

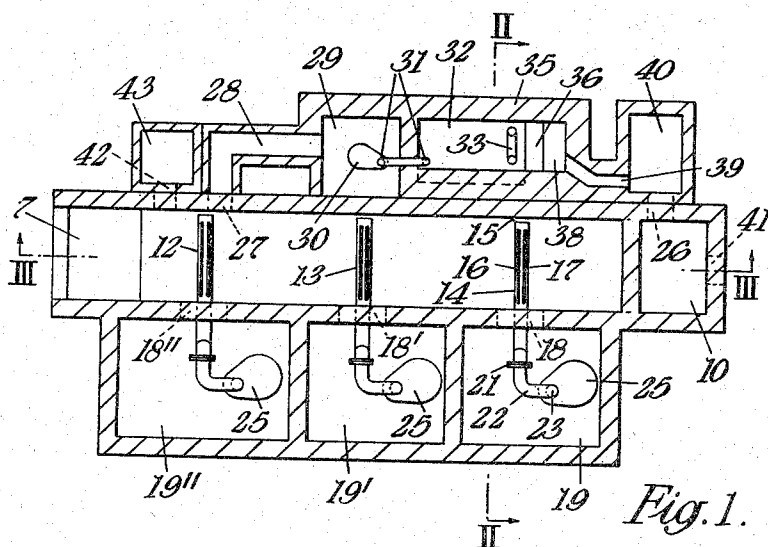
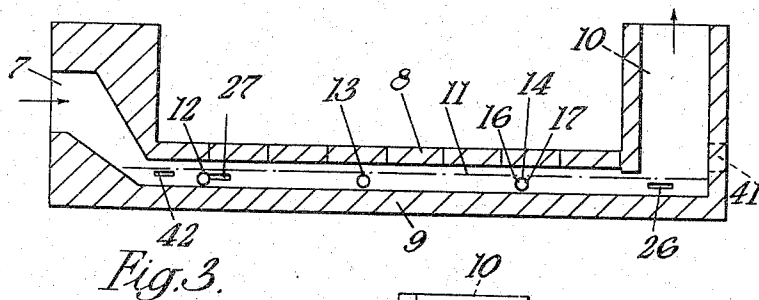
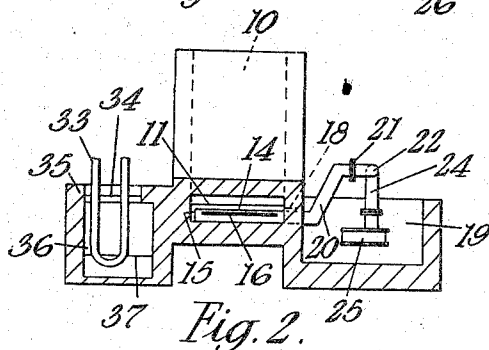
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CONDENSER FOR CONDENSING METAL VAPOURS

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CONDENSER FOR CONDENSING METAL VAPOURS

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3 Claims. (Cl. 266—15)

This invention relates to the condensation of metal vapours from gases containing these and more particularly to the condensation of zinc vapours by agitation with a molten condensing metal such as lead. Such a method has been described in specification of British Patent No. 572,961 which relates to a shock-chilling method of condensing the zinc from the zinc-vapour containing gases.

This invention is more especially concerned with arrangements for ensuring rapid and intimate contact between the gases and the condensing metal.

The invention consists of a method of condensing metal vapours from gases containing these by means of agitation with a molten condensing metal in a condenser in which the gases are passed between the surface of a bath of the molten condensing metal and a low roof located thereover.

By having the roof only a short distance above the surface of the metal the cross-sectional area for the passage of the gases through the condenser may be considerably reduced as compared with the cross-sectional area of the inlet leading to the condensing region of the condenser and of the outlet leading therefrom, which means that the velocity of the gases sweeping over the surface of the condensing metal is considerably increased and the gases act to clean the surface of the molten condensing metal sweeping away any dross to the outlet end of the condenser, where it can be removed by suitable means, and enabling more intimate contact of the incoming gases with the molten condensing metal, since they meet a cleaner surface.

This means that the metal vapours are more efficiently taken into solution and the process of condensation can be carried on for longer periods of time without intermission, e. g. for cleaning out accumulated dross.

Gas velocities of 10–30 ft./sec. (N. T. P.) have been employed, but these velocities are not to be regarded as limiting, as higher or even smaller velocities can be used. Condensation efficiency under the right conditions is better than for the condenser of patent specification No. 572,961, and the dust carry-over from the exit is smaller.

It is preferred to agitate the molten condensing metal and this can be achieved by pumps placed, for example, in external chambers pumping into delivery pipes which are removable and are below the surface of the condensing metal, thus allowing a change of pump or pipe without discontinuing condensation; this is not possible with condensers using rotors to throw up the condensing metal. The delivery pipes are cut in places to give holes or slots through which condensing metal passes to give the desired irrigation.

Alternatively, agitation of the molten condensing metal by means of compressed gas may be used by using high compression and the expansion effect with temperature, i. e. compressed gas, cooled if desired, is brought into contact with the metal and the high temperature of the metal causes a great expansion of the gas which thus

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agitates the metal. Good agitation of the metal can be obtained with quite small amounts of gas.

The invention may usefully be applied to any mixture of zinc vapour and other gases, such as are obtained when zinc is smelted in vertical retorts, electrothermic furnaces and blast furnaces. When the concentration of the zinc is relatively high (35–50% by volume) as from vertical retorts and electrothermic furnaces, zinc is preferred as the condensing medium. When the concentration of the zinc is low (less than 10% by volume), as from blast furnaces, lead is preferred as the condensing medium. If molten lead is used it is much preferred to cause agitation by gas rather than by pumping. The gas used for agitation would generally have to be inert whether zinc or lead was used in the condenser, but furnace gas could be used providing it was dried and did not contain too much carbon dioxide.

When zinc is smelted in vertical retorts or electrothermic furnaces, it has been customary to introduce some gas or air into the bottom of the retort or furnace. The amount of gas, or air, that can be introduced has been limited, because large quantities would dilute the zinc vapour so that efficient condensation would become difficult in the customary types of condenser. We have found that the introduction of a relatively large amount of air into the bottom of a vertical retort or electrothermic furnace greatly increases the yield of zinc and permits the throughput of zinciferous materials to be increased, while still obtaining a high recovery of zinc; even if the amount of air introduced is sufficiently large to reduce the zinc content of the gas to 20% or less, the zinc can be efficiently condensed from these gases by the process of our invention. For dealing with such gases we find it convenient to pass them first through a condenser according to our invention, with zinc used as the condensing metal, and then through a second condenser with lead used as the condensing metal.

The invention further consists of a condenser for condensing metal vapours from gases containing these comprising an inlet for the gases, a long condensing region of width considerably greater than its height and adapted to be filled with molten condensing metal up to a level such that the free space above the metal is of cross-sectional area considerably less than that of the inlet and an outlet for the gases of cross-sectional area generally at least as large as that of the inlet.

The invention will be further described with reference to the accompanying drawings.

Figure 1 is a sectional plan of a condenser according to the invention, suitable for condensing zinc by means of molten lead.

Figure 2 is a section of the condenser on the line II—II of Figure 1.

Figure 3 is a section on the line III—III of Figure 1.

Zinc-bearing gases enter from an inlet through a downcomer 7 reducing gradually in cross-section to that of the condensing region and pass through the condensing region, the roof 8 of which in this specific example is 10 inches above the floor 9, the dezinced gases then leaving the offtake 10 (Figures 1 and 3). The condenser is filled with lead up to a level 11 which is four inches below the roof 8. This roof 8 is constructed of removable tiles to facilitate cleaning of the condenser.

Below the surface of the lead a plurality (shown as three) similarly constructed and connected steel pipes 12, 13 and 14 are placed at intervals across the condenser. With pipe 14 as an example, one end 15 is blanked off; along the upper half of the pipe are two slots 16 and 17, extending for most of the width of the condenser. The open end of the pipe then passes through a rectangular opening 18 in the wall of the condenser (leaving a space around the pipe) into the chamber 19

(Figures 1 and 2), which is likewise filled with lead. Here the pipe is continued as an upwardly sloping portion 20, followed by a horizontal portion leading to a flanged joint 21, which is well above the level of the lead. Hence a pipe continues horizontally, with a right-angled bend at 22, and then at the bend 23 it continues by a vertical portion 24 to connect with a pump 25.

Lead is pumped from chamber 19 out through the slots 16 and 17 of the pipe 14. Similarly the other two pumps force lead out through the slots of the pipes 12 and 13, and thus agitate the molten lead in the condenser and bring it into intimate contact with the zinciferous gases, with the result that most of the zinc vapour is condensed and dissolved in the lead. The pressure drop in the gas passing through the condenser may be equivalent to a head of about 1 inch of lead, and the offtake 10 from the condenser is maintained at substantially atmospheric pressure. The surface of the lead in the pump chamber 19 (and the two similar chambers 19' and 19'') at atmospheric pressure and the freedom of passage of lead from the condenser through the rectangular opening 18 back to the chamber 19 is such that there is no appreciable pressure drop incurred. Consequently, during operation the level of lead in the condenser falls somewhat, by up to 1 inch, compared with its level at rest. The rectangular openings 18, 18' and 18'' which act as drowned ports or underflow weirs, must be below the lead level in the condenser during operation, so that no gas can escape to the pump chambers 19, 19' and 19''; the upper edges must be set at more than 1 inch, and preferably at 2-2½ inches below the static level to which the lead is originally filled in both condenser and pump chambers.

Should it be necessary to remove the pipe 14 during the operation of the condenser, this can be readily effected because the flanges 21, which have to be disconnected, are at an accessible point, and the width of the port 18 in the condenser wall, in conjunction with the manner in which the position of the pump 25 is offset by the distance between the bends 22 and 23, facilitates the removal of the pipe 14. By making the chamber 19 longer (in a direction transverse to the direction of the condenser) it should be possible to remove slotted tube and pump together and to replace them by a new assembly without disconnecting any flanges.

Cold dezinced lead enters the condenser through an inflow port 26 (Figures 1 and 3), the upper edge of which is about 2 inches below the static level of lead in the condenser. This lead passes along the condenser, taking zinc into solution and rising in temperature as it absorbs the sensible heat of the gases and the latent heat of condensation of the zinc. At the other end of the condenser the lead is heated up to 480° C. but by controlling its rate of flow it could be allowed to become considerably hotter up to somewhat over 600° C. This hot lead leaves through an outflow port 27, the upper edge of which is about 2½ inches below the static level of lead in the condenser, and flows through a conduit 28 to a chamber 29, exposed to atmospheric pressure, where consequently the level of the lead is substantially the same as in the pump chambers 19, 19' and 19''. In chamber 29 there is a pump 30 which conveys the lead, still at a temperature at which it holds all its dissolved zinc in solution, through the pipe 31 into a chamber 32, where it is cooled by suitable means, such as by inserting a U-tube 33 through which water flows (Figures 1 and 2). As a result of this cooling a layer of zinc 34 is formed on top of the lead. This zinc is ladled out when its depth has reached 2-3 inches; alternatively a continuous run-off or a hole from which the zinc could be tapped intermittently can be arranged at a suitable height in the wall 35. At one end of the chamber 32 is a baffle 36, the lower end 37 of which is well below the level of the separated zinc; the lead flows beneath this baffle into chamber 38, along conduit 39 to chamber 40, and thence through port 26

into the condenser, its temperature being preferably 420-430° C.

The gases flowing along the condenser clean the surface of the lead, sweeping away most of such dross as is formed towards the gas outlet; a door 41 is provided here, so that this accumulated dross may be removed at intervals. Not much loose dross is left at the gas-inlet end of the condenser, but some dross adheres at this point; access here is provided by the drowned port 42, which communicates with the external lead-well 43. To remove any accretions in the condenser not accessible from door 41 or port 42, the roof tiles can be removed while the condenser is temporarily not in operation.

Methods other than that illustrated in the drawings, may be used for cooling the lead to cause separation of zinc. The water-cooled launders described in the Keeping application for Letters Patent of the United States, Serial No. 361,041, filed June 11, 1953, now Patent No. 2,801,162, may be used; with these, as with the water-cooled tubes 33 immersed in chamber 32, it is impracticable to cool the lead down below the lead-zinc monotectic temperature, 418° C. The drum cooler described in British Patent No. 686,559 might also be used; with this it is possible to cool the lead down to the point at which solid zinc has separated, and indeed to cool down to any temperature above the lead-zinc eutectic point, 318° C.

The gas leaving the condenser exit contains some zinc and lead vapour and carries some dust (consisting mainly of zinc and some lead) with it; these can be collected in a dust settler and/or scrubber. The dust has been found to be richer in zinc and lower in lead than that from rotor condensers, this being due to the fact that less zinc, but correspondingly even less lead, is carried over, so that the amount of dust carried over is also smaller as already stated. The reason for the smaller carry over of lead may be due to the fact that rotors tend to break up the lead into small droplets, while in the present invention the lead particles tend to remain more together. The smaller lead carry-over in particular is an advantage, as it cuts down the makeup lead which must be added to the condenser and/or reduces the lead content of the dross lead recirculated to the zinc smelting apparatus, which latter consists not only of the dross forming inside and removed from the condenser, but includes also zinc and lead obtained (e. g. as described) from the dust and gases leaving the condenser.

By "low" used in relation to the height of the roof above the surface of the molten condensing metal we intend a distance which gives a substantial reduction in the cross-sectional area of the passage for the gas. In a condenser of the kind specifically described, the distance between the surface of the molten lead when unagitated, and the roof of the condenser, is designed to be four to six inches.

We claim:

1. A condenser for condensing metal vapors from gases containing these comprising an inlet for the gases, a long condensing region of width considerably greater than its height and adapted under operating conditions to contain a bath of molten condensing metal up to a level such that the free space above the surface of the molten condensing metal is of cross-sectional area considerably less than that of the inlet, said inlet being adapted under operating conditions to deliver the gases to said free space, an outlet for the gases of cross-sectional area generally at least as large as that of the inlet, a plurality of longitudinally spaced pipes positioned in and extending transversely across the condensing region under the surface of the molten condensing metal adapted to be contained therein, each of said pipes having for most of the width of the condensing region means of communication between the interior of the pipe and the condensing region, pumps for supplying molten condensing metal to said pipes from chambers arranged at

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the side of the condensing region, the side walls of the condensing region having openings through which said pipes pass, each opening being larger than the pipe passing therethrough to provide around the pipe a space permitting return of molten condensing metal from the condensing region to the chamber arranged at the side thereof.

2. A condenser according to claim 1 further characterized in that flow of molten condensing metal counter-current to the gas flow is provided by inlet and outlet ports connected respectively to inflow and outflow chambers positioned on the opposite side of the condensing region to the chambers for the pumps, and a pump for returning molten condensing metal from the outflow chamber to the inflow chamber.

3. A condenser for zinc vapors comprising an elongated condensing chamber of substantially rectangular cross-section and having a gas inlet at one end and a gas outlet at the opposite end, said chamber being characterized by a width substantially greater than its height and adapted under operating conditions to contain a bath of molten condensing metal up to a level such that the cross-sectional area of the free space above the surface of the

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metal is considerably less than the cross-sectional area of said gas inlet, said gas inlet being adapted under operating conditions to deliver to said free space the zinc vapors to be condensed, means near the gas outlet end of said chamber for introducing therein a molten condensing metal, means near the gas inlet end of said chamber for withdrawing therefrom molten condensing metal, a plurality of longitudinally spaced pipes positioned in and extending transversely across said chamber below the level of the molten condensing metal adapted to be contained therein, each of said pipes having for most of the width of said chamber means of communication between the interior of the pipe and the chamber, and means for supplying a fluid agitating medium to said pipes under sufficient pressure to agitate the bath of molten condensing metal adapted to be contained in the chamber.

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