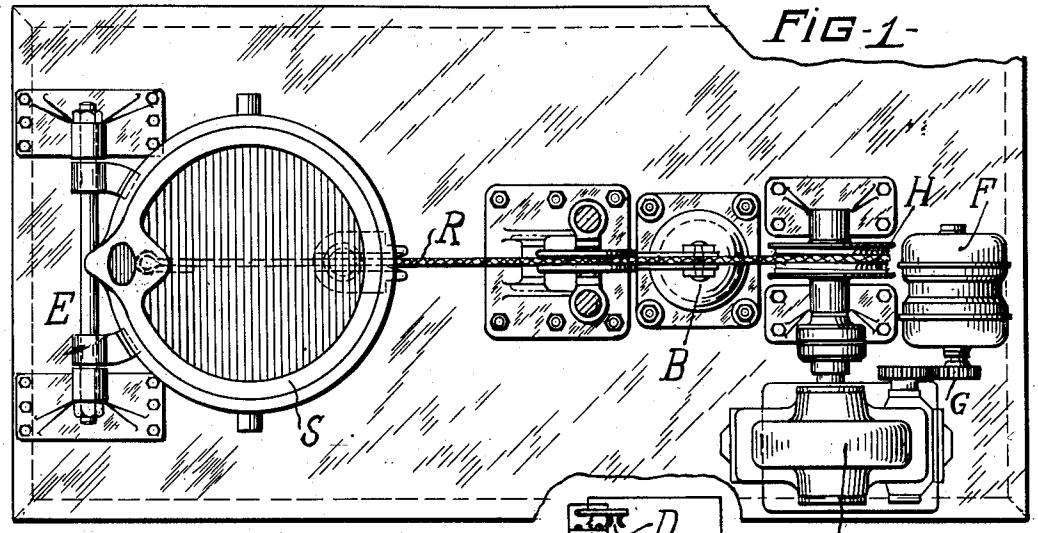
March 4, 1930. A. W. MORRIS ET AL 1,749,083

APPARATUS FOR POURING LIQUIDS SUCH AS MOLTEN METAL

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FIG-1-



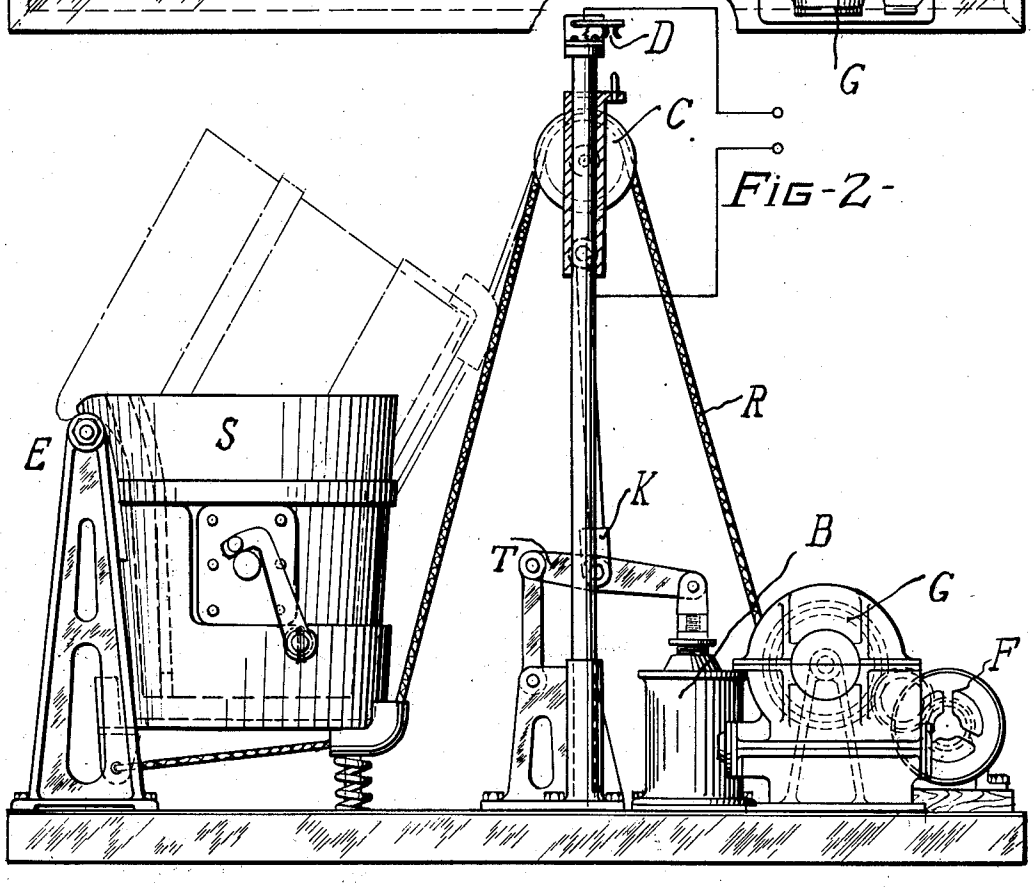


FIG-2-

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Fig-3-

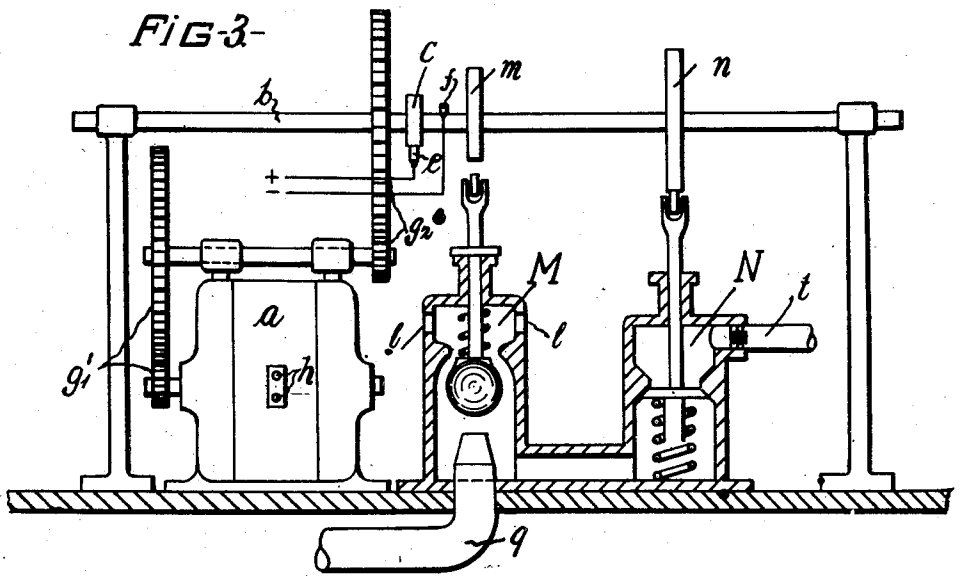


Fig-4-

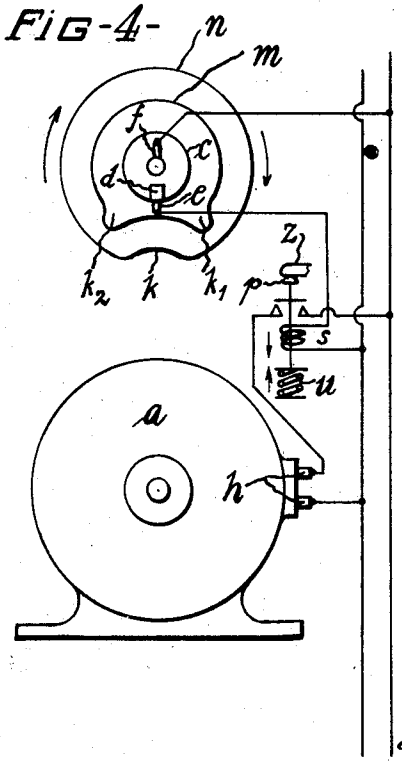
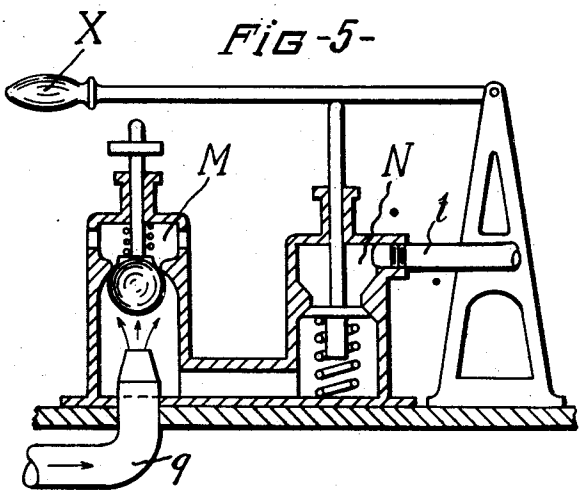


Fig-5-



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1,749,083

UNITED STATES PATENT OFFICE

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APPARATUS FOR POURING LIQUIDS SUCH AS MOLTEN METAL

Application filed March 18, 1929. Serial No. 347,976.

This invention relates to an improved apparatus or machine for pouring liquids and particularly molten metal. The improved machine may be used to advantage as the means for intermittently supplying the charging ladle in an automatic casting apartus such as shown in our copending applications Serial No. 341,142, filed February 19, 1929, and Serial No. 336,556, filed January 31, 1929. Another particular use is in the pouring of molten metal to a centrifugal casting machine such for example as is now quite effectively used in making cast-iron pipe. But apart from such particular uses, our present improvement has features useful in the general operations of pouring molten metal or liquids where care or precision is desired in the operations.

According to one important feature of the invention we provide a machine by which, according to a predetermined cycle of operations, a ladle or liquid container is tilted to pour, then tilted back in time to dampen or completely avoid the effect of the surging tendency of the liquid to spill over in excess of the desired pouring rate, and then again tilted to pour in time to carry on a substantially continuous pouring operation without the surging effect. So far as we know, we are the first to arrange a machine which will carry out this cycle of operations in exact measured sequence beyond the normal control of an operator and render the pouring effect the same in each operation. In prior practice the operation depended on the skill of the workmen and the danger of spilling due to surging at the start of the pouring operation had to be kept in mind by the workmen.

According to another feature of the invention the machine invariably tilts the ladle back a slight degree at the end of the pouring operation to cause the molten metal to recede to a point a little below that of being flush with the lip or spout. This also aids in the nice rate of pouring operation desired from the machine, as otherwise the metal, when level with the top edge, would dribble from the lip at the start of each operation.

Many other improved features will be apparent from the specific description of the drawings and annexed claims.

In the embodiment of the invention chosen for illustration of its preferred form, we have taken a pouring machine particularly designed to work with the automatic casting operations as illustrated in our said copending cases. But the control means for coordinating all the movements throughout the casting operations are not particularly pertinent to the disclosure of the present invention. For this reason we have simplified the control means herein shown to one which is adapted to this machine alone. It should be understood, however, that we contemplate connecting up the present machine with the timed control means of the other automatic machines as a definite part of our specific developments.

In the accompanying drawings:

Fig. 1 is a plan view of the apparatus arrangement according to this invention, but with part of the control not shown;

Fig. 2 is a side elevation of the parts in Fig. 1;

Fig. 3 shows in some detail a control mechanism for the automatic operation of the apparatus;

Fig. 4 illustrates schematically how the whole mechanism may be controlled by a single push-button; and

Fig. 5 shows a modification of the control arranged to be operated semi-automatically.

Referring to Figs. 1 and 2, S is the container with molten metal. This container may be filled by taking it to and from the main supply, as a cupola or open-hearth furnace, or by using another container attached to a crane as supply carrier for ladle S. The container can be turned or tilted about pivot E which supports the edge of the ladle in the manner shown. The rope R guided over a sheave C is wound about the drum H. This drum, by means of the gears G, is rotated from the motor F. By substituting other gears G the pouring rate may be conveniently varied, assuming the motor speed to be the same.

For an understanding of the other parts shown in Figs. 1 and 2, the preliminary ex-

planation of the machine operation will help.

When the motor is set in operation, a definite and sudden acceleration of the ladle S and its contents is unavoidable. This starts a surging tendency in the metal and unless it is corrected the metal will suddenly overflow and spill beyond the desired pouring rate. This tendency is corrected by slightly but quickly tilting back the container shortly after the forward tilting has begun.

With this special object in mind, the machine is arranged for the automatic succession of the following pouring actions:

(*a*) Starting the forward tilting of the container S.

(*b*) Back-tilting shortly after starting.

(*c*) Continuing the forward tilting and pouring.

(*d*) Back-tilting to stop pouring.

(*e*) Holding the container with its content almost flush with the spout after the stop-pouring action.

After this cycle has been completed the same succession of actions can be repeated again, starting now from the position that the container assumed under the final actions (*d*) and (*e*), and it may be repeated as frequently as desired until the container is emptied. Thus, container S may be emptied at one pouring operation or only after a series of independent pouring operations. After the container S has been entirely discharged it can be dropped back to its initial position and then either be refilled or be replaced by another filled container of the same kind, the frame support being adapted for this purpose. The dropping back of the container to its initial upright position is an action outside the cycle described, and it is not performed automatically, as here shown, but could readily be made so by an automatically operable slip clutch in the motor drive.

The functions of the various parts represented in Fig. 1 and Fig. 2 will now easily be understood.

The lower chamber of piston cylinder B is connected to an air pressure supply. When pressure is being admitted the piston of cylinder B will be pushed upwardly. By means of several lever arms T, suitably connected as shown, the push rod K and its crosshead, the upward push of the cylinder piston will raise the sheave C mounted on a crosshead between the two vertical uprights shown, and when the sheave is in its uppermost position a suitable switch D, normally open as indicated in Fig. 2, will be closed and start the motor F, or, in other words, the forward-tilting of the container S will begin.

A short and quick back-tilting is now performed by exhausting a part or all of the air pressure charge of the cylinder B with the result that the sheave will be lowered a certain amount, that the switch D will open and stop the motor, and that the container will tilt back. Since the exhaustion period is only of short duration the piston under the action of renewed air pressure supply will soon resume an upward movement and take the sheave back to its uppermost position, with switch D again closed so that the forward tilting movement of the container will continue and pouring will take place. After a certain desired amount of metal has been poured the container is tilted back in the same way as explained before. But in this case the forward tilting action will not be resumed again. The container will now be held in its tilted-back position with the metal almost flush. This stopping action is performed by automatically shutting off the pressure supply to cylinder B simultaneously with the opening of the exhaust valve or immediately afterwards, with the result that the sheave C will be kept now in a lower position with switch D open.

Referring now to Figs. 3 and 4 (which illustrate one form of control mechanism in simpler arrangement than the ones used in our automatic casting apparatus), it will be noted that we have provided two valves, an exhaust valve M and an admission valve N. As long as the air pressure supply *q* is disconnected, the valves M and N by means of springs are held open and closed respectively, as shown in Fig. 3. But as soon as pressure is admitted, valve M will close automatically, thus filling the lower chamber of both valves with compressed air ready for action. The valve stems are operated from cam disks *m* and *n*. In order to admit air to the cylinder B by means of the pipe line *t*, it is only necessary to depress the stem of valve N. Quick exhaustion is obtained by depressing the stem of valve M and leaving valve N at the same time in its depressed position. As will best be understood from the illustration, the mouth of the air supply duct *q* acts in this case as an ejector of air from the cylinder, by discharging through the openings *l* in the upper chamber of valve M.

The cam shaft *b* is driven from an electric motor *a* with terminals *h*. This motor is coupled to the shaft *b* by means of two sets of gears g^1 and g^2. Besides the cam disks *m* and *n* an electric contact disk *c* is mounted on the shaft.

Fig. 4 indicates in a schematic way how the desired automatic control may be performed. The motor *a* can be started by depressing a push-button *p*. This push-button forms part of an electric relay provided with a solenoid *s* and a spring *u*. The spring tends to break the contact, and the solenoid when energized tends to make the contact. The solenoid is connected to a brush *e* sliding on the contact disk *c*. The surface of this disk is of conductive material with the exception of a small segment *d* which consists of some insulating material. As soon as the motor has

been started by depressing the push-button p the disk c will start rotating, the brush e will leave the insulated segment d and a relay current will be established through brush f bearing on some portion of the shaft b, through brush e, and the coil of solenoid s. Therefore, the push-button will be kept in contact position until after a complete turn of 360 degrees the relay current will be broken again, opening thereby the circuit of the valve motor a.

It will be noted that the disk n carries a cam elevation almost all around its periphery, a depression to its basic periphery exists only at K. The disk m is provided with two cam elevations k^1 and k^2.

Assuming that the shaft and its disks start to rotate in a clockwise direction, with air pressure from q holding valve M closed and filling the bottom of both valve chambers, the actions of the valves and the operations of the whole mechanism resulting therefrom will now be briefly summarized.

(a) Valve N opens, sheave C is being raised to its uppermost position, switch D closes—starting the drum motor F, the container is being tilted forwardly.

(b) Valve m opens, actuated by cam elevation k^1, valve n remains open, cylinder B is exhausted to a certain degree, sheave c is lowered, drum motor F is disconnected, the container is tilted back.

(c) Valve m closes, valve n remains open, air is supplied again to the cylinder—raising the sheave again to its uppermost position, closing switch D and starting the drum motor again, pouring takes place.

(d) Before the shaft b has performed one complete revolution valve m is opened once more by means of cam elevation k^2, sheave C is lowered, the drum motor F is stopped and the container tilted back, pouring is interrupted now.

(e) Both valves close, sheave C remains in a lowered position with switch D open, all action is stopped, the container is held in forwardly tilted position with its content slightly below that position which is flush with the spout, ready for a second pouring cycle, the push-button p returns to its initial position, valve-motor a is stopped.

After several such pouring cycles, each of which is initiated by depressing the push-button p, the container will be emptied and should be turned back to its initial upright position. Since the container tends to return to its initial position under its own weight, it will only be necessary to provide one of the well known means, such as a clutch, that will permit disengagement with the motor drive and apply a brake for slowly tilting back the container.

If it is desirable to operate the pouring control by hand, the arrangement of Fig. 5 may be used. As here shown, the handle X is pivoted with relation to the valve stems of valves M and N so that on depressing it N opens first and then M and then by slightly elevating the handle valve M is permitted to close and N to stay open until the pouring is finished to the desired amount. If the handle X is depressed to open valve M, just previous to its final elevation, it is clear that the same operating cycle may be conveniently carried on by hand, as has been previously described in connection with the automatic control.

From the foregoing it will also be clear that the desired valves might be controlled magnetically by push-button control, and other varieties of control, leading to the manipulation of the ladle or container S through the mechanism as described, will occur to those skilled in the art.

One particularly useful arrangement of this pouring mechanism in connection with the automatic casting machines we have in mind, is as follows:

We arrange the push-button p indicated in Fig. 4 in position to be closed by a scale beam or part of a scale operated means. Thus, if the ladle S is used to supply molten metal to a charging ladle in our casting machine and such charging ladle is resting on a scale platform, then when the molten metal does not register sufficient weight, the scale beam part z will move to close switch p. The latter will be held closed until ladle S has poured enough metal to the charging ladle to cause part z to move to switch open position. This arrangement is more fully described in our copending application Serial No. 341,142, filed February 19, 1929, and is here mentioned because the pouring mechanism and its control fully described herein is of particular advantage in the assembly of the various casting and accessory mechanisms assembled as a unit in our copending case.

We wish to emphasize that the structures described heretofore and shown in the illustrations, represent merely a specific embodiment of our invention whose general object and some of the specific objects have been stated in the course of this specification. These objects can be carried out in other forms of apparatus without departing from the scope of the invention embodied in the annexed claims.

What we claim is:

1. A ladle manipulating mechanism for pouring operations comprising means to support a ladle for pivotal movements, power tilting means operably connected to the ladle, a starting device for the tilting means, and means operable after the tilting means starts to automatically reverse its action on the ladle and again start the tilting operation whereby a surging action of liquid in the

ladle is dampened upon initial pouring actions of the ladle.

2. In combination a ladle and power means to manipulate the ladle for pouring operations, a control device for said power means to start the ladle pouring movement and means to momentarily interrupt the ladle-pouring movement and reverse its direction, said last named means being under control of the power operating mechanism and beyond the normal control of the operator.

3. A pivotally suspended container for receiving and pouring liquid substances, a power means operatively connected to the container for tilting the same forwards and backwards about its pivotal suspension, means for automatically controlling the power means in such a way as to produce a predetermined succession of pouring and stop-pouring actions consisting of repeated forward tilting and backward tilting movements, and of a final stoppage of said container in a forward tilted position with its liquid content nearly flush with its pouring edge.

4. An apparatus for pouring liquids carefully, comprising in combination, a liquid container with a pouring edge, a frame on which the container is mounted for tilting movement, power means to accomplish the tilting of the container, and control devices for the power means arranged to start the latter to tilt for pouring, to reverse the tilting operation to prevent surging and to resume the tilting operation for pouring.

5. An apparatus for pouring liquids carefully, comprising in combination, a liquid container with a pouring edge, a frame on which the container is mounted for tilting movement, power means to accomplish the tilting of the container, and control devices for the power means arranged to start the latter to tilt for pouring, to reverse the tilting operation to prevent surging and to resume the tilting operation for pouring, and power means to operate said control devices in the desired cycle for each pouring operation.

6. In an apparatus for the purpose described a pivotally mounted pouring ladle, a tackle mechanism including rope, pulley, and windlass operatively mounted to tilt the ladle back and forth on its pivot, and means to manipulate the pulley independently of the windlass whereby the rope may be slackened to avoid surging in the ladle.

7. In an apparatus for the purpose described a pivotally mounted pouring ladle, a tackle mechanism including rope, pulley, and windlass operatively mounted to tilt the ladle back and forth on its pivot, and means to manipulate the pulley independently of the windlass whereby the rope may be slackened to avoid surging in the ladle, said windlass and manipulating means having an interlocking control means.

8. In combination a pouring ladle, a frame on which the ladle is mounted for tilting movements, a motor and mechanism operable thereby to tilt the ladle, said mechanism having a lost motion device to interrupt the tilting effect on the ladle, and manipulating means for the lost motion device to intermittently make it effective and ineffective according to the desired tilting movements of the ladle.

9. In combination a ladle for molten metal, a frame having a pivotal support connected to the ladle adjacent its pouring edge, a rope connected to the lower edge of the ladle to tilt it, a pulley to receive the rope as it passes to a winding mechanism, a reciprocable mounting for the pulley, means to reciprocate the pulley mounting independently of the winding mechanism, to reverse the tilting of the ladle.

10. In combination a ladle for molten metal, a frame having a pivotal support connected to the ladle adjacent its pouring edge, a rope connected to the lower edge of the ladle to tilt it, a pulley to receive the rope as it passes to a winding mechanism, a reciprocable mounting for the pulley, means to reciprocate the pulley mounting independently of the winding mechanism, to reverse the tilting of the ladle, a motor for the winding mechanism and a switch to start and stop said motor, said switch being closed and opened by the reciprocation of said pulley mounting.

11. In combination a ladle for molten metal, a frame having a pivotal support connected to the ladle adjacent its pouring edge, a rope connected to the lower edge of the ladle to tilt it, a pulley to receive the rope as it passes to a winding mechanism, a reciprocable mounting for the pulley, means to reciprocate the pulley mounting independently of the winding mechanism, to reverse the tilting of the ladle, a motor for the winding mechanism and a switch to start and stop said motor, said switch being closed and opened by the reciprocation of said pulley mounting, and a power operated control device for the reciprocating means having a predetermined sequence of movements whereby the pulley is given a quick switch closing and opening reciprocation and then a switch closing movement and a delayed switch opening movement.

12. In combination a frame having a pivotally mounted ladle holder, a ladle for molten metal removably fastened in said frame to be tilted by its movements, vertical supports spaced from the frame, a crosshead in said support, a pulley mounted in the crosshead, pneumatic means with link connections to reciprocate the crosshead, a motor driven winding drum spaced from the vertical sup-

ports, a rope operatively connected to the ladle at its lower part and passing over said pulley to the winding drum so that the latter's operation tilts the ladle in one direction, said pneumatic means being adapted to lower the pulley and tilt the ladle backwardly a slight distance during the winding drum operation.

13. In combination a frame having a pivotally mounted ladle holder, a ladle for molten metal removably fastened in said frame to be tilted by its movements, vertical supports spaced from the frame, a crosshead in said support, a pulley mounted in the crosshead, pneumatic means with link connections to reciprocate the crosshead, a motor driven winding drum spaced from the vertical supports, a rope operatively connected to the ladle at its lower part and passing over said pulley to the winding drum so that the latter's operation tilts the ladle in one direction, said pneumatic means being adapted to lower the pulley and tilt the ladle backwardly a slight distance during the winding drum operation, and a switch to close and open the motor circuit operable on the lifting and lowering of said crosshead, respectively.

In testimony whereof we have affixed our signatures.

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