

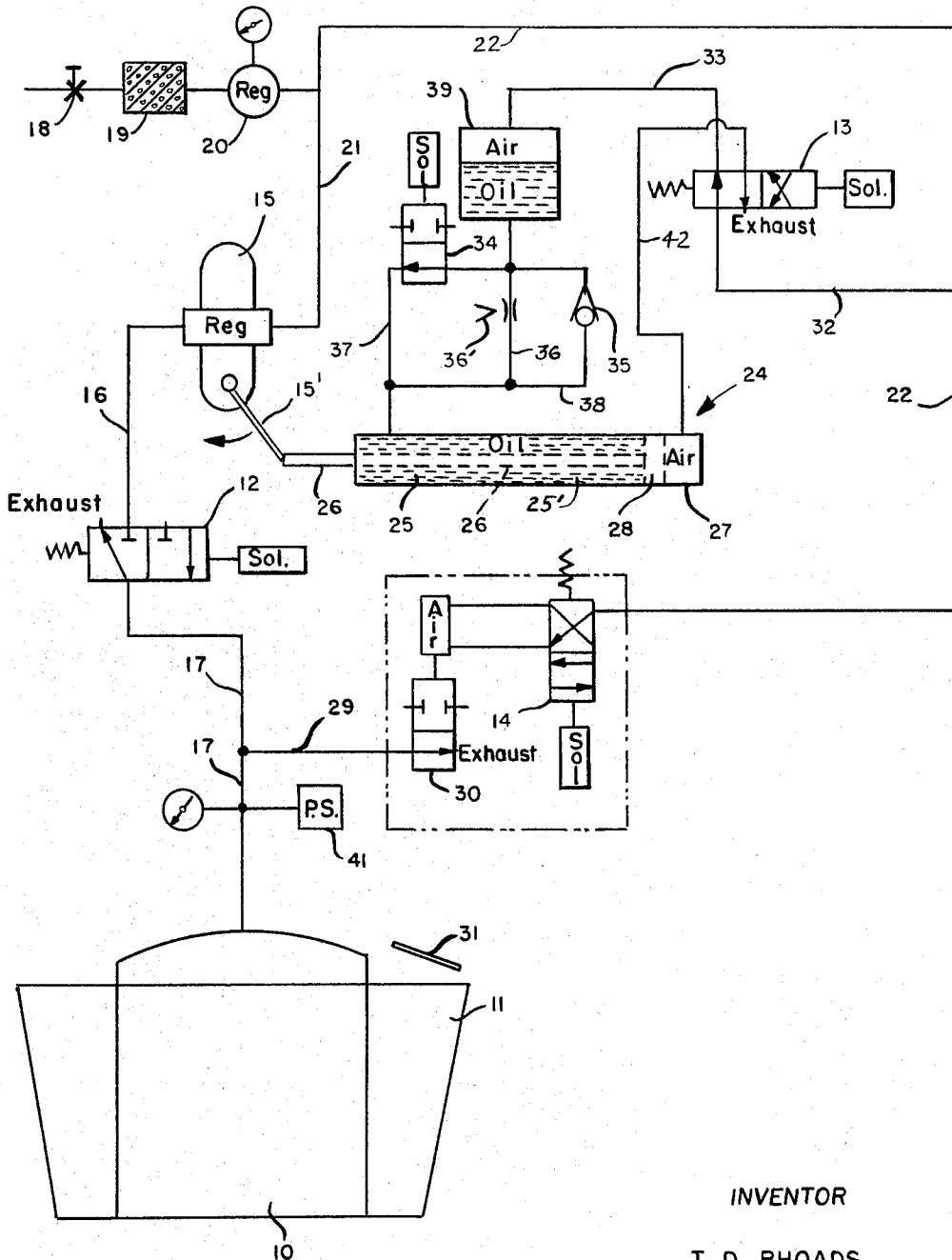
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CONTROL APPARATUS FOR POURING MOLTEN METAL

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CONTROL APPARATUS FOR POURING MOLTEN METAL

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1 Claim. (Cl. 22—69)

This invention relates to an improved control apparatus for pouring molten metal.

The present invention relates to ladles or holding furnaces of the type wherein air pressure is utilized to force the molten metal therefrom and into a mold or other receptacle, such a pneumatic pouring system being disclosed in U.S. Patent No. 3,058,180, owned by the assignee of the present application. The principal object of the present invention is to provide a novel pouring control apparatus and circuit which is generally similar to that disclosed in said prior patent, but wherein the pressure build-up rate in the vessel is automatically adjusted during operation to permit extremely accurate control of the pour by the operator.

A more specific object of the present invention is to provide a novel automatic pressure regulating mechanism including a combination pneumatic-hydraulic cylinder and ram assembly which provides a fast pressure build-up within the ladle at the start of the operating cycle to overcome inertia and air leaks, and wherein a slower, more easily regulated pressure increase is obtained in the later stages to permit close control of the actual pouring operation.

Still further objects of the present invention are to provide a novel control apparatus and circuit for pouring molten metal which is simple and inexpensive in design, which is completely safe and reliable in operation, and which is otherwise particularly well suited for its intended purpose.

With the above and other objects in view, the invention consists of the improved apparatus and circuit for pouring molten metal or other material, and all of the parts and combinations thereof, as set forth in the following specification and claims, and all equivalents thereof.

In the accompanying drawing a preferred embodiment of the improved pouring control system is shown in diagrammatic form, said system being illustrated in its de-energized and vented condition.

Referring more particularly to the drawing, the complete pouring control apparatus and circuit comprising the present invention is designed for use with a closed pressure vessel 10, such as a covered and sealed ladle or holding furnace for molten metal, and which vessel includes a pouring spout 11. The pressure control circuit will best be understood by the following description of its operational sequence.

When it is desired to pour a quantity of molten metal from the vessel 10 the operator activates an electrical switch to energize the solenoid valves 12, 13 and 14, causing them to simultaneously shift from the positions shown, the required electrical circuitry being well known to those skilled in the art. When the solenoid 14 shifts, a venting valve 30 connected to the vessel air line 17 by line 29 is closed to seal the vessel, and the valve 12 closes to form a circuit permitting pressurized air to pass through lines 16 and 17 from a precision air regulator 15 to the interior chamber of said closed vessel, thus building up the pressure in said vessel and causing the molten metal to rise in the discharge spout 11. Ultimately the increasing air pressure within the vessel will cause a quantity of molten metal to overflow said spout, as will be hereinafter described, and it will flow into a mold or

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other receptacle therebelow. The advantage of such a pneumatic pouring device is that it eliminates the necessity for mechanically tipping the ladle to pour, which is difficult and dangerous when large ladles or holding furnaces are involved. Moreover, with the present method it is much easier to obtain accurate control of the quantity discharged.

In the preferred form of the invention the gas utilized in the system is ordinary air drawn from the atmosphere through a valve 18, filter 19, and first regulator 20. The aforementioned precision air regulator 15 is connected to the latter by a line 21 and is of a conventional, commercially-available type, said regulator having a control lever 15' which may be moved in the direction of the arrow to increase the air pressure delivered thereby to the vessel.

One of the critical features of the present invention is the particular mechanism utilized to activate and control the precision air regulator 15. Said control device is designated generally by the numeral 24 and includes a cylinder 25 having a rearward, air chamber or portion 27 and a forward, oil chamber 25', said chambers being defined by the head 28 of a movable ram or piston 26. The forward, projecting end of said ram is operatively attached to the aforementioned control lever 15' on the air regulator in a manner whereby the forward travel or extension of said ram causes said lever to shift in the direction of the arrow to increase the pressure within the vessel, and retraction of said ram returns said lever to its original, non-operative position.

When it is desired to actuate said pressure-controlling cylinder and ram assembly 24 to commence the pouring cycle the operator first energizes the solenoid valves including the valve 13, as described. Operating pressure for said valve 13, as well as the valve 14, is supplied through the line 22, the aforementioned pressure regulator 20 being designed to control the pressure in the system. From said valve 13 pressurized air is directed through line 42 into the rear chamber or portion 27 of the cylinder 25, and against the ram head 28, to move the ram forwardly. As said ram is extended, oil which is normally carried in the forward chamber 25' of the cylinder is displaced and flows unrestricted through line 37 to a combination air-oil tank 39, thus allowing a relatively rapid extension of said ram, and corresponding pressure increase in the vessel, and causing the molten metal to rise quickly in the discharge spout 11. A fast initial pressure build-up in the vessel not only increases the speed and efficiency of the pouring cycle, but is desirable in order to overcome the natural inertia and unavoidable air leaks in the system.

Mounted adjacent the vessel pouring spout 11 in the present invention is a sensing device 31, such as a capacitance probe or plate, which is adapted to indicate when the molten metal reaches a predetermined height in said spout. When said predetermined liquid level is reached, a solenoid 34 is energized by said plate to block the flow of oil from the cylinder 25 to the tank through line 37, and causing said oil to be directed instead through a line 36 and flow control valve 36'. The latter valve is designed to impede the oil flow from the cylinder forward end, and causes a substantial reduction in the traverse rate of the ram 26. The result is a slower, more accurately controlled pressure increase in the ladle just as the molten metal approaches the overflow point and during the actual pouring, thus providing a steadier discharge and permitting extremely accurate control of the amount of metal deposited in the adjacent mold or other receptacle.

When the desired volume of metal has been discharged from the vessel the operator releases the electrical switch

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to de-energize the solenoids 12, 13, 14, and 34, thus opening the vent valve 30 and simultaneously blocking the circuit from the regulator through the lines 16 and 17 to reduce the ladle pressure to zero. In addition, the shifting of the valve 13 causes the air pressure from the line 22-32 to be directed through line 33 into the top area of the tank 39 to force the oil in said tank through a free flow check valve 35 and back into the forward portion of the cylinder 25. At the same time, the air in the cylinder rear portion 27 is exhausted through the line 42 and to the atmosphere through said valve 13, thus permitting the ram to return to its non-operative, retracted position at a fast, efficient rate. When another mold or receptacle is to be filled, the operator merely again energizes the solenoids 12, 13, and 14, and the operational cycle is repeated.

One of the advantageous features of the present system is that the pouring operation is entirely under the control of the operator, and he can discharge any desired amount of molten metal in each pouring cycle. In the preferred form of the invention a suitable pre-set pressure switch 41 is mounted in the circuit to prevent further pouring if the metal level in the vessel becomes dangerously low. The present circuit is also completely safe in the event of a power failure during operation because the de-energization of the solenoids 14 and 12 causes the vessel to be immediately vented and the circuit connection between the lines 16 and 17 from the regulator blocked, thus instantly stopping the pouring operation.

As will be seen from the foregoing description, the present invention provides a novel pouring control apparatus and circuit wherein the pressure build-up rate in the vessel is automatically adjusted during operation to permit extremely accurate control of the pour by the operator. Moreover, the present apparatus is safe and reliable in use, and it is relatively simple and inexpensive in design. It is to be understood, of course, that the invention is intended to include not only the embodiment illustrated and hereinabove described, but also any and all modifications or changes therein as may come within the spirit of said invention and within the scope of the following claim.

What I claim is:

In a pneumatic pouring control apparatus for a molten metal vessel having a sealed interior chamber and a discharge spout, having a pressure regulator connected to a source of air and provided with a lever for controlling the air pressure delivered thereby, having an air line leading from said regulator to the interior chamber of said vessel, and having a sensing device adapted to detect the liquid level in the vessel discharge spout, the improved regulator control means comprising:

a combination pneumatic and hydraulic cylinder and double-acting ram assembly operatively associated

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with said regulator lever, said cylinder having a forward, oil chamber and a rearward, air chamber and said movable, double-acting ram having a head thereon within said cylinder and defining said forward and rearward chambers, and said ram having a forwardly-projecting end operatively associated with said regulator lever;

a combination air-oil tank;

an air line associated with said tank for directing air under pressure into the rearward, air chamber of said cylinder;

valve means associated with said air line;

a first oil line between said tank and the forward, oil chamber of said cylinder;

adjustable valve means in said first oil line having a closed position and having an open position permitting the unrestricted flow of oil from said cylinder forward chamber to said tank as said ram moves forwardly, thereby permitting a relatively fast ram extension rate to actuate said regulator lever and cause a corresponding rapid initial pressure build-up in the vessel;

a second oil line between said tank and said cylinder forward chamber;

a flow control valve in said second oil line, whereby oil flowing to the tank through said second oil line when said first oil line valve is closed will be impeded to reduce the ram extension rate and corresponding pressure build-up rate within the vessel during pouring;

means operatively associated with said level-sensing device adapted to automatically close said first oil line valve when the metal reaches a predetermined level in the vessel discharge spout, thereby obtaining said slower, more readily controlled pressure increase in the vessel during pouring; and

means for directing oil from said tank into the cylinder forward chamber after a desired amount of metal has been poured from the vessel to move said ram rearwardly, thereby actuating said regulator lever to halt the pressure build-up within the vessel, and thereby halting the pouring operation.

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