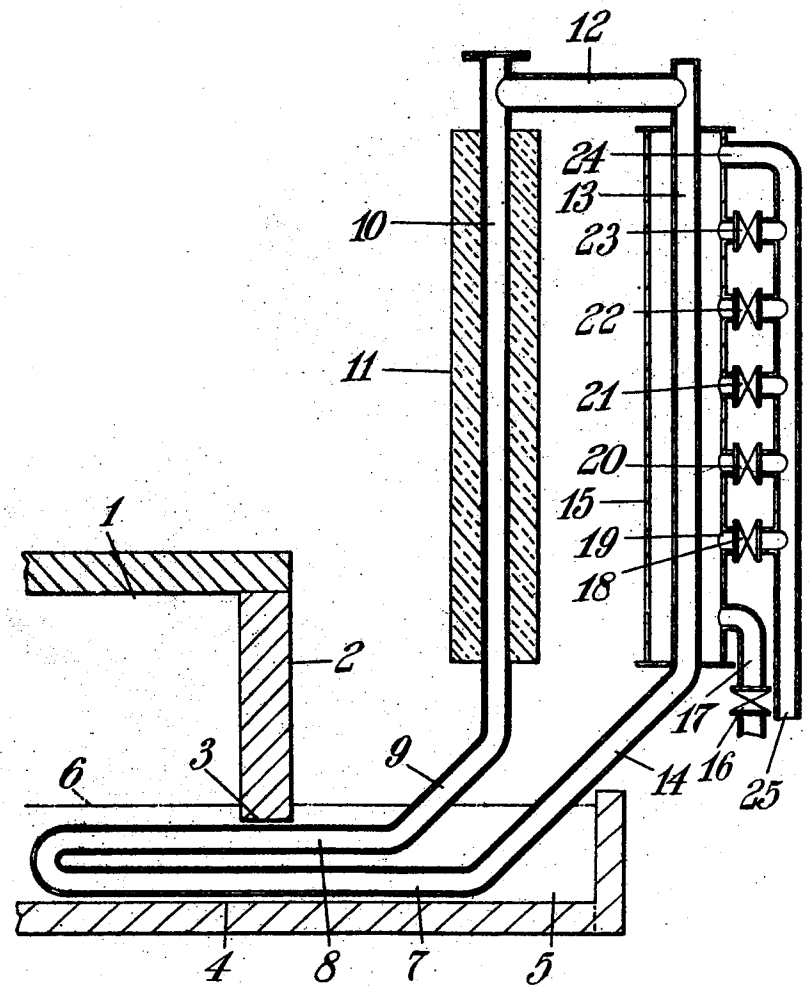
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PRODUCTION OF ZINC

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PRODUCTION OF ZINC

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This invention relates to the production of zinc. Various arrangements for condensing zinc vapour by means of a pool or bath of molten metal have been described.

Various cooling systems for the pool of molten metal have been tried as it is necessary to have a system in which the rate of abstraction of heat can be closely controlled so as to maintain the temperatures in the condenser at the desired level.

With water as the cooling medium the rate of heat abstraction per unit area of heating surface cannot be usefully controlled by varying the rate of water circulation; furthermore if for any reason the water supply fails, or the water circulation becomes too slow, steam is generated and the coils become heated; and if water is now readmitted there is a danger of explosion.

Therefore according to the invention it is proposed in connection with the condensing of zinc vapours by means of a pool of molten metal to use a circulating readily fusible metal alloy in molten or liquid form as the cooling medium for the pool of molten metal. The molten metal pool might consist for example of lead, zinc containing another metal in solution, or a solution of zinc in lead. The rate at which heat is abstracted from the pool of molten metal can thus be controlled by varying the rate at which the alloy is circulated through a closed circuit of tubes or pipes having a cooling coil part submerged in the pool of molten metal or the temperature to which the alloy is cooled in another part of the circuit outside the pool of molten metal which is completely or partly inside the condenser. The cooling coil can be inserted in a fixed position in a well of the molten metal communicating with the condenser, or in a pool of metal within the condenser. The cooling coil within the condenser may be generally horizontal.

To remove the heat several cooling coil units each consisting of a single loop of pipe are preferably fitted in the condenser and immersed in the pool or bath of metal and through these the readily fusible metal alloy is circulated, being cooled in the other part of their respective closed tubular circuits outside the condenser, for example by externally applied water.

Conveniently, the circulation of the molten or liquid alloy may be effected by a thermo-siphon. Externally to the pool of molten metal from which heat is to be abstracted, the pipe or tube through which the fusible alloy flows is in the shape of an inverted U having two generally vertical limbs or parts interconnected at their top ends and

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with their bottom ends respectively connected to the two ends of the part for fitting into the pool of molten metal. Of these two generally vertical limbs one is cooled, as, for instance, by the external application of water, and the difference in density between the cooled alloy in this limb and the hot alloy in the other vertical limb of the pipe provides the motive force necessary for circulating the alloy without the use of pumps. Within the condenser each cooling coil consists of a single loop of pipe submerged in the pool of molten metal. To obtain adequate cooling surface, several such coils may be used in a single condensing chamber. Each coil, with its thermo-siphon, constitutes an independently controlled unit, with suitable means, such as a valve, for controlling the rate of circulation of alloy, and facilities, such as an insulating jacket around the vertical limb or part containing the hot alloy and a water cooling jacket of variable length around the water-cooled section for varying the temperature to which the alloy is cooled.

In this way the forced cooling is quickly controlled so that the temperatures may be maintained at the desired levels.

The invention will be further described with reference to an embodiment shown in the accompanying drawing which shows a section transverse to the condenser.

The condenser 1 is of rectangular cross-section. For part or all of its length, the side wall 2 of the condenser extends down only to level 3, some distance above the floor-level 4 of the condenser. There is thus provided an opening between the condenser and a well 5. The level 6 of the lead, or other molten metal, in the condenser is above that of the lower end 3 of the side wall, which therefore dips into the molten metal between the condenser and the well.

The metal in the condenser and well is cooled by means of a molten fusible alloy circulated through a U-shaped pipe in the direction from limb 7 to limb 8 in a closed tubular circuit which is completely filled with and confines the circulating molten alloy. Leaving horizontal limb 8, the alloy passes by an upwardly inclined limb 9 and up through a vertical pipe or column 10 which is surrounded by heat-insulating material 11. From the top of column 10 the alloy passes along a horizontal pipe 12 and thence downwardly through a vertical pipe or column 13 all or part of the length of which can be water-cooled. This cooling makes the alloy in column 13 denser than that in column 10. This difference in density provides the motive force for circulating the alloy

which completes the circuit by passing by pipe **14** to the horizontal limb **7**.

The cooling of pipe **13** is effected by water contained within the surrounding jacket **15**. Water enters this jacket through valve **16** and pipe **17**. If valve **18** is open the water leaves by pipe **19** and therefore cools pipe **13** only up to this level. If valves **18, 20, 21, 22** and **23** are all shut, the water leaves by pipe **24** and hence effects cooling of the whole of pipe **13**. When less than this full amount of cooling is required, whichever of the valves **18, 20, 21, 22** and **23** controls water outflow at the desired level is opened and all the lower ones are closed. In any case the cooling water finally leaves by pipe **25**. For fine control of cooling rate, the water flow is controlled by valve **16**.

The fusible alloy may consist of lead and tin in approximately the proportions required to form a eutectic mixture, that is, by weight, about 38% lead and 62% tin. To attain a very low melting-point, an alloy consisting of 50% bismuth, 27% lead, 13% tin and 10% cadmium may be used. Other mixtures of these four metals, or any two or three of them, can be used. One suitable composition is 50% tin, 32% lead and 18% cadmium. It is characteristic of such fusible alloys that their boiling temperatures, at atmospheric pressure, are relatively high and higher than the highest temperature to which any such alloy is raised in circulating through the pool of molten metal, being in excess of 400° C. and preferably as high as 450° C., so that any possibility of vapor formation within the closed alloy circuit, with its attendant dangers, is practically negligible. Additionally, these alloys have a high heat of vaporization to further guard against vapor formation. On the other hand, these fusible alloys have relatively low melting temperatures, that of the bismuth-lead-tin-cadmium alloy being approximately 10° C., since in the condensation of zinc vapor in a molten metal bath or pool, the fusible alloy cooling medium should have a wide range of cooling, varying in practice from about 70° C. up to about 450° C.

We claim:

1. A cooling system for a pool of molten metal comprising a closed circuit of tubes containing a readily fusible metal alloy in liquid form and having a part for fitting into the pool of molten metal and two generally vertical parts interconnected at their top ends and with the bottom ends respectively connected to the two ends of the part for fitting into the pool of molten metal, the boiling temperature of said metal alloy being higher than the temperature to which the alloy is raised in that part of said circuit which is fitted into the pool of molten metal, and a water cooling jacket around one of said generally vertical parts.

2. A cooling system for a pool of molten metal comprising a closed circuit of tubes containing a readily fusible metal alloy and having a part for fitting into the pool of molten metal, and two generally vertical parts interconnected at their top ends and with the bottom ends respectively connected to the two ends of the part for fitting into the pool of molten metal, a water cooling jacket of variable length around one of said generally vertical parts, an insulating jacket around the other of said generally vertical parts, and means including a control valve for supplying cooling water to said water-cooling jacket.

3. A cooling system for a pool of molten metal comprising a closed circuit of tubes containing a readily fusible metal alloy and having a part for fitting into the pool of molten metal, and two generally vertical parts interconnected at their top ends and with the bottom ends respectively connected to the two ends of the part for fitting into the pool of molten metal, a water cooling jacket of variable length around one of said generally vertical parts and an insulating jacket around the other of said generally vertical parts.

4. In the condensation of zinc vapor in a pool of molten metal, the improved method of cooling the pool of molten metal which comprises circulating therethrough and out of contact therewith a readily fusible metal alloy in liquid form confined in and completely filling a closed circuit of which one part is submerged in said pool and another part is outside said pool, the boiling temperature of said metal alloy being higher than the highest temperature to which the alloy is raised in circulating through said pool, and cooling said alloy in that part of said circuit outside said pool.

5. In the condensation of zinc vapor in a pool of molten metal, the improved method of cooling the pool of molten metal which comprises circulating therethrough and out of contact therewith a readily fusible metal alloy in liquid form confined in and completely filling a closed circuit of which one part is submerged in said pool and another part is in the form of two vertical columns communicating with one another at their tops and having their bottoms in communication with the opposite ends respectively of the submerged part of said circuit, the boiling temperature of said metal alloy being higher than the highest temperature to which the alloy is raised in circulating through said pool, and cooling the alloy in one of said columns until its density exceeds that of the alloy in the other column and thereby inducing a flow of the cooler alloy into the submerged part of said circuit and a flow of hot alloy from the submerged part of said circuit into said other column.

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