shocks due to speed changes, and prevents the driving mechanism for said casting wheel from transmitting any shocks or jerks to said casting wheel in its rotation.

In testimony whereof I have hereunto set my hand.

DANIEL R. FRANCIS.

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