

June 16, 1953

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2,641,806

INGOT STRIPPER

Filed Jan. 29, 1949

3 Sheets-Sheet 1

Fig. 1.

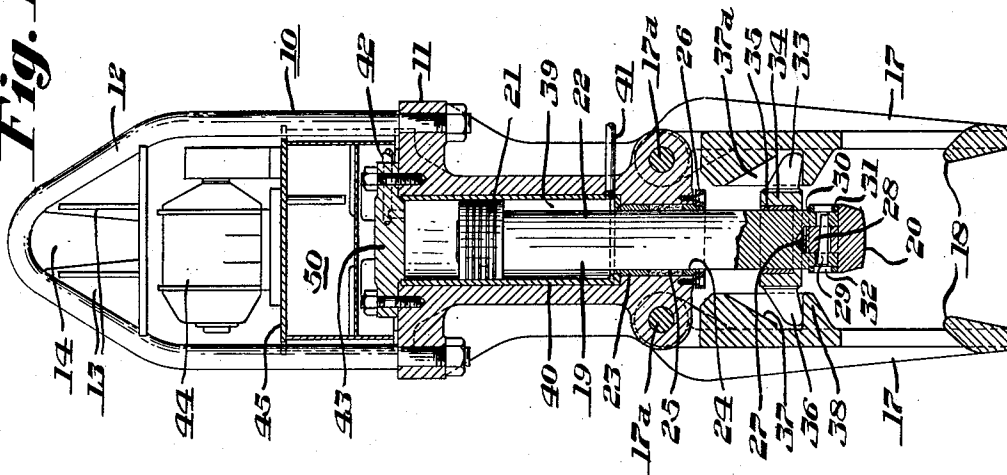
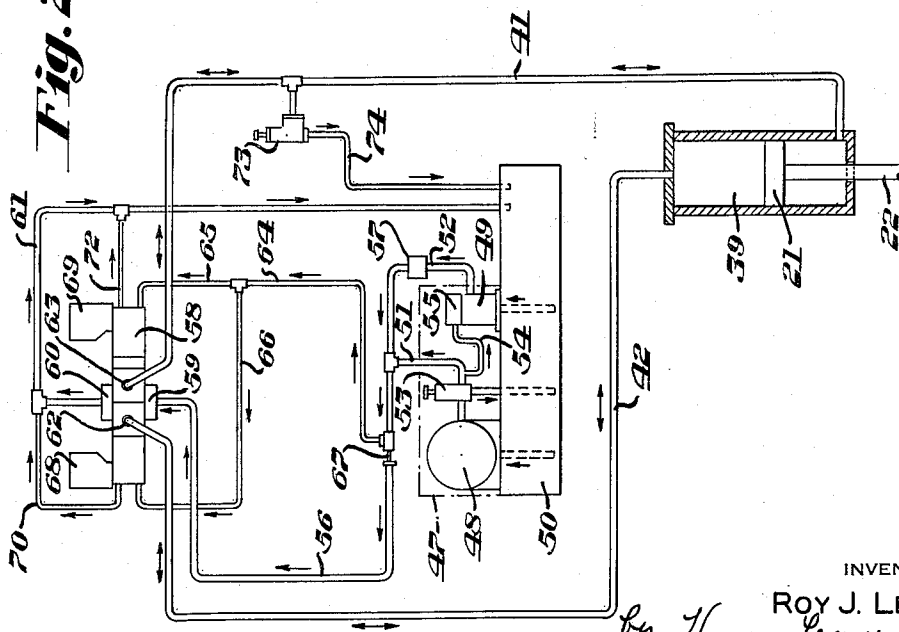


Fig. 2.



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Fig. 7.

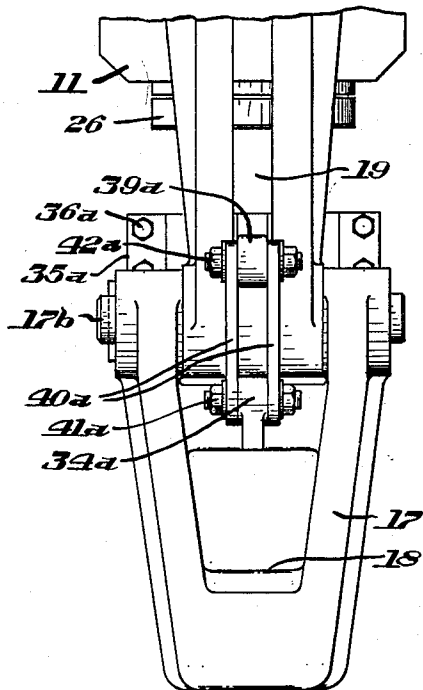


Fig. 6.

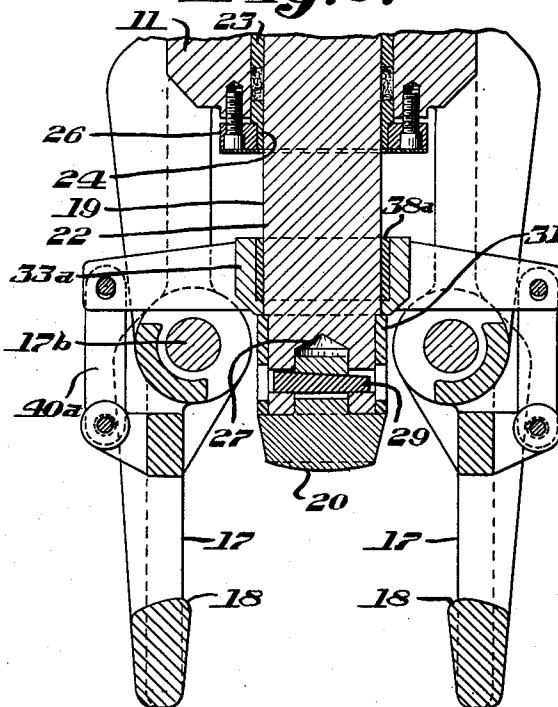
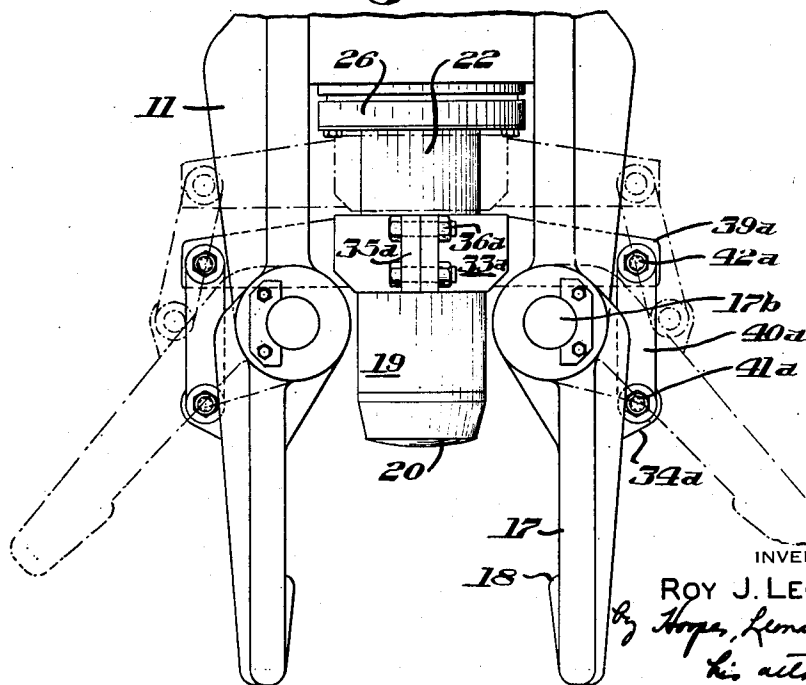


Fig. 8.



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UNITED STATES PATENT OFFICE

2,641,806

INGOT STRIPPER

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Application January 29, 1949, Serial No. 73,473

1 Claim. (Cl. 22—95)

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This invention relates to the stripping of ingots from molds and more particularly to apparatus for stripping ingots from the molds in which they are cast, particularly in the case of large metal ingots.

The apparatus required for stripping large ingots from their molds is necessarily large and powerful in view of the weight of the mold and the ingot and in view of the considerable force necessary to separate the mold from the ingot. Two kinds of ingot strippers which are in common use are those which operate on the screw principle and are mounted on special overhead traveling cranes and those which operate on the ram principle and are mounted in a fixed emplacement. A stationarily mounted stripper has the disadvantage that the mold with the ingot therein must be brought to the stripper for stripping and then the ingot and mold must be removed from the location of the stripper to the places where they are respectively needed. The screw type of stripper mounted on a special traveling crane has the advantage of mobility but the cost of a special crane for the stripper is high and the special crane interferes with the movement of the other overhead crane or cranes in the same plant.

I provide a self-contained ingot stripping unit which may be suspended from the hook of a traveling crane while the stripper is in use and may be removed from the crane and stored elsewhere when the stripper is not in use. A special crane is not required; any conventional or other overhead traveling crane of sufficient capacity may be used. Moreover, the crane is used for supporting the stripper only at times when molds are to be stripped.

My stripper in addition to being portable is inexpensive and its maintenance cost is low. It is of relatively light weight and any standard ten, fifteen or twenty ton crane can be used to carry it. My stripper will strip the same sizes and types of ingots as a standard stripper of much greater weight and cost.

My stripper preferably employs a self-contained power unit which is remotely controlled from the crane cab. I preferably utilize a hydraulic ram which through the remote control apparatus may be moved relatively slowly and with relatively great force in stripping an ingot and may be returned to its initial position relatively quickly. This may be accomplished by a duplex pump system which renders available selectively hydraulic fluid under relatively high pressure moving at relatively low speed and hydraulic fluid under relatively low pressure moving at relatively high speed.

My stripper preferably employs mold gripping means and ingot pushing means. Those respective means may be connected so that the gripping and stripping functions may be accomplished in a single operation. Means are prefer-

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ably provided in connection with the ingot pushing means for controlling movement of the ingot mold gripping means between operative and inoperative positions.

I provide for lifting the stripper together with the mold and the ingot therein and pushing the ingot down out of the mold while the mold is suspended. The stripper may then carry the empty mold to any desired location and deposit it.

Other details, objects and advantages of the invention will become apparent as the following description of certain present preferred embodiments thereof and certain present preferred methods of practicing the same proceeds.

In the accompanying drawings I have shown certain present preferred embodiments of the invention and have illustrated certain present preferred methods of practicing the same, in which:

Figure 1 is a view partly in elevation and partly in central vertical cross section of an ingot stripper with most of the hydraulic connections removed for clarity;

Figure 2 is a diagram showing the hydraulic connections of the ingot stripper;

Figure 3 is a side elevational view to reduced scale of the ingot stripper shown in Figure 1;

Figure 4 is a front elevational view of the ingot stripper shown in Figures 1 and 3;

Figure 5 is a fragmentary front elevational view showing a portion of the stripper with the gripping tongs spread apart;

Figure 6 is a fragmentary cross-sectional view to greatly enlarged scale showing a different form of structure in which the gripping tongs are operated by the ram through linkage;

Figure 7 is a fragmentary side elevational view of the structure shown in Figure 6; and

Figure 8 is a fragmentary front elevational view of the structure shown in Figures 6 and 7 showing the parts in one position in solid lines and in another position in chain lines.

Referring now more particularly to the drawings and considering first the form of structure shown in Figures 1-5, there is provided a rigid frame 10 including a body portion 11 and an inverted U-bar 12 bolted at each end to the body portion 11. Structural members 13 are welded within the top of the U-bar 12 and define with the upper extremity of the U-bar an opening 14 extending therethrough beneath the top thereof, the opening 14 constituting an eye adapted to receive the hook of a traveling crane so that the hook may engage the top of the U-bar 12 in order to support the stripper. When not in use the stripper is removed from the crane hook and is supported by opposed extensions 15 (Figure 3) of the body portion 11 respectively on opposite sides of the body portion and having downwardly facing surfaces 16 adapted to rest on spaced stationary supports (not shown).

The stripper has a pair of dependent tongs 17

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pivotaly mounted on the body portion 11 at 17a and having hooks 18 at their lower ends extending inwardly and upwardly for the purpose of engaging beneath the lugs on opposite sides of conventional ingot molds. The weight of each of the tongs 17 is so distributed that when the tongs hang down freely their hooks 18 are suitably spaced for gripping an ingot mold. While the tongs 17 grip the mold a ram 19 now to be described extends between the tongs 17 and pushes down on the ingot in the mold until the ingot is stripped from the mold.

The ram 19 comprises a head 20 at its lower end, a double-acting piston 21 operable in a cylinder 39 presently to be described at its upper end and a piston rod 22 secured to the piston 21 and extending downwardly therefrom. The rod 22 extends through an opening in the bottom of the body portion 11 and is slidably mounted in bearings 23 and 24 spaced one above the other and secured to the body portion 11. Packing 25 fills the space between the bearings 23 and 24, the body portion 11 and the piston rod 22. The bearings 23 and 24 and the packing 25 are held against downward movement by a ring 26 extending around the piston rod 22 and bolted to the bottom of the body portion 11. The lower end of the piston rod 22 has a recess 27 receiving a neck 28 extending up from the ram head 20. A key 29 extends horizontally through the lower end of the piston rod 22 and through the neck 28 in order to attach the ram head 20 to the piston rod 22 securely but removably. Downward pressure of the piston rod 22 on the ram head 20 is transmitted principally from the lowermost end of the piston rod 22 to the upper surface of the ram head 20 surrounding the neck 28, and when this pressure is removed the key 29 prevents the neck 28 of the ram head 20 from sliding downwardly out of the recess 27 of the piston rod 22. The lower end of the piston rod 22 is reduced in circumference to provide a narrow overhanging shoulder 30 and is encircled by a ring 31 which has a lower edge resting on the top of the ram head 20 and an upper edge projecting outwardly from beneath the shoulder 30. Openings 32 extend through opposite sides of the ring 31 in order to permit the key 29 to be passed through the ring 31 to lock and unlock the piston rod 22 and the ram neck 28, and the key 29 is held in place by rotating the ring 31 relative to the piston rod 22 and ram head 20.

A cam 33 actuates the tongs 17 and is actuated by the ram 19. The cam 33 has a collar portion 34 encircling the piston rod 22 between the rings 26 and 31. A bearing 35 secured to the collar portion 34 is in sliding engagement with the piston rod 22 and part of the collar portion 34 extends beneath the bearing 35 adjacent the piston rod 22 in order to engage the projecting upper edge of the ring 31 when the ram 19 is retracted upwardly. Cam fingers 36 project on either side of the collar portion 34 toward the tongs 17. The upper portions of the tongs 17 have inwardly and downwardly facing sloping surfaces 37 extending above the cam fingers 36, and during the upstroke of the piston rod 22 the ring 31 engages the collar portion 34 of the cam and forces the cam fingers 36 upwardly against the sloping surfaces 37 in order to spread the tongs 17 apart (Figure 5). The sloping surfaces 37 are flanked on both sides with walls 37a forming guideways for the fingers 36 to maintain them in proper cooperative relationship with the surfaces 37. Projections 38 extending inwardly from the tongs 17 beneath the cam fingers 36 engage those fingers and sup-

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port the cam 33 while the tongs 17 are in their freely dependent position (Figures 1 and 4). While the cam 33 rests on the projections 38 the piston rod 22 slides through the collar portion 34.

The piston 21 is slidable within a cylinder 39 in the body portion 11 which is lined by a cylindrical liner 40. The cylinder is closed at the top by a closure member 43 bolted to the body portion 11. A fluid conduit 41 extends through the body portion 11 into the bottom of the cylinder 39 and a fluid conduit 42 extends into the upper end of the cylinder 39 through the member 43.

The hydraulic system serving the cylinder 39 through the conduits 41 and 42 is powered by a constant speed electric motor 44 mounted on a platform 45 which is secured to the body portion 11 and to the U-bar 12 of the stripper frame 10. The motor 44 through a belt 46 drives a conventional duplex pump 47. The pump 47 and the other elements of the hydraulic system of the stripper are mounted on the frame 10 of the stripper and are illustrated diagrammatically in Figure 2. The pump 47 comprises a positive drive radial piston pump 48 capable of delivering hydraulic fluid at a relatively slow rate and at a maximum pressure of about 4000 pounds per square inch and a positive drive gear-type pump 49 capable of delivering hydraulic fluid at a relatively fast rate and at a maximum pressure of about 300 pounds per square inch. The inlets of the pumps 48 and 49 are separately connected to a hydraulic fluid reservoir 50. The outlet of the pump 48 is connected to a conduit 51 and the outlet of the pump 49 is connected to a conduit 52. A 3000 pounds per square inch relief valve 53 is connected to the conduit 51 and exhausts into the tank 50. A conduit 54 connects the conduit 51 and a 300 pounds per square inch check and choke valve 55 controlling the operation of the pump 49. When the pressure in the conduit 51 and hence in the conduit 54 is below 300 pounds per square inch the valve 55 does not affect the operation of the pump 49, but when the pressure in the conduits 52 and 54 exceeds 300 pounds per square inch the valve 55 opens a by-pass (not shown) from one side of the pump 49 to the other so that the pump merely circulates hydraulic fluid within itself and does not feed hydraulic fluid into the conduit 52. The pump outlet conduits 51 and 52 are connected to a main supply conduit 56 and a check valve 57 is connected to the conduit 52 to prevent back pressure at the outlet of the pump 49 from exceeding 300 pounds per square inch when the pressure in the conduit 56 rises above 300 pounds per square inch.

A valve 58 controls the flow of hydraulic fluid between the duplex pump 47, the ram cylinder 39 and the reservoir 50. The valve 58 is a conventional electric pilot operated 4-way valve manufactured by the Oilgear Company of Milwaukee, Wisconsin, and has an inlet port 59 connected to the main supply conduit 56, an outlet port 60 connected to a conduit 61 exhausting into the reservoir 50, a port 62 connected to the conduit 42 extending into the upper part of the cylinder 39 and a port 63 connected to the conduit 41 extending into the lower end of the cylinder 39. A slidable spool valve within the valve 58 is movable to a neutral position in which the ports 59 and 60 are connected to return the fluid from the main supply line 56 to the reservoir 50 and at the same time the ports 62 and 63 are connected so that the conduits 41 and 42 open into each other and establish a by-pass line

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from the upper and lower interior portions of the cylinder 39. In another position of the slidable spool valve the main supply conduit 56 is connected to the conduit 42 while the port 63 is connected to the port 60 so that as fluid enters the upper portion of the cylinder through the conduit 42 an equal amount of fluid will be exhausted from the lower portion of the cylinder through the conduit 41 and conduit 61 into the reservoir 50. In a third position of the slidable spool valve the port 59 is connected to the port 63 so that the main supply conduit 56 is connected with the conduit 41 and at the same time the port 62 is connected to the port 60 so that as fluid enters the lower portion of the cylinder 39 through the conduit 41 an equal amount of fluid will be exhausted through the upper portion of the cylinder through the conduit 42 into the conduit 61 exhausting into the reservoir 50. In order to supply the power necessary to move the slidable spool valve a conduit 64 is connected to the main supply conduit 56 with a branch 65 connected to one end of the valve 58 and a branch 66 connected to the other end of the valve 58 in order to provide pressure within the conduit 64 when the duplex pump 47 is not working against a load on the ram 19. An orifice 67 is mounted in the main supply conduit 56 on the downstream side of the junction of conduits 56 and 64. When the slidable spool valve is in its neutral position the duplex pump 47 circulates fluid through the main supply contact 56 and back to the reservoir 50 through the conduit 61 at a rate determined by the combined delivery rates of the pumps 48 and 49, and the orifice 67 builds up about 80 pounds per square inch upstream back pressure in the main supply conduit 56. This pressure extends through the conduit 64 and the branches 65 and 66 to provide the force to move the slidable spool valve within the valve 58. When the duplex pump 47 is working against a load on the ram 19 the back pressure in the main supply conduit 56 will be higher than the back pressure provided by the orifice 67. This will increase the available force to move the spool valve in valve 58 but will not alter the action of valve 58. Within the valve 58 a solenoid 68 operates a pilot valve (not shown) which releases the pressure in the branch 66 to move the slidable spool valve in one direction, a solenoid 69 operates a second pilot valve (not shown) to move the slidable spool valve in the opposite direction and a spring (not shown) returns the slidable spool valve to neutral position when the solenoids 68 and 69 open both of the pilot valves to apply the equal pressures in the branches 65 and 66 against opposite ends in the spool valve. When one of the solenoids closes one of the pilot valves the fluid entering through the opposite pilot valve moves the spool valve to one of its extreme positions. When this occurs the fluid which had previously entered through the closed pilot valve is expelled through an exhaust port at the end of the valve 58. The pilot valve exhaust port at one end of the valve 58 is connected to the exhaust conduit 61 by a conduit 70 and the pilot valve exhaust port at the other end of the valve 58 is connected to the exhaust conduit 61 by the conduit 72. Conventional electrical controls are provided to cause the solenoids 68 and 69 to act through their pilot valves to move the slidable spool valve within the valve

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58 selectively to any one of the three operating conditions described above.

The stripper is operated through electrical controls from the cab of the crane from which the stripper is operated. The motor 44 is controlled by conventional push button controls but is usually running constantly while the stripper is suspended from the crane. The control and power leads for the motor and the control leads for the solenoids 68 and 69 are led to a common plug (not shown) which may be extended up from the stripper to be connected to a complementary plug adjacent the crane hook. The lines connected to the complementary plug extend upwardly to a reel mounted on the crane above the stripper. The reel takes up and pays out the lines as the stripper is raised and lowered. The lines are electrically connected to the crane cab in the case of the control circuits and to a power source in the case of the power line.

It is desirable to build up a high pressure on the piston 21 during its downstroke so that the ram 19 will be effective to strip an ingot from the mold held between the tongs 17. However, during the upstroke of the piston 21, the cam 33 operates to spread apart the tongs 17 and it would be hazardous to allow enough pressure to build up during the piston upstroke to force the tongs 17 apart while they are supporting a mold. A relief valve 73 is therefore connected to the conduit 41 and this valve is set to open a by-pass conduit 74 discharging into the reservoir 50 when the pressure in the conduit 41 exceeds about 75 pounds per square inch. This pressure is sufficient to draw the cam 33 up to spread apart the tongs 17 when they are not gripping a mold but is insufficient to spread apart the tongs 17 when they are gripping and supporting a full or empty mold.

The stripper is operated as follows:

When the stripper is not in use it may be rested upon any suitable support such as a U-shaped support resting on the ground and extending upwardly on both sides of the tongs 17 to engage the surfaces 16 of the extensions 15 of the stripper (Figure 3). When the stripper is needed the hook of a traveling crane is hooked through the eye 14 under the top of the U-bar 12, the electric power and control lines are plugged in from the stripper to connections on the crane as above explained and the crane is then operated to lift the stripper and to move it from place to place as desired. In order to strip a mold, the stripper is suspended by the crane over a mold with the ram 19 raised and the tongs 17 spread apart as shown in Figure 5. The crane is then operated to lower the stripper over the mold and the electrical controls of the stripper are then operated to cause the valve 58 to connect the main supply conduit 56 with the conduit 42 for a sufficient period to allow the ram 19 to move downwardly with the cam 33 until the tongs 17 grip the lugs of the mold with the tong hooks 18. The valve 58 is then returned to its neutral position in order to neutralize the pressures on the opposite sides of the piston 21 and the crane is operated to lift the stripper with the mold suspended between its tongs 17. The valve 58 is again operated to connect the main supply line 56 with the conduit 42 and the ram 19 resumes its downward movement until the ram head 20 touches the top of the ingot in the mold. During this period the downward movement of the ram 19 has required relatively little force and the ram has been moved relatively quickly by the combined action of the

pumps 48 and 49. If the ingot is easily removed from the mold the ram 19 continues to move downward quickly, but usually the ingot is stuck to the mold and considerable force is required to free it from the mold. The force required to strip such an ingot induces a considerable back pressure in the main supply conduit 56 and the valves 55 and 57 thereupon operate to isolate the low pressure pump 59 from the rest of the hydraulic system. This reduces the rate of flow through the main supply line 56 but the pump 48 has the power necessary to force the ram 19 against the ingot with sufficient force to strip the ingot from the mold. The crane is operated to suspend the mold not far above a suitable support during the stripping operation so that the ingot will not fall very far after it is disengaged from the mold. After the ingot has been stripped the crane is operated to lift the stripper with the mold still suspended between the tongs 17 until the mold is entirely free of the ingot and then the crane is operated to carry the stripper and mold to the place where the mold is to be deposited. The stripper and mold are then lowered until the mold is deposited on a support, whereupon the valve 58 is actuated by the electrical controls of the stripper to connect the main supply conduit 56 with the conduit 41 in order to cause the ram 19 to move upwardly to spread the tongs 17 apart and thus to release the stripper from the mold. The stripper may then be moved by the crane to another filled mold for another stripping operation or it may be returned to its fixed support and disconnected from the crane in order to release the crane for other operations.

In Figures 6-8 there is shown a structure in which the cam 33 is replaced by a ring or block 33a and the surfaces 37 and projections 38 on the tongs are done away with in favor of arms 34a extending outwardly from the tongs 17. The block 33a comprises a split collar 35a secured together by bolts 36a and having a bearing 38a lining the upper part of its inner surface and in vertical sliding engagement with the piston rod 22. Part of the collar 35a extends under the bearing 38a and closely embraces the piston rod 22 in order to engage the projecting upper edge of the ring 31 when the ram is retracted upwardly. Arms 39a extend from opposite sides of the collar 35a and each arm 39a is disposed above an arm 34a extending from each of the pair of tongs 17. The outer ends of the arms 39a are connected to the outer ends of the arms 34a by links 40a which are pivotally fastened to the arms 34a by pins 41a and are pivotally fastened to the arms 39a by pins 42a. The openings in the arms 39a receiving the pins 42a are vertically slotted to allow for vertical movement of the pins 42a as a result of changes of the angularity of links 40a as the block 33a slides up and down on the piston 22.

The operation of the structure of Figures 6-8 will now be described. When the ram 19 is retracted upwardly the ring 31 engages the lower portion of the collar 35a and the block 33a is thereby raised and the arms 39a through the links 40a pull up the arms 34a of the tongs 17 and thereby cause the tongs to pivot outwardly on their pins 17b. As the ram moves downwardly the block 33a is lowered and the tongs 17 are thereby allowed to resume their normal dependent position. The block 33a comes to rest when the tongs have resumed their normal dependent position; thereafter the ram 19 continues its downward movement with the piston rod 22 sliding against the block 33a. During

the return upward movement of the ram the ring 31 again engages beneath and raises the block 33a and the tongs are again spread apart.

While I have shown and described certain present preferred embodiments of the invention and have illustrated certain present preferred methods of practicing the same it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claim.

I claim:

An ingot stripper comprising a frame, a double-acting cylinder vertically mounted in the frame, means to supply fluid under pressure alternately to opposite ends of the cylinder, a piston in the cylinder, a piston rod secured to the piston and extending downwardly therefrom out of the cylinder, a cap secured to the lower end of the piston rod to engage an ingot, a pair of mold-gripping members pivotally mounted on and dependent from the frame to support a mold in fixed relation to the frame, said members being disposed on opposite sides of the piston rod and each having a slot facing the portion of the piston rod projecting from the cylinder, a ring slidable along the piston rod adjacent the lower end of the cylinder, and ears extending from said ring into said slots, said slots having sides along which the ears are vertically slidable and having upper base surfaces which face downwardly and slant upwardly toward the piston rod for camming the mold-engaging members outwardly as the ears move vertically upwardly against said upper base surfaces of the slots, and said slots having lower base surfaces which face upwardly and support said ears after the mold-engaging members have swung toward each other into mold-engaging position, said cap being engageable with said ring to lift it and thereby carry the ears against the upper base portions of the slots to cam the mold-engaging members outwardly during a final portion of the retracting movement of the piston rod in the cylinder, said ring and the bottom of the cylinder having bearing surfaces which alternately slide along common portions of the outer surfaces of the piston rod during its cycle of downward and retracting movement.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
713,029	Wellman et al.	Nov. 4, 1902
781,708	Baltzell	Feb. 7, 1905
792,630	Taylor	June 20, 1905
800,712	Blount	Oct. 3, 1905
801,136	Cheever	Oct. 3, 1905
1,059,668	Gathmann	Apr. 22, 1913
1,352,026	Price	Sept. 7, 1920
1,570,474	Geer	Jan. 19, 1926
1,774,082	Camerota	Aug. 26, 1930
2,278,116	Nielsen	Mar. 31, 1942
2,365,282	Lester et al.	Dec. 19, 1944
2,439,705	Urmetz	Apr. 13, 1948

FOREIGN PATENTS

Number	Country	Date
9,312	Great Britain	Sept. 27, 1906
564,208	Great Britain	Sept. 18, 1944
611,884	Great Britain	Nov. 4, 1948
422,823	France	Mar. 31, 1911
633,211	Germany	July 22, 1936