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(54) **INDUCED DEVICE AND PROCESS FOR INHIBITING ELECTRODEPOSITION OF ACID MIST**

(57) The present invention discloses a device for inductively suppressing acid mist from electrowinning. The device comprises a polar plate. A first isolation net and a second isolation net are respectively provided at two sides of the polar plate. Gaps are left between the first and second isolation nets and the two sides of the polar plate respectively. A first isolation piece and a second isolation piece are respectively provided to two sides of a top of the polar plate and are respectively located above the first and second isolation nets. The present invention also discloses a process for inductively suppressing acid mist from electrowinning by using the above device. The acid mist suppressing device and process of the present invention can prevent formation of acid mist during an electrowinning process so that pollution of acid mist can be eliminated and clean production can be realized.

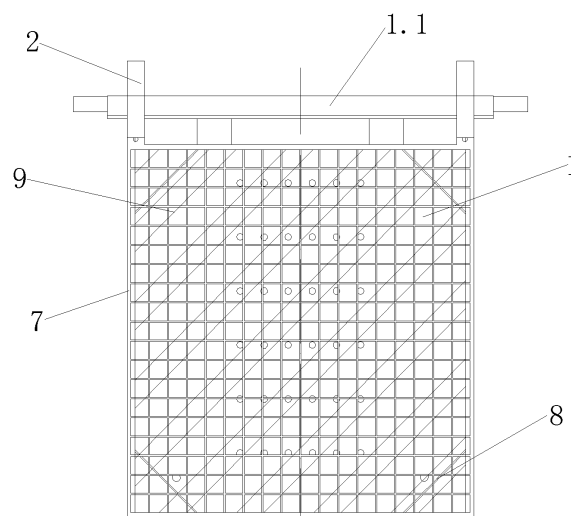


Figure 1

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Description

Technical Field

[0001] The present invention relates to fields of hydrometallurgy, electroplating and chemical engineering, and particularly to a device and process for inductively suppressing acid mist from electrowinning.

Background Art

[0002] At present, during production in the fields of hydrometallurgy, electroplating and chemical engineering, a plenty of gas is generated due to electrochemical reactions at the cathode and anode. When the gas precipitates from the polar plates, it adheres to the surface of the electrodes in the primary stage. As bubbles grow such that buoyance of the bubbles is greater than the adhering force, the bubbles are released from the polar plates and flow upwards from the solution. When the bubbles reach surface of the liquid, they will certainly carry liquid due to liquid surface tension. When the bubbles carrying the liquid encounter cold air at the cell surface, they burst to form mist. As the solution is acidic, a plenty of acid mist is formed above the cell surface, which damages health of operation personnel, pollutes operation sites and the environments. This also corrodes factories and equipment, and increases the consumption of reagents.

[0003] To solve the problem of acid mist pollution at low altitude, most manufacturers adopt mechanical air discharge. That is, after acid mist is formed, large power blowers supply air to the factory to substantially increase ventilation in the factory and decrease the acid mist concentration. Or, gas collecting covers are mounted above solution storage cells to collect acid mist above the cell surface and the acid mist is pumped by blowers to absorption towers for absorption by alkali liquor to reduce acid mist pollution. Both the above methods are all post-treatment processes with complex operations, high processing cost and low efficiency. In addition, some manufacturers treat acid mist using cell surface covering methods. Specifically, in one of the methods, the solution surface in the cell is covered by plastics or foam balls to increase the resistance when bubbles overflow such that the bubbles burst at the surfaces of the foam balls. In this manner, acid-containing liquid drops are adhered to the surfaces of the foam balls thereby preventing discharge of acid-containing liquid drops and effectively reducing formation of acid mist. In another method, a surfactant is added to the liquid in the cell and a foam layer is formed on the liquid surface, such that the foam layer can effectively prevent diffusion of acid mist liquid drops when bubbles overflow. However, this method has a problem that the foam balls can be easily stuck to the polar plate and pipes can be easily blocked. Therefore, the acid mist prevention effect is not desirable. In addition, its operations are complex and costly. At present, many manufacturers treat acid mist pollution by adding acid mist suppression

agents into the solution to reduce the viscosity of the solution such that bubbles can overflow quickly with less liquid drops carried. Acid mist pollution can thus be reduced. The problems of this method include high production cost and unstable suppression efficiency due to failure of the suppression agents. In addition, some additives will affect the product quality.

[0004] To root out the problem of acid mist pollution, the Chinese patent application CN200710009588.7 adopts a method of wrapping the anode by a plastic grid and an isolation cloth. By using this method, the ascending path of the gas generated at the anode is extended such that the bubbles grow bigger and fewer bubbles will burst on the liquid surface and thereby suppress acid mist pollution. Although this method can prevent formation of acid mist, as the anode is completely wrapped by the isolation cloth, flowing of the electrolysis liquid is hindered such that the voltage in the cell increases and power consumption increases. In addition, because the anode is completely wrapped by the isolation cloth, plenty of gas gathers around the conductive beam of the anode such that the corrosion rate of the conductive beam of the anode is increased and thereby shortening the service life of the anode. Therefore, it is necessary to develop a new device and process which can not only prevent formation of acid mist but also eliminate acid mist pollution and prevents increase of the voltage in the cell.

Summary of the Invention

[0005] To solve the technical problem of the prior arts in which acid mist pollution can easily occur during an electrochemical reaction process in the fields of hydrometallurgy, electroplating and chemical engineering, the present invention provides a device for inductively suppressing acid mist from electrowinning. With this device, it can prevent formation of acid mist during an electrodeposition process, eliminate acid mist pollution and realize clean production.

[0006] The technical solutions of the present invention used for solving the above technical problems are as below:

A device for inductively suppressing acid mist from electrowinning is provided which comprises a polar plate with a first isolation net and a second isolation net being respectively provided at two sides of the polar plate. The first and second isolation net is respectively placed with a gap to the corresponding side of the polar plate. A first isolation piece and a second isolation piece are respectively placed at two sides of a top of the polar plate and the first isolation piece and the second isolation piece are located above the first and second isolation nets, respectively.

[0007] In electrowinning process of an electrochemical reaction, a plenty of gas will be generated from the polar

plate. When the gas is generated from the polar plate, it adheres to the surface of the electrode in the primary stage. As bubbles grow such that the buoyance of the bubbles is greater than the adhering force, the bubbles are released from the polar plate and flow upwards from the electrowinning liquid. Because the first and second isolation nets are provided at two sides of the polar plate respectively and the gaps are provided between the first and second isolation nets and the two sides of the polar plate respectively, the electrowinning liquid can enter from bottoms of the first and second isolation nets and the bubbles flow in a bottom-to-top direction along with the electrowinning liquid between the first and second isolation nets. In this process, the electrowinning liquid gradually flows out. Due to presence of the first and second isolation nets, on one hand, the resistance to the bubbles to ascend increases such that the retaining time of the bubbles in the electrowinning liquid is extended. Most bubbles burst in the electrowinning liquid or flow out along the circulation of the electrowinning liquid so that the number of bubbles bursting on the liquid surface can be substantially reduced. On the other hand, for small bubbles gathering continuously to form big ones in the electrowinning liquid, Because the retaining time of the bubbles in the electrowinning liquid is extended by the first and second isolation nets, the number of bubbles bursting on the liquid surface is also substantially reduced which in turn reduces or suppresses generation of acid mist. In addition, as the gaps are respectively provided between the first and second isolation nets and the two sides of the polar plate, circulation of the solvent is facilitated and gas can be induced to ascend. Driven by the ascending force, the bubbles accelerate the migration rate of solvent ions in the electrochemical reaction cell so that decrease of polarized concentration difference and the voltage of the cell can be facilitated.

[0008] The first isolation piece and second isolation piece are respectively placed at two sides of the top of the polar plate and are respectively located above the first and second isolation nets. By applying such a design, gas in the bubbles can be inductively discharged from the first and second isolation pieces such that the overflow amount of acid-containing liquid drops can be reduced. Further, a small amount of acid-containing liquid drops overflowing from the solution is filtered by the first and second isolation pieces and substantially blocked on the later. This can prevent formation of acid mist on the surface of a cell during an electrowinning process, eliminate acid mist pollution and help to realize clean production. In addition, while gas can be inductively discharged by the first and second isolation pieces, a phenomenon of "swelling bag" due to presence of the first and second isolation pieces on the polar plate can be prevented. In this manner, sticking between polar plates and bursting of gas on the gas-liquid interface can be avoided. Interface corrosion of the polar plate can also be alleviated effectively.

[0009] As an improvement by the technical solution of

this invention, the device further comprises an acid mist frame plate group including an outer frame, an inner frame and a diaphragm cloth. The diaphragm cloth is embedded in the outer frame via the inner frame. The polar plate, together with the first and second isolation nets and the first and second isolation pieces, is inserted into the inner frame. And the first and second isolation pieces are connected to the diaphragm cloth respectively.

[0010] By embedding the diaphragm cloth in the outer frame via the inner frame, expansion of the diaphragm cloth due to gas generated on the polar plate can be avoided. In addition, by inserting the polar plate in the inner frame together with the first and second isolation nets and the first and second isolation pieces, effective space can be formed between the polar plate and the acid mist frame plate group. This can facilitate flow of the electrowinning liquid and discharge of the gas generated on the polar plate and thus avoids acid mist on the cell surface.

[0011] With the first and second isolation pieces being connected to the diaphragm cloth respectively, overflow of acid mist can be avoided effectively.

[0012] As an improvement by the technical solution of this invention, the first isolation net and the polar plate are connected by a first insulating connecting member. By connecting the first isolation net and the polar plate via the first insulating connecting member, the polar plate can be prevented from projecting from top of the first isolation net due to increased buoyance. On the other hand, bursting of gas on the gas-liquid interface can be avoided, interface corrosion of the polar plate can be alleviated effectively, and corrosion of the conductive bar of the polar plate can be avoided. Thus, service life of the polar plate can be extended.

[0013] As an improvement by the technical solution of this invention, the second isolation net and the polar plate are connected by a second insulating connecting member. Similar to the above, by connecting the second isolation net and the polar plate via the second insulating connecting member, gas can be prevented from flowing from a side of the second isolation net due to increased buoyance. On the other hand, bursting of gas on the gas-liquid interface can be avoided, interface corrosion of the polar plate can be alleviated effectively, and corrosion of the conductive bar of the polar plate can be avoided, thereby extending the service life of the polar plate.

[0014] As a further improvement by the technical solution of this invention, the first and second isolation pieces are connected to the two sides of the top of the polar plate by a fixing assembly respectively. By providing the fixing assemblies, installation of the first and second isolation pieces and the polar plate can be facilitated.

[0015] As another improvement by the technical solution of this invention, the fixing assembly comprises a buckle, a first insulating loop bar and a second insulating loop bar. The first and second insulating loop bars pass two sides of the buckle respectively.

[0016] The first isolation piece is clipped between the first insulating loop bar and a side of the polar plate and the second isolation piece is clipped between the second insulating loop bar and a side of the polar plate.

[0017] In the above fixing assembly, the buckle is mainly used to fix the first and second insulating loop bars. The first and second insulating loop bars are used to clip the first and second isolation pieces respectively.

[0018] As an improvement by the technical solution of this invention, the first insulating loop bar and/or the second insulating loop bar is/are sleeved with a loop bar fixing sleeve. The loop bar fixing sleeve can not only protect the first insulating loop bar and/or the second insulating loop bar but also help to increase frictional force between the first insulating loop bar and the first isolation piece or frictional force between the second insulating loop bar and the second isolation piece. In this manner, clipping between the first or second insulating loop bar and the first or second isolation piece can be enhanced.

[0019] As an improvement by the technical solution of this invention, both ends of the top of the outer frame are connected to a conductive bar at the top of the polar plate by a hanging buckle respectively. The buckle can fix the diaphragm cloth such that a certain distance between the diaphragm cloth and the polar plate can be maintained and sticking therebetween can be avoided. At the same time, the buckle can facilitate installation of the above acid mist frame plate group.

[0020] As yet an improvement by the technical solution of this invention, the hanging buckle comprises a hanging member having a triangular section, a first buckle plate and a second buckle plate at two sides of the bottom of the hanging member respectively. The inner sides of the first buckle plate and the second buckle plate are provided with a fastener respectively. The fastener cooperates with a fastener installation hole at the top of the outer frame. The conductive bar of the polar plate is inserted in a hollow chamber of the hanging member. By using such a hanging buckle, the structure thereof can be simplified, mounting of the outer frame and the conductive bar can be facilitated, and the diaphragm cloth can be fixed therewith. A certain distance can be kept between the diaphragm cloth and the polar plate thereby helping to improve the product quality. In addition, because the hanging member has a triangular section, grooves can be provided to the polar plate easily and short circuits between the cathode and the anode can be prevented.

[0021] In the device for inductively suppressing acid mist from electrowinning of this invention, the polar plate is an anode plate.

[0022] This invention also provides a process for inductively suppressing acid mist from electrowinning by using the above device. The process comprising the steps of:

providing the first and second isolation nets at the left and right sides of an anode plate respectively and leave gaps between the first and second isola-

tion nets and the left and right sides of the anode plate, respectively;

connecting the first isolation net to a side of the anode plate by the first insulating connecting member, and connecting the second isolation net to a side of the anode plate by the second insulating connecting member;

providing the first and second isolation pieces at two sides of a top of the anode plate respectively such that the first and second isolation pieces are respectively located above the first and second isolation nets, thereby forming the device for inductively suppressing acid mist from electrowinning;

arranging the device for inductively suppressing acid mist from electrowinning thus obtained and a cathode plate in an electrowinning cell with a spacing therebetween and leaving the spacing between the adjacent devices for inductively suppressing acid mist from electrowinning being 50-150mm; and

after arrangement of the device for inductively suppressing acid mist from electrowinning and the cathode plate in the electrowinning cell, bubbles being generated from the anode plate and flowing in a bottom-to-top direction between the first and second isolation nets, when the bubbles reaching a liquid surface of electrowinning liquid, acid mist in the bubbles being blocked by the first and second isolation pieces while gas in the bubbles overflowing through the first and second isolation pieces.

[0023] The process of this invention is simple. By using the above device for inductively suppressing acid mist from electrowinning, the process can prevent formation of acid mist during an electrowinning process and eliminate acid mist pollution.

[0024] In the device for inductively suppressing acid mist from electrowinning, a spacing between adjacent acid mist suppression devices is set to 50-150mm. If this spacing is less than 50mm, the electrowinning reaction therebetween may be affected. If this spacing is greater than 150mm, because length or width of a cell surface of an electrowinning cell is limited, the number of the acid mist suppression devices to be arranged in the electrowinning cell will substantially reduce thereby affecting the electrowinning efficiency.

[0025] As an improvement by the technical solution of this invention, after the step of providing the first and second isolation pieces at two sides of the top of the anode plate respectively such that the first and second isolation pieces are respectively located above the first and second isolation nets, the process further comprises the steps of:

selecting the diaphragm cloth, the inner frame and

the outer frame that meet a certain requirement, and embedding the selected diaphragm cloth in the outer frame via the inner frame; and

inserting the anode plate, together with the first and second isolation nets and the first and second isolation pieces, in the inner frame, and connecting the first and second isolation pieces with the diaphragm cloth, in which:

a gap between the first isolation net and the side of the anode plate is 2-50mm, and a gap between the second isolation net and the side of the anode plate is 2-50mm.

[0026] If the gap between the first and second isolation nets and the two sides of the anode plate is less than 2mm respectively, circulation of the electrowinning liquid will be hindered and thus guiding of the gas to ascend will be hindered. If the gap is greater than 50mm respectively, the size of the device for inductively suppressing acid mist from electrowinning will be increased unnecessarily, which will make operations thereof inconvenient and will cause the first and second isolation nets to be ineffective.

[0027] In addition, in the description of this invention, if any means are not specially described, it means that they can be realized by conventional technical means in the art.

[0028] Therefore, the device and process for inductively suppressing acid mist from electrowinning as provided by this invention can prevent formation of acid mist during an electrowinning process, eliminate acid mist pollution and realize a clean production.

Brief Description of the Drawings

[0029]

Figure 1 is a schematic drawing showing a device for inductively suppressing acid mist from electrowinning of the present invention;

Figure 2 is a schematic drawing of the polar plate;

Figure 3 is a side view of Figure 2;

Figure 4 is a close-up view of the part A in Figure 3;

Figure 5 is a schematic drawing of the diaphragm cloth;

Figure 6 is a schematic drawing of the outer frame;

Figure 7 is a schematic drawing of the inner frame;

Figure 8 is a schematic drawing of the hanging buckle.

[0030] Explanation to reference labels in the drawings is as follows:

1-polar plate; 1.1-conductive bar; 2-hanging buckle; 2.1-hanging member; 2.2-first buckle plate; 2.3-second buckle plate; 2.4-fastener; 3-first isolation net; 4-second isolation net; 5-first isolation piece; 6-second isolation piece; 7-outer frame; 7.1-fastener installation hole; 8-inner frame; 9-diaphragm cloth; 10-first insulating connecting member; 11-second insulating connecting member; 12-buckle; 13-first insulating loop bar; 14-second insulating loop bar; 15-loop bar fixing sleeve.

15 Detailed Description to the Embodiments

[0031] To make the purposes and technical solutions of this invention more clear, hereinafter the invention is described in detail with reference to the drawings and the embodiments. It should be understood that the specific embodiments described herein are only intended to explain rather than limit this invention.

Embodiment I

[0032] Figure 1 shows a device for inductively suppressing acid mist from electrowinning which comprises a polar plate 1.

[0033] As shown in Figures 2-3, a first isolation net 3 and a second isolation net 4 are respectively provided at the left and right sides below the top of the polar plate 1. The first isolation net 3 and the left side of the polar plate 1 are connected by a first insulating connecting member 10 and the second isolation net 4 and the right side of the polar plate 1 are connected by a second insulating connecting member 11. Gaps are provided between the first and second isolation nets 3, 4 and the left and right sides of the polar plate respectively.

[0034] As shown in Figures 2-3, a first isolation piece 5 and a second isolation piece 6 are respectively provided to the left and right sides of the top of the polar plate 1 by a fixing assembly and the first isolation piece 5 and second isolation piece 6 are respectively located above the first and second isolation nets 3, 4. As shown in Figure 4, the fixing assembly includes a buckle 12, a first insulating loop bar 13 and a second insulating loop bar 14. The first and second insulating loop bars 13, 14 extend at the left and right sides of the buckle 12 respectively. The first insulating loop bar 13 and the second insulating loop bar 14 are sleeved by a loop bar fixing sleeve 15 respectively. The first isolation piece 5 is clipped between the first insulating loop bar 13 and the left side of the polar plate 1 and the second isolation piece 6 is clipped between the second insulating loop bar 14 and the right side of the polar plate 1.

[0035] In addition, this invention further comprises an acid mist frame plate group including an outer frame 7, an inner frame 8 and a diaphragm cloth 9. Structures of

the outer frame 7, the inner frame 8 and the diaphragm cloth 9 are shown in Figures 6, 7 and 5 respectively. As shown in Figure 1, the diaphragm cloth 9 is embedded in the outer frame 7 via the inner frame 8. The polar plate 1, together with the first and second isolation nets 3, 4 and the first and second isolation pieces 5, 6, is inserted into the inner frame 8. The first and second isolation pieces 5, 6 are connected to the diaphragm cloth 9 respectively. Both ends of the top of the outer frame 7 are connected to a conductive bar 1.1 at the top of the polar plate 1 by a hanging buckle 2.

[0036] The polar plate 1 is an anode plate.

[0037] The gap between the first isolation net 3 and the left side of the polar plate 1 is 2-50mm and it may be 2, 5, 8, 10, 12, 14, 19, 27, 36, 40, 43, 47 or 50 mm or other suitable values. The gap between the second isolation net 4 and the right side of the polar plate 1 is 2-50mm and it may be 2, 4, 7, 9, 10, 13, 17, 19, 20, 24, 27, 30, 36, 41, 47 or 50 mm or other values.

[0038] The outer frame 7 is provided with grids with each grid having a size larger than 2*2mm or having a diameter larger than 2mm. Both the outer and inner frames 7, 8 are made of non-metal materials, such as plastics, glass steel or the like. The diaphragm cloth 9 is made of chemical fibers, such as polyester fibers, acrylic fibers, polyamide fibers or the like.

[0039] The first and second insulating loop bars 13, 14 are circular or square in shape and made of non-metal materials which have certain rigidity. Thus the clipping degree between the first insulating loop bar 13 (or the second insulating loop bar 14) and the first isolation piece 5 (or the second isolation piece 6) can be improved.

[0040] Both the first and second isolation pieces 5, 6 are mounted at a gas-liquid boundary at the top of the polar plate 1. In other words, a part of the first and second isolation pieces 5, 6 are located below the liquid surface and a part thereof above the liquid surface. The gas-liquid boundary is 5-50mm higher than the liquid surface. Specifically, the gas-liquid boundary may be 5, 7, 10, 14, 17, 19, 23, 26, 30, 35, 39, 43, 47 or 50mm higher than the liquid surface. Length of the polar plate 1 below the liquid surface is 5-50mm and it may be 5, 8, 11, 15, 18, 21, 25, 27, 29, 34, 37, 44, 47 or 50mm. By adopting the above designs, bubbles can be prevented from bursting on the gas-liquid interface which effectively reduces corrosion of the interface of the anode plate. In this embodiment, Distance between the anode and cathode plates is 10-100mm and it may be 10, 15, 20, 26, 31, 40, 56, 68, 72, 79, 85, 90 or 100mm

[0041] In this embodiment, the first and second isolation pieces 5, 6 are made of PP cotton.

Embodiment II

[0042] This embodiment is basically the same as Embodiment I. The only difference is that this embodiment defines the hanging buckle as below:

As shown in Figure 8, the hanging buckle 2 comprises a hanging member 2.1 having a triangular section, a first buckle plate 2.2 and a second buckle plate 2.3 at two sides of the bottom of the hanging member 2.1 respectively. The inner sides of the first buckle plate 2.2 and the second buckle plate 2.3 are provided with a fastener 2.4 respectively. The fastener 2.4 cooperates with a fastener installation hole 7.1 at the top of the outer frame 7. The conductive bar 1.1 of the polar plate 1 is inserted in a hollow chamber of the hanging member 2.1. By using the above structure, the hanging buckle 2 has a simple structure, mounting between the outer frame 7 and the conductive bar 1.1 can be facilitated and the diaphragm cloth 9 can be fixed such that a certain distance is kept between the diaphragm cloth 9 and the polar plate 1. This can improve product quality.

[0043] In addition, because the hanging member 2.1 has a triangular section, grooves can be provided to the polar plate easily and short circuits between the cathode and anode can be prevented.

Embodiment III

[0044] This embodiment is basically the same as Embodiment I and it differs from Embodiment I as follows:

An upper portion of the polar plate 1 is provided with a stopper plate that is spirally inclined downwards, such that the acid mist blocked by the stopper plate condenses and flows back to the electrochemical reaction cell, which can help prevent formation of acid mist on the cell surface.

Embodiment IV

[0045] This embodiment is basically the same as Embodiment I and it differs from Embodiment I as follows:

At least one filtering net is provided inside the first and second isolation pieces respectively to filter the acid mist carried by the gas.

Embodiment V

[0046] This embodiment provides a process for inductively suppressing acid mist from electrowinning by using the above device. The process comprises the steps of:

Step (1): providing the first and second isolation nets at the left and right sides of an anode plate respectively, and leaving gaps between the first and second isolation nets and the left and right sides of the anode plate respectively;

Step (2): fixedly connecting the first isolation net to the left side of the anode plate by the first insulating

connecting member, and fixedly connecting the second isolation net to the right side of the anode plate by the second insulating connecting member;

Step (3): providing the first and second isolation pieces at the left and right sides of the top of the anode plate respectively such that the first and second isolation pieces are respectively located above the first and second isolation nets;

Step (4): selecting the diaphragm cloth, the inner frame and the outer frame as required and embedding the selected diaphragm cloth in the outer frame via the inner frame; the warp and weft density of the diaphragm cloth is (50-600)*(50-600) which can improve the effect of isolating bubbles by the diaphragm cloth; length of the diaphragm cloth is greater than that of the inner frame by 2-5mm, or specifically by 2, 3, 4 or 5mm; width of the diaphragm cloth is greater than that of the inner frame by 2-5mm, or specifically by 2, 3, 4, 4.5 or 5mm; length of the inner frame is smaller than that of the outer frame by 3-10mm, or specifically by 3, 3.5, 4.2, 5, 5.3, 6.4, 7, 8.5 or 10mm; and width of the inner frame is smaller than that of the outer frame by 3-10mm, or specifically by 3, 3.7, 4.6, 5.6, 6.6, 7.8, 9 or 10mm; these configuration can all facilitate installation of the diaphragm cloth, the inner frame and the outer frame;

Step (5): inserting the anode plate, together with the first and second isolation nets and the first and second isolation pieces, in the inner frame, and connecting the first and second isolation pieces to the diaphragm cloth to form the above device for inductively suppressing acid mist from electrowinning;

Step (6): arranging the devices obtained in Step (5) and cathode plates in an electrowinning cell with equal spacing with the spacing between the adjacent acid mist suppressing devices being 50-150mm;

Step (7): after arranging the acid mist suppressing devices and the cathode plates in the electrowinning cell, bubbles are generated from the anode plate and flow in a bottom-to-top direction between the first and second isolation nets; when the bubbles reach a liquid surface of an electrowinning liquid, acid mist in the bubbles are blocked by the first and second isolation pieces while gas in the bubbles overflow through the first and second isolation pieces.

[0047] The flow rate of the electrowinning liquid in the above electrowinning cell is 10-1,000L/min, or specifically 10, 30, 100, 200, 370, 480, 520, 600, 735, 846 or 1,000 L/min. Temperature of the electrowinning liquid is between 20 and 75°C, or specifically 20, 28, 37, 44, 50, 63, 70 or 75°C.

[0048] In this embodiment, the electrowinning liquid in-

cludes the compositions of an electrowinning copper solution which contains H_2SO_4 with a concentration of 100-180g/L and Cu^{2+} with a concentration of 30-50g/L.

5 Embodiment VI

[0049] This embodiment is basically the same as Embodiment V and it differs from Embodiment V as follows:

10 In this embodiment, the electrowinning liquid is an electrowinning zinc solution, which contains H_2SO_4 with a concentration of 100-200g/L and Zn^{2+} with a concentration of 30-50g/L.

15 Embodiment VII

[0050] This embodiment is basically the same as Embodiment V and it differs from Embodiment V as follows:

20 In this embodiment, the electrowinning liquid is an electrowinning nickel solution, which contains H_2SO_4 with a concentration of 10-60g/L and Ni^{2+} with a concentration of 40-80g/L.

25 Embodiment VIII

[0051] This embodiment is basically the same as Embodiment V and it differs from Embodiment V as follows:

30 In this embodiment, the electrowinning liquid is an electrowinning manganese solution, which contains H_2SO_4 with a concentration of 10-50g/L, Mn^{2+} with a concentration of 15-30g/L, and $(NH_4)_2SO_4$ with a concentration of 120-180g/L.

35 **[0052]** It should be understood that improvements or modifications may be made by those skilled in the art based on the above descriptions and all such improvements or modifications shall fall into the protection scope of the appended claims of this invention.

Claims

45 1. A device for inductively suppressing acid mist from electrowinning comprising:

a polar plate (1),
a first isolation net (3) and a second isolation net (4) being respectively provided at two sides of the polar plate (1) with gaps being provided between the first and second isolation nets (3, 4) and the two sides of the polar plate (1) respectively;
50 a first isolation piece (5) and a second isolation piece (6) being respectively provided at two sides of a top of the polar plate (1) and being respectively located above the first and second

isolation nets (3, 4).

2. The device of claim 1, wherein it further comprises:
an acid mist frame plate group including an outer frame (7), an inner frame (8) and a diaphragm cloth (9), the diaphragm cloth (9) being embedded in the outer frame (7) via the inner frame (8); the polar plate (1), together with the first and second isolation nets (3, 4) and the first and second isolation pieces (5, 6), being inserted into the inner frame (8); and the first and second isolation pieces (5, 6) being connected to the diaphragm cloth (9) respectively. 5
3. The device of claim 1, wherein the first isolation net (3) and the polar plate (1) are connected by a first insulating connecting member (10), and the second isolation net (4) and the polar plate (1) are connected by a second insulating connecting member (11). 10
4. The device of claim 1, wherein the first and second isolation pieces (5, 6) are respectively connected to the two sides of the top of the polar plate (1) by a fixing assembly. 20
5. The device of claim 4, wherein the fixing assembly comprises a buckle (12), a first insulating loop bar (13) and a second insulating loop bar (14), the first and second insulating loop bars (13, 14) extending at two sides of the buckle (12) respectively; the first isolation piece (5) being clipped between the first insulating loop bar (13) and a side of the polar plate (1) and the second isolation piece (6) being clipped between the second insulating loop bar (14) and another side of the polar plate (1). 25 30 35
6. The device of claim 5, wherein the first insulating loop bar (13) and/or the second insulating loop bar (14) is/are sleeved by a loop bar fixing sleeve (15). 35
7. The device of claim 2, wherein both ends of a top of the outer frame (7) are connected to a conductive bar (1.1) at the top of the polar plate (1) by a hanging buckle (2). 40
8. The device of claim 7, wherein the hanging buckle (2) comprises a hanging member (2.1) with a triangular section, a first buckle plate (2.2) and a second buckle plate (2.3) at two sides of a bottom of the hanging member (2.1) respectively, inner sides of the first buckle plate (2.2) and the second buckle plate (2.3) being provided with a fastener (2.4) respectively; the fastener (2.4) cooperating with a fastener installation hole (7.1) at the top of the outer frame (7); and the conductive bar (1.1) of the polar plate (1) being inserted in a hollow chamber of the hanging member (2.1). 45 50 55
9. A process for inductively suppressing acid mist from

electrowinning by using the device according to any of claims 1-8, comprising steps of:

providing the first and second isolation nets at two sides of an anode plate respectively and leaving gaps between the first and second isolation nets and the two sides of the anode plate respectively;
connecting the first isolation net to a side of the anode plate by the first insulating connecting member and connecting the second isolation net to another side of the anode plate by the second insulating connecting member;
providing the first and second isolation pieces at two sides of the top of the anode plate respectively such that the first and second isolation pieces are respectively located above the first and second isolation nets, thereby forming the device for inductively suppressing acid mist from electrowinning;
arranging the device for inductively suppressing acid mist from electrowinning and a cathode plate in an electrowinning cell with a spacing therebetween, the spacing between adjacent the devices for inductively suppressing acid mist from electrowinning being 50-150mm; and
after arranging the device for inductively suppressing acid mist from electrowinning and the cathode plate in the electrowinning cell, bubbles being generated from the anode plate and flowing in a bottom-to-top direction between the first and second isolation nets; when the bubbles reach a liquid surface of an electrowinning liquid, acid mist in the bubbles being blocked by the first and second isolation pieces while gas in the bubbles overflowing through the first and second isolation pieces.

10. The process of claim 9, wherein after providing the first and second isolation pieces at two sides of the top of the anode plate respectively such that the first and second isolation pieces are respectively located above the first and second isolation nets, the process further comprises steps of:

selecting the diaphragm cloth, the inner frame and the outer frame as required, and embedding the selected diaphragm cloth into the outer frame via the inner frame;
inserting the anode plate, together with the first and second isolation nets and the first and second isolation pieces, into the inner frame, and connecting the first and second isolation pieces to the diaphragm cloth; and
the gap between the first isolation net and a side of the anode plate is 2-50mm, and the gap between the second isolation net and another side of the anode plate is 2-50mm.

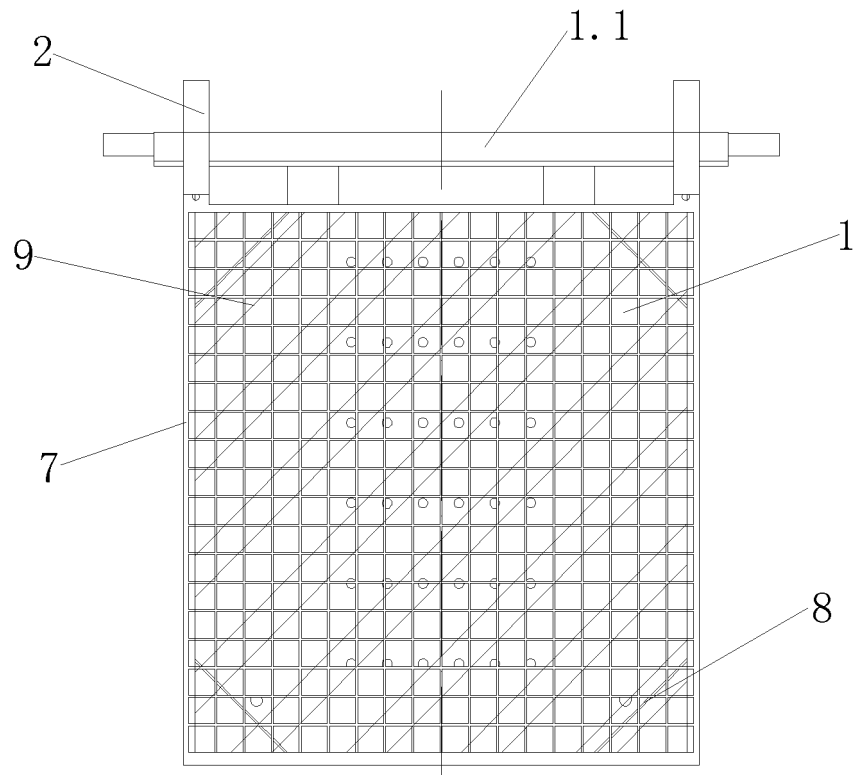


Figure 1

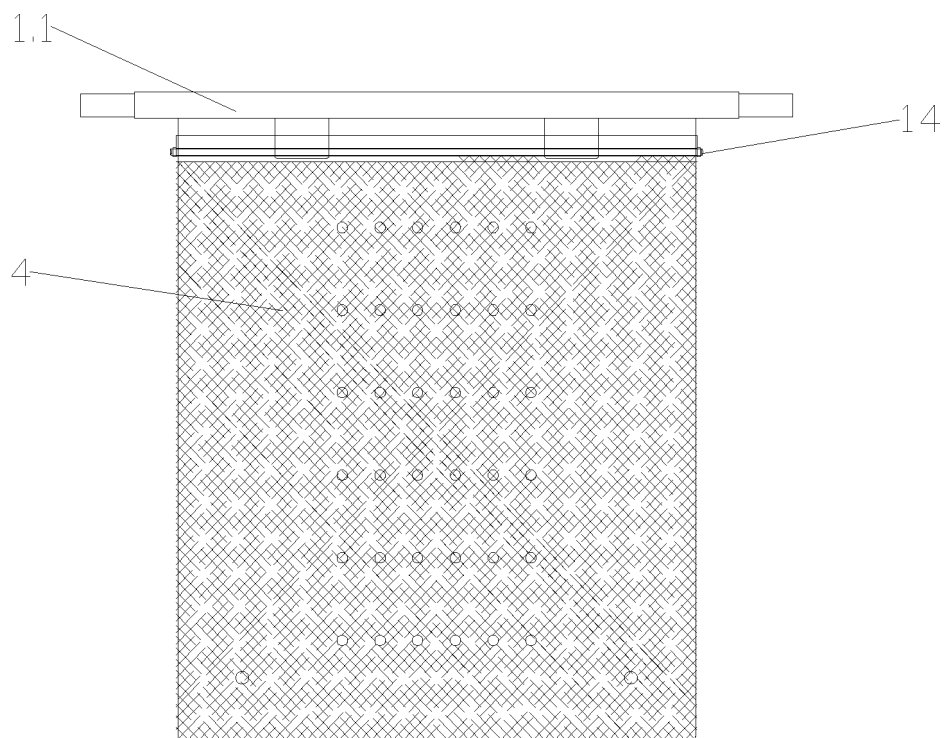


Figure 2

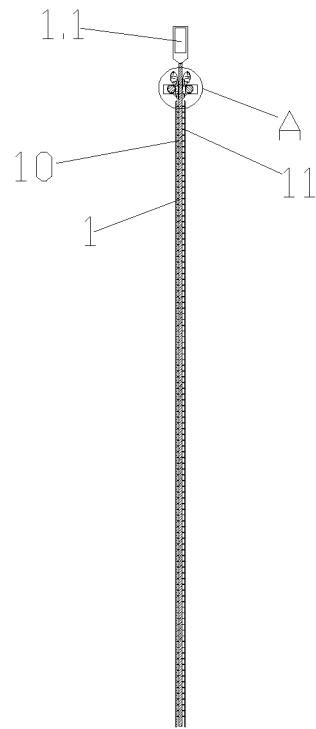


Figure 3

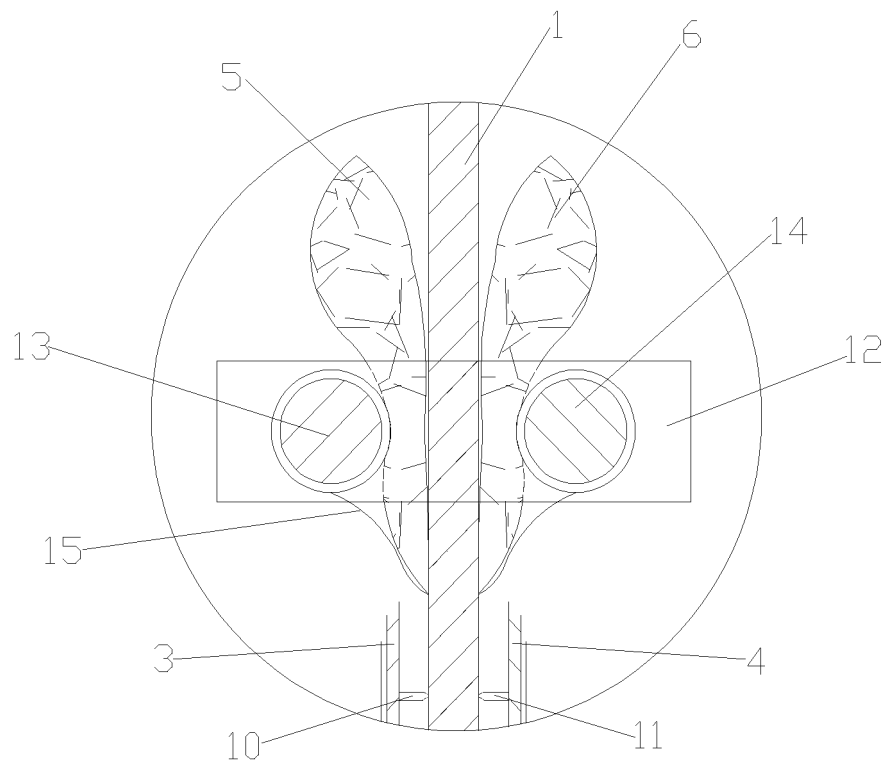


Figure 4

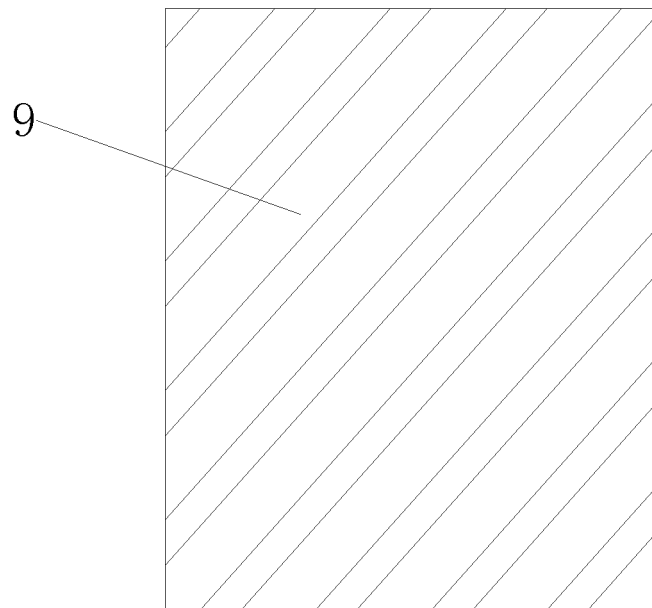


Figure 5

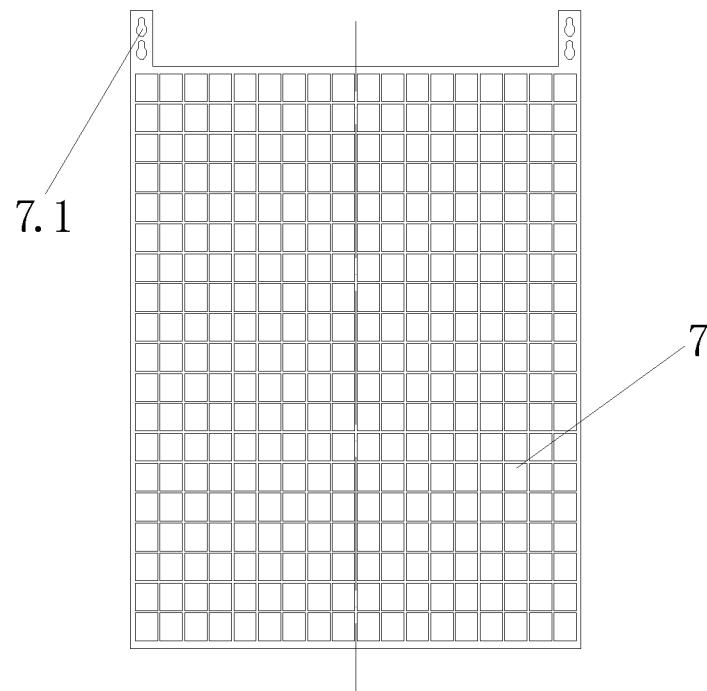


Figure 6

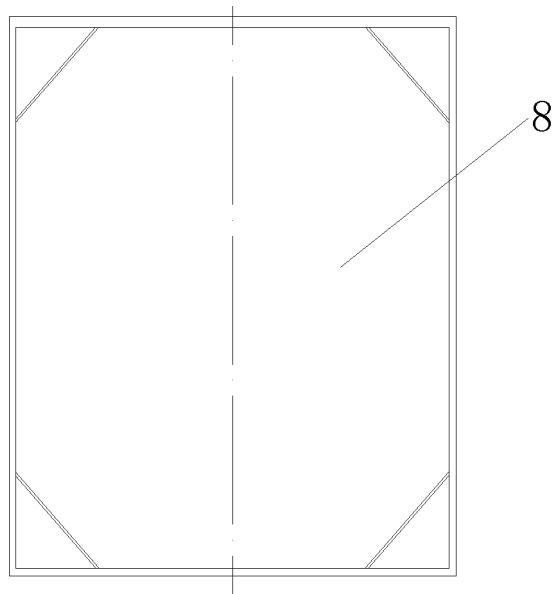


Figure 7

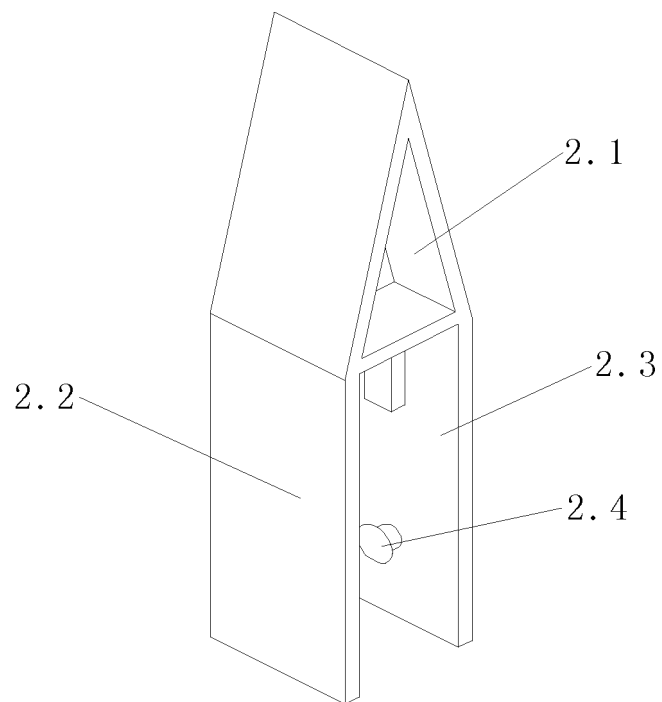


Figure 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/089547

A. CLASSIFICATION OF SUBJECT MATTER

C25D 17/00 (2006.01) i; C25D 17/10 (2006.01) i; C25D 7/00 (2006.01) i; C25D 7/02 (2006.01) i
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C25D 17/-, C25D 7/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI, CNABS, EPODOC, WPI: acid fog, restrain, interval, acid, fog, mist, electrodeposit+, deposit+, electrode?, anode?, cathode?, mesh+, net+, isolat+, seperat+, insulat+, bubble, break+, burst+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 104674308 A (HANGZHOU SANNAI ENVIRONMENTAL TECHNOLOGY CO., LTD.), 03 June 2015 (03.06.2015), see description, paragraphs [0009]-[0025] and [0042], and figures 1-8	1-10
A	CN 103820839 A (HANGZHOU SANNAI ENVIRONMENTAL TECHNOLOGY CO., LTD.), 28 May 2014 (28.05.2014), see description, paragraphs [0022]-[0030], and figures 1-2	1-10
A	CN 203938745 U (HANGZHOU SANNAI ENVIRONMENTAL TECHNOLOGY CO., LTD.), 12 November 2014 (12.11.2014), see description, paragraphs [0022]-[0030], and figures 1-2	1-10
A	CN 101220490 A (ZIJIN MINING GROUP CO., LTD.), 16 July 2008 (16.07.2008), see the whole document	1-10
A	US 2006021880 A1 (SANDOVAL, S.P. et al.), 02 February 2006 (02.02.2006), see the whole document	1-10

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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“A” document defining the general state of the art which is not considered to be of particular relevance

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“O” document referring to an oral disclosure, use, exhibition or other means

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“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search
03 November 2015 (03.11.2015)

Date of mailing of the international search report
02 December 2015 (02.12.2015)

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Facsimile No.: (86-10) 62019451

Authorized officer

CAO, DongfangTelephone No.: (86-10) **62084555**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2015/089547

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 104674308 A	03 June 2015	None	
CN 103820839 A	28 May 2014	None	
CN 203938745 U	12 November 2014	None	
CN 101220490 A	16 July 2008	None	
US 2006021880 A1	02 February 2006	US 2008047839 A1	28 February 2008

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 200710009588 [0004]