

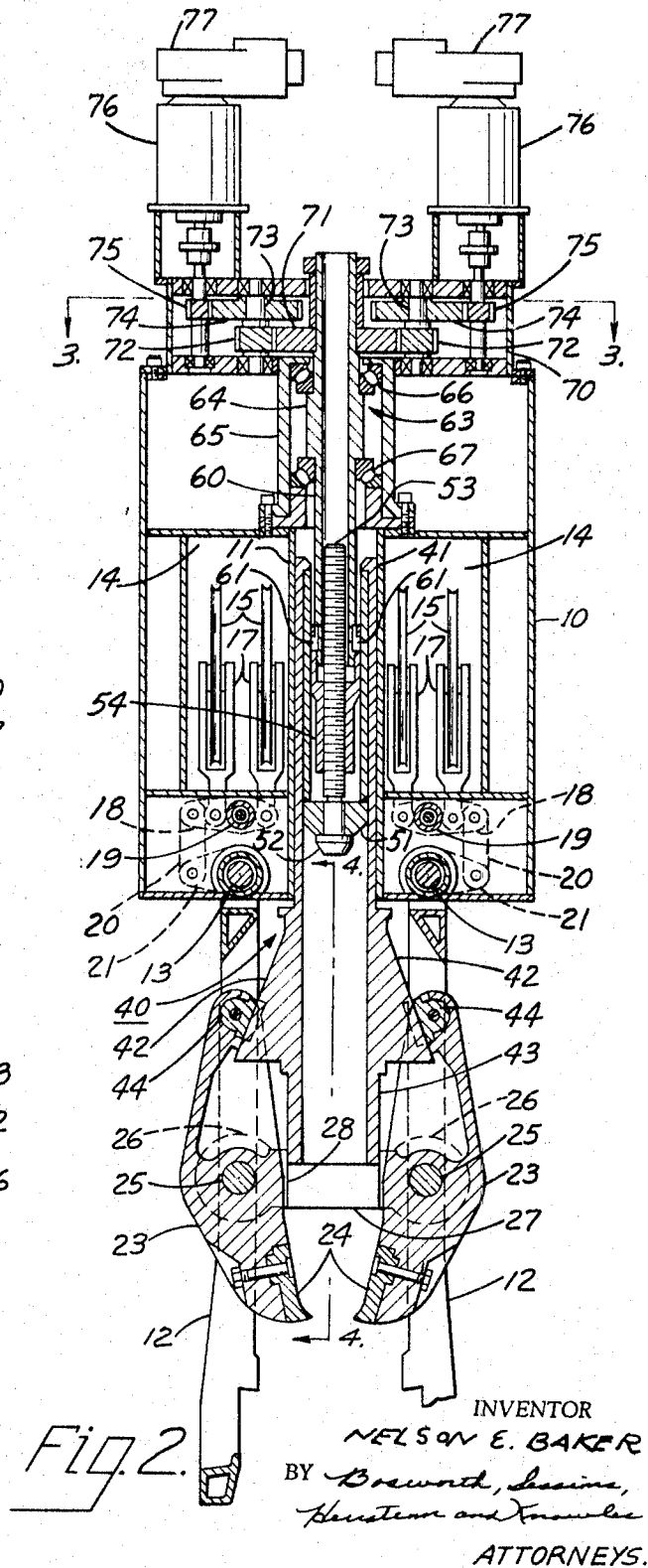
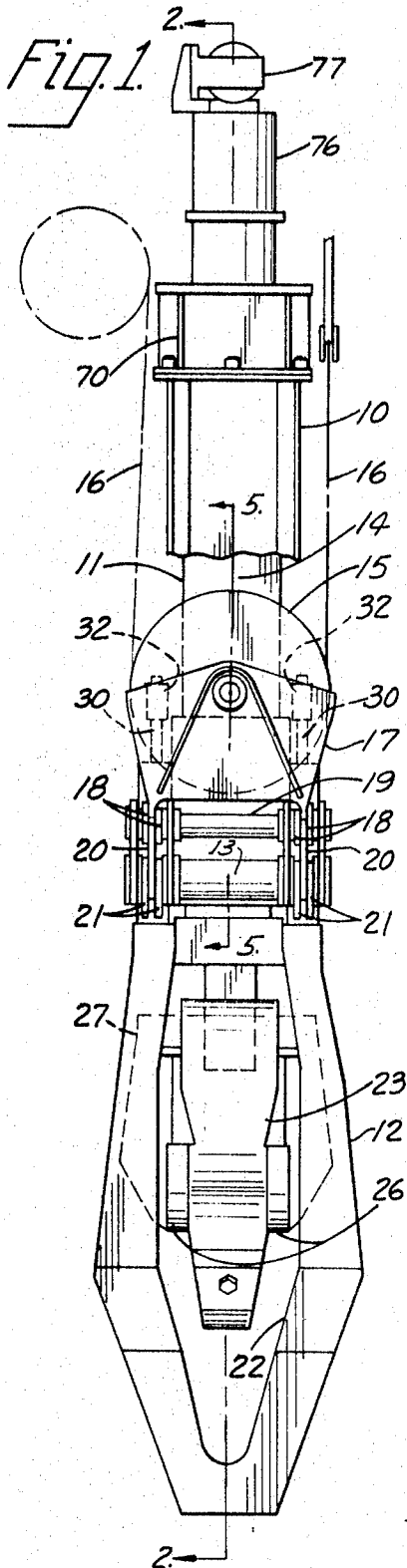
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N. E. BAKER
INGOT STRIPPING MECHANISM WITH SPHERICAL
TAPERED ROLLER BEARINGS

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2 Sheets-Sheet 1



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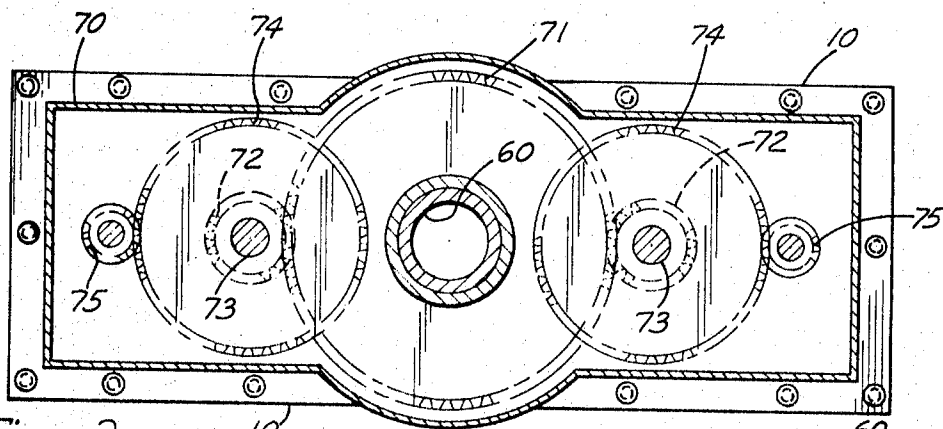


Fig. 3.

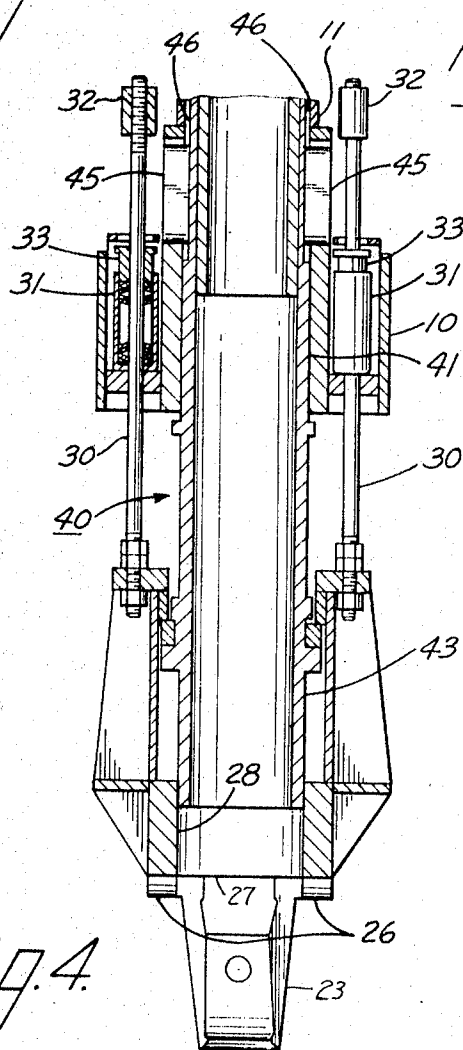
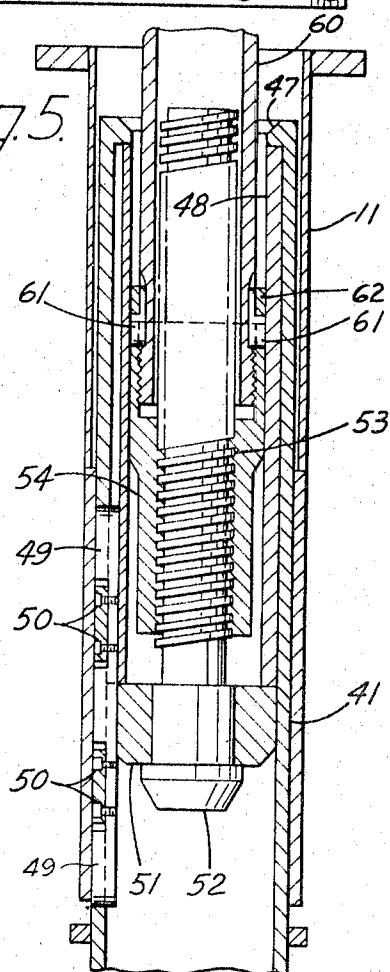


Fig. 4.

Fig. 5.



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INGOT STRIPPING MECHANISM WITH SPHERICAL TAPERED ROLLER BEARINGS

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3 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to an ingot stripping mechanism adapted to grip a metal ingot while in engagement with the ingot mold, and to pull the ingot loose by exerting suitable extraction forces. The mechanism utilizes pull tongs and a screw assembly for applying the gripping and extracting forces. The screw assembly is mounted in bearings which accommodate pendulous movement and the drive for the screw assembly is obtained from a plurality of vertically mounted motors arranged in geometrically balanced relation around a central main drive gear.

Background of the invention

This invention relates to stripping mechanisms for separating metal ingots from the molds in which the ingots are cast. More particularly the invention relates to a new and improved screw-driven ingot stripping mechanism and especially to a mechanism that can be supported by cables from an overhead traveling crane so as to be transportable along the entire length of a metal processing line.

The stripping of large metal ingots such as steel ingots from the mold in which they are cast has long been practiced in the metal refining industries. The mechanisms for accomplishing this are necessarily quite large and capable of exerting enormous forces. In the manufacture of steel, it is usually desirable that the stripping mechanism be suspended by cables from an overhead traveling crane such as by means of hoist machinery. With this arrangement an operator can move the mechanism to any one of several mold stations along a steel processing line.

Current designs utilize a motor-driven screw assembly including male and female threaded members to provide the vertical force and movement for stripping the ingot from its mold. One of the threaded members is mounted for vertical movement but held against rotation while the other is rotated by a drive motor. A typical screw type stripping mechanism is shown in the U.S. patent to Harry (No. 3,009,219).

Current ingot mold designs are adapted to form the big-end-up type ingot which is tapered from a smaller cross-section at its lower end to a larger cross-section at its upper end. This design enables the ingot to be extracted upwardly from the mold and either lifted free or carried in the mold to a desired location by the stripping mechanism. While the preferred embodiment of the invention is directed to the extraction of big-end-up ingots, the invention is also adaptable to the reverse situation where the ingot must be pushed downwardly out of the mold as in the case of the small-end-up type ingot.

The operation of a typical stripping mechanism generally comprises engaging the upper rim of the ingot mold from above with a pair of restraining lugs secured to the housing of the mechanism while at the same time gripping the exposed neck of the ingot with a pair of pull tongs. The pull tongs are generally pivotally mounted on a forked cross head suspended from the housing and the upwardly extending ends thereof are engageable by

a vertically movable V block or cam located between them. Upward movement of the V block or cam forces the upper ends of the pull tongs outwardly away from one another and pivots the lower ends or jaws inwardly to a limiting position in gripping engagement with the neck of the ingot, after which the lifting force is divided into both pulling and gripping components. The mechanism is usually capable of engaging the lifting lugs of the mold with the restraining lugs so that the overhead crane may be used to transport molds as well as ingots.

During ingot stripping, the resisting forces vary in both magnitude and direction. These variations often result in uneven loads being imposed upon the screw assembly and in extreme instances the uneven loads may cause damage to one of the threaded members, especially to the bearings of the rotatable threaded member, and thus necessitate extensive repair.

Since periodic repairs can generally be expected on the screw assembly it is desirable that the screw assembly and particularly the rotary threaded member, be capable of removal from the stripping mechanism with a minimum of disassembly of other components. Prior art designs, however, have not afforded this advantage and have necessitated extensive break-down of the mechanism prior to removal and replacement of the screw assembly and associated parts.

The stripper mechanism of the present invention overcomes the difficulties indicated above and affords other features and advantages not obtainable from the prior art.

Summary of the invention

According to the preferred embodiment of the invention there is provided an ingot stripping mechanism adapted to be supported from above by hoist machinery carried on an overhead traveling crane. The mechanism includes a housing defining a central barrel, sheaves for the hoist cables and pair of restraining lugs supported by the housing, the spacing between the lugs being adjustable to accommodate different mold sizes. Mounted below the housing are a pair of pull tongs pivotally connected to a forked cross head which is preferably supported by the housing on spring-mounted rods. The pull tongs are engageable by a reciprocable V block or cam for exerting the gripping and lifting force on the ingot. The V block or cam is reciprocated by a screw assembly which includes a male threaded member and a female threaded member threadedly received on the male member. One of the threaded members is mounted for axial movement but keyed to the barrel to prevent rotation. This member is operatively connected to the V block or cam member and serves to drive it through its range of operating movement. The other threaded member of the screw assembly is mounted for rotation and restricted from axial movement. The rotatable member is supported on a drive shaft which is mounted for rotary movement in a spherically tapered roller bearing assembly defining a spherical surface that enables the drive shaft and rotatable threaded member to pivot in compound pendulum fashion relative to said housing from an effective point of suspension coincident with the center of said spherical bearing surface to accommodate uneven loads imposed on the threads of the screw assembly. Secured to the drive shaft above the bearing assembly is a main drive gear which is engaged by a plurality of pinions located in balanced geometric relation around the circumference thereof, each pinion being driven either directly or through reduction gears by a separate motor. The pinions preferably have crown teeth to accommodate the pendulous movement of the tubular drive shaft in its bearings.

It is among the objects of the invention to provide a multi-motored drive means for an ingot stripping mechanism.

nism utilizing vertically mounted motors which drive pinions are arranged in balanced geometrical relation around the final drive gear that operates the screw assembly.

Another object of the invention is to provide a new and improved screw assembly for an ingot stripping mechanism, the screw assembly having a single screw design whereby the drive shaft for the rotary threaded member is mounted in a bearing assembly that enables the screw assembly to accommodate uneven loads on the threads developed during the stripping of an ingot from its mold.

A further object of the invention is to provide a replaceable, rotatable, threaded member for a screw assembly of an ingot stripping mechanism, the member being removable from the basic stripping mechanism by first removing the gear drive unit from the housing but without disassembly of the gear drive unit itself or other components of the stripping mechanism.

Other objects, uses and advantages of the invention will be apparent from the following detailed description and drawings.

Brief description of the drawings

FIGURE 1 is an elevational view of an ingot stripping mechanism embodying the invention with parts broken away for the purpose of illustration, the pull tongs being shown in their upper-most position;

FIGURE 2 is a sectional view of the ingot stripping mechanism shown in FIGURE 1 taken on the line 2—2 of FIGURE 1;

FIGURE 3 is a horizontal sectional view on an enlarged scale of the ingot stripping mechanism of FIGURE 1 taken on the line 3—3 of FIGURE 2;

FIGURE 4 is a fragmentary sectional view on an enlarged scale taken on the line 4—4 of FIGURE 2; and

FIGURE 5 is a fragmentary sectional view on an enlarged scale taken on the line 5—5 of FIGURE 1.

Description of the preferred embodiment

Referring more particularly to the drawings there is shown an ingot stripping mechanism embodying the present invention and adapted to be supported by cables from hoist machinery located above on an overhead traveling crane. The mechanism includes a housing 10 formed of heavy steel plates welded together and defining a central barrel 11. Pivotally connected to the housing 10 are restraining lugs 12 which have a hinge pin 13 at their upper ends that turns in bearings in the housing 10. Extending laterally through the housing 10 are two apertures 14 within each of which are mounted two sheaves 15 for the hoist ropes 16. The sheaves 15 are mounted on bifurcated mounting members 17 the two mounting members 17 in each aperture 14 being pivotally connected to opposite sides of a pair of parallel levers 18. Each pair of levers 18 is mounted on a hinge pin 19 that turns in bearings in the housing 10, one pin being provided for each pair of sheaves 15. The outward ends of the levers 18 of each pair are connected by a pair of links 20 to a pair of arms 21 extending laterally from each of the restraining lugs 12. Accordingly varying the tension in the hoist ropes 16 of the sheaves 15 in each aperture 14 serves to adjust the spacing between the ends of the restraining lugs 12.

The restraining lugs 12 are each provided with an aperture 22 which accommodates both the pivotal and vertical movement of a pair of pull tongs 23, the tongs having lower ends 24 which provide a pair of gripping jaws. Each pull tong 23 is mounted for pivotal movement about a hinge pin 25, the pins 25 being mounted between the forked arms 26 of a cross head member 27.

The cross head member 27 defines a central bore 28 and is suspended from the housing 10 by rods 30 as best shown in FIGURE 4. Each rod 30 is received in a Schnorr spring assembly 31 and is provided with a threaded bushing 32 firmly secured at the upper end

thereof. Each bushing 32 is engageable with a plunger 33 which bears downwardly against the springs in the assembly 31. This provides an upward biasing force when the pull tongs 23 and cross head member are at their lowermost position.

The pull tongs 23 are operated by means of a V block member 40 comprising an upwardly extending tubular portion 41 slidably received in the barrel 11, a cam portion 42 which operates the upper ends of the pull tongs 23 and a downwardly extending tubular portion 43 slidably received in the base 28 of the cross head member 27. The cam portion 42 of the member 40 has corresponding cam surfaces on opposite sides, each of which engages a slide block 44 one of which is pivotally connected to the upper end of each pull tong 23. Each slide block 44 has a lip which is received in a recessed portion in the corresponding cam surface.

Vertical movement of the V block member 40 serves to pivot the pull tongs 23 about their hinge pins 25 between a jaw open position when the V block member is at its lowermost position relative to the tongs 23, and a closed position when the V block member is raised to its uppermost limiting position. When the jaws 24 of the pull tongs 23 have engaged the neck of an ingot to be stripped, further upward movement of the V block member carries the pull tongs 23 upward correspondingly while at the same time exerting a powerful gripping force on the ingot.

The upper end of the tubular portion 41 is received in the barrel 11 of the housing 10 and is slidable vertically therein. Turning movement of the tubular portion 41 relative to the barrel 11 is prevented by means of two keys 45 which are located in opposed relation and extend through both the barrel 11 and into longitudinal slots 46 formed in the portion 41 as best shown in FIGURE 4.

Located at the upper end of the portion 41 is an inwardly extending radial flange 47. Slidably received within the tubular portion 41 at the upper end thereof is a sleeve 48 which bears upwardly against the radial flange 47. The sleeve 48 is keyed to the tubular portion 41 by means of three keys 49 located in geometrically spaced relation around the circumference thereof and held in place by machine screws 50 as best shown in FIGURE 5. The bottom end of the sleeve 48 has a head member 51 located within the tubular portion 41. The head member 51 is supported by the enlarged head 52 of a male threaded member or screw 53 which extends upwardly within the sleeve 48. Accordingly vertical movement of the screw 53 serves to lift the V block member 40 to operate the pull tongs 23.

Threadedly received on the screw 53 within the sleeve 48 is a rotatable threaded female member or drive unit nut 54 which is preferably formed of bronze or other hard durable metal alloy. The threads of the drive nut 54 are so arranged that they are all in engagement with the threads of the screw 53 throughout the operating travel of the screw relative to the housing 10.

The drive nut 54 is turned by means of a tubular drive shaft 60 having male threads at its lower end which engage female threads formed in an upwardly extending ring portion of the drive nut 54. The tubular drive shaft 60 is also keyed to the drive nut 54 by means of six longitudinal keys 61 uniformly spaced around the diameter of the lower end of the tubular drive shaft 60 and held in position by a retaining ring 62 (FIGURE 5).

The tubular drive shaft 60 extends upwardly through the barrel 11 of the housing 10 and into a bearing assembly 63, the portion of the tubular drive shaft 60 within the bearing assembly 63 having a collar 64 formed thereon (FIGURE 2). The bearing assembly 63 is encased within a bearing housing 65 and comprises two sets of tapered spherical bearing units 66 and 67. The bearings of each unit 66 and 67 define a spherical bearing surface, the bearing surfaces of both units having a com-

mon center. The upper bearing unit 66 is positioned between the top of the bearing housing 65 and the collar 64 and the lower bearing unit 67 is positioned between the bottom of the bearing housing and the collar 64.

The upper end of the tubular drive shaft 60 extends above the bearing housing 65 into a gear housing 70 which is bolted to the housing 10. Secured to the tubular drive shaft 60 is a main drive gear 71 which is engaged by two pinions 72 diametrically opposed to one another (FIGURES 2 and 3). The pinions 72 have crown teeth to accommodate a swinging movement of the tubular drive shaft 60 in the spherical bearing assembly 63. Each pinion 72 is secured to a shaft 73 which carries another larger reduction gear 74. The reduction gears 74 are each driven by the input gear 75 of one of two drive motors 76 mounted on the top of the housing 70. Brake units 77 are provided for each of the drive motors 76, the brake units 77 being located at the end of the motor opposite the output gear 75.

Operation

During normal operation of the stripper mechanism, the overhead crane is operated to transport the mechanism to a position over an ingot mold from which an ingot is to be stripped. The hoist machinery is then operated to lower the mechanism downward until the restraining lugs 12 are positioned slightly above the mold. The hoist cables are operated in such a way that the pairs of sheaves in the apertures 14 of the housing 10 initially position the restraining lugs 12 at their widest possible spacing. Then by varying the tension in the cables, the restraining lugs 12 are brought together until the mold engaging portions are approximately over the shoulders of the mold. The housing 10 and restraining lugs 12 are then lowered until the lugs engage the mold shoulders. The pull tongs 23 and V block 40 are both located at their lowermost position and the jaws 24 of the pull tongs 23 are at their widest spacing.

At this point in the operation the drive motors 76 are actuated and the drive nut 54 turns to move the screw 53 upwardly carrying the V block 40 along with it. Accordingly the weight of the V block 40 is now borne by the sleeve 48. As the V block 40 raises it pivots the jaws 24 of the pull tongs 23 together until they engage the neck of the ingot to be stripped. This limits further inward travel of the jaws 24 so that further upward movement of the V block 40 serves to lift the pull tongs 23 upward while applying strong gripping forces to the neck of the ingot. Ultimately the ingot is stripped from the mold and raised until the upward limiting position of the V block is reached. The hoist machinery may now be operated to lift the stripping mechanism and ingot upward clear of the mold after which the traveling crane may be operated to carry the ingot to a desired position for further processing. Alternatively the ingot may be lowered back into the mold and the hoist machinery and traveling crane used to carry the mold with the ingot therein to a desired location.

The ingot is released by lowering the mechanism using the hoist machinery until the bottom of the ingot rests on a suitable base. The drive motors 76 are then operated in reverse to turn the drive nut 54 and lower the screw 53 together with the V block 40. Lowering the V block 40 serves to open the jaws 24 of the pull tongs 23 and release the ingot. The hoist machinery may then be operated to raise the stripper mechanism clear of the ingot.

Removal and replacement of the drive nut of the stripper mechanism is facilitated by the invention and may be accomplished by first rotating the tubular drive shaft 60 counterclockwise to remove the drive nut 54 from the screw 53. Once the nut 54 is free of the screw threads the gear drive unit is removed from the housing 10 by removing the bolts which secure the gear housing 70 to the housing 10, and thereafter removing

the gear housing 70 and all parts of the gear drive unit from the housing 10. Then the tubular drive shaft 60 and drive nut 54 may be removed from the mechanism and the drive nut repaired or replaced as desired.

It will be understood that this invention has been shown and described with reference to a preferred embodiment thereof which is intended for the purpose of illustration rather than limitation, and that other variations and modifications will be apparent to those skilled in the art within the intended spirit and scope of the invention, wherefore the patent is not to be limited to the form or forms herein specifically illustrated and described nor in any manner inconsistent with the progress by which the art has been promoted by this invention.

I claim:

1. In a mechanism for stripping a metal ingot from the mold in which the ingot is cast, including a housing, means for holding said mold against movement relative to said housing, means carried forward of and movable relative to said housing for engaging an end of said ingot, and a screw assembly for operating said ingot engaging means, said screw assembly including a male threaded member and a female threaded member threadedly received on said male threaded member, one of said members being rotatable in said housing and the other being non-rotatable relative to said housing and movable axially therein longitudinally of said ingot, said axially movable member being operatively connected to said ingot engaging means; the improvement which comprises spherical tapered roller bearings mounted in an annular support on said rotatable member, said bearings defining a spherical bearing surface wherein said bearings bear against said housing for supporting said rotatable member for compound pendulous movement relative to said housing from an effective point of suspension coincident with the center of said spherical bearing surface, and drive means mounted rearward of said housing for turning said rotatable member whereby said ingot engaging means is operable to strip said ingot longitudinally from its mold.

2. A mechanism as defined in claim 1 wherein said bearing means includes two sets of tapered roller bearings, each set defining a spherical bearing surface and being mounted in an annular support on said rotatable member, the bearings of one set bearing rearwardly against said housing and the bearings of the other set bearing forwardly against said housing, the spherical bearing surfaces defined by each set having a common center.

3. A mechanism as defined in claim 1 wherein said rotatable member is the female threaded member of said screw assembly and comprises a nut which engages the threads of said axially movable member and a tubular drive shaft secured to said nut and extending rearwardly therefrom, said drive shaft being keyed to said nut by a plurality of longitudinally aligned keys located in spaced relation around the junction of said nut and said drive shaft whereby said keys transmit torsional force from said drive shaft to said nut.

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