UNITED STATES PATENT OFFICE

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LADLE TIPPING MECHANISM

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6 Claims. (Cl. 22—82)

1. This invention relates to mechanism for controllably tilting ladles used in foundry furnaces and the like where molten metal is poured into molds.

Several types of ladle tilting mechanisms are utilized at the present time employing gear driving mechanism or windlasses or hooks for applying power to tilt the ladle in the desired manner for pouring. With such mechanisms as are known to applicant, the tilting of the ladle during pouring is accompanied with jerkiness and lack of uniformity. Such jerkiness becomes accentuated after wear and long use of the tilting mechanism.

In the making of excellent castings, the uniform control of the flow of metal from the crucible to the mold is essential to prevent pockets and fissures in the castings. Sudden flow of a mass of molten metal produces trapping and pocketing of gases, sometimes producing explosions at the point of pouring with, of course, injury to attendants and operators.

It is an object of my invention to provide a simplified, highly efficient ladle tilting mechanism which is steady and positive in its operation; overcomes the objectionable features of mechanisms now conventionally used, and which may be controlled very sensitively and accurately by an operator removed a short distance from the point of pouring.

Another object of my invention is the provision of ladle tilting mechanism designed to be entirely supported from a traveling crane or the like and further adapted to be readily installed and applied to conventional types of ladles now in commercial use.

It is a more specific object to provide ladle tilting mechanism of the class described wherein smooth and uniform hydraulic power is applied through finger control of an operator and the medium of efficient lever connections with the ladle to eliminate jerkiness and unsteady pouring which are prevalent in mechanisms of the prior art.

Another object is the provision of a power-actuated bellcrank lever mechanism for controllably tilting foundry ladles wherein points of fulcruming and connection with power source and with the ladle are positioned to insure at all times, positive and uniform control in tilting as well as utilization of power with accurate and sensitively controlled effect.

A still further object is the provision of ladle tilting mechanism of the class described which combines compact hydraulic system, a ladle support and operating mechanism, all compactly embodied in an integral unit which may be readily utilized with overhead cranes and conventional ladles in commercial use.

These and other objects and advantages of my invention will more fully appear from the following description made in connection with the accompanying drawings wherein like reference characters refer to similar parts throughout the several views and in which:

Fig. 1 is a side elevation showing an embodiment of my invention applied to a conventional foundry ladle and supported from the hook of the traveling crane with the ladle disposed in horizontal or upstanding position;

Fig. 2 is a top plan view of the same with portions of the base-supporting cables broken away; and

Fig. 3 is a vertical section taken substantially along the line 3—3 of Fig. 2 showing the ladle in almost full tipped position.

My improved mechanism, in its preferred form as shown, includes a large generally rectangular base or supporting platform 5 which may be conveniently constructed from a thick, suitable metal having as shown upstanding, heavy attachment lugs 5a extending upwardly from the corners thereof for connection with supporting media (preferably flexible) such as cables 6 which converge upwardly at a point centrally above base 5 and as shown are connected with a heavy ring 7 adapted to be connected with a depending supporting hook 8 such as is furnished by a traveling crane structure.

Base or platform 5, as shown, is provided centrally with a depending heavy supporting hook 5 which is adapted to engage and support the usually notched, upper portion of the bail 16a of a conventional ladle 10 of the type used in foundries or in pouring furnaces for holding and distributing molten metals into molds. The bail 10a at its lower ends has the usual smooth trunnions 10b for connection with suitable bearings in the central portion of the peripheral wall of the ladle. The said ladle-supporting hook 5 may be slightly biased to one side of the center of gravity of base 5 for most efficient balancing of a hydraulic operating system mounted on the top of the base or platform 5.

My tilting mechanism includes a bell crank lever 11 pivoted on a fulcrum pin 12 between a pair of heavy upstanding fulcrum lugs 13 which are rigidly affixed to the top and central portion of plate 5. In this connection, it will be noted that the fulcrum pin 12 is vertically aligned with the bail 16a of the ladle, this being deter-
mined by the relative positioning of the fulcrum pin with respect to depending supporting hook 9. Bell crank lever 11, fulcruming on a horizontal axis parallel with the axis of the ladle trunnions 10, has an elongated arm 11a which works through an elongated slot 5b formed through the base 5, said arm 11a in the normal unlifted position of the ladle, extends outwardly from the lever fulcrum and terminates at a point disposed outwardly, and a short distance above the rear of the upper edge of ladle 10 for pivotal connection by a pivot pin 14, with the upper end of a depending link 15, which is shown as slightly longer than the full height of ladle 10 and is pivotally connected at its lower end with a heavy pouring lug 16 rigidly affixed to the lower portion of ladle 10 at its rear side and fixed directly opposite from the pointed-spool 18c of the ladle. The axis of the pivot pin 14, connecting the long arm of the bell crank lever with link 15, is preferably disposed in an imaginary line extending in a vertical plane diametrically bisecting the ladle, such line extending substantially at 45° to the plane defined by the upper edge of the ladle. Bell crank lever 11 rigidly carries a short power-receiving arm 11b which extends preferably at an angle somewhat less than 90° to the longer arm 11a being disposed with the ladle in normal unlifted position, as shown in Fig. 1.

While a wide variety of hydraulic power systems may be utilized with my invention mounted upon the base or supporting foundation 5, I prefer to employ in the system utilized a substantially horizontal hydraulic cylinder 17 pivotally mounted at its outer end between a pair of heavy upstanding mounting brackets 18 and having slidably mounted therein, a suitable piston 19 fixed to the end of an elongated piston rod 19a which extends through a suitable packing gland 19b on the rear end of cylinder 17 and is connected by pivot pin 20 with the outer end of the short arm 11b of the bell crank lever. The axis of the pivot for mounting the forward end of cylinder 17 is disposed parallel with the fulcrum axis of lever 11 and the piston rod 19a lies substantially in a common plane with bell crank lever 11.

My hydraulic system is such that fluid under finger control of an operator may be forced through cylinder supply conduits 21 and 22 against either the outer end or inner end of the piston 19. As shown, my hydraulic system comprises a hydraulic pump P driven by a motor M rigidly affixed to the base 5, said pump having its discharge connected by conduit 23 with a fluid reservoir R and having also branch connection with a conduit 24 which is medially connected to a selector valve mechanism 5 mounted on base 5 adjacent the cylinder 17. The selector valve casing has an overflow conduit 25 which is connected in the system to an accumulator tank A which in turn is connected with the return of the system through a conduit 26 having communication, as does supply conduit 24, with a relief valve V. Relief valve V is in turn connected for recirculation by a conduit 27 with the intake of pump P.

The selector valve mechanism 5 includes a valve system (not shown) of conventional type wherein passage of fluid under pressure through conduit 21 to the outer end of cylinder 17, with return of fluid through conduit 22, may be accomplished or where reverse flow of fluid for retracting the piston 19 may be accomplished or where fluid may be locked in both of the communicating conduits 21 and 22. This valve system is subject to immediate and sensitive control by any suitable conventional means such as a solenoid or electromagnetic core (not shown) or if desired, manually controlled handles may be supplied. In the form of the invention illustrated, an external rearwardly directed switch 28 is connected with the wires or conductors for operating the hydraulic system. In opposite directions are housed in a service valve C extending over the top of the base plate 5 to a push button switch X which may be finger controlled from a distance of 15 to 20 feet from the position of the ladle.

**Operation**

From the drawings and the foregoing description, it will readily be seen that my entire mechanism, including the lever and linkage mechanism and the hydraulic system are combined as a compact unit adapted to readily be connected with conventional foundry ladles and to be supported from an overhead crane, carriage or other adjustable overhead supporting structure.

In operation, my invention, which supports the ladle 16 is properly positioned above a mold 5 into which molten metal is to be poured and adjusted to the proper height. The mechanism when adjusted to position is positioned as shown in Fig. 1 with the ladle 16 in horizontal or normal unlifted condition.

To tilt the ladle, the operator standing at a point of vantage some 10 to 20 feet away from the ladle, controls the mechanism by finger pressure, actuating the proper button or other element to cause hydraulic fluid to flow through the cylinder supply conduit 21 against the outer end of piston 19. Piston rod 19a is protracted steadily, slowly and uniformly applying its power to the short end 11b of the bell crank lever. Instant release of the control element locks the hydraulic mechanism and lever mechanism immediately. No jerkiness is encountered since the connection of the piston rod 19a through the medium of the bell crank lever and linkage with the ladle is positive and free from lost motion. The nature of the hydraulic system with balancing of fluid on both sides of the piston eliminates any impulse or jerkiness in the hydraulic system itself.

The ladle is further tilted or returned to normal pouring position by manipulation of the proper element of the valve control which may be instantly and sensitively controlled by the operator.

The tilting or swinging of the ladle with my mechanism is always uniform and may be regulated as to speed to suit the particular need, according, of course, to the pressure upon the hydraulic fluid and the proportions of the working parts of the hydraulic system.

In the foregoing description, it will be seen that I have provided a compact, simplified and highly efficient mechanism adapted to be utilized as an attachment for conventional ladles and pouring furnaces now in use and eliminating most of the objectionable features from the structures of the prior art.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the parts without departing from the scope of my invention. Where, herein the term "hydraulic" is used in the specification and claims, that term contemplate not only systems and parts thereof where hydraulic liquid is utilized but systems wherein...
any fluid (gaseous or liquid) under pressure is employed.

What I claim is:

1. Mechanism for controllably tilting a foundry ladle comprising an overhead supporting base having means thereon for connection with the ball of a ladle to support the same, a bellcrank lever pivotally connected with said supporting base for fulcruming on a horizontal axis extending parallel to the axis of the trunnions of said ladle, said bellcrank lever having a longer ladle-connection arm extending downwardly to the rear of said ladle when said ladle is disposed in upright position and having a shorter, power-receiving arm angling with respect to said longer arm, a link pivotally connected at its upper end to the outer end of said longer bellcrank arm and pivotally connected at its lower end to the lower portion of said ladle at a point on the opposite side thereof relative to the pouring spout of said ladle and instantly controlled power mechanism mounted on said base and including a longitudinally reciprocable rod pivotally connected at its outer end to the outer end of said shorter bellcrank arm.

2. The structure set forth in claim 1, said power mechanism comprising a hydraulic cylinder pivotally mounted at its outer end and a fluid-actuated piston mounted in said cylinder and connected with said reciprocable rod and a valve system for selectively introducing fluid under pressure, into either end of said cylinder.

3. Mechanism for controllably tilting a foundry ladle comprising an overhead supporting base having means thereon for connection with the ball of a ladle to support the same, a bellcrank lever pivotally mounted upon said base for fulcruming on an axis parallel to the tilting axis of said ladle, said lever having a relatively long ladle-connection arm working through an aperture in said base and extending downwardly to the rear upper edge of said ladle when said ladle is disposed in upright position, said lever having a shorter, power-receiving arm extending upwardly above said supporting base, a link pivoted at its upper end to the outer end of said longer bellcrank arm and pivotally connected at its lower end with the lower portion of said ladle at a point disposed on the opposite side of said ladle respective of the pouring spout thereof and hydraulic power mechanism mounted on said base and including a hydraulic cylinder pivotally supported thereon said base at its outer end and having a piston mounted therein, a piston rod having its outer end pivotally connected with said shorter bellcrank arm, a selective valve system for introducing fluid under pressure selectively to the outer or the inner end of said cylinder for action against either side of said piston and valve controlling elements extending from said base to a point remote therefrom for instantly controlling said valve system.

4. Mechanism for controllably tilting a foundry ladle comprising an overhead supporting base having means thereon for connection with the ball of a ladle to support the same, a bellcrank lever pivotally mounted upon said base for fulcruming on an axis parallel to the tilting axis of said ladle, said lever having a relatively long ladle-connection arm working through an aperture in said base and extending downwardly to the rear upper edge of said ladle when said ladle is disposed in upright position, said lever having a shorter, power-receiving arm extending upwardly above said supporting base, a link pivoted at its upper end to the outer end of said longer bellcrank arm and pivotally connected at its lower end with the lower portion of said ladle at a point disposed on the opposite side of said ladle respective of the pouring spout thereof and hydraulic power mechanism mounted on said base and including a hydraulic cylinder pivotally supported thereon said base at its outer end and having a piston mounted therein, a piston rod having its outer end pivotally connected with said shorter bellcrank arm, a selective valve system for introducing fluid under pressure selectively to the outer or the inner end of said cylinder for action against either side of said piston and valve controlling elements extending from said base to a point remote therefrom for instantly controlling said valve system.

EMUND F. SCHULZE.

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