June 13, 1961 F. T. SMITH ET AL 2,987,786

LADLE HANDLER

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Fig-1

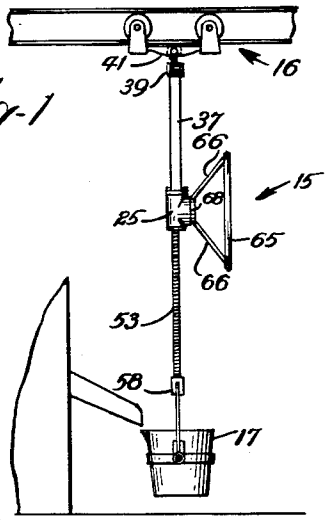


Fig-2

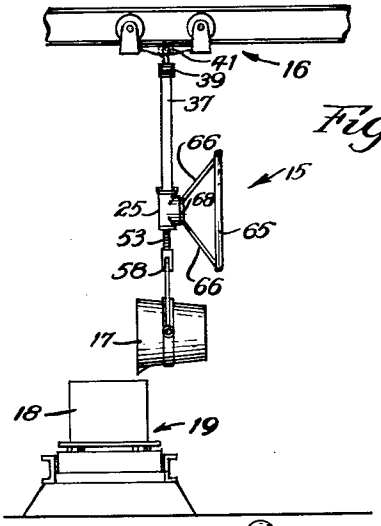


Fig-3

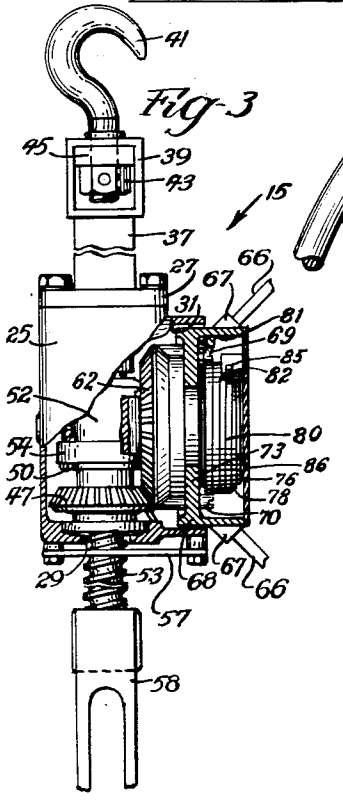
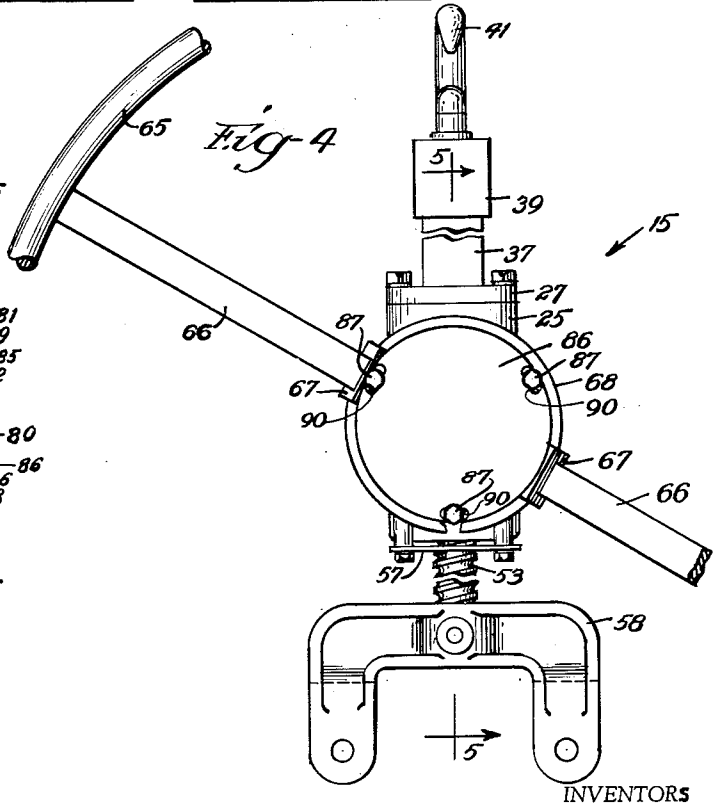


Fig-4



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LADLE HANDLER

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Fig-5

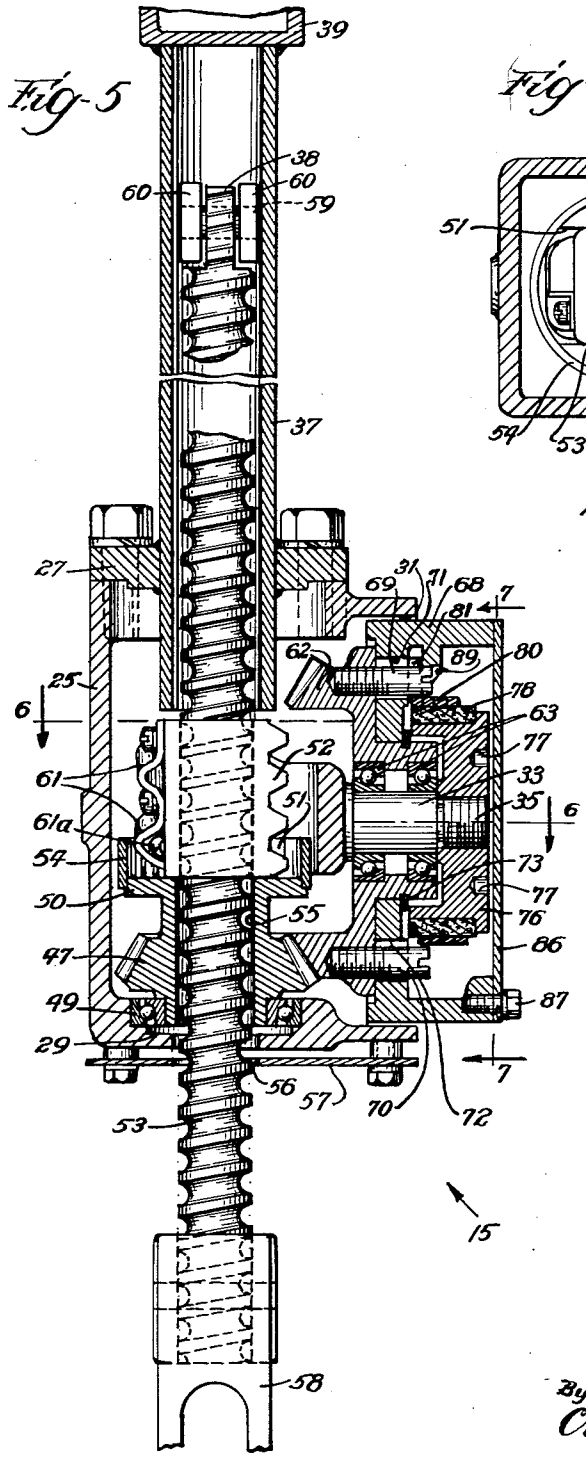


Fig-6

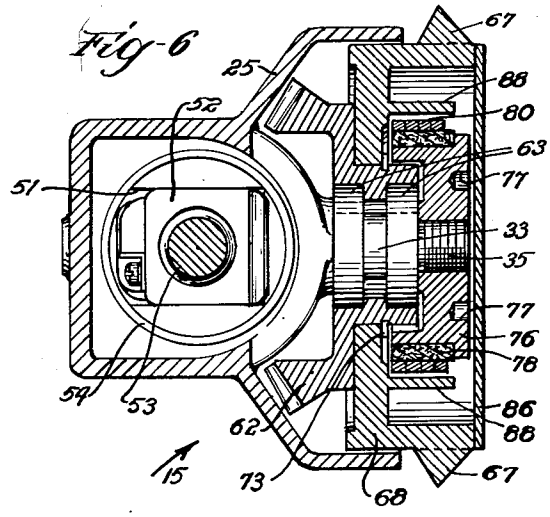
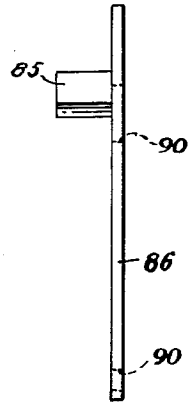


Fig-12



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LADLE HANDLER

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Fig-7

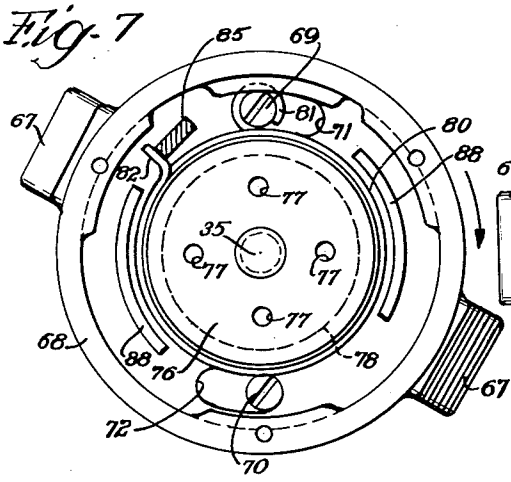


Fig-8

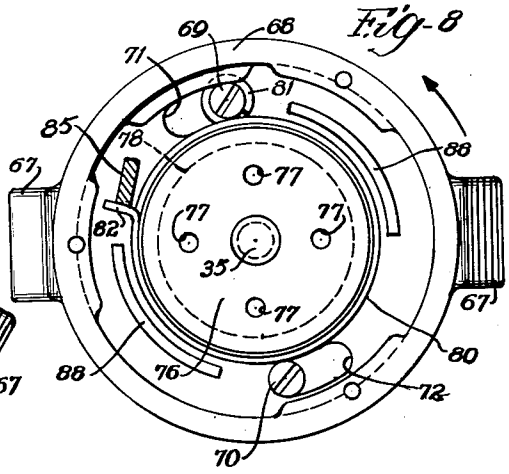


Fig-9

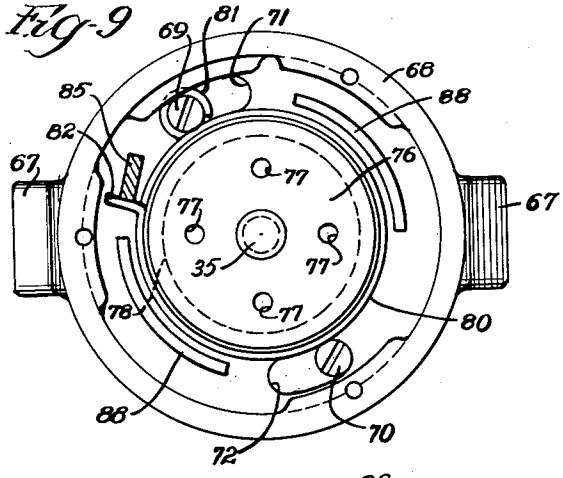


Fig-10

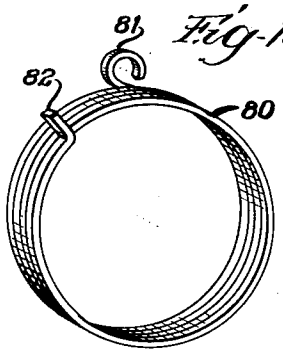
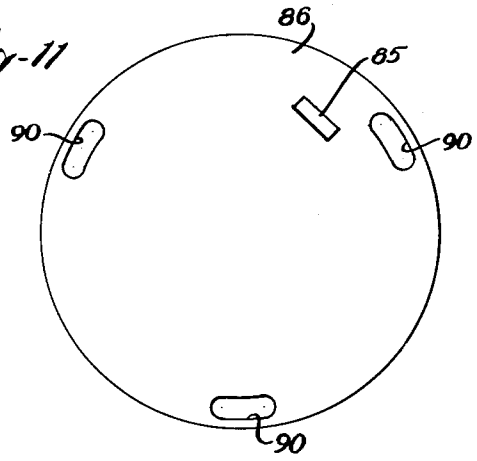


Fig-11



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2,987,786

LADLE HANDLER

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Filed May 2, 1958, Ser. No. 732,518
11 Claims. (Cl. 22—82)

This invention relates to a ladle handler and more particularly to a ladle handler manually operable by one person to raise and lower heavy lades filled with molten metal.

The general object of the invention is to provide a new and improved manually operable ladle handler for use in foundries to permit one operator to handle ladles full of molten metal weighing as much as a ton or more.

Another object of the invention is to provide a new and improved ladle handler which is adapted to be suspended from an overhead supporting structure, e.g. an overhead trolley, which is easily operable by one man rotating a handwheel or crank, and which includes a spring controlled clutch brake device permitting raising and lowering of a ladle upon rotation of a handwheel while preventing lowering of the ladle under its own weight when the handwheel is released.

Another object of the invention is to provide a ladle handler of the character described which is economical to produce, requires no lubrication and little or no maintenance, is efficient and smooth in operation as well as being simple for one person to operate, is sensitive and accurate as to control, has outstanding safety features, and which minimizes operator fatigue as a result of its easy maneuverability, low lifting pull and over-all simplicity of operation.

Certain other objects of the invention will, in part, be obvious, and will in part appear hereinafter. For a more complete understanding of the nature and scope of the invention reference may now be had to the accompanying drawings wherein:

FIG. 1 is a side elevational view of a preferred form of the invention with a ladle shown in a lowered position to receive a charge of molten metal;

FIG. 2 is a side elevational view similar to FIG. 1 showing the ladle in a raised position and tilted for pouring into a mold;

FIG. 3 is an enlarged side elevational view of the invention shown in FIGS. 1 and 2 with a portion of the casing broken away to better show the internal structure thereof;

FIG. 4 is a broken, front elevational view of FIG. 3 looking toward the handwheel;

FIG. 5 is an enlarged vertical sectional view taken generally on the line 5—5 of FIG. 4;

FIG. 6 is a horizontal sectional view taken generally on the line 6—6 of FIG. 5;

FIG. 7 is a vertical sectional view taken generally on the line 7—7 of FIG. 5 during rotation of the handwheel in a clockwise direction for a raising operation;

FIG. 8 is a vertical sectional view similar to FIG. 7 during rotation of the handwheel in a counterclockwise direction for a lowering operation;

FIG. 9 is a vertical sectional view similar to FIGS. 7 and 8 with the invention in a braked condition after stopping the handwheel in the position shown in FIG. 8 during counterclockwise rotation thereof;

FIG. 10 is a perspective view of the flat coil spring used in the invention;

FIG. 11 is an elevational view of the inner surface of the cover plate secured over the hub portion of the handwheel; and

FIG. 12 is a side elevational view of the cover plate shown in FIG. 11.

In FIGS. 1 and 2, a ladle handler or ladle hoist embodying the invention, indicated generally by the reference number 15, is shown suspended from an overhead track-and-trolley assembly 16 and has a ladle 17 for molten metal supported thereby. In FIG. 1, the ladle 17 is shown in a lowered position to receive a charge of molten metal whereas in FIG. 2 the ladle 17 is shown in a raised position and tilted for pouring molten metal into a mold 18 supported on a roller conveyor 19.

The details of the invention may best be described with reference to FIGS. 3 to 12 inclusive. A casing or housing 25 is provided which has an upper end closed by a fitting 27, a stepped opening 29 at its lower end, a relatively large diameter opening 31 in one side thereof, and a horizontally extending, fixed shaft 33 extending coaxially through the opening 31 and having a reduced, threaded-end portion 35 at its outer end. An elongated, vertically extending tubular guide member 37, which has a square cross sectional configuration, is secured, as by welding, in an opening in the top fitting 27 of the housing 25 and extends downwardly into the housing and upwardly therefrom. A small housing 39 is secured to the upper end of the tubular member 37 and has a swivel hook 41 connected thereto for supporting the ladle handler 15 from an overload structure, such as the track-and-trolley assembly 16 shown in FIGS. 1 and 2. The swivel connection between the hook 41 and the housing 39 includes a nut 43 and a thrust bearing 45, as shown in FIG. 3. This swivel connection permits swiveling or rotation of the ladle handler 15 relative to the supporting hook 41.

A beveled pinion gear 47 is supported for rotation about a vertical axis by a sealed bearing 49 of known type seated in the stepped bottom opening 29 of the housing 25. The pinion gear 47 is provided with an integral upper portion 50 in which is formed a relatively wide, horizontally extending groove or slot 51, FIG. 6, in which is fitted a generally rectangularly shaped nut 52 of a ball bearing screw-and-nut assembly of a well known type which also includes an elongated ball bearing screw 53 extending therethrough. A retaining ring 54 is provided to close the open ends of the slot 51. The ladle supporting screw 53 extends upwardly into the tubular guide member 37 and downwardly through an axial bore 55 formed in the pinion gear 47 and through the opening 29 in the bottom of the housing 25. The lower end of the screw 53 also passes through an opening 56 formed in a heat shield 57 secured to the bottom of the housing 25, which shield acts to prevent the passage upwardly through the casing 25 of hot gases and fumes given off by a ladle full of molten metal. A ladle supporting bail 58 is connected to the end of the screw. The upper end of the screw 53 has a reduced portion 38 through which extends a horizontal bearing shaft 59 having a pair of radial thrust bearings 60 of known type supported on the ends thereof and engageable with the square tubular guide member 37 to prevent rotation of the screw 53 relative to the tubular member 37. With this structural arrangement, rotation of the pinion gear 47 causes direct rotation of the nut 52 seated in the groove 51 formed therein and non-rotatable upward or downward movement of the screw 53, depending upon the direction of rotation of the gear 47.

In the well known type ball bearing screw-and-nut assembly disclosed herein, a series of ball bearings 61*a* are trapped between internal threads on the nut 52 and external threads on the screw 53 whereby rotation of the nut 52 relative to the screw 53 advances the ball bearings lengthwise of the nut 52 and imparts movement to the screw 53. A guide track 61 disposed externally of the

nut 52 provides a return path for the transfer of the ball bearings 61a between opposite ends of the nut, suitable openings being provided between adjacent ends of the track and the thread of the nut. Thus, a ball bearing advanced to one end of the nut thread, as a result of rotation of the nut, leaves and returns to the opposite end of the nut thread through the external guide track. The particular ball bearing screw-and-nut assembly shown in the drawings is marketed commercially by the Saginaw Steering Gear Division of General Motors Corporation. It is to be understood that the ball bearing screw-and-nut assembly described herein could be replaced by a screw-and-nut assembly of a more conventional type within the scope of the invention, the ball bearing type being preferable inasmuch as it is relatively frictionless.

In order to rotate the nut-driving gear 47, a rotatable member or bevel gear 62 is rotatably mounted by sealed bearings 63 of known type on the fixed, horizontally extending shaft 33 in driving engagement with the gear 47. As the thrust load between the gears 47 and 62 and the downward load of the ladle 17 extend through the center of the ball bearing 49, there is no capsizing force exerted on the drive gear 47 and thus the bearing 49 alone is sufficient to support the drive gear 47 in the casing 25.

A manual rotating or crank means is provided to operate the gear 62, such as a hoop-like handwheel 65 having a pair of diametrically extending spokes 66 secured to a pair of bosses 67 disposed on a cylindrical casting or hub portion 68. The hub portion 68 of the handwheel 65 is rotatably mounted on a reduced end portion of the bevel gear 62 for rotation within the opening 31 formed in the side of the housing 25. To provide a driving connection between the hub portion 68 and the bevel gear 62, a pair of studs 69 and 70 project from the outer face of the gear 62 adjacent the circumference thereof and extend through a pair of elongated arcuate slots 71 and 72, respectively, formed in the hub portion adjacent the outer circumference thereof. This driving connection is a lost motion type connection, the reason for which will be fully explained hereinafter. The length of each of these slots is equal approximately to two or three times the diameter of the studs so that in reversing the direction of rotation of the handwheel 65 there will be some relative movement or lost motion between the hub portion 68 and the bevel gear 62. A split ring 73 is provided to hold the hub portion 68 in position on the reduced end portion of the gear 62.

With the structure disclosed herein, rotation of the handwheel 65 in a clockwise direction (as viewed in FIGS. 4 and 7) will cause diametrically opposed ends of the slots 71 and 72 to engage the studs 69 and 70 to rotate the gear 62 and thus the drive gear 47 and the nut 52 so as to raise the ladle-supporting screw 53. Obviously, rotation of the handwheel in a counterclockwise direction will cause the opposite ends of the slots 71 and 72 to engage the studs 69 and 70 to rotate the gears 62 and 47 and the nut 52 in the opposite directions so as to lower the ladle-supporting screw 53.

When the handwheel 65 is released while the ladle 17 is in a raised position, the weight of the ladle 17 exerts a torque on the nut 52 tending to permit the ladle 17 to move downwardly under its own weight with corresponding rotation of the gears 47 and 62 and the handwheel 65. Such lowering action of the ladle 17 under its own weight, obviously would be undesirable for both operational and safety reasons. Accordingly, a brake is provided of a type which automatically prevents such free-lowering action while permitting unrestricted raising and lowering of a ladle upon rotation of the handwheel in opposite directions. The clutch brake acts as a clutch during operation of the handwheel and as a brake when the handwheel is released and there is a tendency for the ladle to descend under its own weight.

The clutch brake comprises a stationary brake drum member 76 tightly threaded on the reduced threaded-end portion 35 of the fixed shaft 33, the brake drum member 76 being provided with pairs of spanner wrench recesses 77 for tightening it on the threaded-end portion 35. The outer periphery of the brake drum member 76 is preferably knurled or otherwise mutilated and has tightly fitted thereover a brake band 78 formed of suitable friction material, such as brake lining. It will be seen that the drum 76 with the brake band 78 are fixedly mounted relative to the housing 25 and are coaxially aligned with the rotatable gear 62.

A flat coil spring 80 (FIG. 10) having several turns is disposed about or embraces the brake band 78 and is rotatable relative thereto when in a loosened or distended condition. Conversely when the spring 80 is tightened or constricted about the brake band 78 no relative rotation therebetween is permitted. As shown in FIG. 10, the inner or rear end 81 of the spring 80 is looped into an eye while the outer or front end 82 is bent so as to extend radially to the main body portion of the spring.

The spring 80 is formed of a spring wire material, e.g. steel, and is designed to have an inner diameter when in a non-stressed condition (before it is mounted on the brake lining 78) which is slightly less than the outer diameter of the brake lining. As an illustration, a spring for a $3\frac{19}{32}$" brake lining may have an inner diameter of $3\frac{7}{16}$". Thus, when it is assembled on the brake lining 78, the spring 80 is in a somewhat distended condition and there is a frictional force existing therebetween due to the tendency of the spring to assume its normal smaller diameter position. Therefore, either a counterclockwise force exerted on the inner end 81 of the spring or a clockwise force exerted on the outer end 82 thereof (as viewed in FIGS. 7 to 9) tends to increase the tightening action of the spring on the brake lining 78 and the frictional force therebetween. It is noted that it is not necessary that the above described tightening forces be exerted simultaneously on both ends of the spring due to the normal frictional force existing between the spring and the brake lining which tends to hold the end of the spring against which the force is not exerted against movement relative to the brake lining. A particularly important physical characteristic of this arrangement lies in the fact that a slight force exerted either on the inner end 81 of the spring in a clockwise direction or on the outer end 82 in a counterclockwise direction acts to loosen the spring 80 sufficiently on the brake lining 78 to permit substantially free rotation of the spring about the brake lining as long as such a loosening force is applied. Therefore, a loosening force applied to either end of the spring will loosen or distend the spring so as to permit rotation thereof relative to the brake lining.

As illustrated in FIGS. 5 and 7 to 9, the loop end 81 of the spring 80 fits over the projecting end of the stud 69 so as to in effect secure or connect the inner end of the spring to a point on the outer face of the rotatable gear 62. The inner end 81 of the spring is looped to facilitate such connection to the stud 69. The outer end 82 of the spring is not similarly secured or connected but is adapted to be engaged by a member or bar 85 which is rotatable with the hub portion 68.

With this arrangement, any tendency of the gear 62 to rotate in a counterclockwise direction (as viewed in FIG. 8) will, through the stud 69, exert a counterclockwise force on the inner end 81 of the spring which force tends to tighten the spring 80 on the brake lining 78. With the spring tightened on the brake lining and fixed relative thereto, the gear 62 which is connected to the inner end of the spring by the stud 69 is prevented from rotating in the counterclockwise direction. As previously described herein, downward movement of the ladle 17 under its own weight would cause counterclockwise rotation of the gear 62. Therefore, lowering of the ladle 17 under its own weight upon release of the handwheel 65 is prevented inasmuch as such lowering movement would exert a counterclockwise rotative force on the gear 62

which, as explained herein, acts on the inner end of the spring to tighten the spring on the brake lining **78** and prevents such ladle lowering or counterclockwise rotation of the gear **62**.

This brake arrangement also insures non-restricted raising of the ladle **17** upon rotation of the handwheel **65**. Initial rotation of the gear **62** in a clockwise direction (as viewed in FIG. 7) will, through the stud **69**, exert a clockwise force on the inner end **81** of the spring which unwinds or loosens the spring on the brake lining **78** whereby continued clockwise rotation of the gear **62** will result in clockwise rotation of the spring therewith relative to the stationary brake lining **78**. As previously described, clockwise rotation of the gear **62** produces ladle raising movement of the screw **53**. Rotation of the handwheel **65** in a clockwise direction causes the left end of the slot **71** (as viewed in FIG. 7) to engage the stud **69** to drive the gear **62** in a clockwise direction and to simultaneously exert the above described loosening force on the inner end **81** of the spring to permit unrestricted raising movement of the screw **53**..

In order to permit unrestricted positive lowering of the ladle **17** upon rotation of the handwheel **65** in a counterclockwise direction (as viewed in FIG. 8), means are provided to offset or overcome the previously explained tightening force which would be applied to the inner end **81** of the spring **80** as the result of ladle lowering or counterclockwise rotation of the gear **62**. The means provided for this purpose includes the member or bar **85** which projects inwardly from a cover plate **86** secured against the outer end of the hub portion **68** of the handwheel **65** by a series of bolts **87**. The member **85** is so positioned on the cover plate **86** that upon counterclockwise rotation of the handwheel (as viewed in FIG. 8) to lower the ladle **17**, either from a rest position or as a reversal of clockwise ladle-raising rotation of the handwheel **65**, the member **85** engages the bent outer end **82** of the spring **80** and exerts a force thereon in a counterclockwise direction which unwinds or loosens the spring on the brake lining **78** during the limited degree of counterclockwise movement of the hub portion **68** relative to the gear **62**, that is until the right end of the slot **71** (as viewed in FIG. 8) engages the stud **69** to rotate the gear **62** in the ladle-lowering or counterclockwise direction. Thus, during ladle-lowering or counterclockwise rotation of the handwheel **65**, the member **85** exerts a continuous loosening force on the outer end **82** of the spring **80** which overcomes or offsets the previously described tightening force applied to the inner curved end **81** of the spring due to the ladle-lowering or counterclockwise rotation of the gear **62** and permits counterclockwise rotation of the spring relative to the brake lining **78** and unrestricted lowering of the ladle **17**. This action is best illustrated by a comparison of FIGS. 7 and 8 showing ladle raising-and-lowering rotation of the handwheel, respectively, wherein the distance the outer bent end **82** of the spring is moved relative to the inner curved end **81** upon initial ladle-lowering or counterclockwise rotation of the handwheel is clearly evident.

However, as soon as such ladle-lowering rotation of the handwheel **65** is stopped, the loosening force applied by the member **85** is removed from the outer end **82** of the spring **80**, thereby permitting the tightening force applied to the inner curved end **81** of the spring by the stud **69** to become effective to tighten the spring **80** upon the brake lining **78** and effectively stop the ladle-lowering rotation of the gear **62**. Assuming that ladle-lowering or counterclockwise rotation of the handwheel **65** is stopped in the position shown in FIG. 8, the gear **62** will continue rotating in a counterclockwise direction until the stud **69** reaches the position shown in FIG. 9 adjacent the left end of the slot **71**, in which position the spring **80** has been sufficiently tightened upon the brake lining **78** as the result of the tightening force applied to the inner end **81** by the stud **69** to bring the gear **62** to a stop, thereby preventing any further downward movement of the ladle **17**. It is noted that this continued counterclockwise rotation of the gear **62** after stopping of the handwheel **65**, in the embodiment shown in the drawings, amounts to approximately one eighth of a full revolution which results in a negligible corresponding downward movement of the ladle-supporting screw **53**. The invention thus provides sensitive and smooth control of the movement of the ladle **17**.

Should the handwheel **65** be given a counterclockwise or ladle-lowering spin when the ladle **17** is in a raised position, the ladle **17** will continue moving downwardly until the inertia force of the handwheel becomes less than the spring loosening force required at the outer bent end **82** of the spring **80**, at which time the handwheel will come to a stop and the clutch brake described herein will immediately brake the downward movement of the ladle to a stop, as previously explained.

The brake drum **76** and the threaded-end portion **35** are provided with threads such that the braking force exerted on the brake lining **78** tends to tighten the brake drum on the threaded end portion **35** of the shaft **33**. In the embodiment shown in the drawings, these threads are left-handed.

As best shown in FIGS. 6 and 7 through 9 inclusive, a pair of arcuate flanges or webs **88** are formed on the hub portion **68** so as to embrace and contain the spring **80** and prevent undue unwinding of individual coils thereof, particularly the inner and outer coils, when a loosening or unwinding force is applied thereto. Thus, when a loosening force is applied to either end of the spring, it is transmitted substantially evenly throughout the length of the spring to insure proper loosening of the spring on the brake lining **78**.

In order to prevent loosening of the stud **69** as a result of its contact with the looped inner end **81** of the spring **80**, a finger-like member **89**, FIG. 5, is carried on the hub portion **68** and is engageable with a screwdriver recess formed in the head end of the stud.

Referring to FIGS. 4, 11 and 12, it is noted that the bolts **87** for securing the cover plate **86** to the hub portion **68** pass through arcuate slots **90** formed in the cover plate **86**. Thus, should either the brake lining **78** or the coil spring **80** become sufficiently worn that the unconnected outer end **82** of the spring shifts from its normal position toward the looped end **81** thereof in a clockwise direction (as viewed in FIGS. 7 to 9 inclusive), the cover plate **86** may be rotated relative to the hub portion **68** to bring the projecting member or bar **85** carried thereon into proper relationship with the displaced outer end of the spring.

In operation, the handwheel **65** is rotated in a clockwise direction to raise the ladle **17** and in a counterclockwise direction to lower the ladle (as viewed in FIGS. 7 to 9 inclusive). Rotation of the handwheel causes rotation of the gear **62** through the stud and slot connections **69—71** and **70—72** which in turn drives the gear **47** and the nut **52** of the ball bearing screw-and-nut assembly to raise or lower the ladle-supporting screw **53**. The coil spring **80** of the friction brake has one end **81** operably connected to the gear **62** by means of the stud **69** so that any tendency of the ladle to descend under its own weight when the handwheel is released exerts a tightening force on the one end **81** of the spring to prevent rotation of the gear **62** and lowering of the ladle. When the handwheel **65** is rotated in a clockwise direction to raise the ladle, a loosening or unwinding force is exerted on the end **81** of the spring whereby to permit unrestricted raising of the ladle under the influence of the handwheel. A loosening or unwinding force is exerted on the other end **82** of the spring of the friction brake when the handwheel is rotated in a counterclockwise direction whereby to permit unrestricted lowering of the ladle under the influence of the handwheel. The in-

vention thus provides a new and improved manually operable ladle handler which permits unrestricted raising and lowering of a ladle under the influence or control of a handwheel, crank, or the like yet which prevents lowering of the ladle under its own weight when the handwheel is released.

With the structure disclosed herein a relatively small force is required to rotate the handwheel 65, the force being so small that an operator using one hand can accurately manipulate a full ladle of molten metal weighing as much as a ton or more. Because of the over-all simplicity of the operation of the ladle handler disclosed herein and its easy maneuverability and low-lifting wheel pull, operator fatigue is greatly minimized.

The ladle handler described herein is economical to produce and inasmuch as sealed bearings of known type are preferably used in the assembly thereof there is no need to provide lubrication of the other moving parts, thereby eliminating the necessity of providing sealing rings and gaskets.

Although the invention illustrated and described herein is directed to a ladle handler, the structure disclosed may be utilized as a manually operable, mechanical hoist for many other purposes.

It will be understood that certain changes may be made in the construction or arrangement of the ladle handler disclosed herein without departing from the spirit and scope of the invention as defined in the appended claims.

We claim:

1. A ladle handler of the hoist type comprising, in combination, a housing, means for suspending the housing from an overhead supporting structure, a ladle supporting member extending vertically through said housing, means in said housing for raising and lowering said ladle supporting member relative to said housing, one element of said latter means being a gear rotatable about a horizontal axis, a manually operable handwheel having a hub portion rotatably mounted coaxially with and adjacent to said gear, a pin carried on said gear and extending through an elongated slot formed in the hub portion of said handwheel whereupon rotation of the handwheel imparts rotation to said gear and raising and lowering of said ladle supporting member, said pin-and-slot arrangement between said gear and said handwheel permitting a limited degree of relative rotation therebetween, a stationary member in said housing formed of friction material, a flat coil spring distended into embracing engagement with said friction member coaxially of said gear, said spring being freely rotatable relative to said friction member when a loosening force is exerted on either end thereof and frictionally secured thereto when a tightening force is exerted on either end thereof, means connecting one end of said spring to said pin on said gear whereby said gear is permitted to rotate to raise and lower a ladle only when said spring has a loosening force exerted thereon, said gear through said pin exerting a tightening force on said one end of said spring upon ladle-lowering rotation thereof under the weight of the ladle and exerting a loosening force on said one end of said spring upon ladle raising rotation thereof under the influence of said handwheel, and a member mounted on the hub portion of said handwheel for exerting a loosening force on the other end of said spring during said limited relative rotation between said handwheel and said gear upon initially rotating said handwheel in a direction to lower the ladle.

2. In a ladle handler of the hoist type having a housing, means for suspending the housing from an overhead supporting structure, a ladle supporting screen member extending vertically through the housing and vertically movable relative thereto, means to hold said screw member against rotation in said housing, a nut member embracing said screw and adapted to be rotated to cause vertical movement of said screw, and manually operable

rotating means for raising and lowering the ladle supporting member, the improvement which comprises an actuating mechanism operable to permit unrestricted raising and lowering of a ladle upon movement of the rotating means while preventing downward movement of the ladle under its own weight when the rotating means is released, said mechanism comprising, a rotatable gear mounted in said housing and operably connected to said nut member for rotating the same, said gear being axially aligned with said rotating means, a pin-and-slot driving connection between said gear and said rotating means with the pin being secured to the face of the gear whereby to permit limited relative rotation therebetween, a stationary cylindrical brake lining mounted in axial alignment with said gear, a flat, coil spring embracing said brake lining and adapted to be rotatable relative thereto only when a loosening force is exerted on either end thereof, one end of said spring being connected to said pin on said gear so that ladle raising and lowering rotation of said gear is possible only when said spring is rotatable about the brake lining, said spring and gear being so connected that ladle raising rotation of said gear exerts a loosening force on said one end of said spring permitting raising of the ladle whereas ladle lowering rotation of said gear immediately exerts a tightening force on said one end of said spring to stop said rotation of the gear and lowering of the ladle, and a member on the rotating means which is operable upon ladle lowering rotation of said rotating means during said limited rotation thereof relative to said gear to exert a loosening force on the other end of said spring prior to the application of said tightening force on said one end of said spring to permit lowering of the ladle under the influence of the rotating means, said loosening force exerted on said other end of the spring being removed therefrom when the rotation of said rotating means is stopped whereupon the tightening force applied to said one end of the spring becomes effective to brake the downward movement of the ladle to a stop.

3. A ladle handler of the hoist type comprising, in combination, a housing, means for suspending the housing from an overhead supporting structure, ladle supporting means in said housing and extending vertically therebelow, a gear in said housing operably connected to raise and lower said ladle supporting means, a manually operable member having a hub portion rotatably mounted coaxially with and adjacent to said gear, pin-and-slot means interconecting said gear and the hub portion of said member whereupon rotation of said member provides rotation of said gear, said pin-and-slot means permitting a limited degree of relative rotation between said gear and said hub portion, a cylindrical brake lining member formed of friction material fixedly mounted in axial alignment with said gear, a flat, coil spring normally tightly embracing said brake lining member so that a frictional force exists therebetween normally preventing rotation of said spring relative to said fixedly mounted brake lining member, said spring being substantially freely rotatable relative to said brake lining upon the application of a loosening force to either end thereof, means operably connecting one end of said spring to a point on the face of said gear so that any tendency of said gear to rotate under the weight of a ladle connected to said ladle supporting means when said manually operable member is released is prevented whereas rotation of said member in a direction to raise a ladle exerts a loosening force on said one end of the spring to permit ladle raising rotation of said gear, and means for exerting a loosening force on the other end of said spring during said limited relative rotation between said hub portion and said gear when rotating said manually operable member in a direction to lower a ladle to permit ladle lowering rotation of said gear.

4. In combination with a ladle handler of the hoist type having a housing, means for suspending the housing

from an overhead supporting structure, a vertically extending ball bearing screw-and-nut assembly associated with the housing for raising and lowering a ladle adapted to be supported from the lower end of the screw thereof and with the nut thereof being supported in the housing for rotational movement only, gear means for rotating the nut in either of two directions to raise or lower the screw, and a handwheel operably connected to the gear means, an improved clutch-brake to prevent lowering of the screw under the weight of a ladle when the handwheel is released comprising, a cylindrical brake lining member fixedly mounted in axial alignment with one of the gears of said gear means, a flat, coil spring normally frictionally embracing said brake lining member so as to normally prevent relative rotation therebetween but being substantially freely rotatable relative to said brake lining member upon the application of a loosening force to either end thereof, means connecting one end of said spring to said one gear so that said gear is rotatable only when a loosening force is applied to said spring, said gear and said spring being interconnected so that any tendency of said gear to rotate in a ladle lowering direction under the weight of the ladle when the handwheel is released is prevented, and means operable upon rotation of the handwheel in either direction to apply a loosening force to said spring so as to permit ladle lowering and raising rotation of said one gear.

5. In combination with a ladle handler of the hoist type having a housing, means for suspending the housing from an overhead supporting structure, a ladle supporting vertically disposed screw and an associated nut assembly mounted in the housing with the screw extending from within the housing vertically therebelow, a rotatably mounted member operably connected to the nut assembly to raise and lower the ladle supporting screw, and manually rotatable means operably connected to the rotatably mounted member by a lost motion connection, a clutch-brake mechanism permitting raising and lowering of said ladle supporting screw upon actuation of the manually rotatable means while preventing lowering of the ladle supporting screw under the weight of a ladle when the manually rotatable means is released, which clutch-brake mechanism comprises a stationary member formed of friction material disposed in said housing in axial alignment with said rotatably mounted member, a flat coil spring grippingly disposed about said friction member coaxially of said rotatably mounted member so as to be normally held against rotation relative to said friction member, said spring being substantially freely rotatable about said friction member upon the application of a loosening force on either end of the spring, means operably connecting one end of said spring to the rotatably mounted member so that said member is rotatable to raise and lower the ladle supporting screw only when a loosening force is applied to said spring, said rotatably mounted member and said one end of said spring being so interconnected that movement of said member in a ladle-lowering direction under the weight of a ladle when the manually rotatable means is released is prevented, means on said manually rotatable means which is operable to exert a loosening force on said one end of the spring when the manually rotatable means is rotated in a direction to raise a ladle, and other means on said manually rotatable means which is spaced thereon relative to said first mentioned spring loosening means for engaging with and exerting a loosening force on the other end of said spring when the manually rotatable means is rotated in an opposite direction to lower a ladle.

6. In combination with a ladle hoist of the type having a housing, a rotatably mounted member in the housing, means for suspending the housing from an overhead structure, a ladle supporting screw-and-nut assembly in the housing and operably connected to the rotatably

mounted member with the screw thereof extending vertically below the housing whereby rotation of the member in opposite directions raises and lowers the ladle supporting screw, and a handwheel operably connected to the rotatably mounted member, an improved clutch brake for preventing lowering of the ladle supporting screw under the weight of a ladle connected thereto when the handwheel is released comprising, a fixedly mounted cylindrical member formed of friction material in axial alignment with the rotatably mounted member, a flat, coil spring mounted on said fixed cylindrical member for frictional engagement therewith so as to normally prevent relative rotation therebetween but being substantially freely rotatable relative to said cylindrical member upon the application of a loosening force to either end thereof, means connecting one end of said spring to the rotatably mounted member so that rotation of the rotatably mounted member under the weight of a ladle connected to the ladle supporting screw when the handwheel is released exerts a tightening force on said one end of said coil spring to prevent rotation of the spring relative to said cylindrical member and thus any rotation of the rotatably mounted member, and separate abutment means in spaced relation on the handwheel which are engageable with the opposite ends of the spring upon rotation of the handwheel in one direction or in the opposite direction to exert unwinding forces upon the ends of said coil spring and thereby loosen said coil spring for rotation relative to said fixed cylindrical member and permit raising and lowering rotation of the rotatably mounted member associated with the ladle supporting screw.

7. A ladle handler of the hoist type comprising, in combination, a housing, means for suspending the housing from an overhead supporting structure, a ball bearing screw-and-nut assembly supported in said housing with the screw extending vertically below said housing, means at the lower end of the screw for connecting a ladle thereto, means for preventing relative rotation between the screw and the housing, means for rotating the nut to raise and lower the screw, one element of said latter means being a gear rotatable about a horizontal axis, manual rotating means operably connected to rotate said gear, a coil spring mounted on a stationary brake lining member coaxially of said gear, said spring normally gripping said brake lining member so as to be normally held against rotation relative thereto but being substantially freely rotatable thereon during the application of a loosening force on either end thereof, means connecting one end of said spring to said gear so that any tendency of the gear to rotate under the weight of a ladle when said manual rotating means is released is prevented, and means operable upon manual rotation of said manual rotating means in either direction to exert a loosening force on the spring so as to permit rotation of said spring about said brake lining member and either ladle-raising or ladle-lowering rotation of said gear.

8. A ladle handler of the character described in claim 7 wherein said loosening force exerted on said spring is exerted on opposite ends of the spring when said manual rotating means is rotated in opposite directions.

9. A ladle hoist comprising, in combination, a housing, means for suspending the housing from an overhead supporting structure, ladle supporting means including a screw-and-nut assembly in said housing with the screw depending from within said housing, means for preventing relative rotation between the screw and the housing, means for rotating the nut to raise and lower the screw including a gear rotatable about a horizontal axis, a handwheel having a lost motion connection with said gear, a flat, coil spring mounted on a sleeve-like core of friction material, which core of friction material is fixedly mounted in axial alignment with said gear, said spring being freely rotatable on said core only when in

a loosened condition as a result of having a loosening force exerted on either end thereof and said spring having one end connected to said gear so that rotation of said gear under the weight of a ladle when the handwheel is released exerts a tightening force on the spring and prevents the ladle from descending, and separate spaced abutment means on the handwheel which are operable upon rotation of said handwheel in one direction or in the opposite direction to exert loosening forces on the ends of the spring whereby to loosen said spring and permit rotation of said spring about said core and ladle raising and lowering rotation of said gear.

10. In combination with a ladle handler of the hoist type having a housing, means for suspending the housing from an overhead supporting structure, a ladle supporting ball bearing screw depending from the housing and vertically movable relatively thereto, a ball bearing nut member embracing said screw and adapted to be rotated to cause vertical movement of said screw, said screw being held against rotation, and a manually operable handwheel, an actuating mechanism permitting raising and lowering of a ladle upon rotation of the handwheel while preventing downward movement of a ladle under its own weight when the handwheel is released comprising, a rotatable gear operably connected to rotate said nut member and axially aligned with the handwheel, a pin projecting from one face of the gear and engageable with a hub portion of the handwheel to provide a driving connection therebetween, a cylindrical member formed of brake lining material fixedly mounted in axial alignment with said gear and handwheel, a flat coil spring disposed about and normally gripping said cylindrical member and adapted to be rotatable relative thereto only when a loosening force is applied to either end thereof, means connecting one end of said spring to said pin on said gear so that rotation of said gear by said handwheel in a direction to move a ladle upwardly exerts a loosening force on said one end of said spring to permit rotation thereof relative to said cylindrical member and ladle-raising rotation of said gear, and a member mounted on the hub portion of the handwheel engageable upon ladle-lowering rotation of the handwheel with the other end of said spring to exert a loosening force thereon to permit rotation of said spring relative to said cylindrical member and ladle-lowering rotation of said gear.

11. A ladle hoist comprising, in combination, a housing having a cylindrical opening formed in one side with a fixed shaft extending coaxially through said opening, means for suspending the housing from an overhead track-and-trolley assembly comprising a hollow, square

guide tube extending through and secured to the upper surface of the housing and having its upper end connected to a swivel hook engageable with the trolley, a bevel gear rotatably mounted on said fixed shaft in driving engagement with a hollow pinion gear rotatably mounted in an opening formed in the lower surface of the housing in axial alignment with said hollow guide tube, a ball bearing screw-and-nut assembly wherein the nut is supported on the upper end of said pinion gear in driving engagement therewith and the screw extends upwardly into said guide tube and downwardly through said hollow pinion gear and below the housing, bail means connected to the lower end of the screw for supporting a ladle, means preventing rotation of the screw relative to the housing whereby rotation of the nut in one direction raises the screw and in the opposite direction lowers the screw, a cylindrical hub casting rotatably mounted on a reduced end portion of said bevel gear for rotation within said cylindrical opening in said housing, motion-transmitting means interconnecting said bevel gear and said hub casting, a handwheel secured to said hub casting, clutch-brake means for preventing lowering of the screw under the weight of a ladle when the handwheel is released comprising, a cylindrical member formed of friction material fixedly mounted in axial alignment with said bevel gear, and a coil spring gripping said friction member so as to be normally held against rotation relative thereto and having one end connected to said motion-transmitting means whereby to normally prevent rotation of said bevel gear, said spring being substantially freely rotatable about said friction member upon application of a loosening force on either end thereof, and clutch-brake releasing means operable to apply a loosening force on one end of said spring upon rotation of said handwheel in one direction and a loosening force on the other end of said spring upon rotation of said handwheel in the opposite direction whereby to permit raising and lowering of the ladle-supporting screw under the influence of the handwheel.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,987,786 June 13, 1961

Fred T. Smith et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 27, for "overload" read -- overhead --; column 7, line 70, for "screen" read -- screw --.

Signed and sealed this 2nd day of January 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents