Oct. 3, 1967 J. J. KERIN 3,344,965

POURING NOZZLE FOR MOLTEN STEEL LADLE

Filed Oct. 18, 1965 4 Sheets-Sheet 1

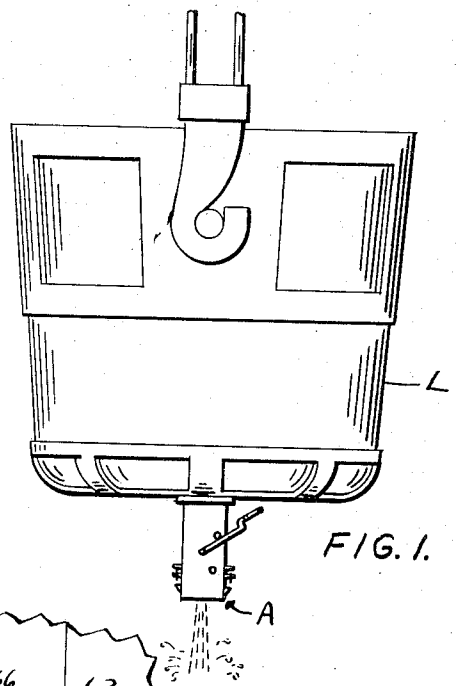


FIG. 1.

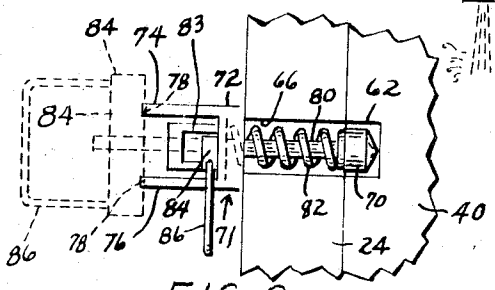


FIG. 9.

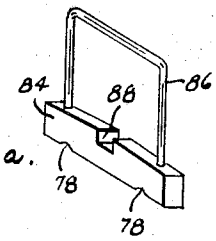


FIG. 9a.

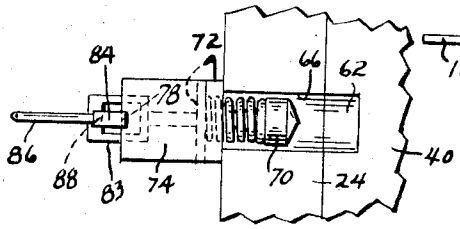


FIG. 10.

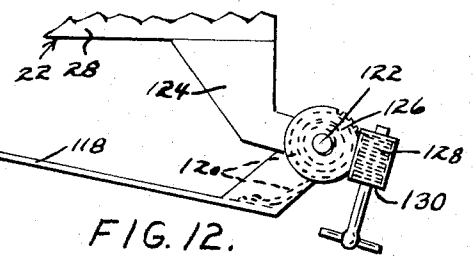


FIG. 12.

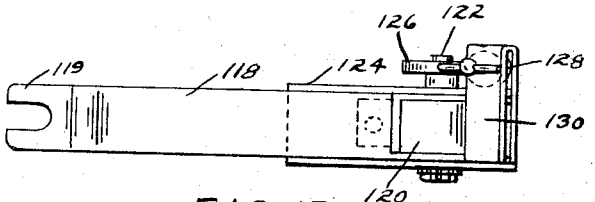


FIG. 13.

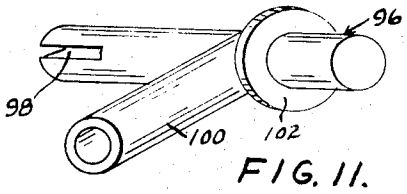


FIG. 11.

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POURING NOZZLE FOR MOLTEN STEEL LADLE

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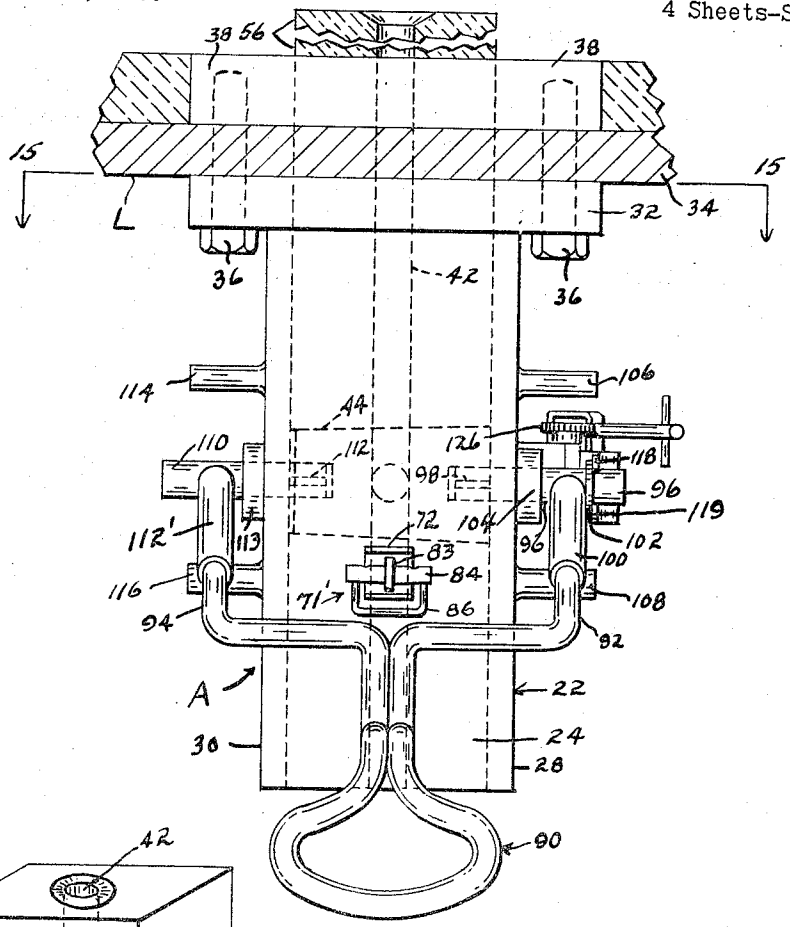


FIG. 2.

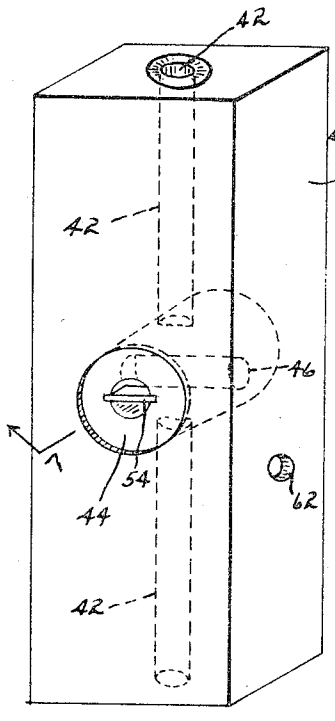


FIG. 4.

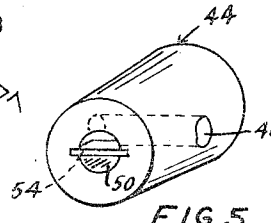


FIG. 5.

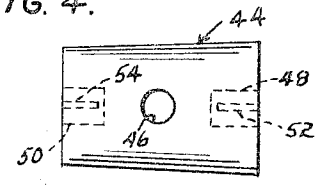


FIG. 6.

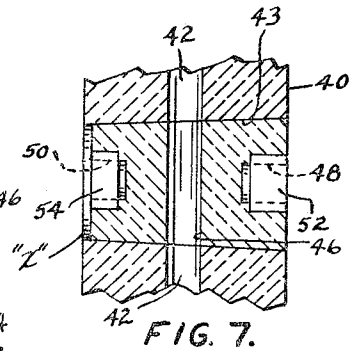


FIG. 7.

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POURING NOZZLE FOR MOLTEN STEEL LADLE

Filed Oct. 18, 1965 4 Sheets-Sheet 3

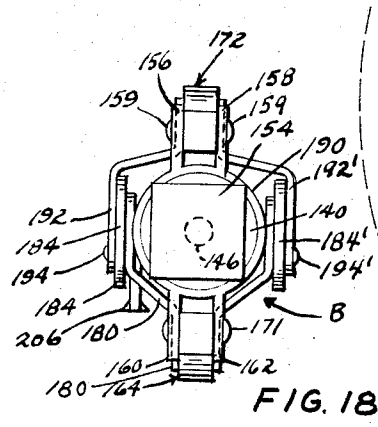


FIG. 18.

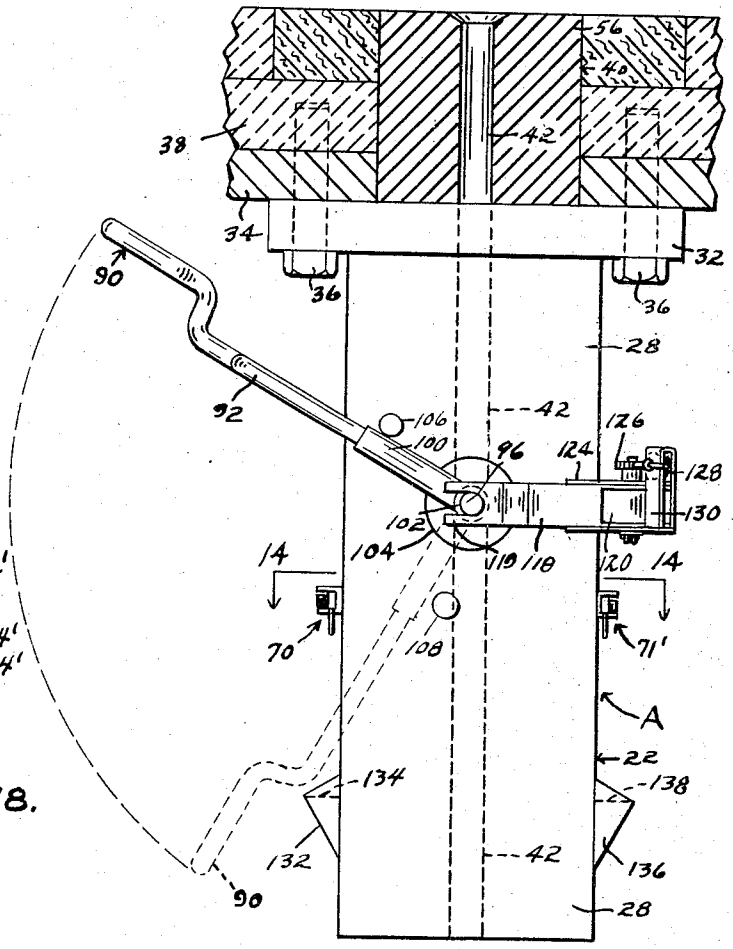


FIG. 3.

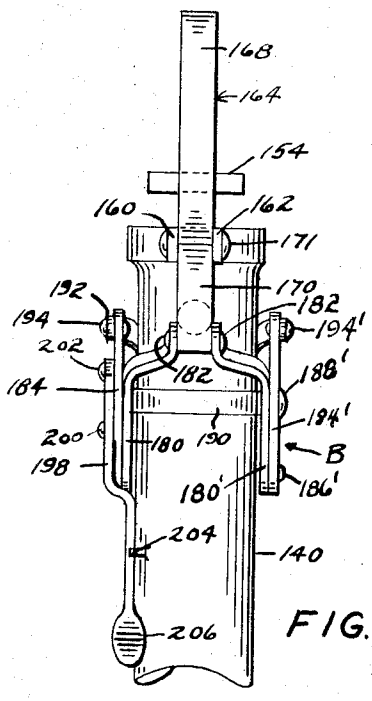


FIG. 19.

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POURING NOZZLE FOR MOLTEN STEEL LADLE

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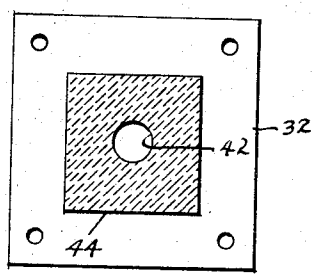


FIG. 15.

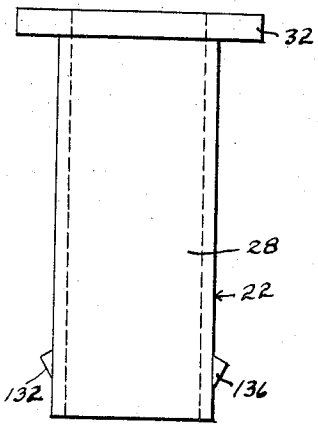


FIG. 8.

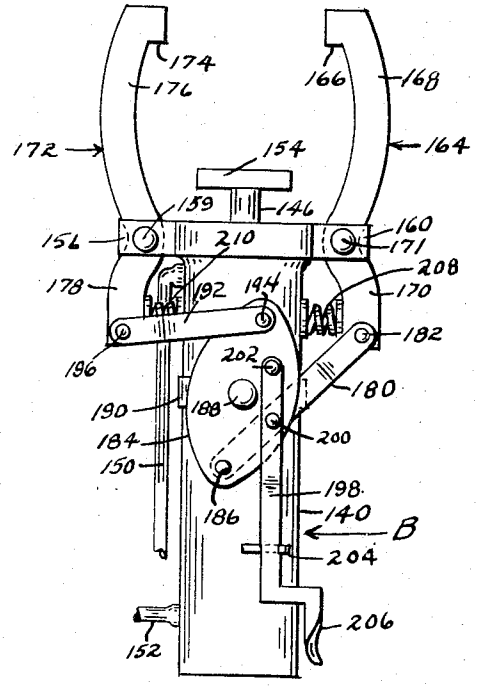


FIG. 16.

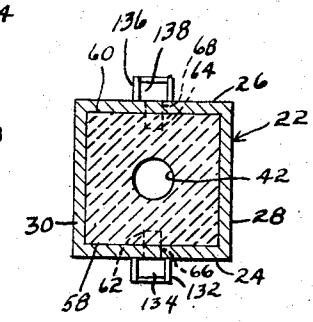


FIG. 14.

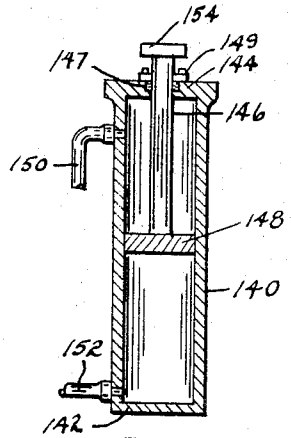


FIG. 17.

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United States Patent Office

3,344,965
Patented Oct. 3, 1967

3,344,965

POURING NOZZLE FOR MOLTEN STEEL LADLE

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Filed Oct. 18, 1965, Ser. No. 497,310
5 Claims. (Cl. 222—563)

ABSTRACT OF THE DISCLOSURE

The invention is a nozzle for a steel ladle and includes a casing which has a core removably positioned therein, the core having an outlet hole extending longitudinally throughout the core. The core also includes a cylindrical opening extending through the core intersecting and normal to the outlet hole together with a cylindrical valve member in the cylindrical opening. The valve member has key means on each end and a passageway extending through the valve for alignment with the outlet hole of the core together with means on the casing for engaging the key means of the valve member for rotating the valve to cause the passageway of the valve to align or misalign with the outlet hole.

The invention relates broadly to an improvement in ladles used in handling molten steel and more particularly to outlet valving means thereof used to draw off the molten steel from the ladle.

Present day ladle valving means has to be refurbished after the emptying of every ladle due to the destruction caused by the high intense heat of the molten metal. It is an object of the invention to provide a nozzle valve for a steel ladle having a new and novel construction which allows effective pouring from the ladle and which withstands the pouring of a number of ladlesful of molten steel before replacement of the core thereof.

It is also an object of the invention to provide a device for removing the core of a nozzle valve for a steel ladle.

It will not be here attempted to set forth and indicate all of the various objects and advantages incident to the invention, but other objects and advantages will be referred to in or else will become apparent from that which follows.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings, showing by way of example a preferred embodiment of the inventive idea wherein like numerals refer to like parts throughout.

In the drawings forming part of this application:

FIGURE 1 is a side elevational view of a steel ladle with a nozzle embodying the invention mounted in operative position thereon.

FIGURE 2 is a front elevational view of the nozzle illustrated as secured to the bottom portion of a steel ladle, portions thereof being in section, with the control handle in a closed position.

FIGURE 3 is a side elevational view of the nozzle similar to FIGURE 2 but rotated ninety degrees.

FIGURE 4 is a perspective view of the nozzle core removed from the nozzle.

FIGURE 5 is a perspective view of the nozzle valve cylinder removed from the core.

FIGURE 6 is a longitudinal side elevation of the valve cylinder.

FIGURE 7 is a sectional view on the line 7—7 of FIGURE 4 with portions of the core being broken away.

FIGURE 8 is a side elevational view of the core casing.

FIGURE 9 is a side elevational view of the core-positioning plug in extended core-engaging position and removed from the device, a withdrawn position of the plug shown in broken lines.

FIGURE 9*a* is a perspective view of the pull ring of the stop bolt.

FIGURE 10 is a top plan view of that shown in FIGURE 9 with the plug shown in withdrawn position.

FIGURE 11 is a perspective view of the key rod removed from the device.

FIGURE 12 is a top plan view of the pressure arm mechanism with a portion of the casing shown.

FIGURE 13 is a longitudinal side view of the mechanism shown in FIGURE 12.

FIGURE 14 is a sectional view on the line 14—14 of FIGURE 3.

FIGURE 15 is a top plan view of the nozzle removed from the ladle on the line 15—15 of FIGURE 2.

FIGURE 16 is a longitudinal side view of a core-removing mechanism.

FIGURE 17 is a longitudinal sectional view of the casing of the mechanism shown in FIGURE 16.

FIGURE 18 is a top plan view of the core-removing mechanism shown in FIGURE 16.

FIGURE 19 is a longitudinal side view of the core-removing mechanism of FIGURE 16 rotated ninety degrees.

Referring to the drawings in detail, the nozzle A includes the casing **22** formed of cast steel or the like including the front wall **24**, the rear wall **26** and the side walls **28** and **30**. Formed on the outside of the upper ends of the walls and around the perimeter thereof is the flange **32** used in mounting the nozzle on the bottom **34** of the ladle L by means of the bolts **36** which engage the block **38** mounted on the ladle bottom **34**. Further provided is the nozzle core **40** made of a high heat resistant refractory material such as "Alumina Castable." The core **40** is rectangular in cross section and extending internally and longitudinally throughout the length thereof is the outlet hole **42**. The core **40** may be polygonal in cross section and has a press fit within the casing **22**. The rectangular cross section of the core provides positive alignment of the same relative to the casing **22**, and the mechanism thereon hereinafter described.

The numeral **43** designates a tapered cylindrical hole which extends transversely through the core **40** and which intersects the outlet hole **42**. Positioned within the cylindrical hole **42** is the tapered cylindrical valve **44** which has extending there through the valve hole **46** normal to the longitudinal axis of the valve **44**. The valve **44** is made of a high heat resistant material such as the refractory material above mentioned. Extending axially into the end of the valve **44** is the bearing hole **48** and at the opposite end the bearing hole **50** and positioned across a diameter of each bearing hole are the fixed key members **52** and **54**, respectively. The length of the valve **44** is such that it is short at the smaller end thereof, as illustrated particularly in FIGURE 7 so that when wear occurres, the valve can seal further and take up the space indicated at "X." The length of the core **40** is such that it extends throughout the length of the casing and out-

wardly thereof at the top of the casing as at 56, particularly FIGURE 2. The nozzle core 40 extends beyond the upper end of the casing 22 whereby the same is extended through the ladle bottom 34 and the securing block 38 to a point within the ladle proper.

The core 40 has formed in the oppositely dispoed front and rear sides 58 and 60, respectively the identically formed and aligned recesses 62 and 64, respectively. The front wall 24 of the casing 22 is formed with the opening 66 which is in alignment with the recess 62 of the core 40, and the rear wall 26 is formed with the opening 68 which is in alignment with the recess 64. The recess 62 of the valve core 40 is engaged by the lock bolt 70 operated by the lock bolt mechanism 71, and the recess 64 is engaged by a second identical stop bolt not shown but operated by identical mechanism 71', therefore, only the mechanism 71 for operation of the lock bolt 70 being shown in detail, particularly in FIGURES 2, 9 and 10. The identical portions of the stop bolt mechanism 71' have the same number with a prime, thus (') added.

The stop bolt mechanism 71 includes the bracket 72 secured to the wall 24 of the casing in alignment with hole 66 and formed with the spaced flanges 74 and 76 extending outwardly therefrom, each of the flanges 74 and 76 formed with a notch 78 on the outer edge thereof. Further provided is the shaft 80 with the bolt 70 secured to inner end thereof, together with a coil spring 82 mounted on the shaft 80 interposed between the bolt 70 and the bracket 72 thereby urging this bolt 70 inwardly of the wall 24 and into the recess 62 of the core 40.

The shaft 80 has formed on the outer end thereof the rectangular ring 83 through which is extended the bar portion 84 of the pull ring 86. The bar 84 is formed with a notch 88 in which the ring 83 is engaged when the pull ring 86 is pulled to withdraw the lock bolt 70 from the recess 62 as shown particularly in FIGURE 10. With the ring 83 in the notch 88 of bar 84 the pull ring 86 is then rotated ninety degrees and placed in the notches 78 thereby holding the lock bolt 70 out of recess 62 of the core against the action of the coil spring 82 shown in FIGURE 10 and in broken lines in FIGURE 9. With the lock bolts 70 out of engagement with the recesses 62 and 64 the core 40 may be forced out of the casing 22.

To place the lock bolts into engagement with the recesses 62 and 64 of the nozzle core, the pull ring 86 is pulled against the urging of the spring 82 and rotated ninety degrees and allowed to move inwardly with the bar 84 between the flanges 74 and 76 as shown in full lines in FIGURE 9.

The numeral 90 designates a valve handle formed with the spaced arm portions 92 and 94. Further provided is a first key rod 96 which has formed on the inner end thereof the slot 98 which engages the key 52 of the cylindrical valve 44. Extending from the key rod 96 is the hollow arm 100 into which is removably inserted the arm portion 92 of the handle 90. The key rod 96 has secured thereon the flange 102. The key rod 96 is rotatable in the bearing 104 mounted on the sidewall 28 of the casing 22, and the arm 100 is movable within the limits of the stops 106 and 108 projecting from the casing wall 28. Also provided is a second key rod 110 which is identical to the key rod 96 and includes the slot 112 formed on the inner end thereof which engages the key 54 of the cylindrical valve 44. Extending from the key rod 110 is the hollow arm 112' into which is removably inserted the arm portion 94 of the handle 90. The key rod 110 is rotatable in the bearing 113 mounted on the sidewall 30 of the casing 22, and the arm 112' is movable within the limits of the stops 114 and 116 projecting from the casing wall 30.

With the handle 90 in a down position with the arms 100 and 112 against lower stops 108 and 116, as in FIGURE 2, the cylindrical valve member 44 is rotated to a position with the valve hole 46 thereof out of register with outlet hole 42 thus closing off valve nozzle A, while with the handle 90 in an up position with the arms 100 and 112 against upper stops 106 and 114, as in FIGURE 3, the cylindrical valve member 44 is rotated to a position with the valve hole 46 thereof in register with the outlet hole 42 thus opening the valve Nozzle A.

So that the handle 90 and the valve 44 do not rotate too freely and to keep the valve 44 tightly fit in the valve hole 43, the pressure arm 118 is provided which bears at its outer end 119 against the flange 102, the arm 118 urged by the flat coil spring 120 connected to the arm 118. The coil spring 120 is connected on its inner end to the shaft 122 rotatably mounted on the bracket 124 connected to the side wall 28 of the casing 22. Connected to the upper end of the shaft 122 is the gear 126 rotatable by means of the worm gear 128 mounted on the bracket 130 connected to bracket 124. With rotation of the worm gear 128 the spring can be wound more tightly thereby increasing the pressure of the arm 118 against the flange 102 thereby forcing the valve 44 more tightly in the valve hole 43, which automatically provides a take-up for rotational wear of the valve 44. The casing 22 has formed on the front wall 24 the lug 132 formed with the cavity 134. Formed on the rear wall 26 is the lug 136 having the cavity 138.

Referring to FIGURES 16, 17, 18 and 19, there is disclosed therein a device B for removing the core of a molten steel nozzle such as disclosed above in nozzle A. The device B includes the cylinder 140 closed at the bottom by the plate 142 and at the top by the plate 144 through which the piston rod 146 slidably extends in sealing engagement by means of gasket 147 and retaining ring 149. Connected to the inner end of the rod 146 is the piston 48 which is slidably mounted within the cylinder 140. Further provided is the oil line 150 which enters the cylinder 140 at the top thereof and the oil line 152 which enters the cylinder 140 at the bottom. Oil pressure is supplied and relieved at the lines 150 and 152 by conventional means not shown thereby making the piston 148 double acting to move the rod 146 in and out of the cylinder. Secured to the outer free end of the rod 146 is the pressure plate 154.

The numerals 156 and 158 designate a pair of spaced flanges extending from the top of the cylinder 140, and the numerals 160 and 162 designate a further pair of spaced flanges extending from the top of the cylinder and oppositely disposed to the flanges 156 and 158. Further provided is the tong 164 having the hook portion 166 formed on the outer end thereof, the tong being pivoted intermediate its end portions 168 and 170 to the flanges 160 and 162 by means of pin 171. A companion tong 172 is provided having the hook portion 174 formed on the outer end thereof, the tong being pivoted intermediate its end portions 176 and 178 to the flanges 156 and 158 by means of the pin 159. The lower end of the end portion 170 of tong 164 is pivotally connected to the upper end of a first offset link 180 by means of the pin 182. The lower end of the offset link 180 is pivotally connected to the lower end of the elliptical cam plate 184 by means of the pin 186. The cam 184 is pivotally mounted on the pin 188 formed on the collar 190 secured to the cylinder 140. The numeral 192 designates a second offset link pivotally connected at its inner end to the upper end of the cam plate 184 by means of the pin 194, the outer end of the second link 192 being pivotally connected to the lower end of the lower end portion 178 of tong 172 by means of the pin 196.

The numeral 198 designates a lever the upper end of which is connected rigidly to the outer surface of the cam plate 184 by means of the bolts 200 and 202. Secured to and extending from the casing 140 is the dog 204 which is engaged by the lever 198 to hold the tongs 164 and 172 in a separated or expanded condition by means of the cam and link mechanism above described. The lever

198 is provided with the offset pad portion 206 for easy operation of the lever 198.

Further provided is a second cam plate 184' substantially identical to cam plate 184 which is pivotally mounted on the pin 188' mounted on the collar 190 opposite to cam plate 184. The lower end of the end portion 170 of tong 164 is pivotally connected by means of the pin 182 to the upper end of the offset link 180'. The lower end of the link 180' is pivotally connected to the lower end of the cam plate 184' by means of the pin 186' as in the case of link 180 and cam plate 184. Additionally provided is the offset link 192' pivotally connected by means of the pin 194' to the upper end of the cam plate 184'. The opposite end of the link 192' is pivotally connected to the lower end of the end portion 178 of tong 172 by means of the pin 159. Thus the tongs 164 and 172 are actuated by a pair of cam and lever mechanisms. By pressing the pad 206 toward the casing 140, the hook portions 174 and 166 of the tongs are separated further against the action of the spring 208 interposed between the tong portion 170 and the cylinder 140 and the spring 210 interposed between the tong portion 178 and the casing 140, the springs 208 and 210 normally urging the upper ends of the tongs toward each other.

When it is desired to remove the core 44 from the casing 22 for replacement, the device B is positioned adjacent the lower end of the nozzle casing 22 and the hook ends 174 and 166 are positioned in engagement with the lugs 132 and 136 of the casing. The hook ends 174 and 166 are separated by operating the lever 198. With the hooks 174 and 166 in engagement with the lugs 132 and 136 and the head 154 adjacent the lower end of core 40, oil pressure is introduced into line 152, and as a result, the pressure plate 154 is forced against the lower end of the core 40 thereby forcing the core from the casing upwardly there through and into the ladle. The core 40 is removed when the ladle is cold. The hooks 174 and 166 are released from the lugs 132 and 136 by pressing on the pad 206 whereby the device B can be removed from the casing 22. Prior to operating the hydraulic operated head 154, the lock bolts 70 are removed from the recesses 62 and 64 of the core 40 in the manner hereinbefore described, and the key rods 96 and 110 are removed from the bearings 104 and 113. With the core 40 removed a new core can be inserted in place thereof.

The invention is not to be understood as restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A nozzle for a steel ladle comprising:
(a) a casing open at both ends,
(b) a core removably positioned in said casing,
(c) said core having an outlet hole extending longitudinally and internally throughout the length thereof,
(d) said core having a cylindrical opening extending therethrough intersecting and normal to said outlet hole,
(e) a cylindrical valve member mounted for rotation in said cylindrical opening,
(f) said valve member having key means formed on each end thereof,
(g) said valve member having a passageway extending therethrough normal to the longitudinal axis thereof for alignment within said outlet hole of said core,
(h) means mounted on said casing and engaging said key means of said valve member for rotating said valve member to cause said passageway to align or misalign with said outlet hole, and
(i) means for mounting said casing on the bottom of a steel ladle with the upper end of said outlet hole in communication with the interior of the ladle.

2. A nozzle for a steel ladle comprising:
(a) a casing having a polygonal transverse cross sectional outline,
(b) a core having a polygonal transverse cross section and removably positioned in said casing,
(c) said core having an outlet hole extending longitudinally and internally througout the length thereof,
(d) said core having a tapered cylindrical opening extending therethrough interestcing and normal to said outlet hole,
(e) a cylindrical valve having a taper substantially that of said tapered cylindrical opening mounted for rotation in said cylindrical opening,
(f) said valve having a length less than the length of said tapered cylindrical opening of said core,
(g) said valve member having key means formed on each end thereof,
(h) said valve member having a passageway extending therethrough normal to the longitudinal axis thereof for alignment within said outlet hole of said core,
(i) means mounted on said casing for engaging each of said key means for rotating said valve member to cause said passageway to align or misalign within said outlet hole, and
(j) means for mounting said casing on the bottom of a steel ladle with the upper end of said outlet hole in communication with the interior of the ladle.

3. A nozzle for a steel ladle comprising:
(a) a casing having a polygonal transverse cross sectional outline and fully open at both ends,
(b) a core having a polygonal transverse cross section and removably positioned in said casing,
(c) said core extending in its entirety throughout the length of said casing,
(d) said core having an outlet hole extending longitudinally and internally throughout the length thereof,
(e) said core having a tapered cylindrical opening extending therethrough intersecting and normal to said outlet hole,
(f) a cylindrical valve having a taper substantially that of said tapered cylindrical opening mounted for rotation in said cylindrical opening,
(g) said valve member having a passageway extending therethrough normal to the longitudinal axis thereof for alignment within said outlet hole of said core,
(h) means for rotating said valve member to cause said passageway to align or misalign within said outlet hole, and
(i) means for mounting said casing on the bottom of a steel ladle with the upper end of said outlet hole in communication with the interior of the ladle,
(j) means for urging said valve into said tapered cylindrical opening.

4. A nozzle for a steel ladle comprising:
(a) a casing having a polygonal transverse cross sectional outline,
(b) a core having a polygonal transverse cross section and removably positioned in said casing,
(c) said core having an outlet hole extending longitudinally and internally throughout the length thereof,
(d) said core having a tapered cylindrical opening extending therethrough intersecting and normal to said outlet hole,
(e) a cylindrical valve having a taper substantially that of said tapered cylindrical opening mounted for rotation in said cylindrical opening,
(f) said valve member having a passageway extending therethrough normal to the longitudinal axis thereof for alignment within said outlet hole of said core,
(g) said valve member having key means formed on each end thereof,
(h) means for rotating said valve member to cause said passageway to align or misalign within said outlet hole, and
(i) means for mounting said casing on the bottom of

a steel ladle with the upper end of said outlet hole in communication with the interior of the ladle,

(j) spring arm means mounted on said casing and in contact with said valve member for urging said valve into said tapered cylindrical opening and,

(k) means for locking said core in said casing to prevent displacement therein.

5. The device of claim 4, wherein said core-locking means includes:

(k) said core having a recess formed therein,

(l) rod means mounted on said casing,

(m) means for engaging said rod means with said core recess and disengaging the same therefrom.

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R. D. BALDWIN, *Assistant Examiner*