

(51) Int. Cl. ⁷	Identification code	FI	Theme codes (reference)
C25D 21/06 17/00		C25D 21/06 17/00	4D051 C K Z
// C02F 1/40		C02F 1/40	B

Request for examination Requested Number of claims 4 OL (Total of 28 pages)

(21) Application number Japanese Patent Application H11-369087

(71) Applicant 500017069

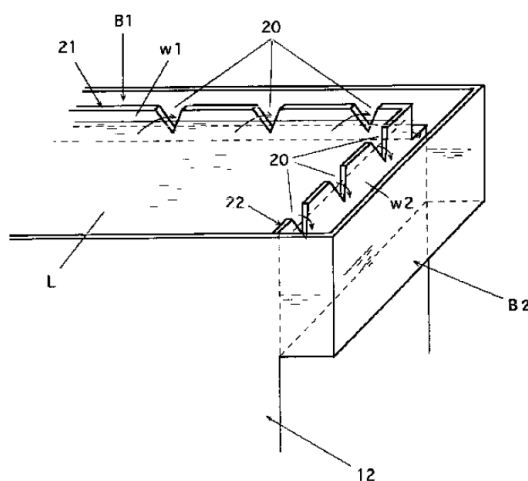
Akira Kawaguchi
1-15-5 Yamasaka, Higashi-Sumiyoshi-ku,
Osaka-shi

(22) Application date December 27, 1999 (12/27/1999)

(72) Inventor Osamu Osada
2-9-18 Hikarigaoka, Ikoma-shi, Nara-ken(72) Inventor Akira Kawaguchi
1-15-5 Yamasaka, Higashi-Sumiyoshi-ku,
Osaka-shi(72) Inventor Kenji Kawaguchi
1-15-5 Yamasaka, Higashi-Sumiyoshi-ku,
Osaka-shi(74) Representative 100074125
Patent Attorney Masao Tanikawa
F terms (reference) 4D051 AA06 AB01 CA15 CA23 DB03
DB11 DD25**(54) (TITLE OF THE INVENTION) Liquid tank and weir member****(57) (ABSTRACT)**

(PROBLEM) To provide: a liquid tank that is a liquid tank having one, two, or more overflow boxes in order to force the overflow of impurities that may be suspended in a top layer part of liquid accumulated in the liquid tank along with liquid from a weir part, wherein it is possible to perform stable liquid filtration without causing any marked changes in the liquid amount that may flow into the overflow box over the weir part even if there is vertical variation in the position of the liquid surface in the liquid tank and, furthermore, it is possible to perform efficient liquid filtration by forcing the inflow of not only the floating impurities that can easily float on the liquid surface in the liquid, but also of impurities that may easily float in lower layers, into the overflow box for recovery; and a weir member for the liquid tank.

(MEANS FOR SOLVING) Each liquid tank 11 to 15 has overflow boxes B1 and B2 in order to force the overflow of impurities that may be suspended in the top layer part in the liquid accumulated in each liquid tank along with the liquid from weir parts 21 and 22, and, in the weir parts 21 and 22, overflow notches 20 are formed in top margin part of partition walls w1 and w2 between the overflow box and the liquid tank, or detachable weir members 8 and 8' are provided in which overflow notches 80 are formed.



(SCOPE OF PATENT CLAIMS)

(CLAIM 1) A liquid tank, characterized by having one, two, or more overflow boxes in order to force the overflow of impurities that may be suspended in the top layer part in liquid accumulated in the liquid tank along with liquid from a weir part, in which weir part, an overflow notch is formed in a top margin part of a partition wall between the overflow box and the liquid tank or a detachable weir member is provided in which an overflow notch is formed.

(CLAIM 2) The liquid tank set forth in Claim 1 wherein there are a plurality of notches provided in the weir part, each notch being a notch with an inverted triangular shape or rectangular shape.

(CLAIM 3) A weir member characterized by being a weir member to provide a weir part of a liquid tank that has one, two, or more overflow boxes in order to force the overflow of impurities that may be suspended in a top layer part of liquid accumulated in the liquid tank along with liquid from the weir part, an overflow notch being formed in the weir member, and the weir member being capable of being attached to or detached from an upper margin part of a partition wall between the overflow box and the liquid tank.

(CLAIM 4) The weir member set forth in Claim 3 wherein there are a plurality of said notches, each notch being a notch with an inverted triangular shape or rectangular shape.

(DETAILED DESCRIPTION OF THE INVENTION)

(0001)

(TECHNICAL FIELD OF THE INVENTION) The present invention relates to a liquid tank that can be utilized in an article processing device to perform processing using a liquid, and in particular, to an article processing device that involves a liquid for which filtration of the processing liquid is desired, such as a plating device, a photographic developing device, or a dyeing processing device, or to a liquid processing device to perform filtration processing of a liquid such as water without article processing, and also to a weir member that can be installed in this type of liquid tank.

(0002)

(PRIOR ART) The processing of an article using a processing liquid may be performed in a wide variety of fields, such as the well-known plating of articles using a plating liquid, photographic developing using a developing liquid, dyeing processing of fabric or the like using a stain, cleaning treatment for articles, and the like. Also, this type of article processing using a processing liquid may be performed using a variety of methods, such as spraying a liquid onto the article or placing the article in contact with a downward flowing liquid. However, as an exemplary method that may be used, a method can be described in which the processing liquid is housed in a liquid tank, and processing is performed by immersing the article to be processed in the processing liquid present in said liquid tank while controlling parameters such as the liquid quality and liquid composition of said liquid, the volume of processing liquid in the liquid tank, filtration volume, temperature, and the like, as necessary. The aforementioned plating, photographic development, and dyeing processing or the like may normally be performed using this method.

(0003) This type of immersion treatment may be performed using only a single liquid tank, but in many cases, multiple liquid tanks are employed in order to process large quantities or multiple types of products. In any case, in the case of an article processing device that uses a liquid and that utilizes an article processing liquid tank, as the number of uses of the processing liquid in said liquid tank increases, there will be an increase in the impurities carried over from the article to be processed,

the impurities that may be generated by changes in the processing liquid such as through the degradation of the processing liquid, or impurities that may fall into the liquid in the liquid tank from the outside. Therefore, it is common to use this processing liquid while filtering it through a filtration device that includes a pump and filter. A representative example is the case in which circulating filtration is performed using a circulating filtration device to filter the processing liquid that includes a liquid circulating pump and filter.

(0004) Also, processing to remove impurities in a liquid without article processing is also performed. A representative example of this is water filtration treatment. In any case, the impurities present in the liquid in the liquid tank may move in the liquid, following a complicated flow path, but these impurities tend to be sorted based on the size of the specific gravity, separating sequentially into impurities that are suspended in the topmost layer of the liquid, impurities that float in the middle layer, impurities with larger specific gravity that float in the lower layer the liquid, and further, impurities that sink to the bottom or near the bottom of the liquid tank. In addition, there are many cases in which aeration may be performed in order to blow air into the liquid from the bottom of the liquid tank, and in this case, the impurities with an intermediate specific gravity may disperse and float as though to draw an oval pattern between the top and bottom of the liquid tank due to the effects of the upwelling current of said air in the liquid.

(0005) Therefore, during filtering of the liquid, while the liquid in the liquid tank is being suctioned from the bottom of the liquid tank using the pump, an overflow box is installed in the top part of the liquid tank via a weir part for use in liquid overflow, and floating material is forced to flow into this box along with the liquid, after which the pump is used to suction the liquid from said box and the suctioned liquid is filtered through the filter. In an article processing device that uses a liquid or the like, the liquid after filtration may normally be returned to the normal liquid tank for reuse.

(0006)

(PROBLEM TO BE SOLVED BY THE INVENTION) However, the conventional method involves the use of a weir part of which the top margin extends linearly in the horizontal direction (a so-called rectangular weir) as the weir part in said overflow box, leading to the following problems. Specifically, when using the rectangular weir that has been widely used conventionally, if the height of the liquid surface of the processing liquid in the liquid tank rises just a bit too much over the top margin of said weir part, the liquid volume that crosses over this weir part will markedly increase, and if the length of the weir part is lengthened, the liquid volume to be overflowed will markedly increase even more.

(0007) In order to perform the appropriate filtration of the processing liquid in a liquid tank, it is fundamental to establish the amount of liquid to be suctioned from the bottom of the liquid tank and the amount of liquid to be suctioned from the overflow box in advance according to the capacity of the filter and pump. However, if the amount of liquid flowing from the processing liquid tank over the weir part into the overflow box becomes excessive, the proportion of liquid that is suctioned by the pump from said box will decrease relatively, and over time, the liquid level in the liquid layer and the liquid level in the box will reach the same height, resulting in inflow of the processing liquid into said box without any elevation difference.

(0008) In this way, in the state in which there is no liquid inflow into the overflow box based on an elevation difference, the flow rate of the liquid flow from the liquid tank to the overflow box over the weir part

will be dramatically reduced, and the inflow of impurities in the liquid into the overflow box will also be reduced. In other words, with the conventional rectangular weir, the floating impurities that are suspended in the top layer of the processing liquid in the liquid tank will flow into the overflow box, being carried along with the flow rate of the liquid, as there is inflow of the liquid into said box based on the elevation difference between the liquid surface levels in the liquid tank and said box, but in the state in which this elevation difference is absent, there will be a marked decrease in the inflow amount of the processing liquid into said box, and there will also be a marked decrease of the amount of inflow of impurities. Therefore, the impurity concentration in the processing liquid in the liquid tank will increase over time, leading to the occurrence of defective products.

(0009) In addition, the amount of processing liquid in the liquid tank to be used in article processing will gradually decrease due to evaporation as a result of the working temperature for the processing liquid in the liquid tank and the extraction of the processing liquid associated with the transfer of the processed goods to the next process. If the liquid level decreases, the amount of liquid flowing beyond the rectangular weir into the overflow box will decrease. In this way, the ratio of liquid that is suctioned from said box by the pump for the circulating filtration will increase relative to the amount of liquid flowing into said box, and the amount of liquid stored in said box will gradually decrease over time such that, if left as-is, said box will become increasingly dry. In the end, said pump will suction air and it will be necessary to stop the operation of the pump, thereby stopping the operation of the entire circulating filtration process.

(0010) In addition, in the conventional so-called rectangular weir in which the upper margin extends linearly in the horizontal direction, the floating impurities suspended on the liquid surface will primarily flow into the overflow box over the weir part, but it will be difficult for the impurities suspended in lower layers to cross over the weir part. In other words, most of the impurities that cross over the weir part had been floating on the liquid surface in the liquid tank, and over time, the concentration of impurities remaining in the liquid tank will increase, leading to problems in which it is difficult to adequately perform filtration of these impurities.

(0011) Therefore, a problem addressed by the present invention is to provide a liquid tank having one, two, or more overflow boxes to force the overflow of impurities suspended in the upper layer of the liquid accumulated in the liquid tank together with the liquid from the weir part, resulting in the following advantages.

(1) Even if the liquid level position in the liquid tank changes vertically, there will be no significant change in the amount of liquid flowing over the weir part into the overflow box.

(2) In addition to the floating impurities that are easily suspended on the liquid surface in the liquid tank, impurities that are more likely to be suspended in the lower layers can be efficiently recovered following flow into the overflow box.

(3) Therefore, it will also be possible to reduce the amount of impurities remaining in the liquid tank.

(4) As a result, when filtration of said liquid is performed by suctioning the liquid from both the bottom of the liquid tank and the overflow box using the pump, it will be possible to effectively perform this filtration processing.

(5) Therefore, when performing article processing using the processing liquid in the liquid tank, it will be possible to reduce the effects of impurities and to improve the quality of the article after processing.

(6) It will be easier to set the volume of liquid flowing into the overflow box.

(0012) Furthermore, another problem addressed by the present invention is to provide a weir member to provide the weir part of a liquid tank having one, two, or more overflow boxes to force the overflow of impurities suspended in the upper layer of the liquid accumulated in the liquid tank together with the liquid from the weir part, resulting in the following advantages.

(1) When used as the weir part following attachment to the liquid tank, even if the liquid level position in the liquid tank changes vertically, there will be no significant change in the amount of liquid flowing into the overflow box.

(2) In addition to the floating impurities that are easily suspended on the liquid surface in the liquid tank, impurities that are more likely to be suspended in the lower layers can be efficiently recovered following flow into the overflow box.

(3) Therefore, it will also be possible to reduce the amount of impurities remaining in the liquid tank.

(4) As a result, when filtration of said liquid is performed by suctioning the liquid from both the bottom of the liquid tank and the overflow box using the pump, it will be possible to effectively perform this filtration processing.

(5) Therefore, when performing article processing using the processing liquid in the liquid tank, it will be possible to reduce the effects of impurities and to improve the quality of the article after processing.

(6) It will be easier to make changes to the volume of liquid flowing into the overflow box.

(0013)

(MEANS FOR SOLVING THE PROBLEM) In order to solve the above-noted problems, the present invention provides a liquid tank, characterized by having one, two, or more overflow boxes in order to force the overflow of impurities that may be suspended in the top layer part in liquid accumulated in the liquid tank along with liquid from a weir part, in which weir part, an overflow notch is formed in a top margin part of a partition wall between the overflow box and the liquid tank or a detachable weir member is provided in which an overflow notch is formed.

(0014) With the liquid tank according to the present invention, when the liquid is filtered in said liquid tank, the liquid in the liquid tank can be suctioned from the bottom of the liquid tank together with the impurities accumulated therein using a pump, while at the same time, the liquid can be pumped into the overflow box together with the floating impurities from the weir part, and these suctioned liquids can be provided for filtration. In this way, impurities can be suctioned and filtered together with the liquid.

(0015) With the liquid tank according to the present invention, the portion in which the notch for liquid overflow is formed acts as the weir part, and the liquid overflows from said notch to the overflow box. Therefore, even if the liquid surface in the liquid tank rises slightly above the desired liquid surface position for liquid overflow, as long as the rising liquid surface position is at the notch, there will be no instance such as is observed with the conventional rectangular weir, in

which the amount of overflow will increase rapidly over the entire length of the upper margin of the weir, resulting in a marked increase in the overall amount of overflow. As a result, the amount of overflow will increase by only the amount of increase of the cross-sectional area of the liquid flow due to the rise in the liquid surface at said notch. In addition, even if the liquid level in the liquid tank falls, there will be no instance such as that observed with the conventional rectangular weir in which the overflow amount decreases simultaneously over the entire length of the upper margin of the weir part, leading to a marked decrease in the overall overflow amount, and the overflow amount will decrease by only the amount of the decrease in the cross-sectional area of the liquid flow due to the drop in the liquid surface at said notch. Therefore, even if there is vertical variability in the liquid surface in the liquid tank, the amount of overflow will increase or decrease very slowly when compared to the conventional rectangular weir. In other words, even if there are vertical fluctuations in the liquid level in the liquid tank, the fluctuations in the overflow amount can be suppressed to a very small extent when compared to the conventional rectangular weir.

(0016) In order to ensure the appropriate filtration of this liquid, it will be possible to achieve the appropriate filtration of the liquid by maintaining the amount of liquid suction from the bottom part of the liquid tank (such as approximately 70% of the circulation liquid volume in the case of circulating filtration) and the amount of liquid suction from the overflow box (such as approximately 30% of the circulation liquid volume in the case of circulating filtration) as may be configured according to the liquid volume during filtration, such as during circulating filtration, based on the capacity of the filtration pump. In addition, the liquid tank according to the present invention utilizes a weir part in which is formed the notch for use in liquid overflow, and the liquid will overflow into the overflow box from said notch. Because said notch extends in the depth direction of the liquid before the liquid crosses over the weir part, it will be easy to ensure the inflow of not only the floating impurities that may easily float on the liquid surface in the liquid tank, but also of the impurities that are susceptible to suspension in the lower layers, into the overflow box from said notch, making it possible to recover and filter out even the impurities that are suspended in the lower layers below the liquid surface.

(0017) Further, this has the advantage that it will be possible to easily configure the overflow volume by selecting the shape or number of notches. The number of weir parts and the number of overflow boxes that may be combined with these may be established according to the liquid volume in the liquid tank, the shape of the liquid tank, and the like, and it is possible to select one, two, or more boxes, placing these at the appropriate position.

(0018) The overflow box may be located on the upper peripheral side of the wall surrounding the liquid tank or on the inner peripheral side. The box may also be provided on both the outer and inner periphery sides. The number of notches for use in liquid overflow in a single weir part may be established as needed. It is preferable to provide multiple notches over a broad range, and it is even more preferable to provide these notches at uniform spacing to ensure that it is possible to force the flow of all of the floating impurities that are easily suspended on the liquid surface and impurities that are more likely to be suspended in the lower layers into the overflow box over the entirety of the liquid in the liquid tank.

(0019) A variety of shapes may be used for the shape of the notch, such as an inverted triangle shape (in other words, a V-shape), a U-

shape, or a rectangular shape. Among these shapes, it is possible to use a rectangular notch with a narrow opening or an inverted triangular notch that is formed such that the opening gradually narrows from the top of the notch towards the bottom as shapes that facilitate the configuration of the desired overflow volume and that are easy to produce, and it is even more preferable to provide a plurality of these notches.

(0020) If an inverted triangular notch is adopted, an example of this type of notch may have a lower vertical angle of the inverted triangular shape of 40° to 90°, although there are no particular restrictions on the angle. It is even more preferable to use an angle of approximately 50° to 60°. In any case, said weir part may form the overflow notch at the upper margin part of the partition wall between the overflow box and the liquid tank, or a weir member in which the overflow notch is formed may be detachably provided.

(0021) When detachably providing a weir member forming the overflow notch at the upper margin of the partition wall between the overflow box and liquid tank as the weir part, it will be possible to easily configure the overflow volume by selecting the appropriate weir member for use from among weir members for which various types of overflow volumes have been established. Also, for instance, by changing the attachment height of the weir member or replacing the weir member using an easy method such as inserting a liner of the appropriate thickness between the weir member and the upper margin of the partition wall, it will also be possible to easily change the overflow volume.

(0022) Therefore, the present invention also provides a weir member characterized in that it is a weir member to provide the weir part of a liquid tank that has one, two, or more overflow boxes in order to force the overflow of impurities that may be suspended in the top layer part in the liquid accumulated in the liquid tank along with the liquid from said weir part, an overflow notch being provided in the weir part, and the weir part being capable of being attached to or detached from the upper margin part of the partition wall between the overflow box and liquid tank.

(0023) The same as was said of the weir part in the discussion related to said liquid tank can also be said regarding the number, shape, and the like of the notches of this weir member. In order to collect the impurities that tend to accumulate in the bottom of the liquid tank and facilitate the smooth suctioning of these impurities, an internal bottom groove that has been formed as one, two, or more inserts along the periphery at the bottom inside the liquid tank may also be provided in said liquid tank. Also, if this type of internal bottom groove is provided, the liquid present in the liquid tank from the start or cleaning liquid will flow into this groove during the cleaning of the liquid tank, ensuring smooth cleaning. The number of such internal bottom grooves may be set to be one, two, or more depending on the liquid volume in the liquid tank, the shape of the liquid tank, and the like. This type of internal bottom groove may be provided along an appropriate site, for example, at the periphery at the bottom inside the tank.

(0024) In order to enable suctioning of the impurities accumulated in said internal bottom groove from the entirety of the internal bottom groove to the extent that is possible, a first suction head having a plurality of liquid suction holes that extends along the longitudinal direction of said groove may be installed. In addition, by installing the first suction head in the internal bottom groove in this way, even when installing an aeration device at the bottom of the liquid tank, it will be possible to inhibit any intake of air that may be emitted from said of air, which is the worst-case scenario for filters, thereby making it possible to ensure the smooth suctioning and filtration of impurities.

(0025) The liquid tank may further be equipped with one, two, or more suction heads (the third suction head to be described below) for suctioning impurities that tend to accumulate in the bottom of the liquid tank in a portion other than said internal bottom groove in the periphery of the bottom inside the tank. If said first suction head and the third suction head are connected to a centrifugal pump to suction the liquid for liquid filtration, it is preferable for the aperture of each liquid suction hole in these suction heads to be the same as or smaller than the height of the impeller blades in said centrifugal pump. By setting the aperture of each liquid suction hole in this manner, it will be possible to inhibit damage to said pump, such as when there is a decrease in the volume of liquid for suction following the intake into the centrifugal pump of part of the article to be processed that may have fallen into the liquid tank or contaminants that may have been carried over into the liquid from the outside, leading to entrainment against the impeller blades or the like.

(0026) The processing liquid that flows along with impurities into the overflow box will be suctioned by the pump from the outflow port (liquid flow port) for the processing liquid that was provided in the bottom part inside said box to be transported to the filter. However, the inorganic and organic impurities in the processing liquid that flow into said box over the weir part that range in size from large to small particle diameters, and further, the bits of the article being processed that have dropped into said box from the outside may clog the outflow port at the bottom of said box, leading to repeated marked obstruction of liquid suction by the pump from inside the overflow box, presenting a significant obstacle to the filtration processing.

(0027) Therefore, a further suction head (second suction head) with a plurality of liquid suction holes may also be provided at the inner bottom part of the overflow box. This second suction head allows the liquid in the box to be sucked up once, making it possible to avoid the need to form the liquid outflow port (liquid flow port) at the bottom of the conventional box and to avoid the associated clogging of this port. If said second suction head is connected to a centrifugal pump to suction the liquid for liquid filtration, the aperture of each suction hole of said second suction head may also be the same as or smaller than the height of the impeller blades of said pump.

(0028) An aeration device can be installed on the inner bottom of said liquid tank in order to agitate the liquid, making it possible to achieve the homogenization of each part of the liquid as a result. In addition, when performing article processing using the liquid in the liquid tank, it will also be possible to inhibit the adhesion of impurities floating in the liquid onto the article to be processed using the air that is emitted from the aeration device. If an aeration device is installed, it is preferable to provide an air shut-off wall between said aeration device and said first suction head installed in said internal bottom groove, thereby preventing the first suction head from drawing in the air that was emitted from the aeration device. When the third suction head is installed, it is also desirable to place an air barrier wall adjacent to the third suction head to inhibit air suction into the suction head between the third suction head and the aeration device.

(0029) For said first suction head, it is preferable for said liquid suction holes to be formed so as to be scattered within the range of the desired angle towards the side opposite to said air shut-off wall from the bottom edge of the suction head around the central axis of the suction head in the longitudinal direction of the suction head (such as within a

range of approximately 90°) and within the range of the desired angle towards the side of said air shut-off wall from the bottom edge of the suction head (such as within a range of approximately 45°), and for said liquid suction holes to be formed to be scattered such that it will be possible to suction equivalent volumes of liquid at each part over the longitudinal direction of said first suction head. As a result, it will be difficult to draw in air, making it possible to perform smooth suction of the impurities that can easily settle at the bottom of the internal bottom groove uniformly from the entire portion of the internal bottom groove to the extent that is possible.

(0030) Even when providing said third suction head and said air shut-off wall with this, it is preferable to ensure that the liquid suction holes of said head have the same mutual arrangement relationship with the corresponding air shut-off wall as the liquid suction holes of said first suction head. Furthermore, it is preferable for the liquid suction holes to be formed to be scattered such that it will be possible to perform liquid suction of equivalent volumes at each part over the longitudinal direction of the third suction head.

(0031) Also, in said second suction head as well, it is preferable to form said liquid suction holes in said second suction head such that they are scattered towards the bottom surface of said box to enable the suction of equivalent volumes of liquid at each part over the longitudinal direction of said second suction head, extending along the longitudinal direction at the internal bottom part of said overflow box such that it will be possible to smoothly suction all of the impurities uniformly from said overflow box.

(0032) In the case in which the primary suction head to perform liquid suction from the bottom part of the liquid tank is said first suction head (and therefore, when this head is larger than the third head), when that first suction head is installed without providing an internal bottom groove in the internal bottom part of the liquid tank, or when installing said air shut-off wall facing said first suction head, if that liquid tank is a processing liquid tank (such as a plating liquid processing tank), it is often necessary to increase the liquid level of the processing liquid in the liquid tank by an amount that is equivalent to the height of the air shut-off wall or said first suction head. This is because there is a risk that a hook member that is immersed in the processing liquid, the article to be plated that is suspended on said hook member, or the like will catch on the upper edge of said first suction head and air shut-off wall plate, causing the article to be plated or the hook member to fall into the processing liquid. If there is this type of fallen object, the work to remove the object sometimes necessitates the interruption of the production of the article to be plated, including the repair of the plating device, and this work may require significant expenditures. Therefore, the height (depth) of the liquid tank must be increased to compensate for the height (depth) of the first suction head or air shut-off wall.

(0033) At this time, the increase in the liquid volume due to the increase in the height of the liquid tank may be significant, corresponding to the height of said suction head or air shut-off wall in relation to the liquid tank area. Further, the cost of the liquid tank production for the increased liquid volume, the liquid cost for the increased liquid volume, the cost for improving the performance of the filter and circulating pump, and the management costs associated with these will lead to a significant increase in the production cost to manufacture the article to be processed.

(0034) Thus, it can be said that it is preferable to provide an internal bottom groove in the bottom of the liquid tank as described above, and to provide the first suction head or air shut-off wall for this, in order to avoid this type of significant increase in the volume of the processing liquid and the like. The liquid tank according to the present invention may be applied to an article processing liquid tank in an article processing device that uses various types of liquids, such as a plating device that uses a plating liquid for articles, a dyeing device that uses a stain liquid, a developing device that uses a photographic developing liquid, or an article processing liquid tank in an article cleaning device, and it can also be applied to the liquid tank of a liquid processing device to perform filtration processing of a liquid such as water without article processing.

(0035)

(EMBODIMENTS OF THE INVENTION) Embodiments of the present invention will be described below, with reference to the drawings. Figure 1 shows a plating device that is one example of an article processing device that uses a liquid utilizing the liquid tank according to the present invention. The plating device shown in Figure 1 is provided with five article processing liquid tanks 11, 12, 13, 14, and 15. Each liquid tank is a plating liquid tank in which an article may be plated. Each liquid tank may contain a different amount of plating liquid, and for instance, a different amount of plating liquid may be housed in each of the liquid tanks containing the same liquid, but in this example, each liquid tank has a volume housing the same amount of plating liquid.

(0036) These five liquid tanks may be divided into three groups. Specifically, there is a first group that includes the single liquid tank 11, there is a second group that includes the two liquid tanks 12 and 13, and there is a third group that includes the liquid tanks 14 and 15. Each liquid tank contains the specified plating liquid L. In the figure, the left side of the liquid tank 11 has a pre-treatment water washing tank 16 that houses wash water W such that the article to be plated can be washed as needed prior to plating. A work deck D1 is installed further to the left of liquid tank 16.

(0037) In addition, a work deck D2 is installed between liquid tanks 11 and 12, a work deck D3 is installed between the liquid tanks 13 and 14, and a work deck D4 is installed outside the liquid tank 15. Each liquid tank has substantially the same structure. The structure of the liquid tanks 12 and 13 will be described with reference to Figures 1 to 4 as an example. Figure 2 is an enlarged plan view of the liquid tanks 12 and 13 and the area surrounding these, while Figure 3 is an enlarged side view of the liquid tank 12 and its peripheral area. In addition, a clearing and replacement device 51 is also shown in Figure 3, which will be described later. Figure 4 is a perspective view of one portion of the liquid tank 12.

(0038) Each liquid tank is rectangular when viewed from the front (from a plane perspective), and has a liquid overflow box B1 along one long side of said rectangular shape and a liquid overflow box B2 along one short side of said rectangular shape. The box B1 is formed to be shallower than the box B2, while the box B2 is formed to be deeper than the box B1. The box B1 is connected to the top of the box B2 in

order to allow liquid overflowing here to flow into the box B2, and the bottom of the box B1 is inclined downward toward the box B2. The bottom of the box B1 does not necessarily have to be inclined in this manner.

(0039) The box B1 is installed via a weir part 21 that is provided along the long side of the liquid tank, and the box B2 is installed via a weir part 22 that is provided along the short side of the liquid tank. Each of the weir parts 21 and 22 will be described in detail later. As shown in Figures 2, 3, and 6 (C), an internal bottom groove 102 is integrally made in one of the peripheral edges of an inner bottom 101 of the liquid tank. An internal bottom groove 102 extends over the length of one side along a short side direction of the liquid tank in this example.

(0040) Anode busbars A are erected parallel to each other above each side of the longitudinal direction of the liquid tank, and cathode busbars C are erected parallel to the anode busbars above the center of the liquid tank. When plating an article, for example, one, two, or more conductive hangers H (see Figure 5 (C)) may be hung at the specified intervals on the cathode busbar C, as shown in Figure 2, Figure 3, and Figure 5, and at the same time, a conductive anode case CS (see Figure 5 (A)) that houses an anode material m' may be hung at the specified position of each anode busbar A and immersed in the plating liquid L such that the articles to be plated a1 and a2 may be suspended and supported on the hanging member S (see Figure 5 (C)), and this hanging member S may be hung on the hanger H in order to enable immersion along with the articles a1 and a2 in the plating liquid L. CSb shown in Figure 5 (B) is an anode bag consisting of a filtering cloth, and this is deposited onto anode case CS in order to prevent leakage of impurities occurring on the anode side into the plating liquid.

(0041) While there are many [plating] treatments that may be performed on the material to be treated, such as plating with copper, nickel, zinc, tin, or alloys thereof, in one example in the case of nickel plating, the plating liquid L is used as a nickel plating liquid, the anode case CS is a corrosion-resistant titanium cage, and nickel chips are housed inside this cage as the anode material m'. An aeration device 103 may be installed on the inner bottom 101 of each liquid tank. This device is constructed by linking a series of perforated pipes for air jetting, and it may be connected to a compressed air supply device that is not shown in the figure, enabling air bubbles 103a to be blown into each part of the processing liquid L in order to perform the so-called aeration. The processing liquid L will be agitated by this aeration, and in addition to homogenizing the liquid in each part in terms of the liquid composition or the like, the liquid temperature will also be homogenized. In addition, the impurities in the liquid may be forced to move to a suitable extent such that they can be smoothly suctioned from each part of the processing liquid during the circulating filtration operation that will be described later. Furthermore, aeration also works to inhibit the attachment of impurities in the liquid to articles a1 and a2.

(0042) The internal bottom groove 102 of each liquid tank is positioned such that a first suction head 104 shown in Figure 6 will extend in the longitudinal direction of the internal bottom groove 102. The suction head 104 has a pipe connection port 104a at one end, while the

other end is a closed cylinder, and there are a plurality of the liquid suction holes 104b. An air shut-off wall plate 105 is installed between the first suction head 104 and the aeration device 103. An air shut-off wall plate 105 is slightly upraised from the bottom of internal bottom groove 102 by a support piece 105a to enable liquid to flow under the wall plate 105. A support plate 105b is further provided on the support piece 105a and the air shut-off wall plate 105, supporting the first suction head 104.

(0043) The first suction head 104 is also slightly upraised from the bottom of the internal bottom groove 102 by the support piece 105a, ensuring that liquid can also be distributed under the suction head 104. Liquid suction holes 104b of the first suction head 104 are formed to be scattered within an angle range of $\theta 1$ that is no more than 90° to the side that is opposite the air shut-off wall plate 105 from the bottom edge of the suction head around the central axis line in the longitudinal direction of the suction head, and also within the range of θ ($\theta 1 + \theta 2$) = 135° as the central angle within an angle range of $\theta 2$ that is no more than 45° to the side of air shut-off wall plate 105 from the bottom edge of said head. Said angle θ is a range of angles for directing the liquid suction holes to enable the smooth suctioning of precipitated impurities accumulated in internal bottom groove 102 and to make it difficult to suction air from the aeration device 103. In this example, the angle is approximately 135° .

(0044) In addition, the liquid suction holes 104b of the first suction head 104 are formed to be scattered such that an equal amount of liquid can be suctioned in each part in the longitudinal direction of said suction head. In order to enable an equal amount of liquid suction at each part of the suction head, the number of liquid suction holes and/or the diameter of the liquid suction holes may be adjusted in order to make the total cross-sectional area of the liquid suction holes at the site close to the pipe connection port of the suction head smaller than the total cross-sectional area of the liquid suction holes at sites that are farther away. Here, the diameter of each liquid suction hole is the same, and when looking at the sites close to the pipe connection port 104a and at sites farther away, the liquid suction holes 104b are formed to be more loosely scattered at close sites and more densely scattered at distant sites.

(0045) As a result of using this first suction head 104, it will be difficult to draw in air, making it possible to perform smooth suction of the impurities that can easily settle at the bottom of the internal bottom groove 102 uniformly from the entire portion of the internal bottom groove to the extent that is possible. In addition to the first suction head 104, one, two, or more third suction heads may be installed in a part of the inner base 101 other than the internal base groove 102, such as a part of the peripheral edge of the inner bottom 101, in order to more efficiently suction impurities that tend to accumulate in the bottom of the liquid tank. Figure 3 shows an example of the installation of third suction head 108 at a peripheral edge along the longitudinal direction of the liquid tank bottom 101 using a dot-dash line.

(0046) The third suction head 108 may also be structured in the same way as the first suction head 104, and the liquid suction holes may be formed to be scattered such that an equal amount of liquid can be drawn in each part of said suction head in the longitudinal direction. An air shut-off wall plate 109 may also be installed between the third suction head 108 and the aeration device 103. Further, for each liquid

suction port of the third suction head 108, the ports may be formed to be scattered within an angle range of $\theta 1$ that is no more than 90° to the side that is opposite the air shut-off wall plate 109 from the bottom edge of the suction head around the central axis line in the longitudinal direction of the suction head, and also within the range of θ ($\theta 1 + \theta 2$) = 135° as the central angle within an angle range of $\theta 2$ that is no more than 45° to the side of air shut-off wall plate 109 from the bottom edge of said head.

(0047) The second suction head 106 as shown in Figure 6 (C) or Figure 7 (not shown in Figure 1 or Figure 4) may be installed in the internal bottom part of the overflow box B2, which is the deeper box as described above. The second suction head 106 is supported via a support piece 106c and a support plate 106d mounted thereon, and liquid can also pass below the suction head 106. The suction head 106 extends generally parallel to the short side of the liquid tank and is a cylinder with a pipe connection opening 106a at one end and that is a closed cylinder at the other end, with a plurality of liquid suction holes 106b. Liquid suction holes 106b are formed to be scattered such that an equal amount of liquid can be suctioned in each part in the longitudinal direction of the suction head 106.

(0048) For the second suction head that may be installed in the overflow box B2 as well, in order to enable an equal amount of liquid suction at each part of said suction head, the number of liquid suction holes and/or the diameter of the liquid suction holes may be adjusted in order to make the total cross-sectional area of the liquid suction holes at the site close to the pipe connection port of the suction head less than the total cross-sectional area of the liquid suction holes at sites that are farther away. Here, the diameter of each liquid suction hole 106b is the same, and when looking at the sites close to the pipe connection port 106a and at sites farther away, the liquid suction holes 106b are formed to be more loosely scattered at close sites and more densely scattered at distant sites.

(0049) Due to this second suction head 106, fluid and impurities can be suctioned as uniformly and smoothly as possible from the entire overflow box B2. Conventionally, when suctioning liquid from an overflow box, an external liquid flow port was provided at the bottom of the overflow box, the liquid suction tube was connected to said liquid flow port, and liquid suction was performed downwards in said liquid suction tube. Therefore, impurities in the liquid could easily become clogged in the liquid flow port and its connection site, causing significant obstruction of the filtration work. In this embodiment, the liquid suction tube of second suction head 106 can enable liquid suction upward from the bottom part of said box, making it possible to adequately inhibit any clogging due to impurities in head 106 or the liquid suction tube connected to it.

(0050) This point will be explained further here. Figure 16 shows a conventional example (one example of a plating liquid tank). In Figure 16 (A) and (B), 10' is a liquid tank, B1', B2', and B3' are overflow boxes attached to the liquid tank, 21', 22', and 23' are conventional rectangular weirs provided in the overflow boxes, and V' is a conventional foot valve installed at the bottom of the liquid tank.

(0051) In Figure 16 (A), the overflow box B1' is a groove-shaped box, and a processing liquid L' that has flowed in here flows into box B2'. The bottom of the overflow box B2' shown in Figure 16 (A) is provided with a liquid flow port Lb, which is connected by piping to the liquid

inlet of liquid filter F via valves v1' and v2' and a pump P. The foot valve V' in the liquid tank is connected via valves v7' and v2' and the pump P to the liquid inlet of a liquid filter F. A liquid outlet port of the filter F is connected to a heat exchanger H for liquid warming via valves v3', v4', and v5', and further to a liquid return port 100' that leads to the liquid tank 10' via a valve v6', while also being connected from between the valves v3' and v4', via a valve V8', to a liquid discharge port 511' that leads to a clearing and replacement tank 511. In addition, a foot valve 511v for liquid suctioning is installed at the bottom of the clearing and replacement tank 511, which is connected to a liquid suction port of the pump P via a valve v9'.

Valves	During normal plating	When transferring the liquid to tank 511 for clearing and replacement filtration	When returning the liquid from tank 511 to 10' for clearing and replacement filtration
Pump	Operation	Operation	Operation
v1'	Open	Open	Closed
v2'	Open	Open	Closed
v3'	Open	Open	Open
v4'	Open	Closed	Open
v5'	Open	Closed	Open
v6'	Open	Closed	Open
v7'	Open	Open	Closed
v1''	Open	Open	Closed
v7''	Open	Open	Closed
v8'	Closed	Open	Closed
v9'	Closed	Closed	Open

During the plating operation, when there is a decrease in the amount of overflow liquid to the overflow box B2' (B3') and the inside of the box starts to become dry, the valve V1' (V1'') will be closed in order to prevent air suction in the pump P.

(0054) As shown in Figure 16, conventionally, when suctioning liquid from the overflow box B2' or B3', liquid suction was performed from the liquid flow ports Lb and Lb' at the bottom of the overflow box, so impurities in the liquid could easily become clogged in said liquid flow port and its connection site, causing significant obstruction of the filtration work. However, in this example of embodiment, the liquid suction tube of the second suction head 106 can enable liquid suction upward from the bottom part of said box, making it possible to adequately inhibit any clogging due to impurities in the head 106 or the liquid suction tube connected to it.

(0055) This can be explained by returning to the start. The aperture of each liquid suction hole 104b of the first suction head 104, each liquid suction hole 106b of the second suction head 106, and each liquid suction port of the third suction head 108 may be configured to be equal to or less than the height of impeller blades in a centrifugal pump used for liquid circulation that may be connected to each suction head via a manifold or the like that will be described later.

(0056) By keeping the apertures small in this manner, it will be possible to prevent said pump from failing, such as when parts of the article to be plated that may fall into the liquid tank or contaminants or the like that may be carried into the tank from the outside are sucked into

(0052) The bottom of overflow box B3' shown in Figure 16 (B) is provided with liquid flow port Lb', which is piped to valve v2' in the same manner as that shown in Figure 16 (A) via valve v1', and via foot valve V' and valve v7' in the liquid tank. The other points are similar to the liquid circuit shown in Figure 16 (A). The circuit for the precoating of the filter auxiliary in the filter is not shown in the figure.

(0053) The opening, closing, and the like of each valve is performed as follows.

the centrifugal pump and entrained on the impeller blades. It should be noted that other forms of suction heads may be employed instead of the second suction head 106. For example, a suction head 107 shown in Figure 8 may be used.

(0057) The suction head 107, which can also be referred to as a dust removal strainer, has the form of a small box, with a pipe connection port 107a at the top and multiple scattered liquid suction holes 107b formed on the peripheral wall and the bottom wall. A foot 107c is attached to this head, enabling the head to stand at the bottom of the overflow box B2. Each suction hole 107b may also have its aperture set to be equal to or less than the height of the impeller blade in the centrifugal pump for liquid circulation.

(0058) The first suction head 104, the second suction head 106 (or 107), or even a third suction head 108 as described above may be components of a circulating filtration device to be described next. The circulating filtration device may be provided for each of the groups described above, including a first group including the single liquid tank 11, the second group including the two liquid tanks 12 and 13, and the third group including the liquid tanks 14 and 15. In addition, a circulating filtration device is provided for a fourth group, which includes all of the liquid tanks from the liquid tank 11 to the liquid tank 15.

(0059) In Figure 1, the circulating filtration device for the liquid tank 11 is indicated by the symbol 3, the circulating filtration device for the liquid tanks 12 and 13 is shown as 4A, the circulating filtration device for the liquid tanks 14 and 15 is shown as 4B, and the circulating

filtration device for the liquid tanks 11 to 15 is shown as 6. Among the circulating filtration devices, the circulating filtration device 3 for the first group is a single circulating filtration device for a single liquid tank that uses a single liquid circulating pump (a centrifugal pump in this case), while the circulating filtration device 4A for the second group and the circulating filtration device 4B for the third group are each a circulating filtration device that uses a single liquid circulating pump (a centrifugal pump in this case) for two processing liquid tanks. In addition, the circulating filtration device 6 for the fourth group is a circulating filtration device that uses a single liquid circulating pump (here, a centrifugal pump) for all five of the processing liquid tanks.

(0060) The filtration device 4A for the second group and the filtration device 4B for the third group are circulating filtration devices for two liquid tanks that use a single liquid circulating pump; during the process of circulating filtration, the liquid flow rate for the processing liquids in the two liquid tanks in each group will differ slightly in the circulation circuit, and the liquid level will decrease in one of the two liquid tanks over time. Conversely, in the other liquid tank, an increase in the amount equivalent to the liquid loss in the liquid tank suffering the liquid level decrease will occur, the processing liquid level in one liquid tank will overflow from the other liquid tank, and the liquid level of the processing liquid in one liquid tank will decrease too much, making it impossible to prevent plating operations with the processing liquid in either liquid tank.

(0061) Therefore, for all five of the liquid tanks, the circulating filtration device 6, which performs circulating filtration at the same time, is installed and operated using a single liquid circulating pump, the liquid level is controlled so as to suppress any vertical difference between the liquid levels between the liquid tanks, and liquid mixing is performed in order to enable circulating filtration while homogenizing the composition and liquid temperature in each liquid tank. In other words, the circulating filtration device 6 acts as a circulating filtration device as well as a device for liquid mixing and liquid level control.

(0062) Also, this device that performs liquid mixing and liquid level position control can perform circulating filtration while performing liquid mixing and liquid level position control in each liquid tank, even if the volume of each liquid tank is different. The circulating filtration device 3 for the liquid tank 11 includes a filter 31 and a circulating pump 32 for liquid circulation (a centrifugal pump is used in the present embodiment). The liquid tank 11 may be connected to a liquid suction port of the circulating pump 32 via a liquid suction circuit. The filter 31 can be connected to the liquid tank 11 via a liquid delivery circuit.

(0063) As shown in Figure 1, the liquid suction circuit includes the first suction head 104 and the second suction head 106 (not shown in Figure 1, but shown in Figure 2, Figure 6, and Figure 7), a manifold 33 for liquid merging, a pipe connecting pipe connection ports 104a (see Figure 6) and 106a (see Figure 6) of the suction heads 104 and 106 to branch pipes of the manifold 33 through manual opening/closing valves v11 and v12, respectively, and a pipe connecting a main opening of the manifold 33 through a manual opening/closing valve v13 to the liquid suction port of circulating pump 32.

(0064) When the third suction head 108 is employed, the liquid that is suctioned by the suction head is eventually mixed with the liquid that was suctioned through the valves v11 and v12 and is piped to the pump 32 via the valves and the like, ensuring that the liquid will merge and flowed into the pump 32. The liquid delivery circuit includes a pipe

that branches the liquid delivery port of the filter 31 to two locations of the liquid tank 11 via a manual opening/closing valve v14 and a temperature control circuit 45, as well as two manual opening/closing valves v15. The connection to the liquid tank 1 does not have to be at two locations in this way, and it is acceptable to have a connection at one location or three or more locations.

(0065) A discharge port of the circulating pump 32 is connected to a liquid supply port of the filter 31 via a check valve v16. While a variety of types of filters adapted to the liquid type and filtration volume may be used for the filter 31, in this case, the filter that is used is a type of filter in which impurities may be filtered and purified by passing the liquid that is pressed into the filter through a filter bed having a pre-coated layer with an appropriate filter auxiliary. The filters in the following circulating filtration devices 4A and 4B and also in the device 6 for liquid mixing and liquid level position control are the same type of filter.

(0066) In addition, a clearing and replacement device 51 (see Figure 1 and Figure 3) is attached to the liquid delivery circuit in order to restore the liquid constitution, which may change with the degradation or consumption of the plating liquid in a single liquid tank, and further, to filter and remove any impurities that may have been accumulated. The temperature control circuit 45 and the clearing and replacement device 51 in the circulating filtration device 3 are identical in basic structure to the temperature control circuit 45 and the clearing and replacement device 51 in the circulating filtration devices 4A and 4B, respectively, so the circuit 45 and the device 51 in the filtration device 4A will be described later, while the description of temperature control circuit 45 and the device 51 shall be omitted here.

(0067) Because the circulating filtration device 4A and the circulating filtration device 4B have exactly the same structure and operation, only the device 4A shall be explained, and the description of device 4B shall be omitted. The same parts in the devices 4A and 4B are marked with the same reference numbers in the figures. The circulating filtration device 4A includes a filter 41 and a circulating pump 42 for liquid circulation, as shown in Figure 1. The liquid tanks 12 and 13 can communicate with a liquid suction port of the circulating pump 42 via the liquid suction circuit. The filter 41 can be connected to the liquid tanks 12 and 13 via the liquid delivery circuit.

(0068) The liquid suction circuit includes the first suction head 104 and the second suction head 106 (not shown in Figure 1, but shown in Figure 2) for each of the liquid tanks 12 and 13, manifolds 431, 432, and 430 for liquid merging, piping to connect the pipe connection ports 104a (see Figure 6) and 106a (see Figure 6 and Figure 7) of the suction heads 104 and 106 of one liquid tank 12 to the branch pipes of one manifold 431 via manual opening/closing valves v41 and v42, piping to connect the pipe connection ports 104a and 106a of the suction heads 104 and 106 of the other liquid tank 13 to the branch pipes of the other manifold 432 via opening/closing valves v41 and v42 like those of the liquid tank 12, piping to connect the main opening of the manifolds 431 and 432 to the branch pipes of the manifold 430, and piping to connect the main opening of the manifold 430 to a liquid suction port of the circulating pump 42 via a manual opening/closing valve v43.

(0069) When the third suction head 108 is employed in the liquid tanks 12 and 13, the liquid suctioned by this head will be eventually mixed with the liquid suctioned through the valves v41 and v42, and said head is connected to pump 42 via valves and the like such that the

liquid will be merged to flow into the pump 42. The liquid delivery circuit includes piping connecting the liquid delivery port of the filter 41 to the main opening of the manifold 433 for liquid distribution via a manual opening/closing valve v44 and a temperature control circuit 45, piping connecting one of the branch pipes of the manifold 433 to two locations of the liquid tank 12 via two manual opening/closing valves v45, and piping connecting the other branch pipe of the manifold 433 to two locations of the liquid tank 13 via two manual opening/closing valves v45 like those of liquid tank 12.

(0070) A discharge port of the pump 42 is connected to a liquid supply port of the filter 41 via a check valve v46. The filter 41 is the same type of filter as the filter 31 of the circulating filtration device 3. However, the filter may also be a different type of filter. In addition, a clearing and replacement device 51 (see Figure 3) is provided in the liquid delivery circuit to restore the liquid constitution, which may change with the degradation or consumption of the plating liquid in a liquid tank after selecting a single liquid tank from among the two liquid tanks 12 and 13, and further, to filter and remove any impurities that may have been accumulated.

(0071) The temperature control circuit 45 connects the flow rate adjustment valve V in parallel to a circuit that serially connects a manual opening/closing valve va', a heat exchanger 451, and a manual opening/closing valve vb', with an inlet of the valve va' on the heat exchanger inlet side and an inlet of the flow rate adjustment valve V being connected by piping to the aforementioned valve v44 (the valve on the filter outlet side) via a manifold 452 for liquid distribution, and an outlet of the valve vb' and an outlet of the flow adjustment valve V being connected by piping to the aforementioned liquid distribution manifold 433 for the liquid tank.

(0072) The temperature control circuit 45 in the circulating filtration device 3 has basically the same structure as this temperature control circuit 45. However, in the temperature control circuit 45 in the circulating filtration device 3, the valve corresponding to the valve vb' and the valve outlet corresponding to the flow rate adjustment valve V are collected in a single pipe without using a manifold, and are further branched into two locations of the liquid tank 11 via the two manual opening/closing valves v15.

(0073) As shown in Figure 3, the clearing and replacement device 51 has piping to enable the liquid delivery port of the filter 41 communicate with a clearing and replacement tank 511 via a manual opening/closing valve v51 and has piping to connect the liquid suction port of pump 42 to the conventional foot valve v53 installed in a bottom part of the clearing and replacement tank 511 via a manual opening/closing valve v52. This clearing and replacement device 51 has basically the same structure as the clearing and replacement device 51 in the circulating filtration device 3. "Manifolds" as used previously and later in this specification includes a manifold main body, which has a closed cylindrical shape in which one end of said manifold is closed, as well as a plurality of branch pipes connected to the manifold main body. In a circulating filtration device using such a manifold in a liquid suction circuit from liquid tank and in a liquid delivery circuit from a filter to a liquid tank relying on circulation pumps, the liquid flow volume during liquid suctioning or liquid delivery in each of a plurality of branch pipes that may have the same or different cross-sectional areas and that are provided in the main manifold unit is determined by the cross-sectional area of that branch pipe.

(0074) To further explain, the liquid flow volume per unit cross-sectional area in each of the plurality of branch pipes will essentially be the same as long as there are no problems such as marked clogging in excess of the permissible range for the removal of impurities in the pre-coating layer of the filter auxiliary in the filter or marked changes

in the pressure differential before and after the pre-coating layer, or in other words, marked changes in the pressure differential between the stock liquid chamber in the filter and the filtration chamber. Each branch pipe has the cross-sectional area to achieve the specified liquid flow volume judged to be required based on the equivalent liquid flow volume per unit cross-sectional area. The main manifold unit has the same cross-sectional area over generally the entire length of the cylinder that constitutes the manifold and has a cross-sectional area that is slightly greater than the total cross-sectional area of the plurality of branch pipes. The pressure inside the main body of the manifold will be subject to the same negative pressure or positive pressure under the same cross-sectional area over the entire length of the cylinder, and the specified liquid flow volume for each branch pipe may be achieved without excess or shortage. Returning to the start and continuing with the explanation, manifold 33 for liquid merging and the manifold (not shown in the figure) in the temperature control circuit 45 in the circulating filtration device 3 described above, as well as the manifolds 431, 432, and 430 for liquid merging, manifold 433 for liquid distribution, and manifold 452 in temperature control circuit 45 in circulating filtration devices 4A and 4B all have essentially the same structure as the manifolds shown in Figure 9, while the fabrication material is vinyl chloride resin (PVC), and the manifold shown in Figure 10 below is made of the same material. These manifolds may also be made of other materials, such as other synthetic resins or metals.

(0075) In other words, the manifold 33 for liquid merging in circulating filtration device 3, the manifold (not shown in the figure) in temperature control circuit 45, as well as the manifolds 431, 432, and 430 for liquid merging, the manifold 433 for liquid distribution, and the manifold 452 in the temperature control circuit 45 in the circulating filtration devices 4A and 4B have the structure shown in Figure 9, although the structure is not limited to this example. In this case, the structure consists of two units connected to a manifold main body 401 with a round cross-section, and while not limited to this example, there are two branch pipes 402 and 403 with round cross-sections here. The manifold main body 401 has a main opening 401a at one end for connection to other pipes, while a closed end 401b is a closed cylinder with a generally uniform internal diameter (the cross-sectional area for liquid flow is generally uniform).

(0076) Further, the cross-sectional area of the opening 401a of the manifold main body 401, which is subject to the same positive or negative pressure with respect to the branch pipes 402 and 403, has a cross-sectional area corresponding to the total cross-sectional area of the branch pipes 402 and 403, which provides the required specified liquid flow volume. In addition, the cross-sectional area of the manifold main body 401 has a cross-sectional area that is slightly larger than the opening 401a, as a cross-sectional area that affords some freedom in relation to the total cross-sectional area of the plurality of branch pipes.

(0077) The branch pipes 402 and 403 are inserted as projections into the main body of the manifold from a direction that is orthogonal to the longitudinal direction of the manifold main body 401 at two locations in the longitudinal direction, and the degree of projection (projecting insertion height) α of each of the branch pipes 402 and 403 into the main body of the manifold is approximately at least one-half and no more than three-fifths of the internal diameter R of the manifold main body 401. The projecting insertion heights of the branched pipe 402 and 403 into the manifold main body 401 should be such that the pressure (negative or positive pressure) in the manifold main body will be uniform whether under the pump liquid suction pressure (negative pressure) or the liquid delivery pressure (positive pressure) on the manifold main body.

(0078) The manifold main body 401 may be connected to the two branch pipes 402 and 403 using a liquid-tight adhesive, by welding, or the like. The manifolds shown in Figure 10, to be discussed later, a manifold main body 600, and branch pipes 601 to 605 have the same basic structure as the manifolds described above. In addition, there are no particular restrictions on the connection sites of the branch pipes to the manifold main body in any of these manifolds, and the connections may be made at the desired sites around the manifold main body according to the structure of the liquid circuit. Also, the angle of the branch pipes in these connections do not necessarily have to be in a direction that is orthogonal to the longitudinal direction of the manifold main body.

(0079) With a manifold having this type of structure, when the manifold is used for liquid merging by connecting the liquid suction port of the liquid circulating pump to the main opening 401a of the manifold main body 401, the suction pressure (negative pressure) of the pump, in other words, the liquid pressure (suction pressure) in the manifold main body, will be homogenized in each part of the manifold main body, so the liquid suction volume into the manifold main body 401 from each of the branch pipes 402 and 403 will match the cross-sectional area for liquid passage in each branch pipe.

(0080) In addition, when the pump delivery port is connected to the main opening 401a of the manifold main body 401 and the manifold is used for liquid distribution, the pump delivery pressure (positive pressure), in other words, the liquid pressure (positive pressure) in the manifold main body will be homogenized in each part of the manifold main body, so the amount of liquid that is delivered from each of the branch pipes 402 and 403 corresponds to the liquid distribution cross-sectional area of said branch pipe. In this example, because a manifold with this type of structure is utilized as the manifold 33 in the circulating filtration device 3 and the manifold (not shown in the figure) in the temperature control circuit 45, as well as the manifolds 431, 432, and 430 for liquid merging, the manifold 433 for liquid distribution, and the manifold 452 in the temperature control circuit 45 in the circulating filtration devices 4A and 4B, it will be possible to suction liquid in batches of a specified amount from the internal bottom groove 102 of the liquid tank and from the overflow box B2, to return the filtered liquid in the specified amount to the liquid tank 11 in the circulating filtration device 3, and to return the filtered liquid in batches of the specified amount to the plurality of liquid tanks in the circulating filtration devices 4A and 4B that are provided for said plurality of liquid tanks. Further, by providing the manifold 452 as shown in Figure 3 in each of the temperature control circuits 45, it will be possible to easily deliver the liquid to the heat exchanger at the desired heat exchange flow rate, which may be set using the flow rate adjustment valve V.

(0081) A manifold 9 that is in conventional use has a main opening 91a for use in liquid flow in one location, as shown in Figure 15, and branch pipes 92 are connected in multiple locations, excluding the position of the main opening 91a. The connection of the branch pipes 92 may be made by connecting one end of the branch pipe to match a hole 91b that is provided in the wall of the manifold main body 91. However, with this type of conventional manifold, the liquid pressure in each part of the entire length of the manifold main body will not act uniformly, and when there has been an increase in the over-pressure in the filter due to the removal of impurities in particular, the liquid pressure in each part will not act uniformly even if that over-pressure is within the permissible range for the filter main unit. For instance, if a liquid is introduced into the manifold main body 91 under normal pres-

sure from the main opening 91a using a pump, the majority of the liquid will flow out into the branch pipes that are closest to the main opening 91a, and at each position moving sequentially farther away from main opening 91a, there will be a decrease in the liquid pressure as a result of the liquid outflow into the branch pipes at positions before those positions, meaning that only a small amount of liquid will flow out into the branch pipes at those farther positions.

(0082) On the other hand, if the liquid is allowed to flow into the branch pipes 92 from the outside under the liquid suction pressure (negative pressure) of the pump, when suctioning this liquid from the main opening 91a, it will be possible to suction a large quantity of the liquid from the branch pipes closest to main opening 91a, but the liquid suction action of the pump will decrease moving sequentially further from the main opening 91a, and it will only be possible to suction a small volume of liquid from the branch pipes 92 at those farther positions.

(0083) If this type of manifold is utilized in a liquid circuit for filtration of a processing liquid, in a liquid circuit to maintain homogeneity in a processing liquid in a plurality of liquid tanks, which will be discussed later, or in a liquid circuit to control the liquid level position in each liquid tank, the result will be to obstruct the desired filtration processing, maintenance of processing liquid quality, or liquid level control. In order to solve these types of problems, a flow rate adjustment valve 90 must be provided for each branch pipe, but in addition to being expensive, it is extremely difficult to adjust the degree of opening and narrowing of the flow rate adjustment valve 90 in order to homogenize the amount of filtration, which decreases over time depending on the amount of filtration removal of impurities, as well as the decrease in the amount of liquid passing through each suction and liquid delivery tube due to pipe resistance.

(0084) Regarding this point, by using a manifold with the structure shown in Figure 9, there will be no need to provide the flow rate adjustment valve 90 to adjust the flow rate as shown in Figure 15 in each branch pipe, making it possible to simply, easily, and cheaply achieve the liquid flow amount according to the liquid flow cross-sectional area. For convenience in the explanation, the description of the filtration device and the like described above will start from the filtration device 4A.

(0085) With the circulating filtration device 4A, during the normal circulating filtration, the valves v41 to v45 are opened, while the valves va', vb', and V in the temperature control circuit 45 may each be set to the desired specified degree of openness (or they may always remain open), and the manual opening/closing valves v51 and v52 leading to the clearing and replacement device 51 are closed.

(0086) Further, by operating the circulating pump (a centrifugal pump in this embodiment) 42, it will be possible to suction the plating liquid, which contains primarily precipitated impurities, using the first suction head 104 from the internal bottom grooves 102 of the liquid tanks 12 and 13 via the valve 43, and, when third suction head 108 has also been installed in another site of the bottom inside the liquid tank, as indicated by the dashed line in Figure 3, it will be possible to suction the plating liquid containing impurities in the bottom part of the liquid tank and the surrounding area from the third suction head as well. On the other hand, it will also be possible to use the second suction head 106 to suction the floating impurities collected in the overflow box B2 along with the plating liquid in the box B2 when these impurities have flowed along with the plating liquid over the weir parts 21 and 22 towards the overflow boxes B1 and B2 in the liquid tanks 12 and 13,

making it possible to filter these impurities in the filter 41 and to return the plating liquid after filtering to two locations in each of the liquid tanks 12 and 13. In this way, because the filtered liquid is returned to multiple locations rather than one location in each liquid tank, the cleanliness of the liquid may be improved to that degree in each part of said liquid tank.

(0087) During this circulating filtration, the plating liquid may be controlled to a predetermined temperature using the heat exchanger 451 in the temperature control circuit 45. When the operation of the plating processing device is started during consecutive days off, at the beginning of a holiday, or the like, if the temperature of the plating liquid is significantly outside of the range of the predetermined temperature, the flow rate adjustment valve V in the temperature control circuit 45 can be tightened or closed until the temperature reaches or nears the predetermined temperature, and the plating liquid can be made to flow centrally to the heat exchanger 451 in order to quickly reach the predetermined plating liquid working temperature.

(0088) In general, in the case of an article processing liquid tank, impurities that may be initially attached to the article to be treated and that are carried into the treatment liquid, impurities that adhere to the article being treated following generation during the pretreatment process for the article to be treated, impurities that are generated due to electrolysis, degradation, or the like during the treatment process of the article to be treated in the processing liquid, and the like may act synergistically, resulting in the daily accumulation of impurities. Therefore, it is necessary to perform frequent cleaning and restoration of the filtration bed in the filter, as well as frequent clearing and replacement filtration of the liquid tank, which increases costs.

(0089) To take the example of an article plating liquid tank, the plating liquid contains impurities that may be initially attached to the article to be treated and that are carried into the plating liquid, impurities that adhere to the article being treated following generation during the pretreatment process for the article to be treated, impurities that are generated due to anode electrolysis, degradation of the processing liquid, and the like during the treatment process of the article to be treated in the plating liquid tank, and impurities that may fall into the liquid tank from the outside, and these impurities may act synergistically, resulting in the daily accumulation of the impurities. Therefore, it is necessary to perform frequent cleaning and restoration operations on the filtration bed in the filter, and to perform clearing and replacement filtration of the liquid tank as well. Further, due to these operations, there will be an increase in interruptions of production of plated products and overtime work, leading to an accompanying increase in labor costs, loss of expensive plating liquids, increased management costs for various chemical products or waste liquid, and excessive consumption of energy such as electricity, all of which will result in a steep increase in the cost of the plated product.

(0090) To take an example of clearing and replacement filtration, the cycle for the implementation of clearing and replacement filtration will differ significantly depending on the type of product being produced, but these operations are generally performed every one to three months. Through clearing and replacement filtration, the liquid composition may be regenerated and restored by performing processing such as activated carbon processing, filtration, and the like to remove inorganic and organic impurities, making it possible to return the restored liquid once again to the original liquid tank. The following type of clearing and replacement filtration processing may be performed in plating liquid tanks 11 to 15, which will be discussed here.

(0091) Specifically, when performing clearing and replacement filtration of the plating liquid inside the liquid tank 12, the valve v42 on the liquid tank 12 side, the valves v41 and v42 on the liquid tank 13 side, the valve 44 that connects to the inlet of the temperature control circuit 45, and the valve v52 of the clearing and replacement device 51 are closed, while the valve v41 on the liquid tank 12 side, the valve v43 that connects to the liquid suction port of pump 42, and the valve v51

in the clearing and replacement device 51 are opened, and the pump 42 is operated in the circulating filtration device 4A.

(0092) As a result, it will be possible to recover the plating liquid inside the liquid tank 12 into the clearing and replacement tank 511 via the valve 41 and the manifold 431 on the liquid tank 12 side and the valve v43, the pump 42, the check valve v46, the filter 41, and the valve v51 on the pump liquid suction side. Activated carbon filtration processing, liquid composition restoration processing, and the like are performed on the liquid that was recovered into the clearing and replacement tank 511. In order to return the processed liquid from the clearing and replacement tank 511 to the liquid tank 12, the valve v51 of the clearing and replacement device 51, the valve v43 that connects to the liquid suction port of the pump 42, and the valve v45 on the liquid tank 13 side are closed, while valve v52 of the clearing and replacement device, the valve v44 that connects to the temperature control circuit 45, the valve V of temperature control circuit, and the valve v45 on the liquid tank 12 side are opened, and the pump 42 is operated.

(0093) As a result, the restored plating liquid is drawn in from the foot valve v53 at the bottom of the clearing and replacement tank 511 and is returned to the liquid tank 12 from the valve v45 on the liquid tank 12 side via the valve v52 of the clearing and replacement device, the pump 42, the check valve v46, the filter 41, the valve v44, the manifold 452 of the temperature control circuit 45, the valve V, and the manifold 433. On the other hand, when performing clearing and replacement filtration of the plating liquid in the liquid tank 13, the valve v42 on the liquid tank 13 side, the valves v41 and v42 on the liquid tank 12 side, the valve 44 that connects to the temperature control circuit 45, and the valve v52 of the clearing and replacement device 51 are closed, while the valve v41 on the liquid tank 13 side, the valve v43 that connects to the liquid suction port of the pump 42, and the valve v51 in the clearing and replacement device 51 are opened, and the pump 42 is operated in the circulating filtration device 4A.

(0094) As a result, it will be possible to recover the plating liquid inside the liquid tank 13 into the clearing and replacement tank 511 via the valve 41 on the liquid tank 13 side, the manifold 432, the manifold 430, the valve v43 on the pump liquid suction side, the pump 42, the check valve v46, the filter 41, and the valve v51. Filtration processing or the like may be performed on the liquid that was recovered into the clearing and replacement tank 511. In order to return the processed liquid from the clearing and replacement tank 511 to the liquid tank 13, the valve v51 of the clearing and replacement device 51, the valve v43 that connects to the liquid suction port of the pump 42, and the valve v45 on the liquid tank 12 side are closed, while the valve v52 of the clearing and replacement device, the valve v44 that connects to the temperature control circuit 45, the valve V of temperature control circuit, and the valve v45 on the liquid tank 13 side are opened, and the pump 42 is operated.

(0095) As a result, the restored plating liquid is drawn in from the foot valve v53 at the bottom of the clearing and replacement tank 511 and is returned to the liquid tank 13 from the valve v45 on the liquid tank 13 side via the valve v52 of the clearing and replacement device 51, the pump 42, the check valve v46, the filter 41, the valve v44, the manifold 452 of the temperature control circuit 45, the valve V, and the manifold 433. In this way, it will be possible to perform the clearing and replacement filtration of a part or the entirety of the plating liquid in each of the liquid tanks 12 and 13.

(0096) The reason for enabling the clearing and replacement filtration of the plating liquid in the liquid tanks 12 and 13 individually is that attempting to replace the liquid in the two tanks together would necessitate an increase in the capacity of the clearing and replacement tank 511, which would result in an increased installation space for the clearing and replacement tank 511, leading to higher costs. Further, it is common to have to perform clearing and replacement filtration of each tank.

(0097) If there is installation space for a large-capacity clearing and replacement tank 511, the clearing and replacement filtration work may be performed for the two tanks at the same time. In the case of the circulating filtration device 4B, as in the case of the filtering device 4A, the plating liquid in the liquid tanks 14 and 15 can be subjected to circulating filtration. In addition, the temperature of the plating liquid can be controlled. Further, a part or the entirety of the plating liquid in the liquid tanks 14 and 15 can be subjected to clearing and replacement filtration.

(0098) With the circulating filtration device 3, the valves v11 to v15 are opened during normal circulating filtration, while the opening/closing valves and flow rate adjustment valves in the temperature control circuit 45 may each be set to a predetermined degree of opening, and the opening/closing valves leading to the clearing and replacement device 51 are closed. Then, by operating the circulating pump 32, primarily the precipitated impurities will be suctioned along with the plating liquid by the second suction head 104 from the internal bottom groove 102 of the liquid tank 11. Further, when the third suction head 108 is also provided in another side at the bottom inside the liquid tank, as shown by the dashed line in Figure 3, it will be possible to suction the plating liquid containing impurities at the bottom inside the liquid tank and the surrounding area using the third suction head as well.

(0099) On the other hand, it will also be possible to use the second suction head 106 to suction the floating impurities collected in the overflow box B2 along with the plating liquid in the box B2 when these impurities have flowed along with the plating liquid over the weir parts 21 and 22 towards the overflow boxes B1 and B2 in the liquid tank 11, making it possible to filter these impurities in the filter 31 and to return the filtered plating liquid to two locations in the liquid tank 11. In this way, because the filtered liquid is returned to multiple locations rather than one location in the liquid tank 11, the cleanliness of the liquid may be improved in each part of the liquid tank 11.

(0100) During this circulating filtration process, the plating liquid can also be controlled to a predetermined temperature by the temperature control device 45. When the operation of the plating processing device is started during consecutive days off, at the beginning of a holiday, or the like, if the temperature of the plating liquid is significantly outside of the range of the predetermined temperature, the flow rate adjustment valve V in the temperature control circuit 45 can be tightened or closed until the temperature reaches or nears the predetermined temperature, and the plating liquid can be made to flow centrally to the heat exchanger in order to quickly reach the predetermined plating liquid working temperature.

(0101) When performing clearing and replacement filtration of the plating liquid in the liquid tank 11, as is the case with the clearing and replacement device 51 for the liquid tanks 12 and 13 as described above in the filtration device 3, the valve v11 on the liquid tank 11 side is opened, v12 is closed, the valve v44 that connects to temperature control circuit 45 and valve v52 of device 51 are closed, and the opening/closing valve v51 for the delivery of liquid to the clearing and replacement tank 511 is opened, after which the pump 32 can be operated in order to recover the plating liquid in liquid tank 11 into the clearing and replacement tank.

(0102) Furthermore, the plating liquid that was recovered, regenerated, and restored may be returned to the liquid tank 11 in the same manner as the liquid was returned to the liquid tanks 12 and 13 described above

in the clearing and replacement device 51. The plating processing device described above may be further provided with a device 6 for liquid mixing and liquid level position control in order to control the liquid level position in each liquid tank while recovering and mixing the plating liquid from each of the liquid tanks 11 to 15 and returning the liquids back to each liquid tank again. This will be explained below.

(0103) As shown in Figure 1, the device 6 for liquid mixing and liquid level position control is provided with: a liquid circulating pump 61; a circuit to draw the liquid to the liquid suction port of a pump 61 from the respective overflow boxes B2 of the liquid tanks 11 to 15 via a manual opening/closing valve v71, a first manifold J1 for liquid merging, a second manifold J2 for liquid merging, and a manual opening/closing valve v62; a circuit that can draw the liquid from the respective overflow boxes B2 of the liquid tanks 11 to 15 to a third manifold J3 for liquid merging via a manual opening/closing valve v61 and corresponding motorized valves Va (of which there are a total of five) for liquid discharge from each liquid tank and from the third manifold J3 to a liquid suction port of the pump 61 via the second manifold J2 and the manual opening/closing valve v62; a circuit that can draw the liquid from a discharge port of the pump 61 to the liquid tanks 11, 12, 13, 14, and 15 via a check valve Vo and a filter 60 and via a manual opening/closing valve v6, a fourth manifold J4 for liquid distribution, and a fifth manifold J5 for liquid distribution; and a circuit that can draw the liquid from the discharge port of the pump 61 to the liquid tanks 11, 12, 13, 14, and 15 via the check valve Vo and the filter 60 and via the valve v63, the fourth manifold J4, a sixth manifold J6 for liquid distribution, corresponding motorized valves Vb (of which there are a total of five) for liquid supply to each liquid tank, and a manual opening/closing valve v64. The device 6 for liquid mixing and liquid level position control further includes a liquid level position detection device 62 that may be installed in the overflow box B2 of each liquid tank.

(0104) The motorized valve Va for liquid discharge and the motorized valve Vb for liquid supply are both valves that are provided with a valve opening/closing drive motor. The plating processing device shown in the figure is provided with a control unit 7 that controls the operation of the entire device as shown in Figure 11 (A), and a portion of the control unit 7 comprises a portion of the device 6 for liquid mixing and liquid surface position control, which is currently being described.

(0105) The control unit 7 is connected to an operation panel 71, which is equipped with switches or the like to start and stop each pump. As shown in Figure 11 (A), each pump 32, 42, 42, and 61 is connected to the control unit and may be operated based on instructions from the control unit, and the control unit is also connected to the motorized valve Va for liquid discharge, the motorized valve Vb for liquid supply, and the liquid level position detection device 62 in each liquid tank in the device 6 for liquid mixing and liquid level position control.

(0106) Each liquid level position detection device 62 has the same structure, including a total of five electrodes 621 to 625 that may be inserted from above to hang inside the overflow box B2 as shown in Figure 11 (B), which shows the general structure of one of these devices. These electrodes are shortest to longest in the sequence 621, 622, 623, and 624 and are inserted deeply into box B2 in this sequence. An electrode 625 is a ground electrode and may be inserted into box B2 to approximately the same depth as, or deeper than, the electrode 624.

(0107) Inside the overflow box B2 of each of the liquid tanks, the electrode 621 is an electrode for detecting the upper limit of an abnormal liquid surface, while the electrode 622 is an electrode for detecting when the liquid surface position reaches the upper limit of the permissible range, the electrode 623 is an electrode for detecting when the liquid surface position reaches the lower limit of the permissible range, and the electrode 624 is an electrode for detecting that the overflow box is drying out.

(0108) In any of the liquid tanks 11 to 15, if the liquid level height of the liquid housed inside the overflow box is within the prescribed upper and lower limits beyond the weir parts 21 and 22 in the liquid tank, in other words, if the liquid level position inside the box 82 is located below the lower end of the electrode 622 and above the lower end of the electrode 623, the motorized valve Va for liquid discharge and the motorized valve Vb for liquid supply in that liquid tank will remain open as per the instructions of the control unit 7, and the liquid discharge and supply will continue for said liquid tank.

(0109) However, when the height of the liquid level of the liquid housed in the box B2 flows over the weir parts 21 and 22 in the liquid tank and exceeds a predetermined range, coming into contact with the lower end of the electrode 622, under the instructions of the control unit 7, the motorized valve Vb for liquid supply that is connected via the valve v64 (normally, this valve is open) to that liquid tank will close, stopping the supply of liquid to the liquid tank. On the other hand, the motorized valve Va for liquid discharge will open, discharging the liquid from the liquid tank via the valve v61 (normally, this valve is open).

(0110) Separately from the discharge circuit via motorized valve Va, the liquid that is to be discharged via the valve v71 (normally, this valve is open) and the manifold J1 will be merged with the discharge liquid from the motorized valve Va and the manifold J3 inside the manifold J2, and this merged liquid will be suctioned into the pump 61 via the valve v62. In addition, when the liquid level position inside the liquid tank falls and separates from the lower end of the electrode 623, the motorized valve Va for liquid discharge will be closed under the instructions of the control unit 7, while the motorized valve Vb for liquid supply will be opened and the liquid will be delivered to the liquid tank via the valve v64. At this time, the liquid from the pump 61 is delivered, via the check valve Vo and the filter 60, to the aforementioned manifold J6 and the motorized valve Vb by one of the two branch pipes of the manifold J4, and at the same time, the liquid is returned from the other branch pipe of the manifold J4 to the manifold J5 and to a liquid outflow port 63 to the liquid tank.

(0111) Then, ① the total liquid discharge volume that may be obtained by adding the liquid discharge volume from the valve v61 via the motorized valve Va in the liquid suction circuit of the pump 61 and the liquid volume that may be discharged from the valve v71 via the manifolds J1 and J2 without passing through the motorized valve Va in the circulating filtration device 6 is set from the start to be approximately the same amount as ② the total liquid delivery volume that may be obtained by adding the liquid delivery volume to be returned to the liquid tank via the motorized valve Vb and the valve v64 in the liquid delivery circuit of said pump and the liquid volume to be returned to

the liquid tank from the liquid outflow port 63 via the manifolds J4 and J5 without passing through the motorized valve Vb.

(0112) During this period, the pump 61 continues to operate. Inside the overflow box B2, if the liquid level of the processing liquid is lower than the predetermined height due to unforeseen circumstances or the like and the liquid level of the processing liquid separates from the electrode 624, or if the liquid level of the processing liquid is higher than the predetermined height and the liquid level comes into contact with the electrode 621, the pump 61 as well as all of the other pumps will be stopped on an emergency basis at the direction of the control unit 7. An alarm device may be provided for safety management in order to issue an alarm in this case.

(0113) The aforementioned manifolds J1 to J3 for liquid merging are provided with a manifold main body having a liquid merging space for liquid merging, a liquid distribution main opening that is connected to said liquid merging space in one location, and branch pipes that may be connected at each of a plurality of predetermined locations excluding said main opening of said manifold main body, such that liquid can flow into each branch pipe and flow out from the main opening after mixing in the manifold main body.

(0114) Also, the aforementioned manifolds J4 to J6 for liquid distribution are provided with a manifold main body having a liquid delivery space for liquid delivery, a liquid flow main opening that is connected to said liquid delivery space in one location, and branch pipes that may be connected at each of a plurality of predetermined locations excluding said main opening of said manifold main body, such that liquid can flow into each main opening and flow out from each branch pipe.

(0115) The first manifold J1, the third manifold J3, the fifth manifold J5, and the sixth manifold J6 are each provided with branch pipes in a quantity that matches the number of liquid tanks (in this case, there are five branch pipes), while the second manifold J2 and the fourth manifold J4 each have two branch pipes. The manifold J2 for liquid merging and the manifold J4 for liquid distribution that are utilized in the device 6 have the same basic structure as the manifold shown in Figure 9 that was utilized in the circulating filtration device, so it will be possible to obtain a liquid flow volume according to the liquid flow cross-sectional area of each branch pipe. Also, the manifold J1 and the manifold J3 for liquid merging and the manifold J5 and the manifold J6 for liquid distribution that are utilized in the device 6 have the same structure as the manifold shown in Figure 10 and are manufactured of polyvinyl chloride (PVC) resin. These manifolds may be constructed of other materials, for example other synthetic resins or metal, depending on the quality of the processing liquid or the like. In other words, each of the various manifolds J1, J3, J5, and J6 may, as shown in Figure 10, have a manifold main body 600 with a circular cross-section and five branch pipes 601, 602, 603, 604, and 605 with circular cross-sections that are connected to the main body, although the structure is not limited to this example.

(0116) The manifold main body 600 has a main opening 600a at one end for connection to other pipes, while a closed end 600b is a closed cylinder with a generally uniform internal diameter (the cross-sectional area for liquid flow is generally uniform). Furthermore, the cross-sectional area of the opening 600a of the manifold main body

600, which is subject to the same positive or negative pressure with respect to the branch pipes 601 to 605, has a cross-sectional area corresponding to the total cross-sectional area of the branch pipes 601 to 605, which provides the required specified liquid flow volume. The liquid flow cross-sectional area of each branch pipe is the same in this example. In addition, the cross-sectional area of the manifold main body 600 is slightly larger than said opening 601a, as a cross-sectional area that affords some freedom in relation to the total cross-sectional area of the plurality of branch pipes.

(0117) The branch pipes 601 to 605 are inserted as projections into the main body of the manifold from a direction that is orthogonal to the longitudinal direction of the manifold main body 600 at five locations in the longitudinal direction, and the degree of projection (projecting insertion height) β of each branch pipe to the main body of the manifold is approximately at least half and no more than three-fifths of the inner diameter R' of the manifold main body 600. The projecting insertion heights of the branched pipes 601 to 605 into the manifold main body 600 should be such that the pressure (negative or positive pressure) inside the manifold main body will be uniform whether under the pump liquid suction pressure (negative pressure) or the liquid delivery pressure (positive pressure) of the pump 61 on the manifold main body. The manifold main body 600 may be connected to the branch pipes 601 to 605 using a liquid-tight adhesive, by welding, or the like.

(0118) With a manifold having this type of structure, when the manifold is used for liquid merging by connecting the liquid suction port of the pump 61 to the main opening 600a of the manifold main body 600, the suction pressure (negative pressure) of the pump, in other words, the liquid pressure (suction pressure) inside the manifold main body, will be homogenized in each part inside the manifold main body, so the liquid suction volume into the manifold main body 600 from each of the branch pipes 601 to 605 will match the cross-sectional area for liquid passage in that branch pipe. In this case, the liquid suction volumes are equal.

(0119) In addition, if the discharge port of the pump 61 is connected to the main opening 600a of the manifold main body 600 and the manifold is used for liquid distribution, the liquid pressure (positive pressure) inside the manifold main body will be homogenized in each part of the manifold main body, so the amount of liquid that is discharged from each of the branch pipes 601 to 605 will correspond to the liquid flow cross-sectional area of that branch pipe. In this case, the liquid discharge volume will be equal. As explained above, manifolds that can obtain a liquid flow volume that matches the liquid flow cross-sectional area of each branch pipe are used as the manifolds J1 to J6 (see Figure 1), and as a result, it will be possible to appropriately perform control of the liquid surface position in each of the liquid tank 11 to 15 while continuing to perform liquid mixing in each liquid tank while watching the liquid surface height in each liquid tank. Furthermore, it will be possible to reduce the number of opening/closing events for each of the valves Va and Vb (see Figure 1) due to the control of the liquid surface position as a result, making it possible to extend the durability of the motorized valves Va and Vb in addition to extending the opening/closing cycle for these valves by that amount.

(0120) With the device 6 for liquid mixing and liquid level position control described above, when the liquid level in the overflow box B2 of each liquid tank is in the normal position, each of the valves Va and Vb will be opened and the liquid circulating pump 61 will be operated, ensuring that the liquid is suctioned from the overflow box B2 of each of the plurality of liquid tanks 11 to 15 via the valve v42 for the second suction head and the valves v61 and v71. When the liquid in each tank reaches each branch pipe of the first manifold J1 and the third manifold J3 for liquid merging, it will flow into the main body of said manifold

to be merged, further flowing to the branch pipes of the second manifold J2 for liquid merging from said manifold main body, after which the liquid of each tank will be drawn into the liquid circulating pump 61 after having been mixed via the main body of said manifold J2.

(0121) The liquid drawn into the liquid circulating pump 61 will be discharged from said pump and filtered through the filter 60, after which it will flow into the main body of the fourth manifold J4 for liquid distribution, and furthermore, the liquid will flow from said manifold into the main body of fifth manifold J5 and sixth manifold J6 for liquid distribution and will then flow back to each of the liquid tanks 11 to 15 via the corresponding branch pipe of said manifold. In this way, the plating liquid that was suctioned from each of the liquid tanks is merged in the manifolds J1 and J3, further merged in the manifold J2, and drawn and discharged into the liquid circulating pump 61. Furthermore, the liquid will pass through the filter 60 to be distributed by the fourth manifold J4. Then, in the process of distribution by the fifth and sixth manifolds J5 and J6, the plating liquid from the plurality of liquid tanks 11 to 15 will be mixed, and this mixing will be continuously performed to maintain homogeneity of the plating liquid composition of each liquid tank.

(0122) In addition, the liquid level position of each liquid tank may be controlled as described above. In this way, the processing liquid in each liquid tank can be mixed to continuously perform production operations with a homogeneous liquid composition. Moreover, these liquid mixing and liquid level control operations may be achieved by the single liquid circulating pump 61. In this way, the homogeneity of the processing liquid can be maintained between the liquid tanks while suppressing any increase in the complexity, size, or price of the device structure. Further, it will also be possible to suppress any fluctuations in the liquid surface position in each liquid tank relative to the predetermined liquid surface position.

(0123) It should be noted that, by providing the circuits for guiding the liquid to the liquid circulating pump 61 and the liquid level position detection device 62 in the overflow box B2, as in the device 6 for liquid mixing and liquid level position control described above, plating can be performed with little interference in the area housing the liquid before the liquid level exceeds the weir part of the liquid tank. In addition, it will be possible to perform the appropriate liquid level position control by enabling more precise detection of any fluctuations of the liquid level position in the liquid tank in the overflow box, in which there may be significant fluctuations of the liquid level due to fluctuations of the liquid level in the entire liquid tank.

(0124) The filter 60 may be smaller than the filters 31 and 41 that may be used for the conventional circulating filtration and that can handle the amount of liquid flowing into the overflow box. Further, as already mentioned, it is also adequate to use a single filter 60. With regard to the circulating filtration that may be performed by means of the circulating filtration devices 3, 4A, and 4B on the plating liquid in the plating processing device shown in Figure 1, when looking at each liquid tank, it is possible to perform circulating filtration approximately three times per hour for the volume of liquid housed in a single liquid tank, for example, according to the conventional procedure. In other words, approximately three times the liquid capacity of the tank can be used as a standard. In addition, the liquid processing volume for liquid mixing and liquid level control using the circulating filtration device 6 can be, for example, an amount of circulating filtration that is approximately half of the liquid capacity of a single liquid tank per hour. In other words, approximately 0.5 times the liquid capacity of the tank can be made a standard.

(0125) For example, if the normal volume of liquid that is housed in each of the five liquid tanks shown in Figure 1 is 5 m³, the filtration volume per minute can be set as shown in the following table.

$$\text{Number of filtration operations} \times \text{liquid capacity} \times \text{number of liquid tanks} \div \text{filtration time} = \text{filtration amount per minute}$$

Filtration device 3	$3 \times 5 \text{ m}^3 \times 1 \div 60 \text{ min} = 0.25 \text{ m}^3/\text{min}$
Filtration device 4A	$3 \times 5 \text{ m}^3 \times 2 \div 60 \text{ min} = 0.5 \text{ m}^3/\text{min}$
Filtration device 4B	$3 \times 5 \text{ m}^3 \times 2 \div 60 \text{ min} = 0.5 \text{ m}^3/\text{min}$
Filtration device 6	$0.5 \times 5 \text{ m}^3 \times 5 \div 60 \text{ min} = 0.208 \text{ m}^3/\text{min}$

Next, the weir parts 21 and 22 (see also Figure 4) in the overflow boxes B1 and B2 in each of the liquid tanks 11 to 15 will be described.

(0126) The weir parts 21 and 22 are the same in all of the liquid tanks, so this discussion will look at the weir parts provided in the liquid tank 12 as a representative example. The following explanation applies to the weir parts in the other liquid tanks as well. The weir part 21 is provided at the upper edge of the partition wall w1 (see Figure 4) between the liquid tank 12 and the overflow box B1 so as to form an overflow notch 20. The weir part 22 is provided so as to form an overflow notch 20 at the upper edge of the partition wall w2 (see Figure 4) between the liquid tank 12 and the overflow box B2. Here, the overflow notches 20 in the weir parts 21 and 22 each have the same shape and size.

(0127) Each notch 20 has an inverted triangular shape in this example, and pluralities of the weirs 21 and 22 are formed. In this way, the weir parts 21 and 22 that formed notch 20 for liquid overflow are employed to allow the liquid to overflow from the notches 20 into the overflow boxes B1 and B2, so the liquid from the weir parts 21 and 22 can be made to flow into the overflow boxes B1 and B2 together with floating impurities, and as described above, this material can be suctioned from said box using a pump in order to provide this suctioned material for filtration.

(0128) Further, because the weir parts 21 and 22 in which the liquid overflow notches 20 are formed are used to enable overflow of liquid from said notches 20 into the overflow boxes B1 and B2, even if the liquid surface inside the liquid tank rises slightly above the desired liquid surface position for liquid overflow, as long as the rising liquid surface position is at the notches 20, there will be no instance such as is observed with the conventional rectangular weir, in which the amount of overflow will increase rapidly over the entire length of the upper margins of the weirs, resulting in a marked increase in the overall amount of overflow. As a result, the amount of overflow will increase by only the amount of increase of the cross-sectional area of the liquid flow due to the rise in the liquid surface at the notches 20.

(0129) In addition, even if the liquid level inside the liquid tank falls, as long as that dropping liquid level position is at the notches 20, there will be no instance such as that observed with the conventional rectangular weir in which the overflow amount decreases simultaneously over the entire length of the upper margins of the weir parts, leading to a marked decrease in the overall overflow amount, and the overflow amount will decrease by only the amount of the decrease in the cross-sectional area of the liquid flow due to the drop in the liquid surface at the notches 20.

(0130) Therefore, even if there is vertical variability in the liquid surface in the liquid tank 12, the amount of overflow will increase or decrease very slowly when compared to the conventional rectangular weir. In other words, even if there are vertical fluctuations in the liquid level in the liquid tank 12, the fluctuations in the overflow amount can

be kept very small when compared to the conventional rectangular weir. In order to ensure the appropriate filtration of this liquid, appropriate filtration of the liquid is achieved by maintaining the amount of liquid suction from the bottom part of the liquid tank 12 (such as approximately 70% of the circulation liquid volume) and the amount of liquid suction from the overflow box (such as approximately 30% of the circulation liquid volume), which can be set in accordance with the liquid volume subjected to circulating filtration based on the capacity of the filtration pump.

(0131) Also, by utilizing the weir parts 21 and 22 in which the liquid overflow notches 20 are formed, the liquid will overflow into the overflow boxes B1 and B2 from said notches 20. Because the notches 20 extend in the depth direction of the liquid before crossing over the weir parts 21 and 22, it is easy to ensure the inflow of not only the floating impurities that may easily float on the liquid surface inside liquid tank 12, but also of the impurities that are susceptible to suspension in the lower layers, into the overflow boxes B1 and B2 from the notches 20, making it possible to recover and filter out even the impurities that are suspended in the lower layers below the liquid surface.

(0132) Furthermore, there is the advantage that the overflow amount can be easily set by selecting the shape and quantity of the notches 20 (in particular, the angle of the apex at the bottom of the inverted triangular shape of the notch and the depth of the notch). Although the notches 20 shown in this figure have an inverted triangular shape, they may be of other shapes, such as rectangular shapes, U-shapes, or the like. If inverted triangular notches is adopted as shown in the figure, an example of this type of notch may have a lower vertical angle of the inverted triangular shape of 40° to 90° , although there are no particular restrictions on the angle. It is even more preferable to use an angle of approximately 50° to 60° .

(0133) As shown in Figure 12 (A), there is a weir 200 having a conventional rectangular shape and a width of 500 mm, and the standard liquid level of the liquid tank is at the position $h = 10 \text{ mm}$ raised from the upper end of the rectangular weir 200, so the standard liquid level (specified liquid level) that overflows over the rectangular weir 200 at this time is approximately 55.2 liters/min. If the liquid level of the liquid tank increases to $h = 15 \text{ mm}$, 20 mm , or 25 mm , the amount of liquid that overflows the rectangular weir 200 will be 101.4 liters/min, 156.1 liters/min, or 218.2 liters/min, respectively.

(0134) If, as shown in Figure 12 (B), (C), and (D), in lieu of the rectangular weir 200 here, weir parts 201, 202, and 203 having rectangular notches N1 40 mm in width, inverted triangular notches N2 with a lower apex angle of 90° , and inverted triangular notches N3 with a lower apex angle of 60° are used, in order to obtain the same standard overflow liquid volume of 55.2 liters/min as with the rectangular weir 200, the number P of notches N1 and the height h1 of the liquid distribution cross-section of each notch N for the weir part 201 may be set as shown in the table below.

(0135) For the weir part 202, if the number P of the notches N2 is set to 5, the height h2 of the liquid distribution cross-section of each notch N2 may be set to 28 mm. For the weir part 203, if the number P of the notches N3 is set to 4, the height h3 of the liquid distribution cross-section of each notch N3 may be set to 38.1 mm. In other words, in each of the weir parts 201, 202, and 203, there are notches for liquid overflow and the notches extend in the depth direction of the liquid, so they are cut to be deeper than the height h = 10 mm from the upper end of the rectangular weir 200 to the liquid surface. As a result, it is clear that not only floating impurities that may easily float on the liquid surface, but also impurities that are susceptible to suspension in the lower layers can overflow from the notches.

(0136) In addition, in order to obtain the same amount of overflow liquid as the amount of overflow liquid over the weir 200 if the liquid level of the liquid tank is raised to h = 15 mm, 20 mm, and 25 mm

from the upper end of rectangular weir 200 as described above, the heights h1, h2, and h3 of the liquid distribution cross-sections and the number P of notches in each of the notched weir parts 201, 202, and 203 will be as shown in the following table. In other words, the following table shows that, even if the height of the liquid surface changes by 5 mm (h = 15 mm), 10 mm (h = 20 mm), or 15 mm (h = 25 mm) from the normal liquid surface position, the variation of the overflow liquid volume can be suppressed by the notched weir parts 201, 202, and 203 to be smaller than observed with the rectangular weir 200.

(0137) In the following table, M indicates the overflow liquid volume liter/min over the rectangular weir 200, m indicates the overflow liquid volume liter/min at each notch, and P indicates the number of notches. The units of h, h1, h2, and h3 are millimeters.

Rectangular weir 200 with a width of 500 m			Weir part 201 with rectangular notch N1 having a width of 40 mm			Weir part 202 with notch N2 having a lower apex angle of 90°			Weir part 203 with notch N3 having a lower apex angle of 60°		
h	M		h1	m	P	h2	m	P	h3	m	P
10	55.2	10	18.4	11.0	5	28.0	11.0	5	38.1	13.8	4
15	101.4	15	27.6	20.3	5	39.0	25.2	4	48.6	25.2	4
20	156.1	20	36.8	31.2	5	46.5	39.2	4	57.9	39.2	4
25	218.2	25	46.0	43.6	5	53.0	54.3	4	66.0	54.3	4

When using the conventional so-called rectangular weir in which the upper edge extends in a horizontal line, even if the amount of liquid to be suctioned from the bottom of the liquid tank and the amount of liquid to be suctioned from the overflow box are set at a predetermined ratio depending on the capacity of the filtration pump, if there is a significant increase in the amount of overflow due to a slight increase in the liquid surface in the liquid tank, the amount of liquid in the overflow box will increase excessively beyond the capacity of the pump to suction the liquid from the overflow box. Gradually, the liquid surface in the liquid tank and the overflow box will near the same position, resulting in a small gap, and in the end, it will not be possible to fully

recover floating impurities in the overflow box, as has already been described. This point will be described in a bit more detail.

(0138) For example, during the electroplating liquid processing of an article, the amount of circulating filtration of the plating liquid in the plating processing liquid tank will be depending on the article to be plated, but the standard filtration amount may be treated as being three times greater than the processing liquid volume in the liquid tank per hour. Therefore, the following is an example of the circulating filtration amount of a liquid tank provided with the overflow boxes B1 and B2 as described above, which are used to force the overflow the plating processing liquid over the conventional so-called rectangular weir.

(0139)

	Liquid tank inner width	Length inside the liquid tank and length of the weir	Liquid height (liquid depth)	Liquid volume
Liquid tank	1.0 m	10 m	1.1 m	Liquid tank internal liquid volume 11 m ³
Box B1	0.2 m	10 m	0.3 m	Box B1 liquid volume 0.6 m ³
Box B2	0.4 m	1 m	0.5 m	Box B2 liquid volume 0.2 m ³
				Total of 11.8 m ³

The total circulating filtration volume per hour for the above-noted liquid volume of 11.8 m³ will be 11.8 m³ × 3 = 35.4 m³/hr.

(0140) Further, if the filtration volume of the treatment liquid in the liquid tank and in the overflow box is set to 70% and 30%, respectively, of the total filtration volume, the result will be as shown below.

Amount of filtration of liquid in the liquid tank	35.4 m ³ /hr × 70% = 24.8 m ³ /hr
Overflow box	35.4 m ³ /hr × 30% = 10.6 m ³ /hr
Amount of filtration of the internal liquid	

Total of 35.4 m³/hr

However, if the height h from the top edge to the liquid surface (see Figure 12 (A)) is set to the general average of $h = 10$ mm, the amount of overflow over the conventional rectangular weir will be as follows. (0141) When $h = 10$ mm, if the weir width is set to 500 mm as described above, the overflow amount will be approximately 55.2 liters/min, and because the weir width is a total of 11 m when combining the length of the box B1 (10 m) and the length of the box B2 (1 m), the result will be $55.2 \text{ liters/min} \div 500 \text{ mm} \times 11 \text{ m} \times 60 \text{ min} = 72.86 \text{ m}^3/\text{hr}$, which greatly exceeds the above-noted circulating filtrate amount of $10.6 \text{ m}^3/\text{hr}$ that was set for the overflow boxes.

(0142) This means that the amount of liquid in the overflow box is too large and will exceed the capacity of the pump to suction the liquid from the overflow box, and as the liquid surface in the liquid tank and the liquid surface in the overflow box rapidly near the same position, there will be no difference between these liquid levels, and it will not be possible to sufficiently recover the floating impurities in the overflow box. As a result, there will be occurrence of a serious problem of a large number of defective products, with the occurrence of issues such as insufficient liquid filtration and the adhesion of impurities to the surface of the plated product, resulting in roughness.

(0143) Further, because the position of the liquid surface in the liquid tank varies from time to time due to the introduction of liquid that had adhered to the article to be processed during the pretreatment process of the article, due to the drawing of the liquid onto the article, and due to the evaporation of water during warming of the liquid by the heat exchanger described above, the adjustment of the position of the liquid surface in each liquid tank and the adjustment of the amount of liquid flow into the overflow box frequently became both troublesome and yet critical work.

(0144) To this point, the present invention employs weir parts with notches for liquid overflow as described above, so even if there is vertical variability in the liquid surface inside the liquid tank, the amount of overflow may be kept smaller than may be observed with the conventional rectangular weirs, thereby maintaining the amount of liquid to be suctioned from the bottom of the liquid tank and the amount of liquid to be suctioned from the overflow box as set according to the liquid volume of circulating filtration based on the filtration pump capacity. Therefore, it will be possible to achieve the appropriate filtration of the liquid, thereby greatly reducing the occurrence of defective products.

(0145) In the aforementioned weir parts 21 and 22, notches 20 are formed, and the weir parts are anchored at the upper edge of partition walls $w1$ and $w2$ between the liquid tank and the overflow boxes B1 and B2. However, in order to further simplify and facilitate the proper filtration of the liquid, it is also possible to adopt weir members that can be detachably installed at the upper edge of the partition wall between the liquid tank and the overflow box as the weir parts. Figure 13 shows one example of such a detachable weir member, while Figure 14 similarly shows another example of a detachable weir member.

(0146) Figure 13 (A) is a perspective view of a weir member 8. Figure 13 (B) shows the weir member in use and depicts a cross-section along the X-X line in Figure 13 (A). The weir member 8 integrally forms a wall insertion portion 800 with a cross-sectional gate shape (or U-shape) in a plate 81 formed with four rectangular notches 80 for use in liquid overflow and further integrally forms reinforcement ribs 83 away from the notches 80.

(0147) While not limited to this example, the wall insertion portion 800 here is in the form of a recess, and a flexed plate part 82 having an inverted L-shape is integrally provided in the middle part of one side of a plate 81. The flexed plate part 82 and the bottom portion of the plate 81, which overlaps this part, are each provided with a long hole 82a for bolt penetration that is long in the vertical direction. The weir member 8 is not limited to this example, but here, it is integrally formed entirely of a synthetic resin (for example, vinyl chloride resin if the processing liquid is an electroplating liquid) that is resistant to corrosion by the liquid in the liquid tank.

(0148) This weir member 8 may be inserted from above into the partition wall between the liquid tank 11 (12, 13, 14, and 15) and the overflow boxes B1 and B2. Figure 13 (A) shows the weir member 8 being inserted into the partition wall $w2$ between the liquid tank 11 and the overflow box B2 from above at the wall insertion portion 800. The weir member 8 may be used in as a single member or as two or more members according to the liquid amount in the liquid tank, the sizes of the notches 80, or the like. If more than one member is used, the adjacent weir members 8 may be brought into contact with each other and inserted into the partition wall $w2$. Although not shown in the figure, a weir member similar to the weir member 8 may also be inserted into the partition wall $w1$ between the liquid tank and the overflow box B1.

(0149) As shown in Figure 13 (A), when the weir member 8 is inserted into the partition wall $w2$, a liner LN for height adjustment can be placed at the top end of the aforementioned wall insertion portion 800 as necessary, and the weir member 8 may be mounted directly or via the liner LN to the top end of the partition wall $w2$. Further, if the weir member 8 is inserted into the partition wall $w2$ in this manner, for example, a bolt 84 may be passed through the long holes 82a for bolt penetration from the side of the flexed plate portion 82 with an inverted L-shape, a bolt hole with an inner diameter that is just large enough to enable passage of the bolt 84 that was provided in the wall $w2$ in advance, and the long hole 82a for bolt penetration in the plate 81, and the bolt may be tightened with a nut. At this time, as necessary, a liquid sealant 840 that was integrated onto the bolt 84 may be applied to outer surfaces of the flexed plate portion 82 and plate 81, thereby ensuring liquid-tightness in the closure of the open portion of the long hole 82a for bolt penetration.

(0150) In this way, the weir member 8 may be attached to the partition wall between the liquid tank and the overflow box at the predetermined height, which is to say, the height positions of the notches 80 may be set to a height position at which the predetermined liquid overflow amount may be obtained. With this weir member 8, because liquid overflow notches 80 are formed in the weir member, the weir member has the same advantages as the weir parts 21 and 22, in which the notches 20 were formed as described above.

(0151) Furthermore, according to this weir member 8, an appropriate weir member can be selected from among weir members 8 for which the overflow amount has been set, and the overflow amount can be easily changed by changing the mounting height of weir member 8, such as by changing liner LN to a different height, or by replacing weir member 8.

(0152) When the partition walls $w2$ and $w1$ are made of metallic materials that are inferior in terms of corrosion resistance to the treatment liquid, and the surface is coated with a corrosion-resistant synthetic resin or the like, the portion of the exposed metallic materials or the

like should be protected by inserting a corrosion-resistant sealant into the bolt holes or the like when providing the holes for the insertion of the bolt 84. Figure 14 (A) is a perspective view of the weir member 8'. Figure 14 (B) shows the weir member in use and depicts a cross section along the Y-Y line in Figure 14 (A). The weir member 8' is a variant of the aforementioned weir member 8, and it differs from the weir member 8 in the respects noted below. It is the same in all other respects to the weir member 8, and the same parts are marked with the same reference numbers.

(0153) In this weir member 8', long holes 82a for bolt penetration are also formed at the top of the plate 81, in which are formed rectangular notches 80 for liquid overflow. The long hole 82a is formed here in top sections at both ends of the plate 81. Further, an upper horizontal portion of the flexed plate part 82 with an inverted L-shape has been removed at the outer position of the reinforcement rib 83 at both ends of the plate 81.

(0154) As with the weir member 8, this weir member 8' is also inserted into the partition wall w2 at the wall insertion part 800 as shown in Figure 14 (B). This time, however, a rising wall W', which was integrally extended upwards from the top end of the partition wall w2 in advance, penetrates the site of the removal of said upper horizontal portion of flexed plate part 82 with an inverted L-shape and overlaps the upper parts of both ends of the plate 81. Although not shown in the figure, a weir member similar to the weir member 8' may also be inserted into the partition wall w1 between the liquid tank and the overflow box B1.

(0155) Furthermore, the weir member 8' is not only bolted to the partition wall w2 at the bottom of the plate, as is the case with the weir member 8, but it may also be bolted to the rising wall W' at the top of the plate 81. In other words, the bolt 84' may be passed through a bolt hole that has an inner diameter that is just large enough to be penetrated by the bolt 84' and a long hole 82a for bolt penetration at the top of the plate 81 that was provided in advance in rising wall W', and this bolt may be tightened with a nut. At this time, as necessary, liquid sealant 840 that was integrated onto the bolt 84' may be applied to the plate 81, thereby ensuring liquid-tightness in the closure of the open portion of the long hole 82a for bolt penetration. In this way, the weir member 8' may be attached to the partition wall between the liquid tank and the overflow box at the predetermined height, which is to say, the height positions of the notches 80 may be set to a height position at which the predetermined liquid overflow amount may be obtained.

(0156) This weir member 8' also has the same advantages as the weir member 8. Furthermore, in the weir member 8', the wall W' corresponding to a part of the partition wall w2 is overlaid and anchored to that part, so even if there is a risk of damage due to the application of significant liquid pressure in the liquid tank in the case of the weir member 8, there is no such risk with the weir member 8'. With the weir members 8 and 8', described with reference to Figures 13 and 14, the liquid overflow notches 80 are rectangular notches, but in the weir members 8 and 8', the liquid overflow notches may be inverted triangular notches in the weir parts 21 and 22 as described above, or may be notches of yet another shape.

(0157) Also, in place of the through-bolt 84 described above for securing the weir members 8 and 8' to the partition walls w1 and w2, it is also acceptable to secure said weir members to the partition walls w1 and w2 by threading them into the weir members 8 and 8' such that they abut the wall surfaces of the partition walls w1 and w2.

(0158)

(EFFECT OF THE INVENTION) With the present invention as described above, it is possible to provide a liquid tank having one, two, or more overflow boxes to force the overflow of impurities suspended in the upper layer of a liquid accumulated in a liquid tank together with liquid from a weir part, resulting in the following advantages.

(1) Even if the liquid level position in the liquid tank changes vertically, there will be no significant change in the amount of liquid flowing over the weir part into the overflow box as may be observed with the conventional rectangular weir.

(2) In addition to the floating impurities that are easily suspended on the liquid surface in the liquid tank, impurities that are more likely to be suspended in the lower layers can be efficiently recovered following flow into the overflow box.

(3) Therefore, it will also be possible to reduce the amount of impurities remaining in the liquid tank.

(4) As a result, when filtration of said liquid is performed by suctioning the liquid from both the bottom of the liquid tank and the overflow box using the pump, it will be possible to effectively perform this filtration processing.

(5) Therefore, when performing article processing using the processing liquid in the liquid tank, it will be possible to reduce the effects of impurities and to improve the quality of the article after processing.

(6) It will be easier to set the volume of liquid flowing into the overflow box.

(0159) Also, with the present invention, it is possible to provide a weir member that provides a weir part of a liquid tank having one, two, or more overflow boxes to force the overflow of impurities suspended in the upper layer of the liquid accumulated in the liquid tank together with the liquid from the weir part, resulting in the following advantages.

(1) When used as the weir part following attachment to the liquid tank, even if the liquid level position in the liquid tank changes vertically, there will be no significant change in the amount of liquid flowing into the overflow box.

(2) In addition to the floating impurities that are easily suspended on the liquid surface in the liquid tank, impurities that are more likely to be suspended in the lower layers can be efficiently recovered following flow into the overflow box.

(3) Therefore, it will also be possible to reduce the amount of impurities remaining in the liquid tank.

(4) As a result, when filtration of said liquid is performed by suctioning the liquid from both the bottom of the liquid tank and the overflow box using the pump, it will be possible to effectively perform this filtration processing.

(5) Therefore, when performing article processing using the processing liquid in the liquid tank, it will be possible to reduce the effects of impurities and to improve the quality of the article after processing.

(6) It will be easier to make changes to the volume of liquid flowing into the overflow box.

(BRIEF DESCRIPTION OF THE DRAWINGS)

(FIGURE 1) This is a schematic plan view showing a plating device, which is one example of an article processing device that uses a liquid, that utilizes liquid tanks according to the present invention.

(FIGURE 2) This is an enlarged plan view of part of the liquid tanks and the surrounding area.

(FIGURE 3) This is an enlarged side view of one of the liquid tanks shown in Figure 2 and the surrounding area.

(FIGURE 4) This is a perspective view of one portion of the liquid tank.

(FIGURE 5) (A) is a perspective view of an anode case, (B) is a perspective view of an anode bag, and (C) is a perspective view of a cathode, a hanger, a hook member, and the like.

(FIGURE 6) (A) is a plan view of a first suction head, (B) is a side view of the first suction head, and (C) is a cross-sectional view of a bottom groove in the liquid tank, the bottom of an overflow box, and the related parts thereof.

(FIGURE 7) This is a side view of a second suction head.

(FIGURE 8) This is a perspective view of another example of a second suction head.

(FIGURE 9) This is a side view showing a cross-section of part of a manifold with two branch pipes.

(FIGURE 10) This is a side view showing a cross-section of part of a manifold with five branch pipes.

(FIGURE 11) (A) is a block diagram of a control circuit of the plating processing device shown in Figure 1, and (B) is a diagram showing a schematic configuration of the liquid level position detection device.

(FIGURE 12) (A) is a diagram showing an example of a conventional rectangular weir member, (B) is a diagram showing an example of a weir member having rectangular notches for liquid overflow, and (C) and (D) are diagrams showing examples of weir member having inverted triangular notches for liquid overflow.

(FIGURE 13) (A) is a perspective view of one example of a detachable weir member according to the present invention, and (B) is a cross-sectional view along the X-X line of (A) showing the weir member in use.

(FIGURE 14) (A) is a perspective view of another example of a detachable weir member according to the present invention, and (B) is a cross-sectional view along the Y-Y line of (A) showing the weir member in use.

(FIGURE 15) This is a side view showing a cross-section of part of a conventional example of a manifold.

(FIGURE 16) This is a schematic perspective view of a conventional liquid tank and its surrounding area.

(EXPLANATION OF REFERENCES)

11, 12, 13, 14, 15: Plating processing liquid tank (example of an article treatment liquid tank)

16: Pretreatment water washing tank

L: Plating liquid

W: Wash water

D1, D2, D3, D4: Work deck

101: Internal bottom of the liquid tank

102: Internal bottom groove provided in the liquid tank

103: Aeration device

103a: Air bubbles

104: First suction head

104a: Pipe connection port

104b: Liquid suction hole

105: Air shut-off wall plate

105a: Support piece

105b: Support plate

106: Second suction head

106a: Pipe connection port

106b: Liquid suction hole

106c: Support piece

106d: Support plate

107: Suction head

107a: Pipe connection port

107b: Liquid suction hole

107c: Foot

108: Third suction head

B1, B2: Overflow box

w1, w2: Partition wall between the liquid tank and overflow box

21, 22: Weir part

20: Notch of the weir part

A: Anode busbar

C: Cathode busbar

H: Hanger

S: Hook member

m': Anode material

CS: Anode case

CSb: Anode bag

a1, a2: Article to be plated

3: Circulating filtration device

31: Filter

32: Circulating pump (in this case, a centrifugal pump)

33: Manifold for liquid merging

v11 to v15: Manual opening/closing valve

v16: Check valve

4A, 4B: Circulating filtration device

41: Filter

42: Circulating pump (in this case, a centrifugal pump)

430, 431, 432: Manifold for liquid merging

433: Manifold for liquid distribution

v41 to v45: Manual opening/closing valve

v46: Check valve

45: Temperature control circuit

451: Heat exchanger

va', vb': Manual opening/closing valve

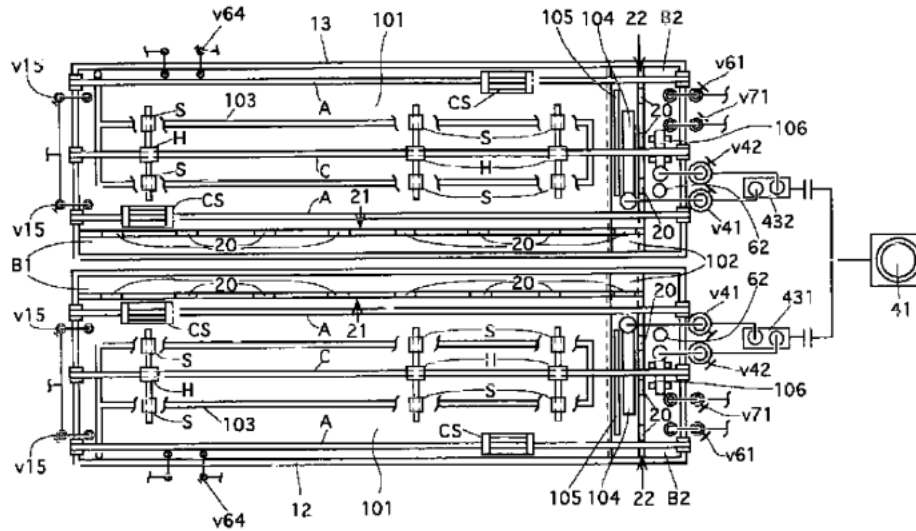
V: Flow rate adjustment valve

452: Manifold for liquid distribution

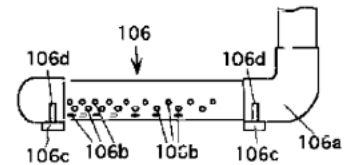
51: Clearing and replacement device
v51, v52, v61 to v64: Manual opening/closing valve
511: Clearing and replacement tank
v53: Foot valve
401: Manifold main body
402, 403: Branch pipe
401a: Main opening of manifold main body 401
401b: Other end of manifold main body 401
9: Conventional manifold
91: Manifold main body
91a: Main opening
91b: Hole
92: Branch pipe
90: Flow rate adjustment valve
6: Device for liquid mixing and liquid level position control
60: Filter
61: Circulating pump (in this case, a centrifugal pump)
62: Liquid level position detection device
621 to 625: Electrode
63: Liquid outflow port
Vo: Check valve
J1, J2, J3: Manifold for liquid merging
J4, J5, J6: Manifold for liquid distribution
Va: Motorized valve for liquid discharge
Vb: Motorized valve for liquid supply
7: Control unit
71: Operation panel
600: Manifold main body
601 to 605: Branch pipe

600a: Main opening of manifold main body 600
600b: Other end of manifold main body 600
200: Conventional rectangular weir
201 to 203: Weir part
N1, N2, N3: Notch
8, 8': Weir member
80: Rectangular notch for liquid overflow
81: Plate
82: Inverted L-shaped flexed plate
82a: Long hole for bolt penetration
83: Reinforced rib
84, 84': Bolt
800: Wall insertion portion
840: Liquid sealant
LN: Liner
W': Rising wall
10': Liquid tank
L': Liquid
B1', B2', B3': Overflow box
21', 22', 23': Rectangular weir
v1' to v7', v1'', v7'', v8', v9': Manual opening/closing valve
V': Foot valve
Lb, Lb': Liquid flow port
F: Filter
P: Circulating pump
H: Heat exchanger
100': Liquid return port
511v: Foot valve
511': Liquid discharge port

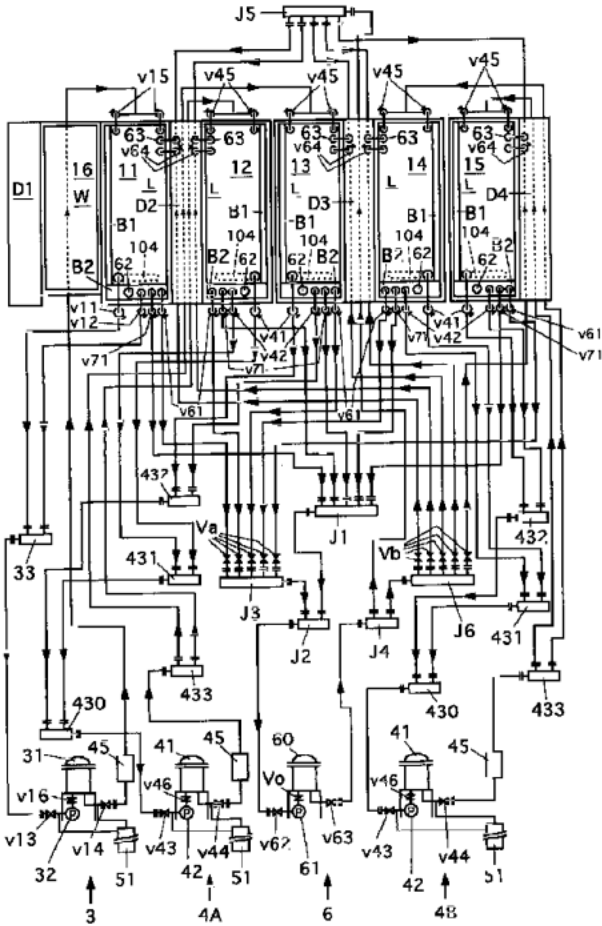
(FIGURE 2)



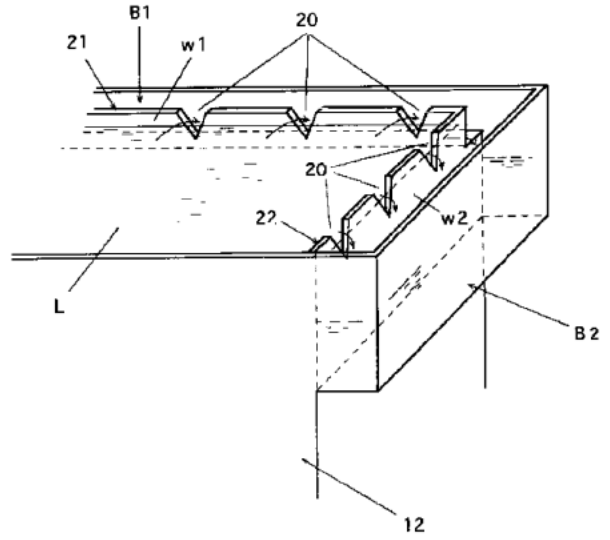
(FIGURE 7)



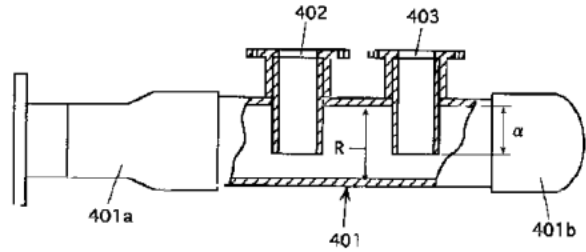
(FIGURE 1)



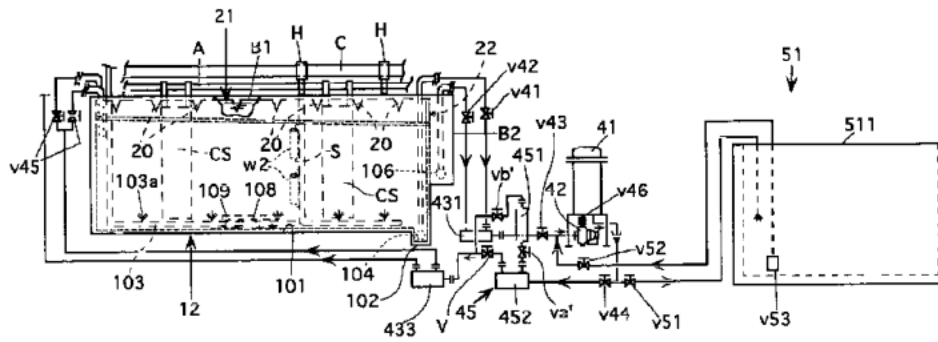
(FIGURE 4)



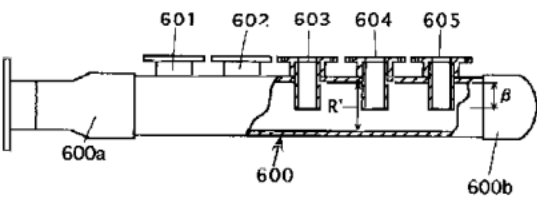
(FIGURE 9)



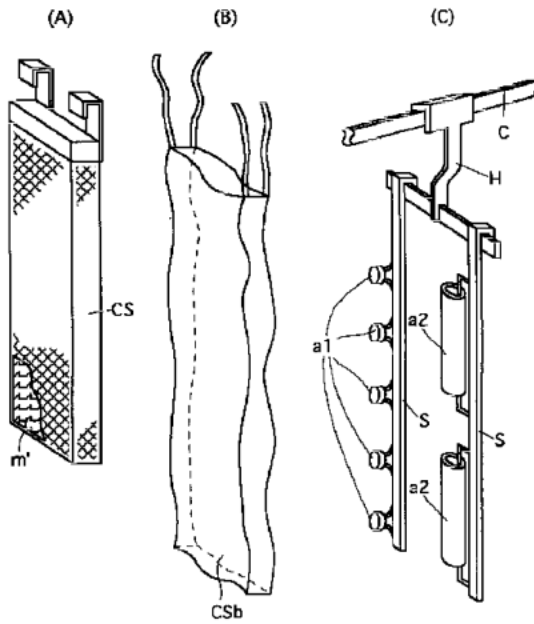
(FIGURE 3)



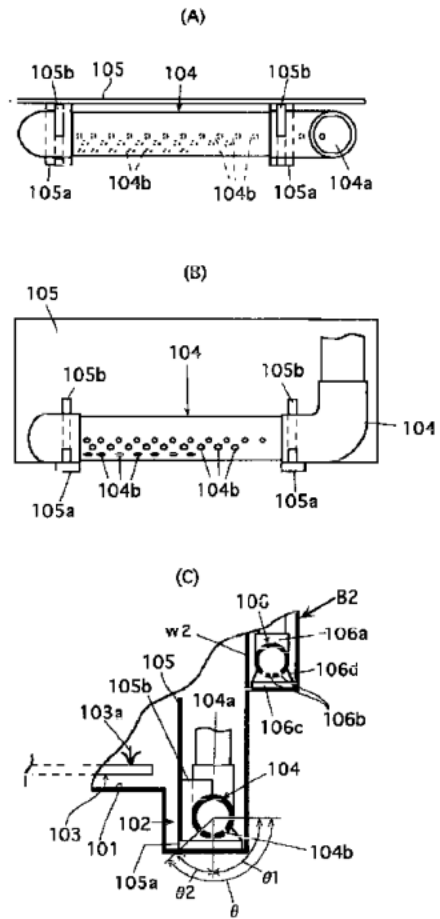
(FIGURE 10)



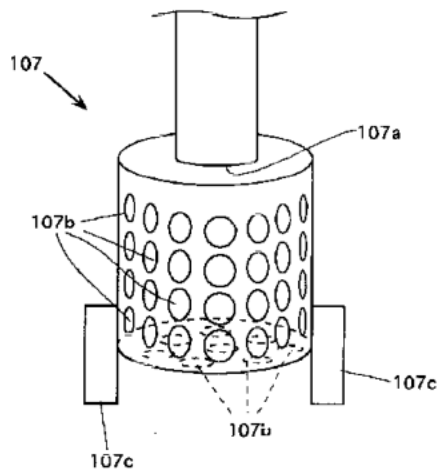
(FIGURE 5)



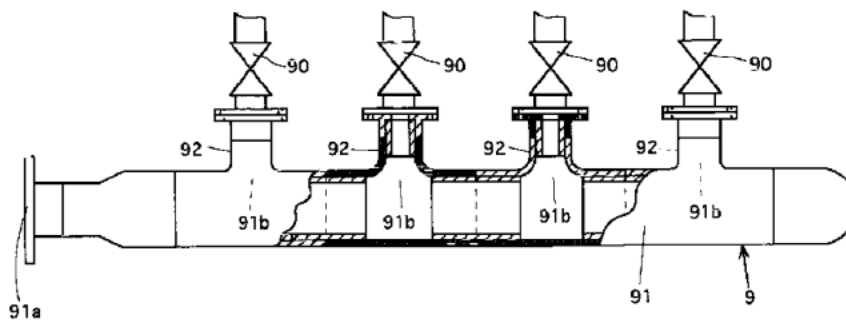
(FIGURE 6)



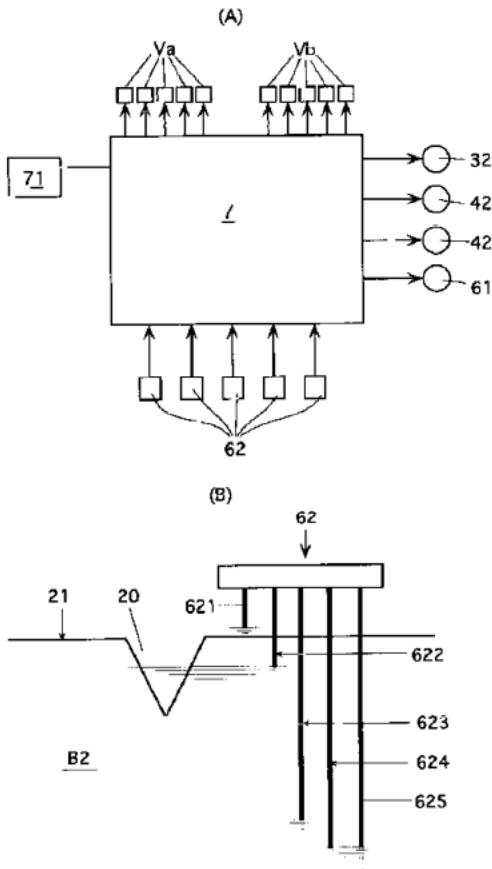
(FIGURE 8)



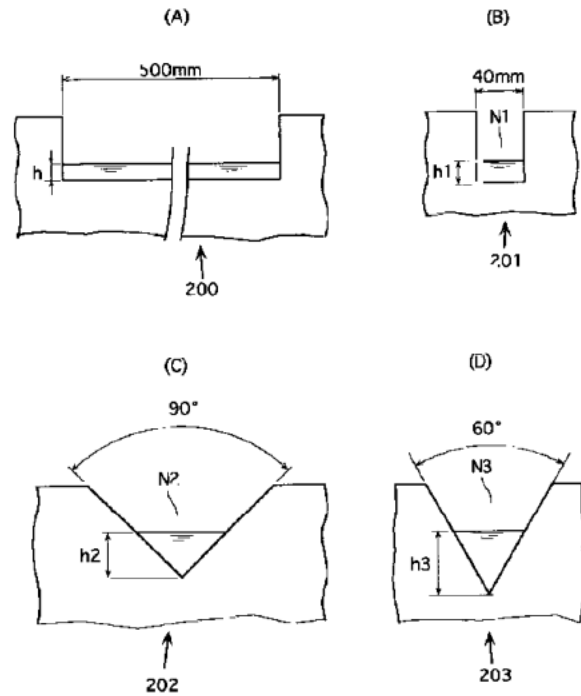
(FIGURE 15)



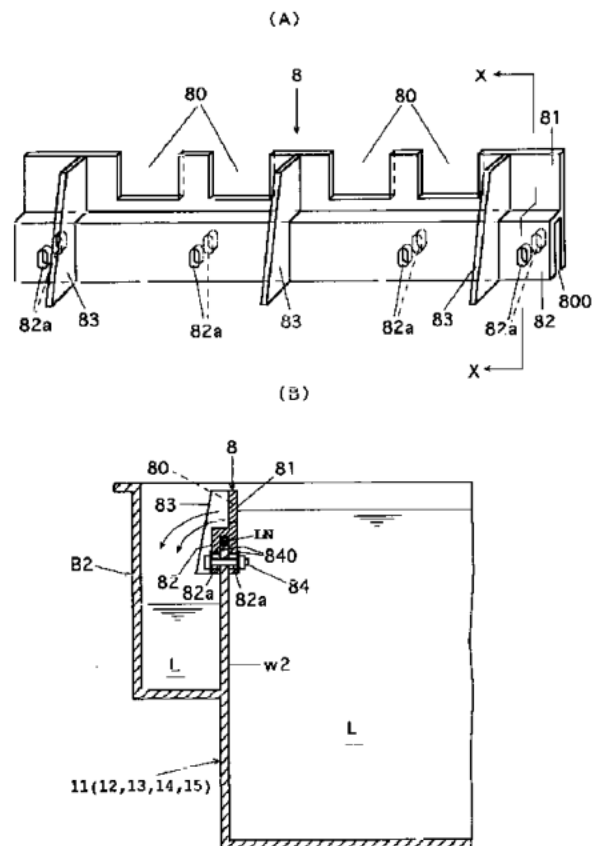
(FIGURE 11)



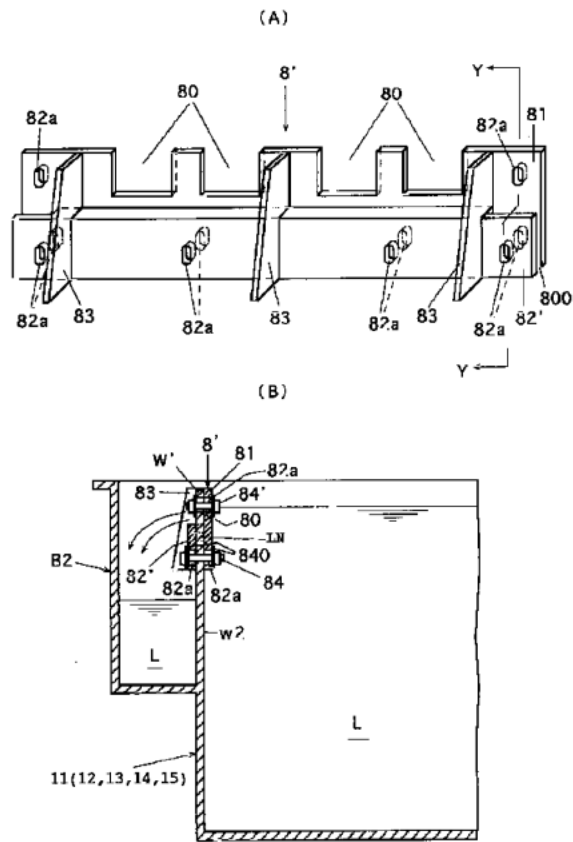
(FIGURE 12)



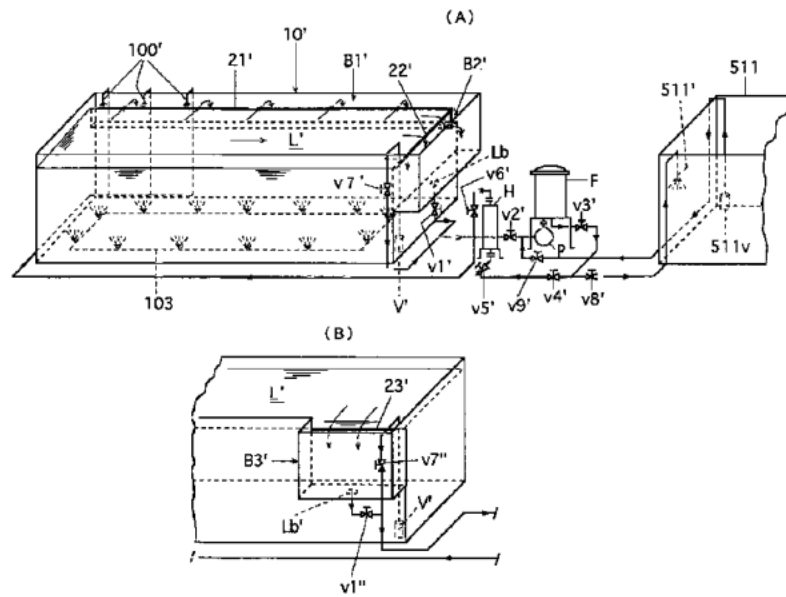
(FIGURE 13)



(FIGURE 14)



(FIGURE 16)



(AMENDMENT)

(DATE OF SUBMISSION) November 2, 2000 (11/02/2000)

(AMENDMENT 1)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0041

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0041) While there are many plating treatments that may be performed on the material to be treated, such as plating with copper, nickel, zinc, tin, or alloys thereof, in one example in the case of nickel plating, the plating liquid L is used as a nickel plating liquid, the anode case CS is a corrosion-resistant titanium cage, and nickel chips are housed inside this cage as the anode material m'.

(AMENDMENT 2)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0064

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0064) When the third suction head 108 is employed, the liquid that is suctioned by the suction head is eventually mixed with the liquid that was suctioned through the valves v11 and v12 and is piped to the pump 32 via the valves and the like, ensuring that the liquid will merge and flowed into the pump 32. The liquid delivery circuit includes a pipe that branches the liquid delivery port of the filter 31 to two locations of the liquid tank 11 via a manual opening/closing valve v14 and a temperature control circuit 45, as well as two manual opening/closing valves v15. The connection to the liquid tank 11 does not have to be at two locations in this way, and it is acceptable to have a connection at one location or three or more locations.

(AMENDMENT 3)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0067

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0067) Because the circulating filtration device 4A and the circulating filtration device 4B have exactly the same structure and operation, only the device 4A shall be explained, and the description of device 4B shall be omitted. The same parts in the devices 4A and 4B are marked with the same reference numbers in the figures. The circulating filtration device 4A includes a filter 41 and a circulating pump 42 for liquid circulation, as shown in Figure 1. The liquid tanks 12 and 13 can communicate with a liquid suction port of the circulating pump 42 (here, a centrifugal pump) via the liquid suction circuit. The filter 41 can communicate with the liquid tanks 12 and 13 via the liquid delivery circuit.

(AMENDMENT 4)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0072

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0072) The temperature control circuit 45 in the circulating filtration device 3 has basically the same structure as this temperature control circuit 45 in the circulating filtration devices 4A and 4B. However, in the temperature control circuit 45 in the circulating filtration device 3,

the valve corresponding to the valve vb' and the valve outlet corresponding to the flow rate adjustment valve V are collected in a single pipe without using a manifold, and are further branched into two locations of the liquid tank 11 via the two manual opening/closing valves v15.

(AMENDMENT 5)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0077

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0077) The branch pipes 402 and 403 are inserted as projections into the main body of the manifold from a direction that is orthogonal to the longitudinal direction of the manifold main body 401 at two locations in the longitudinal direction, and the (projecting insertion height) α of each of the branch pipes 402 and 403 into the main body of the manifold is in the range from approximately one-half to no more than three-fifths of the internal diameter R of the manifold main body 401.

(AMENDMENT 6)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0092

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0092) As a result, it will be possible to recover the plating liquid inside the liquid tank 12 into the clearing and replacement tank 511 via the valve 41, the manifold 431, and the manifold 430 (not shown in figure 3; see figure 1) on the liquid tank 12 side and the valve v43, the pump 42, the check valve v46, the filter 41, and the valve v51 on the pump liquid suction side. Activated carbon filtration processing, liquid composition restoration processing, and the like are performed on the liquid that was recovered into the clearing and replacement tank 511. In order to return the processed liquid from the clearing and replacement tank 511 to the liquid tank 12, the valve v51 of the clearing and replacement device 51, the valve v43 that connects to the liquid suction port of the pump 42, and the valve v45 on the liquid tank 13 side are closed, while valve v52 of the clearing and replacement device, the valve v44 that connects to the temperature control circuit 45, the valve V of temperature control circuit, and the valve v45 on the liquid tank 12 side are opened, and the pump 42 is operated.

(AMENDMENT 7)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0095

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0095) As a result, the restored plating liquid is drawn in from the foot valve v53 at the bottom of the clearing and replacement tank 511 and is returned to the liquid tank 13 from the valve v45 on the liquid tank 13 side via the valve v52 of the clearing and replacement device 51, the pump 42, the check valve v46, the filter 41, the valve v44, the manifold 452 of the temperature control circuit 45, the valve V, and the manifold 433. In this way, it will be possible to perform the clearing and replacement filtration of the entirety of the plating liquid in each of the liquid tanks 12 and 13.

(AMENDMENT 8)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0097

(AMENDMENT METHOD) Modification
(AMENDMENT DETAILS)

(0097) If there is installation space for a large-capacity clearing and replacement tank 511, the clearing and replacement filtration work may be performed for the two tanks at the same time. In the case of the circulating filtration device 4B, as in the case of the filtering device 4A, the plating liquid in the liquid tanks 14 and 15 can be subjected to circulating filtration. In addition, the temperature of the plating liquid can be controlled. Further, the entirety of the plating liquid in the liquid tanks 14 and 15 can be subjected to clearing and replacement filtration.
(AMENDMENT 9)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification
(NAME OF ITEM SUBJECT TO AMENDMENT) 0103

(AMENDMENT METHOD) Modification
(AMENDMENT DETAILS)

(0103) As shown in Figure 1, the device 6 for liquid mixing and liquid level position control is provided with: a liquid circulating pump (here, a centrifugal pump) 61; a circuit to draw the liquid to the liquid suction port of a pump 61 from the respective overflow boxes B2 of the liquid tanks 11 to 15 via a manual opening/closing valve v71, a first manifold J1 for liquid merging, a second manifold J2 for liquid merging, and a manual opening/closing valve v62; a circuit that can draw the liquid from the respective overflow boxes B2 of the liquid tanks 11 to 15 to a third manifold J3 for liquid merging via a manual opening/closing valve v61 and corresponding motorized valves Va (of which there are a total of five) for liquid discharge from each liquid tank and from the third manifold J3 to a liquid suction port of the pump 61 via the second manifold J2 and the manual opening/closing valve v62; a circuit that can draw the liquid from a discharge port of the pump 61 to the liquid tanks 11, 12, 13, 14, and 15 via a check valve V0 and a filter 60 and via a manual opening/closing valve v6, a fourth manifold J4 for liquid distribution, and a fifth manifold J5 for liquid distribution; and a circuit that can draw the liquid from the discharge port of the pump 61 to the liquid tanks 11, 12, 13, 14, and 15 via the check valve V0 and the filter 60 and via the valve v63, the fourth manifold J4, a sixth manifold J6 for liquid distribution, corresponding motorized valves Vb (of which there are a total of five) for liquid supply to each liquid tank, and a manual opening/closing valve v64. The device 6 for liquid mixing and liquid level position control further includes a liquid level position detection device 62 that may be installed in the overflow box B2 of each liquid tank.

(AMENDMENT 10)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification
(NAME OF ITEM SUBJECT TO AMENDMENT) 0106

(AMENDMENT METHOD) Modification
(AMENDMENT DETAILS)

(0106) Each liquid level position detection device 62 has the same structure, including a total of five electrodes 621 to 625 that may be inserted from above to hang inside the overflow box B2 as shown in Figure 11 (B), which shows the general structure of one of these devices. These electrodes are shortest to longest in the sequence 621, 622, 623, and 624, and are inserted more deeply into box B2 the longer the electrodes are. An electrode 625 is a ground electrode and may be inserted into box B2 to approximately the same depth as, or deeper than, the electrode 624.

(AMENDMENT 10)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0110

(AMENDMENT METHOD) Modification
(AMENDMENT DETAILS)

(0110) Separately from the discharge circuit via motorized valve Va, the liquid that is to be discharged via the valve v71 (normally, this valve is open) and the manifold J1 will be merged with the discharge liquid from the motorized valve Va and the manifold J3 inside the manifold J2, and this merged liquid will be suctioned into the pump 61 via the valve v62. In addition, when the liquid level position inside the liquid tank falls and separates from the lower end of the electrode 623, the motorized valve Va for liquid discharge will be closed under the instructions of the control unit 7, while the motorized valve Vb for liquid supply will be opened and the liquid will be delivered to the liquid tank via the valve v64. At this time, the liquid from the pump 61 is delivered, via the check valve V0 and the filter 60 and via the aforementioned manifold J6, the motorized valve Vb, and a valve V64 by one of the two branch pipes of the manifold J4, to the liquid tank, and at the same time, the liquid is returned from the other branch pipe of the manifold J4 to the manifold J5 and to a liquid outflow port 63 to the liquid tank.

(AMENDMENT 12)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification
(NAME OF ITEM SUBJECT TO AMENDMENT) 0117

(AMENDMENT METHOD) Modification
(AMENDMENT DETAILS)

(0117) The branch pipes 601 to 605 are inserted as projections into the main body of the manifold from a direction that is orthogonal to the longitudinal direction of the manifold main body 600 at five locations in the longitudinal direction, and the degree of projection (projecting insertion height) β of each branch pipe to the main body of the manifold is in the range from approximately one-half to no more than three-fifths of the internal diameter R' of the manifold main body 600. The projecting insertion heights of the branched pipes 601 to 605 into the manifold main body 600 should be such that the pressure (negative or positive pressure) inside the manifold main body will be uniform whether under the pump liquid suction pressure (negative pressure) or the liquid delivery pressure (positive pressure) of the pump 61 on the manifold main body.

(AMENDMENT 13)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification
(NAME OF ITEM SUBJECT TO AMENDMENT) 0120

(AMENDMENT METHOD) Modification
(AMENDMENT DETAILS)

(0120) With the device 6 for liquid mixing and liquid level position control described above, when the liquid level in the overflow box B2 of each liquid tank is in the normal position, each of the valves Va and Vb will be opened and the liquid circulating pump 61 will be operated, ensuring that the liquid is suctioned from the overflow box B2 of each of the plurality of liquid tanks 11 to 15 via the valves v61 and v71. When the liquid in each tank reaches each branch pipe of the first manifold J1 and the third manifold J3 for liquid merging, it will flow into the main body of said manifold to be merged, further flowing to the branch pipes of the second manifold J2 for liquid merging from said manifold main body, after which the liquid of each tank will be drawn into the liquid circulating pump 61 after having been mixed via the main body of said manifold J2.

(AMENDMENT 14)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0124

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0124) The filter 60 may be smaller than the filters 31 and 41 that may be used for the conventional circulating filtration and that can handle the amount of liquid flowing into the overflow box. Further, as already mentioned, it is also adequate to use a single filter 60. With regard to the circulating filtration that may be performed by means of the circulating filtration devices 3, 4A, and 4B on the plating liquid in the plating processing device shown in Figure 1, when looking at each liquid tank, it is possible to perform circulating filtration approximately three times per hour for the volume of liquid housed in a single liquid tank, for example, according to the conventional procedure. In other words, approximately three times the liquid capacity of the tank can be used

as a standard. In addition, the liquid processing volume for liquid mixing and liquid level control using the circulating filtration device 6 can be, for example, an amount of circulating filtration that is approximately half of the liquid capacity of a single liquid tank per hour. In other words, approximately 0.5 times the liquid capacity of the tank can be used as a standard.

(AMENDMENT 10)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0137

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0137) In the following table, M indicates the overflow liquid volume liter/min over the rectangular weir 200, m indicates the overflow liquid volume liter/min at each notch, and P indicates the number of notches. The units of h, hl, h2, and h3 are millimeters.

Rectangular weir 200 with a width of 500 mm		Weir part 201 with rectangular notch N1 having a width of 40 mm			Weir part 202 with notch N2 having a lower apex angle of 90°			Weir part 203 with notch N3 having a lower apex angle of 60°		
h	M	hl	m	P	h2	m	P	h3	m	P
10	55.2	18.4	11.0	5	28.0	11.0	5	38.1	13.8	4
15	101.4	27.6	20.3	5	39.0	25.2	4	48.6	25.2	4
20	156.1	36.8	31.2	5	46.5	39.2	4	57.9	39.2	4
25	218.2	46.0	43.6	5	53.0	54.3	4	66.0	54.3	4

When using the conventional so-called rectangular weir in which the upper edge extends in a horizontal line, even if the amount of liquid to be suctioned from the bottom of the liquid tank and the amount of liquid to be suctioned from the overflow box are set at a predetermined ratio depending on the capacity of the filtration pump, if there is a significant increase in the amount of overflow due to a slight increase in the liquid surface in the liquid tank, the amount of liquid in the overflow box will increase excessively beyond the capacity of the pump to suction the liquid from the overflow box. Gradually, the liquid surface in the liquid tank and the overflow box will near the same position, resulting in a small gap, and in the end, it will not be possible to fully recover floating impurities in the overflow box, as has already been described. This point will be described in a bit more detail.

(AMENDMENT 16)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) 0148

(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(0148) This weir member 8 may be inserted from above into the partition wall between the liquid tank 11 (12, 13, 14, and 15) and the overflow boxes B1 and B2. Figure 13 (B) shows the weir member 8 being inserted into the partition wall w2 between the liquid tank 11 and the overflow box B2 from above at the wall insertion portion 800. The weir member 8 may be used in as a single member or as two or more members according to the liquid amount in the liquid tank, the sizes of the notches 80, or the like. If more than one member is used, the adjacent weir members 8 may be brought into contact with each other and inserted into the partition wall w2. Although not shown in the figure, a weir member similar to the weir member 8 may also be inserted into the partition wall w1 between the liquid tank and the overflow box B1.

(AMENDMENT 17)

(DOCUMENT TITLE SUBJECT TO AMENDMENT) Specification

(NAME OF ITEM SUBJECT TO AMENDMENT) Figure 5

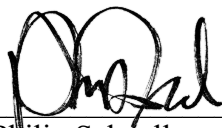
(AMENDMENT METHOD) Modification

(AMENDMENT DETAILS)

(FIGURE 5) (A) is a perspective view of an anode case, (B) is a perspective view of an anode bag, and (C) is a perspective view of a cathode bar, a hanger, a hook member, and the like.

I, Philip Schnell, hereby certify that I am competent to translate from Japanese to English and that the attached translation is, to the best of my knowledge and belief, a true and accurate translation of the document entitled “01a-JP_2001181898_A.pdf” from Japanese to English.

I hereby declare that all statements made herein of my own knowledge are true and correct under penalty of perjury and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code.

A handwritten signature in black ink, appearing to read 'Philip Schnell', is written over a horizontal line.

Philip Schnell
October 7, 2024

(19)日本国特許庁 (J P)

(12) 公 開 特 許 公 報 (A)

(11)特許出願公開番号
特開2001-181898
(P2001-181898A)

(43)公開日 平成13年7月3日(2001.7.3)

(51)Int.Cl.⁷
C 2 5 D 21/06
17/00

識別記号

F I
C 2 5 D 21/06
17/00

テマコード*(参考)
4 D 0 5 1

C
K
Z
B

// C 0 2 F 1/40

C 0 2 F 1/40

審査請求 有 請求項の数4 O L (全 28 頁)

(21)出願番号 特願平11-369087

(22)出願日 平成11年12月27日(1999. 12. 27)

(71)出願人 50001/069

川口 明

大阪市東住吉区山坂1-15-5

(72)発明者 長田 脩

奈良県生駒市ひかりが丘2丁目9-18

(72)発明者 川口 明

大阪市東住吉区山坂1-15-5

(72)発明者 川口 健司

大阪市東住吉区山坂1-15-5

(74)代理人 100074125

弁理士 谷川 昌夫

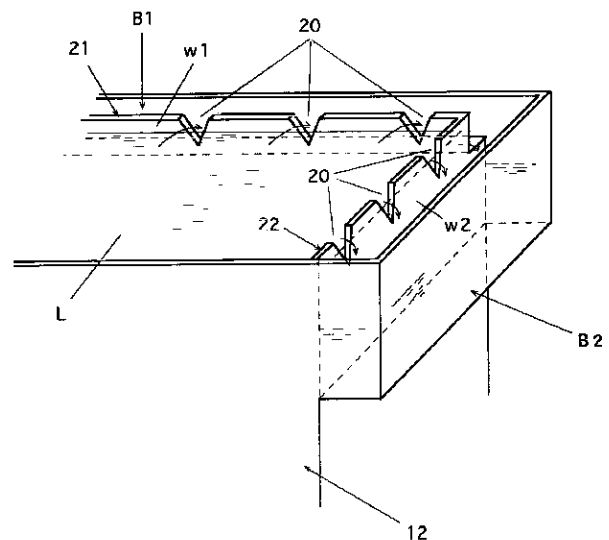
Fターム(参考) 4D051 AA06 AB01 CA15 CA23 DB03
DB11 DD25

(54)【発明の名称】 液槽及び堰部材

(57)【要約】

【課題】 液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部からオーバーフローさせるための1又は2以上のオーバーフローボックスを有する液槽であって、液槽中の液面位置が上下変動しても、堰部を越えてオーバーフローボックスへ流入する液量の著しい変動を招くことがなく、それだけ安定した液ろ過を行うことができ、また、液中の液面に浮上し易い浮上性不純物だけでなく、それより下層に浮遊し易い不純物もオーバーフローボックスへ流入させ、回収して効率よく液ろ過を行うことができる液槽及びそのための堰部材を提供する。

【解決手段】 液槽11~15はそれぞれ液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部21、22からオーバーフローさせるためのオーバーフローボックスB1、B2を有しており、該堰部21、22はそれぞれ該オーバーフローボックスと液槽との間の仕切り壁w1、w2の上端縁部にオーバーフロー用ノッチ20を形成するか、オーバーフロー用ノッチ80を形成した堰部材8、8'を脱着可能に付設して設けられている。



【特許請求の範囲】

【請求項1】液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部からオーバーフローさせるための1又は2以上のオーバーフローボックスを有しており、該堰部はオーバーフローボックスと液槽との間の仕切り壁の上端縁部にオーバーフロー用ノッチを形成するか、オーバーフロー用ノッチを形成した堰部材を脱着可能に付設して設けられていることを特徴とする液槽。

【請求項2】前記堰部を提供するノッチは複数設けられており、各ノッチは逆三角形状又は矩形状のノッチである請求項1記載の液槽。

【請求項3】液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部からオーバーフローさせるための1又は2以上のオーバーフローボックスを有する液槽の該堰部を提供するための堰部材であり、オーバーフロー用ノッチが形成されており、オーバーフローボックスと液槽との間の仕切り壁の上端縁部に脱着可能であることを特徴とする堰部材。

【請求項4】前記ノッチが複数設けられており、各ノッチは逆三角形状又は矩形状のノッチである請求項3記載の堰部材。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は液体による処理を行う物品処理装置、特にメッキ処理装置、写真現像処理装置、染色処理装置等の物品処理装置のように処理液のろ過が要求される液体による物品処理装置や、物品処理を伴わないで水等の液体をろ過処理する液体処理装置などに採用できる液槽、並びにかかる液槽に搭載使用できる堰部材に関する。

【0002】

【従来の技術】物品を処理液によって処理することは、メッキ液による物品へのメッキ処理、現像液による写真の現像処理、染色液による布帛等の染色処理、物品の洗浄処理等で知られているように各種分野において行われている。また、かかる処理液による物品処理は、液を物品に吹き付ける、液を物品に接触流下させる等、様々の方法でなされるが、代表的なものの一つとして、処理液を液槽に収容し、必要に応じ該液の液質乃至液組成、液槽における処理液の量、ろ過量、温度等を管理しながら該液槽内の処理液に被処理物品を浸漬して目的とする処理を実施する場合を挙げることができる。前記のメッキ処理、写真現像処理、染色処理等は通常この方法で実施される。

【0003】このような浸漬を伴う処理は一つの液槽のみを用いて行われることもあるが、物品を大量処理或いは多品種処理するために、多くの場合、複数の液槽が採用される。いずれにしても、液体による物品処理装置であって物品処理液槽を採用するものでは、該液槽中の処理液は使用を重ねるうちに、被処理物品による持ち込み

不純物、処理液の劣化など処理液変質により発生する不純物、外部から液槽内液中へ落下することがある不純物などの不純物が増えてくるから、かかる処理液をポンプとろ過器を含むろ過装置でろ過しつつ使用することが広く行われている。代表例として、処理液を液循環ポンプとろ過器を含む循環ろ過装置により循環ろ過する場合を挙げることができる。

【0004】また、物品処理を伴わないで液体中の不純物を除去する処理も行われている。その代表例として水のろ過処理を挙げることができる。いずれにしても、液槽における液中の不純物は、液中を複雑な流れに沿って移動するものの、概ね比重の小さいものから大きいものに従って、順次液中の上層部に浮遊するものから中層部に浮遊するもの、さらには比重が大きくて液中の下層部に浮遊するもの、さらには液槽の底部やその近傍に沈殿するものに分かれていく傾向にある。また、液槽内底から液中へエアを吹き込むエアレーションを行う場合が多々あり、そのときは、中間的な比重の不純物については、該エアの液中上昇流の影響を受けて液槽内の上下間において楕円形を描くように拡散浮遊するものもある。

【0005】そのため、液のろ過にあたっては、液槽内の液を液槽底部からポンプで吸引する一方、液槽上部に液オーバーフロー用の堰部を介してオーバーフローボックスを設置し、このボックスに液とともに浮遊物を流入させて該ボックスから液をポンプで吸引し、これら吸引した液をろ過器でろ過する。液体による物品処理装置等では、ろ過後の液は通常液槽に戻され、再使用される。

【0006】

【発明が解決しようとする課題】しかしながら、前記オーバーフローボックスに臨む堰部として、従来は上端縁が水平に直線的に延びている堰部（所謂矩形堰）が採用されていたので次の問題があった。すなわち、従来一般に広く採用されている矩形堰によると、液槽内処理液の液面高さが該堰部の上端縁より僅かに上昇し過ぎるだけでも、この堰部を越える流量は加速度的に著しく増大し、堰部の長さが長くなれば、それだけ益々オーバーフローする流量が著しく増大する。

【0007】液槽内処理液の適切なろ過を行うには、予め液層内底部からの吸液量とオーバーフローボックス内からの吸液量の各々を過器及びポンプの能力に応じて設定することを基本とする。しかし、処理液槽から堰部を越えてオーバーフローボックス内に流入する流量が過剰になると、これに対し該ボックス内からのポンプによる吸液量の割合が相対的に低下する結果となり、時間の経過とともに遂には液層内の液面位とボックス内液面位とが同位の高さとなり、落差を伴わない処理液の該ボックス内への流入となる。

【0008】このように落差に基づくオーバーフローボックス内への液流入が無くなった状態では、液槽から堰部を越えてのオーバーフローボックス内への流入液の流

速は極端に低下し、液中不純物のオーバーフローボックスへの流入も減少する。すなわち従来の矩形堰において、液槽内処理液中の上層部あたりに浮遊する浮上性不純物は、液槽とオーバーフローボックスにおける液面位の落差に基づく該ボックス内への液流入とともに、且つ、その液流速に乗って引き寄せられるようにして該ボックスへ流入するが、かかる落差が無い状態では該ボックスへの処理液流入量が著しく減少するとともに不純物の流入量もまた著しく減少する。そのため日時の経過とともに液槽内処理液の不純物濃度は上昇して、不良製品の発生を招くことになる。

【0009】また、物品処理を行う液槽内処理液の量が液槽内処理液の作業温度による蒸発、次工程への処理物品の移送にともなう処理液の汲み出し等によって次第に減少し、液面位が低下してくると、矩形堰を越えてオーバーフローボックス内へ流入する液量が減少してくる。かくして循環ろ過のためのポンプによる該ボックス内からの吸液の割合が該ボックス内への流入液量に対し相対的に増してくる結果となり、該ボックス内の貯液量は時間の経過とともに次第に減少し、そのまま放置すれば該ボックス内は渾濁状態となり、遂には該ポンプがエアを吸入し、該ポンプの運転停止、ひいては循環ろ過作業全体の運休に追い込まれる。

【0010】また、従来の上端縁が水平に直線的に延びている所謂矩形堰では、主として液面に浮上する浮上性不純物が堰部を越えてオーバーフローボックス内へ流入するものの、それより下層に浮遊する不純物については堰部を越え難く、換言すれば堰部を越える不純物の殆どは液槽内液面に浮上していたものだけであり、液槽内に残留する不純物の濃度は日時の経過とともに積増し、かかる不純物のろ過を充分に行い難くなるという問題もある。

【0011】そこで本発明は、液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部からオーバーフローさせるための1又は2以上のオーバーフローボックスを有する液槽であって次の利点を有する液槽を提供することを課題とする。

(1) 液槽中の液面位置が上下変動しても、堰部を越えてオーバーフローボックスへ流入する液量の著しい変動を招くことがない。

(2) 液槽内液面に浮上し易い浮上性不純物だけでなく、それより下層に浮遊し易い不純物もオーバーフローボックスへ流入させて効率よく回収できる。

(3) 従ってまた、それだけ液槽内に残留する不純物量を減らすことができる。

(4) これらにより液槽底部及びオーバーフローボックスの双方からポンプで吸液して該液をろ過処理する際には、そのろ過処理を効率よく行うことができる。

(5) 従ってまた、液槽内処理液により物品処理を行うときには、不純物の影響を少なくして処理後物品の品質

を向上させることができる。

(6) オーバーフローボックスへ流入する液量の設定をたやすくなし得る。

【0012】また本発明は液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部からオーバーフローさせるための1又は2以上のオーバーフローボックスを有する液槽の該堰部を提供するための堰部材であって、以下の利点を有するものを提供することを課題とする。

(1) 液槽に取り付けて堰部として用いた場合において、液槽中の液面位置が上下変動しても、オーバーフローボックスへ流入する液量の著しい変動を招くことがない。

(2) 液槽内液面に浮上し易い浮上性不純物だけでなく、それより下層に浮遊し易い不純物もオーバーフローボックスへ流入させて効率よく回収できる。

(3) 従ってまた、それだけ液槽内に残留する不純物量を減らすことができる。

(4) これらにより液槽底部及びオーバーフローボックスの双方からポンプで吸液して該液をろ過処理する際には、そのろ過処理を効率よく行うことができる。

(5) 従ってまた、液槽内処理液により物品処理を行うときには、不純物の影響を少なくして処理後物品の品質を向上させることができる。

(6) オーバーフローボックスへ流入する液量の設定、変更を簡易になし得る。

【0013】

【課題を解決するための手段】本発明は前記課題を解決するため、液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部からオーバーフローさせるための1又は2以上のオーバーフローボックスを有しており、該堰部はオーバーフローボックスと液槽との間の仕切り壁の上端縁部にオーバーフロー用ノッチを形成するか、オーバーフロー用ノッチを形成した堰部材を脱着可能に付設して設けられていることを特徴とする液槽を提供する。

【0014】本発明に係る液槽によると、該液槽内の液のろ過にあたり、液槽内の液を液槽底部から、そこに溜まった不純物とともにポンプで吸引できる一方、堰部から液を浮遊性不純物とともにオーバーフローボックスへ流入させて、それらを該ボックスからポンプで吸引でき、これら吸引した液をろ過に供することができる。かくして不純物を液とともに吸引してろ過することができる。

【0015】本発明に係る液槽では液オーバーフロー用ノッチを形成した部分が堰部として作用するようになっており、該ノッチからオーバーフローボックスへ液がオーバーフローする。従って液槽内の液面が、望ましい液オーバーフローのための液面位置より少しぐらい上昇しても、その上昇液面位置がノッチに臨んでいる限り、従

来の矩形堰のように堰の上端縁の全長にわたり一斉にオーバーフロー量が急激に増加し、そのために全体のオーバーフロー量が著しく増加してしまうということではなく、該ノッチにおける液面の上昇による液流通断面積の増加分だけオーバーフロー量が増加するだけである。また、液槽内の液面が下降しても、従来の矩形堰のように堰部上端縁の全長にわたり一斉にオーバーフロー量が減少し、そのため全体のオーバーフロー量が著しく減少してしまうということではなく、該ノッチにおける液面の下降による液流通断面積の減少分だけオーバーフロー量が減少するだけである。従って、液槽における液面の上下変動があっても、従来の矩形堰に比べると、オーバーフロー量はごく緩やかに増大又は減少する。換言すれば、液槽における液面の上下変動があっても、従来の矩形堰に比べると、オーバーフロー量の変動はごく小さく抑制される。

【0016】かくして液の適切なる過のために、ろ過用ポンプ能力に見合った循環ろ過等のろ過の液量に応じて設定される液槽底部からの吸液量（例えば循環ろ過の場合の循環液量の略70%）とオーバーフローボックスからの吸液量（例えば循環ろ過の場合の循環液量の略30%）を維持して、液の適切なる過が達成される。また、本発明に係る液槽では液オーバーフロー用ノッチを形成した堰部を採用して、該ノッチからオーバーフローボックスへ液がオーバーフローするようにしてあり、該ノッチは堰部を越える前の液の深さ方向に延びているから、液槽内の液面に浮上し易い浮上性不純物だけでなく、それより下層に浮遊し易い不純物も該ノッチからオーバーフローボックスへ流入しやすく、かかる液面より下層に浮遊する不純物についても回収してろ過することができる。

【0017】さらに、ノッチの形状や数を選んで、オーバーフロー量をたやすく設定できるという利点もある。堰部及びこれと組み合わせのオーバーフローボックスの数は液槽における液量、液槽の形状等に応じて1又は2以上とすることができ、適当な位置に設けることができる。

【0018】オーバーフローボックスは、液槽周囲壁の上辺部外周側に設けても、内周側に設けてもよい。外周側と内周側の双方に設けてもよい。一つの堰部における液オーバーフロー用ノッチの数は必要に応じ複数設けることができる。ノッチは、幅広い範囲にわたり複数配設して、より好ましくは均一に分散させて設け、液槽内の液の全体にわたり、その液面に浮上し易い浮上性不純物及びそれより下層に浮遊し易い不純物を満遍なくオーバーフローボックスへ流入させることが好ましい。

【0019】かかるノッチの形状としては、逆三角形状（換言すればV字形状）、U字形状、矩形状等、種々採用できる。中でも所望オーバーフロー量の設定が容易であり、作り易い等の利点を有するものとして、ノッチ上

端から下方へかけて開口幅が次第に狭くなるように形成されている逆三角形状のノッチや、開口幅の狭い矩形状のノッチを挙げることができ、さらにはこれらを複数設けることが好ましい。

【0020】逆三角形状ノッチを採用するばあい、その逆三角形状の下端頂角として、それには限定されないが、 $40^{\circ} \sim 90^{\circ}$ 、より好ましくは $50^{\circ} \sim 60^{\circ}$ 程度を例示できる。いずれにしても前記堰部は、オーバーフローボックスと液槽との間の仕切り壁の上端縁部にオーバーフロー用ノッチを形成するか、オーバーフロー用ノッチを形成した堰部材を脱着可能に付設して設けることができる。

【0021】なお堰部をオーバーフローボックスと液槽との間の仕切り壁の上端縁部に、オーバーフロー用ノッチを形成した堰部材を脱着可能に付設して設ける場合には、オーバーフロー量を各種に設定した堰部材のうちから適切な堰部材を選択採用して容易にオーバーフロー量を設定でき、また、例えば仕切り壁上端縁部と堰部材との間に適当厚さのライナーを挿入する等容易な手法で堰部材の取付け高さを変更したり、堰部材を交換することにより、オーバーフロー量を容易に変更することもできる。

【0022】そこで本発明はまた、液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部からオーバーフローさせるための1又は2以上のオーバーフローボックスを有する液槽の該堰部を提供するための堰部材であり、オーバーフロー用ノッチが形成されており、オーバーフローボックスと液槽との間の仕切り壁の上端縁部に脱着可能であることを特徴とする堰部材も提供する。

【0023】この堰部材におけるノッチの数、形状等についても、前記液槽に関連して説明した堰部と同様のことが言える。前記液槽には、液槽底部に溜まりやすい不純物を集めて円滑に吸引しやすくするため、液槽内底の周縁部に沿って、1又は2以上の落とし込み形成された内底溝を設けてもよい。また、このような内底溝を設けておくと、液槽清掃時にそこへ、もともと液槽にあった液や清掃液を流し込めるので、それだけ清掃を円滑に行える。かかる内底溝の数も、液槽における液量、液槽の形状等に応じて1又は2以上とすることができる。かかる内底溝は槽内底の例えば周縁部の適当な部位に沿って設けるとよい。

【0024】前記内底溝には、該内底溝に溜まる不純物をできるだけ内底溝の全体から吸引できるように、該溝の長手方向に沿って延び、複数の吸液孔を有する第1吸引ヘッドを設置することができる。またこのように第1吸引ヘッドを内底溝に設置することで、液槽底部にエアレーション装置が設置されるときでも、ろ過器にとって最も都合の悪い事項である空気の吸い込みを抑制すべく、該エアレーション装置から噴出される空気の第1吸

引ヘッドへの吸い込みを抑制でき、それだけ円滑に不純物を吸引してろ過できる。

【0025】前記液槽には、さらに、液槽底部に溜まりやすい不純物を吸引するための吸引ヘッド（後述する第3吸引ヘッド）を液槽内底の周縁部等における前記内底溝以外の部分に1又は2以上設置してもよい。前記第1吸引ヘッドや第3吸引ヘッドが、液ろ過のために吸液する遠心ポンプに連通されるものである場合、それら吸引ヘッドの各吸液孔の口径は、該遠心ポンプにおけるインペラー羽根の高さと同じか、それより小さくしておくことが望ましい。このように各吸液孔の口径を設定しておくことで、液槽中に脱落することがある被処理物品の一部や外部からの持ち込み雑部品等が遠心ポンプに吸い込まれて吸液量が減少したり、インペラー羽根に噛み込む等して該ポンプが故障することを抑制することができる。

【0026】ところで、オーバーフローボックス内へ不純物とともに流入する処理液は、該ボックス内底部に設けられた処理液の流出口（通液口）からポンプによって吸引され、ろ過器へ送られるのであるが、堰部を越えて該ボックス内へ流入する処理液中の無機及び有機不純物の嵩乃至粒度において大きいものから小さいもの、さらに該ボックス内へ外部から落下する物品等が、該ボックス底部の流出口に詰まって、オーバーフローボックス内からのポンプによる吸液が著しく阻害されることが往々にして起こり、ろ過処理に大きく支障を来すことがある。

【0027】従ってオーバーフローボックスの内底部にも、複数の吸液孔を有するさらなる吸引ヘッド（第2吸引ヘッド）を設置してもよい。この第2吸引ヘッドによりボックス内液を一旦上方へ吸い上げることができ、従来のボックス底の液流出口（通液口）の形成及びその目詰まりを回避することができる。該第2吸引ヘッドが液ろ過のために吸液する遠心ポンプに連通されるものである場合、該第2吸引ヘッドの各吸液孔の口径も、該ポンプにおけるインペラー羽根の高さと同じか、それより小さくしておくてもよい。

【0028】前記液槽の内底にはエアレーション装置を設置して液の攪拌を行い、それによる液各部の均質化を図ることができる。また、液槽内の液による物品処理を伴う場合には、エアレーション装置からの噴出空気で、被処理物への液中浮遊不純物の付着を抑制することもできる。エアレーション装置を設置する場合、該エアレーション装置と前記内底溝に設置された前記第1吸引ヘッドとの間にエア遮断壁を配置し、これにより第1吸引ヘッドがエアレーション装置からの噴出空気を吸い込むことを抑制することが望ましい。前記第3吸引ヘッドを設置する場合も、該第3吸引ヘッドに隣り合わせて、第3吸引ヘッドとエアレーション装置との間に該吸引ヘッドへの空気吸い込みを抑制するエア遮断壁を配置すること

が望ましい。

【0029】前記第1吸引ヘッドは、吸引ヘッド長手方向の吸引ヘッド中心軸の周りに吸引ヘッド下端から前記エア遮断壁とは反対側へ所定角度範囲内に（例えば略90度以下の範囲内に）、且つ、吸引ヘッド下端から該エア遮断壁側へ所定角度範囲内に（例えば略45度以下の範囲内に）前記吸液孔が分散形成されており、該吸液孔は該第1吸引ヘッドの長手方向にわたる各部において均等量吸液できるように分散形成されていることが望ましい。これにより空気を吸い込み難く、内底溝の底に沈殿し易い不純物を内底溝のできるだけ全体から一様に、円滑に吸引できる。

【0030】前記の第3吸引ヘッド及びそれに臨む前記のエア遮断壁を設ける場合も、該ヘッドの吸液孔は該エア遮断壁に対して、前記第1吸引ヘッドの吸液孔とそれに対するエア遮断壁との相互配置関係と同様に設けるとよい。さらには第3吸引ヘッドの長手方向にわたる各部において均等量吸液できるように分散形成されていることが望ましい。

【0031】また、前記第2吸引ヘッドについても、前記オーバーフローボックスのできるだけ全体から一様、円滑に不純物を吸引できるように、該オーバーフローボックスの内底部の長手方向に沿って延在させ、該第2吸引ヘッドの前記吸液孔は該第2吸引ヘッドの長手方向にわたる各部において均等量吸液できるように該ボックス底面に向けて分散形成することが望ましい。

【0032】なお、液槽底部から吸液する主たる吸引ヘッドを前記の第1吸引ヘッドとする場合において（従ってそのヘッドは第3ヘッドに比べると大きくなる場合において）、その第1吸引ヘッドを液槽の内底に内底溝を設けずに設置し、或いはさらに該第1吸引ヘッドに対し前記のエア遮断壁を臨設する場合、その液槽が処理液槽（例えばメッキ処理液槽）のときには、該第1吸引ヘッドやエア遮断壁の高さ相当分、液槽内処理液の液面位を高くしなければならないことが多い。何故なら、処理液中に浸漬する引っ掛け部材、該引っ掛け部材に吊り下げられる被メッキ処理物などが該第1吸引ヘッドやエア遮断壁板の上端縁に引っ掛かって被メッキ処理物や引っ掛け部材が処理液中へ落下する恐れがあるからである。かかる落下物が発生すると、その除去作業は、ときにはメッキ装置の補修を含む、メッキ処理物品の生産を中断しての作業となり、そのために大きい出費が必要となる。従って、液槽の高さ（深さ）を該第1吸引ヘッドやエア遮断壁の高さ相当分を加えた高さ（深さ）として、液面位を高くしなければならない。

【0033】このとき、液槽の高さを高くしたことによる液量の増加は、液槽面積に対する該吸引ヘッドやエア遮断壁の高さ相当分であって大量となる。そしてその増加液量に対する液槽製作代価、液量増加分の液代価、ろ過器及び循環ポンプの性能向上代価、そしてそれらにか

かる管理代価等のために処理物品生産の大きい原価高騰を招く。

【0034】よってかかる大量の処理液増加等を招くことのないように、前記のごとく液槽底に内底溝を設け、これに第1吸引ヘッドやエア遮断壁を設けることが望ましいと言える。なお、本発明に係る液槽は各種の液体による物品処理装置における物品処理液槽に適用でき、例えば物品のメッキ液によるメッキ処理装置、染色液による染色装置、写真の現像液による現像装置、物品洗浄装置等における物品処理液槽に適用でき、物品処理を伴わないで水等の液体をろ過処理する液体処理装置の液槽などにも適用できる。

【0035】

【発明の実施の形態】以下、本発明の実施の形態について図面を参照して説明する。図1は本発明に係る液槽を採用した、液体による物品処理装置の1例であるメッキ処理装置を示している。図1に示すメッキ処理装置は、五つの物品処理液槽11、12、13、14、15を備えている。それぞれの液槽はここでは物品にメッキ処理を施すメッキ処理液槽である。各液槽は異なる量のメッキ液、例えば同液質の各槽異なる量のメッキ液を収容するものであってもよいが、ここでの各液槽は同量のメッキ液を収容する容積を有している。

【0036】これら五つの液槽は三つのグループに分けられている。すなわち、一つの液槽11を含む第1グループ、二つの液槽12、13を含む第2グループ、液槽14、15を含む第3グループである。各液槽には所定のメッキ液Lが収容される。図中、液槽11の左側には前処理水洗槽16があり、ここにはメッキ処理前に必要に応じて被メッキ物品を洗浄できるように洗浄水Wが収容される。液槽16のさらに左側には作業デッキD1が設置されている。

【0037】また、液槽11と12の間には作業デッキD2が、液槽13と14の間には作業デッキD3が、液槽15の外側に作業デッキD4がそれぞれ設置されている。各液槽は実質上同じ構造のものである。液槽の構造について液槽12、13を例にとって図1から図4を参照して説明する。図2は液槽12、13とその周辺部分の拡大平面図であり、図3は液槽12とその周辺部分の拡大側面図である。なお、図3にはあけ換え装置51も示してあるが、これについては後述する。図4は液槽12の一部の斜視図である。

【0038】各液槽は、平面視（平面から見ると）長方形であり、該長方形の一つの長辺に沿って液オーバーフローボックスB1を、該長方形の一つの短辺に沿って液オーバーフローボックスB2を有している。ボックスB1はボックスB2より浅く形成されており、ボックスB2はボックスB1より深く形成されている。ボックスB1は、ここにオーバーフローする液をボックスB2へ流入させるようにボックスB2の上部に連通しており、且

つ、ボックスB1の底はボックスB2へ向かって下り傾斜している。なおボックスB1の底は必ずしもこのように傾斜している必要はない。

【0039】ボックスB1は液槽の長辺方向に沿って設けられた堰部21を介して設置されており、ボックスB2は液槽の短辺方向に沿って設けられた堰部22を介して設置されている。各堰部21、22については後ほど詳述する。図2、図3及び図6（C）に示すように、液槽の内底101の周縁部の一か所に内底溝102が一体的に落とし込み形成されている。内底溝102は、ここでは液槽の片側短辺方向に沿って、該短辺の長さにわたって延在している。

【0040】液槽の長手方向の各側部の上方には陽極ブスバー（busbar）Aが互いに平行に架設されているとともに、液槽の中央部上方には陽極ブスバーと平行に陰極ブスバーCが架設されている。物品にメッキ処理するにあたっては、例えば、図2、3及び図5に示すように、陰極ブスバーCに1又は2以上の導電性ハンガーH（図5（C）参照）を所定の間隔で掛けるとともに、各陽極ブスバーAの所定位置にアノード材m'を収容した導電性アノードケースCS（図5（A）参照）を掛け吊るしてメッキ液L中へ浸漬させ、被メッキ物品a1、a2を引っ掛け部材S（図5（C）参照）に引っ掛けて支持させ、この引っ掛け部材SをハンガーHに掛け吊るして物品a1、a2とともにメッキ液L中に浸漬すればよい。なお、図5（B）に示すCSbはろ過布からなるアノードバッグであり、陽極側に発生する不純物のメッキ液への漏出を防止するためにアノードケースCSに被着される。

【0041】被処理物のメッキ処理には、銅、ニッケル、亜鉛、錫、これらの合金などのメッキのように多くのメッキ処理があるが、ニッケルメッキを施す場合を例にとると、メッキ液Lをニッケルメッキ液とし、アノードケースCSを耐食性チタン籠とし、これにアノード材m'としてニッケルチップを収容する場合を例示できる。各液槽の内底101には、エアレーション装置103が設置されている。これは空気噴出用の孔あきパイプを連設して構成したもので、図示を省略した圧縮空気供給装置に接続され、処理液L中の各部に気泡103aを噴出し、いわゆるエアレーションを行う。処理液Lはこのエアレーションにより攪拌され、液組成等の点で液質が各部で均一化されるとともに液温度も均一化される。また、液中の不純物が、後述する循環ろ過にあたり処理液各部から円滑に吸引されるように適度に移動せしめられる。さらにエアレーションにより物品a1、a2への液中不純物の付着も抑制される。

【0042】各液層の内底溝102には、図6に示す第1吸引ヘッド104が内底溝102の長手方向に延在するように設置されている。吸引ヘッド104は一端に管接続口部104aを有し、他端が閉鎖された筒体であ

り、複数の吸液孔104bを穿設したものである。第1吸引ヘッド104とエアレーション装置103との間にはエア遮断壁板105が設置されている。エア遮断壁板105は支持片105aにより内底溝102の底から若干持ち上げられており、壁板105の下にも液が流通できるようにになっている。そして支持片105a及びエア遮断壁板105に支持板105bが渡し設けられており、これが第1吸引ヘッド104を支持している。

【0043】第1吸引ヘッド104も支持片105aにより内底溝102の底から若干持ち上げられており、吸引ヘッド104の下にも液が流通できるようにになっている。第1吸引ヘッド104の吸液孔104bは、吸引ヘッド長手方向の中心軸線の周りに吸引ヘッド下端からエア遮断壁板105とは反対側へ90度以下の角度範囲 θ_1 内、且つ、該ヘッド下端から遮断壁板105側へ45度以下の角度範囲 θ_2 内の中心角度 θ ($\theta_1 + \theta_2$) = 135°の範囲内に分散形成されている。前記角度 θ は、内底溝102に溜まる沈殿性不純物を円滑に吸引できるように、且つ、エアレーション装置103からのエアを吸引し難いように吸液孔を方向付けるための角度範囲であり、ここでは略135度である。

【0044】さらに第1吸引ヘッド104の吸液孔104bは、該吸引ヘッドの長手方向にわたる各部において均等量吸液できるように分散形成されている。吸引ヘッドの各部において均等量吸液できるようにするには、吸引ヘッドの管接続口部に近い部位における吸液孔の断面積合計がより遠い部位における吸液孔の断面積合計より小さくなるように吸液孔の数及び（又は）口径を調整して吸液孔を分散形成すればよい。ここでは各吸液孔の口径を同じにして、管接続口部104aに近い部位と、それより遠い部位とでは、近い部位における方が遠い部位より吸液孔104bを疎に、遠い部位ではより密に分散形成している。

【0045】この第1吸引ヘッド104によると、空気を吸い込み難く、内底溝102の底に沈殿し易い不純物を内底溝のできるだけ全体から一様、円滑に吸引できる。なお、液槽底部に溜まりやすい不純物を一層効率よく吸引するために、第1吸引ヘッド104に加えて、内底溝102以外の液槽内底101の部分、例えば内底101の周縁部の一部等に第3吸引ヘッドを1又は2以上設置してもよい。図3に、液槽底101の長手方向に沿う周縁部に第3吸引ヘッド108を設置する例を鎖線で示している。

【0046】第3吸引ヘッド108についても、第1吸引ヘッド104と同様の構造とし、吸液孔は、該吸引ヘッドの長手方向にわたる各部において均等量吸液できるように分散形成するとよい。また、第3吸引ヘッド108とエアレーション装置103との間にはエア遮断壁板109を設置するとよい。さらに第3吸引ヘッド108の各吸液口についても、吸引ヘッド長手方向の中心軸線

の周りに吸引ヘッド下端からエア遮断壁板109とは反対側へ90度以下の角度範囲 θ_1 内、且つ、該ヘッド下端から遮断壁板109側へ45度以下の角度範囲 θ_2 内の中心角度 θ ($\theta_1 + \theta_2$) = 135°の範囲内に分散形成するとよい。

【0047】前記深い方のオーバーフローボックスB2の内底部には、図6(C)や図7等に示す第2吸引ヘッド106（図1及び図4では図示省略）が設置されている。第2吸引ヘッド106は支持片106c及びこれに立設された支持板106dを介して支持されており、吸引ヘッド106の下方にも液が流通できる。吸引ヘッド106は、液槽の短辺と略平行に延在しており、一端に管接続口部106aを有し、他端が閉鎖された筒体であり、複数の吸液孔106bを有している。該吸液孔106bは、吸引ヘッド106の長手方向にわたる各部において均等量吸液できるように分散形成されている。

【0048】オーバーフローボックスB2に設置される第2吸引ヘッドについても、吸引ヘッドの各部において均等量吸液できるようにするには、該吸引ヘッドの管接続口部に近い部位における吸液孔の断面積合計がより遠い部位における吸液孔の断面積合計より小さくなるように吸液孔の数及び（又は）口径を調整して吸液孔を分散形成すればよい。ここでは各吸液孔106bの口径を同じにして、管接続口部106aに近い部位と、それより遠い部位とでは、近い部位における方が遠い部位より吸液孔を疎に、遠い部位ではより密に分散形成している。

【0049】この第2吸引ヘッド106によると、オーバーフローボックスB2のできるだけ全体から一様、円滑に液及び不純物を吸引できる。なお、従来ではオーバーフローボックスから液を吸引するとき、オーバーフローボックスの底に外部への通液口を設け、該通液口に吸液管を接続し、該吸液管で下方へ吸液していたので、該通液口やその接続部位で液内不純物が詰まり易く、ろ過作業に著しい支障を引き起こす原因となっていたが、ここでは第2吸引ヘッド106の吸液管は、該ボックス底部から上方へ吸液できるので、ヘッド106やそれに接続される吸液管の不純物による詰まりは十分抑制される。

【0050】この点についてさらに説明する。図16は従来例（メッキ処理液槽の1例）を示している。図16(A)及び(B)において、10'は液槽、B1'、B2'、B3'は液槽に付設されたオーバーフローボックス、21'、22'、23'はオーバーフローボックスに臨む従来型の矩形堰、V'は液槽内底に設置された従来型のフット弁である。

【0051】図16(A)においてオーバーフローボックスB1'は溝形のボックスでここに流入した処理液L'はボックスB2'へ流入する。図16(A)に示すオーバーフローボックスB2'の底には通液口Lbが設けられており、これは弁v1'、v2'及びポンプPを

介してろ過器Fの液流入口に配管接続されている。液槽内フート弁V'は弁v7'、v2'及びポンプPを介してろ過器Fの液流入口に配管接続されている。ろ過器Fの液吐出口は弁v3'、v4'、v5'を介して液加温の熱交換器Hに、さらに弁v6'を介して液槽10'への液戻し口100'へ配管接続されている一方、弁v3'とv4'との間から弁V8'を介してあけ換え槽511への液吐出口511'へ配管接続されている。また、あけ換え槽511の底には吸液用フート弁511vが設置されており、これは弁v9'を介してポンプP

弁	通常の メッキ処理時	あけ換えろ過のために 液を槽511へ移す時	あけ換えろ過のために 槽511から10'へ 液を戻すとき
ポンプ	運転	運転	運転
v1'	開	開	閉
v2'	開	開	閉
v3'	開	開	開
v4'	開	閉	開
v5'	開	閉	開
v6'	開	閉	開
v7'	開	開	閉
v1"	開	開	閉
v7"	開	開	閉
v8'	閉	開	閉
v9'	閉	閉	開

なお、メッキ処理運転において、オーバーフローボックスB2' (B3')へのオーバーフロー液量の減少が生じて該ボックス内が渾濁状態になってくると、ポンプPでの空気吸い込みを防止するため、弁V1' (V1")を閉じる。

【0054】このように従来では図16に例示するように、オーバーフローボックスB2'又はB3'から液を吸引するとき、オーバーフローボックス底の通液口Lb、Lb'から吸液していたので、該通液口やそれへの配管接続部位で液内不純物が詰まり易く、ろ過作業に著しい支障を引き起こす原因となっていたが、ここでの第2吸引ヘッド106の吸液管は、該ボックス底部から上方へ吸液できるので、ヘッド106やそれに接続される吸液管の不純物による詰まりは十分抑制される。

【0055】再びもとに戻って説明する。第1吸引ヘッド104の各吸液孔104b、第2吸引ヘッド106の各吸液孔106b、第3吸引ヘッド108の各吸液口のいずれもその口径は、該吸引ヘッドが後述する多岐管等を介して接続される、液ろ過のための液循環用の遠心ポンプにおけるインペラー羽根の高さと同等に、又はそれより小さく設定される。

【0056】このように口径を小さくしておくことで、液槽中に脱落することがある被メッキ物品の一部や部品及びその他外部から持ち込まれた雑品類等が遠心ポンプに吸い込まれてインペラー羽根に噛み込むなどして該ポ

の吸液口に配管接続されている。

【0052】図16(B)に示すオーバーフローボックスB3'の底には通液口Lb'が設けられており、これは弁v1"を介して、また液槽内フート弁V'は弁v7"を介してそれぞれ図16(A)に示すと同様の弁v2'へ配管接続されている。その他の点については図16(A)の液回路と同様である。なお、ろ過器におけるろ過助剤のプレコートのための回路は図示を省略している。

【0053】各弁の開閉等は以下のとおりである。

ンプが故障することを抑制することができる。なお、第2吸引ヘッド106に代えて他の形態の吸引ヘッドを採用してもよい。例えば図8に示す吸引ヘッド107を採用してもよい。

【0057】吸引ヘッド107は、除塵ストレーナとも呼べるもので、小ボックス形態をしており、上部に管接続口部107aを有し、側周壁及び底壁に複数の吸液孔107bを分散形成したものである。足107cが付いており、これでオーバーフローボックスB2の底に立つ。各吸液孔107bも、その口径は液循環用の遠心ポンプにおけるインペラー羽根の高さと同等、又はそれより小さく設定しておくとい。

【0058】以上説明した第1吸引ヘッド104、第2吸引ヘッド106 (又は107)、或いはさらに第3吸引ヘッド108は次に説明する循環ろ過装置の構成部品となる。前述の一つの液槽11を含む第1グループ、二つの液槽12、13を含む第2グループ、液槽14、15を含む第3グループのそれぞれについて循環ろ過装置が設けられている。さらに、液槽11から液槽15までの全液槽を含む第4グループについての循環ろ過装置も設けられている。

【0059】図1中、液槽11に対する循環ろ過装置は符号3で、液槽12、13に対する循環ろ過装置は符号4Aで、液槽14、15に対する循環ろ過装置は符号4Bで、全液槽11～15に対する循環ろ過装置は符号6

で示す。循環ろ過装置において、第1グループの循環ろ過装置3は液循環ポンプ（ここでは遠心ポンプ）1台による1液槽の単独循環ろ過装置であり、第2グループの循環ろ過装置4A及び第3グループの循環ろ過装置4Bは、各々処理液槽二つについて液循環ポンプ（ここでは遠心ポンプ）1台による循環ろ過装置である。さらに第4グループとなる循環ろ過装置6は全処理液槽五つについて液循環ポンプ（ここでは遠心ポンプ）1台による循環ろ過装置である。

【0060】第2グループのろ過装置4A及び第3グループのろ過装置4Bはそれぞれ液循環ポンプ1台による2液槽の循環ろ過装置であり、各グループにおける二つの液槽内の処理液は循環ろ過の過程において、循環回路の液流量に僅かながらも強弱が生じ、時間の経過にともない、二つの液槽のうち一方では液面位が降下し、これに反して他方の液槽では液面位降下の液槽における液減量相当分の液量の増加流入が生じ、遂には該他方の液槽から処理液が溢れ、一方の液槽内処理液の液面位が降下し過ぎて、両液槽ともに処理液によるメッキ作業ができなくなることがある。

【0061】そこでここでは全液槽5槽について、液循環ポンプ1台によって、同時に循環ろ過を行う循環ろ過装置6を設置運転し、これによって液槽間における液面位の上下差を抑制するように液面位を制御するとともに液混合を行って、各液槽における液の組成及び液温度を均一化しつつ循環ろ過を行うようにしている。すなわち、循環ろ過装置6は循環ろ過装置であるとともに液混合用及び液面位置制御のための装置でもある。

【0062】また、この液混合用及び液面位置制御のための装置は、各液槽の容量が異なる場合でも液混合及び各液槽における液面位置制御を行いつつ循環ろ過を行える。液槽11に対する循環ろ過装置3は、ろ過器31及び液循環用の循環ポンプ32（本例では遠心ポンプを採用）を含んでいる。液槽11は吸液回路を介して循環ポンプ32の吸液口に連通できる。ろ過器31は送液回路を介して液槽11に連通できる。

【0063】該吸液回路は図1に示すように、液槽11における第1吸引ヘッド104及び第2吸引ヘッド106（図1では省略、図2、図6、7等参照）と、液合流用の多岐管33と、吸引ヘッド104、106の管接続口部104a（図6参照）、106a（図6、図7参照）をそれぞれ手動開閉弁v11、v12を介して多岐管33の分岐管へ接続する配管と、多岐管33の主開口部を手動開閉弁v13を介し循環ポンプ32の吸液口に接続する配管とを含んでいる。

【0064】第3吸引ヘッド108を採用するときは、これによって吸引される液が最終的には、前記の弁v11、v12を介して吸引される液に混合、合流されてポンプ32へ流入するように弁等を介してポンプ32に配管接続される。送液回路は、ろ過器31の送液口を手動

開閉弁v14及び温度制御回路45、さらに二つの手動開閉弁v15を介して液槽11の2箇所に分岐連通させる配管を含んでいる。なお液槽1への連通はこのように2箇所でなく、一箇所でも、3箇所以上でもよい。

【0065】循環ポンプ32の吐出口は逆止弁v16を介してろ過器31の液供給口に配管接続されている。ろ過器31は、液種、ろ過流量に適應する種々のタイプのもを採用できるが、ここでは、ろ過器に圧入される液が、適当なろ過助剤によるプレコート層を有するろ過床を通過することで不純物がろ過され、浄化されるタイプのろ過器である。後述する循環ろ過装置4A、4B、さらに液混合及び液面位置制御のための装置6におけるろ過器も同タイプのものである。

【0066】また、送液回路には一つの液槽内メッキ液の劣化、消耗等に伴い変化する液組織を還元し、更には蓄積不純物の除去ろ過を行うためのあけ換え装置51

（図1、図3参照）が付設されている。循環ろ過装置3における前記温度制御回路45及びあけ換え装置51は、次に説明する循環ろ過装置4A、4Bにおける温度制御回路45及びあけ換え装置51とそれぞれ基本構造は同一であるから後ほどろ過装置4Aにおいて回路45及び装置51を説明することとし、ここでの温度制御回路45、装置51の説明は省略する。

【0067】循環ろ過装置4Aと循環ろ過装置4Bとは全く同じ構造、作用のものであるから、装置4Aのみ説明し、装置4Bの説明は省略する。装置4Aと4Bにおいて同じ部品については図中同じ符号を付す。循環ろ過装置4Aは図1に示すように、ろ過器41及び液循環用の循環ポンプ42を含んでいる。液槽12、13は吸液回路を介して循環ポンプ42の吸液口に連通できる。ろ過器41は送液回路を介して液槽12、13に連通できる。

【0068】該吸液回路は、液槽12、13のそれぞれにおける第1吸引ヘッド104及び第2吸引ヘッド106（図1では省略、図2等参照）と、液合流用の多岐管431、432、430と、一方の液槽12の吸引ヘッド104、106の管接続口部104a（図6参照）、106a（図6、図7参照）をそれぞれ手動開閉弁v41、v42を介して一方の多岐管431の分岐管へ接続する配管と、他方の液槽13の吸引ヘッド104、106の管接続口部104a、106aをそれぞれ液槽12における同様の手動開閉弁v41、v42を介して他方の多岐管432の分岐管へ接続する配管と、多岐管431、432の主開口部を多岐管430の分岐管へ接続する配管と、多岐管430の主開口部を手動開閉弁v43を介して循環ポンプ42の吸液口に接続する配管とを含んでいる。

【0069】液槽12、13において第3吸引ヘッド108を採用するときは、これによって吸引される液が最終的には、前記の弁v41、v42を介して吸引される

液に混合、合流されてポンプ42へ流入するように弁等を介してポンプ42に配管接続される。送液回路は、ろ過器41の送液口を手動開閉弁v44及び温度制御回路45を介して液分配用の多岐管433の主開口部に接続する配管と、多岐管433の一方の分岐管を二つの手動開閉弁v45を介して液槽12の2箇所に分岐連通させる配管と、多岐管433の他方の分岐管を液槽12の場合と同様の二つの手動開閉弁v45を介して液槽13の2箇所に分岐連通させる配管とを含んでいる。

【0070】ポンプ42の吐出口は逆止弁v46を介してろ過器41の液供給口に配管接続されている。ろ過器41は循環ろ過装置3におけるろ過器31と同タイプのものである。なお異なるタイプのものであってもよい。また、送液回路には二つの液槽12、13から一つの液槽を選択してその液槽内のメッキ液の劣化、消耗等に伴い変化する液組織を復元し、更には蓄積不純物の除去ろ過を行うためのあけ換え装置51（図3参照）が付設されている。

【0071】温度制御回路45は、図3に示すように、手動開閉弁va'、熱交換器451、手動開閉弁vb'を直列接続した回路に流量調整弁Vを並列接続したもので、熱交換器入口側の弁va'の入口及び流量調整弁Vの入口は液分配用の多岐管452を介して前記の弁v44（ろ過器出口側の弁）に配管接続され、弁vb'の出口及び流量調整弁Vの出口は液槽へ通じる前記の液分配用多岐管433に配管接続されている。

【0072】循環ろ過装置3における温度制御回路45はこの温度制御回路45と基本的に同構造である。但し、循環ろ過装置3における温度制御回路45では、弁vb'に相当する弁及び流量調整弁Vに相当する弁の出口は多岐管を介することなく一本の配管に集められ、さらに二つの手動開閉弁v15を介して液槽11の2箇所に分岐連通されている。

【0073】あけ換え装置51は、図3に示すように、ろ過器41の送液口を手動開閉弁v51を介してあけ換え槽511に連通させ得るように配管するとともに、ポンプ42の吸液口を手動開閉弁v52を介してあけ換え槽511の底部に設置した従来型のフート弁（foot valve）v53に配管接続したものである。循環ろ過装置3におけるあけ換え装置51もこのあけ換え装置51と基本的に同構造である。ここで本明細書にいう前述及び後述の「多岐管」について述べると、該多岐管は一端が閉鎖された閉鎖筒体の形態の多岐管本体と、これに接続された複数の分岐管とを含んでいる。そして循環ポンプによる液槽からの吸液回路及びろ過器から液槽への送液回路に該多岐管を用いる循環ろ過装置において、該多岐管の本体に設ける複数の各々同一又は異なる断面面積を持つ分岐管のそれぞれからの吸液又は送液における通液量がその分岐管の断面面積によって決まるものである。

【0074】さらに説明すると、該複数の分岐管のそれぞ

れにおいて単位断面面積あたりの通液量は、例えばろ過器のろ過助剤のプレコート層が不純物除去の許容範囲を超えて著しく目詰まりし、プレコート層前後の圧力差、換言すればろ過器内原液室とろ過室との圧力差が著しく変動するなどの不都合がない限り、実質上同量であり、各分岐管は該単位断面面積あたり等量の通液量に基づいて必要とされる所定の通液量を得る断面面積を有する。多岐管本体はこれを構成している筒体内の略全長にわたり同一断面面積で、且つ、複数の多岐管の合計断面面積より若干大きい断面面積を有する。多岐管本体内部圧力は、筒体内の略全長にわたり同一断面面積のもとに同一の負圧力又は正圧力下におかれ、各分岐管ごとの所定の通液量を過不足無く得られる。再びもとに戻って説明を続けると、以上説明した循環ろ過装置3における液合流用多岐管33及び温度制御回路45の図示省略の多岐管、並びに循環ろ過装置4A、4Bにける液合流用多岐管431、432、430、液分配用多岐管433及び温度制御回路45の多岐管452はいずれも基本的に図9に示す多岐管と同じ構造のものであり、製作材質は塩化ビニル樹脂（PVC）によるもので、後述の図10に示す多岐管も材質は同様である。なおこれら多岐管は他の材料製、例えば他の合成樹脂製や金属製でもよい。

【0075】すなわち、循環ろ過装置3における液合流用多岐管33、温度制御回路45の図示省略の多岐管、並びに循環ろ過装置4A、4Bにける液合流用多岐管431、432、430、液分配用多岐管433及び温度制御回路45の多岐管452はいずれも、構造的には図9に示すように、それとは限定されないがここでは断面円形が多岐管本体401とこれに接続された2本の、それとは限定されないがここでは断面円形の分岐管402、403とからなるものである。多岐管本体401は一端に他の管を接続するための主開口部401aを有し、他端401bが閉鎖された内径略均一な（液流通断面面積が略均一な）閉鎖筒体である。

【0076】そして分岐管402、403に対する正又は負の同一圧力下における多岐管本体401の開口部401aの断面面積は、それぞれ必要とする所定の通液量を与える分岐管402、403の合計断面面積に相当する断面面積を有している。また多岐管本体401の断面面積は該複数の分岐管の合計断面面積に対して余裕のある断面面積として該開口部401aよりは若干大きい断面面積を有している。

【0077】分岐管402、403は多岐管本体401の長手方向における2箇所において、多岐管本体の長手方向に直交する方向から該多岐管本体へ突出挿入され、各分岐管402、403の多岐管本体への突出度（突出挿入高さ） α は本体401の内径Rの略 $1/2$ 以上 $3/5$ 以下である。該分岐管402、403の多岐管本体401内への突出挿入高さは、該多岐管本体におよぶポンプの吸液圧力（負圧力）又は送液圧力（正圧力）

下において、該多岐管本体内の圧力（負又は正圧力）を均一圧力下におくものである。

【0078】多岐管本体401は該二つの分岐管402、403に対して液密に接着剤、溶接等によって接続されている。なお後述する図10に示す多岐管、さらにはその多岐管本体600及び分岐管601～605についても、その基本構成は以上説明した多岐管と同様である。また、いずれの多岐管においても、分岐管の多岐管本体に対する接続部位は特に限定されず、液回路構成に応じて多岐管本体周囲の任意の部位に接続できる。また、その接続にあたっての分岐管の角度は、必ずしも多岐管本体の長手方向に直交する方向でなくてもよい。

【0079】かかる構造の多岐管によると、多岐管本体401の主開口部401aに液循環用ポンプの吸液口を連通させて液合流用の多岐管として用いた場合、ポンプの吸引圧力（負圧力）、すなわち多岐管本体内の液圧（吸引圧）が多岐管本体内部各所で均一化され、従って各分岐管402、403から多岐管本体401内への吸液量は各分岐管の液流通断面積に応じたものとなる。

【0080】また、多岐管本体401の主開口部401aにポンプの吐出口を連通させて液分配用の多岐管として用いた場合、ポンプの吐出圧力（正圧力）、すなわち多岐管本体内の液圧（正圧力）が多岐管本体内部各所で均一化され、従って各分岐管402、403からの吐出液量は該分岐管の液流通断面積に応じたものとなる。ここではこのような構造の多岐管を、循環ろ過装置3における多岐管33及び温度制御回路45の図示省略の多岐管、並びに循環ろ過装置4A、4Bにける液合流用多岐管431、432、430、液分配用多岐管433及び温度制御回路45の多岐管452として採用しているから、液槽の内底溝102及びオーバーフローボックスB2から所定量ずつ液を吸引し、循環ろ過装置3においては液槽11へ所定量のろ過後の液を戻すことができ、また、複数の液槽に対して設けられた循環ろ過装置4A、4Bについては該複数の液槽に所定量ずつろ過後の液を戻すことができ、さらに各温度制御回路45においては、図3に示すように多岐管452を設け、流量調整弁Vによって設定された任意の熱交換流量でもって容易に熱交換器に送液できるのである。

【0081】なお、従来採用されている多岐管9は、概ね図15に示すように、一か所に液流通用の主開口部91aを有し、該主開口部91aの位置を除く複数箇所に分岐管92を接続したものである。分岐管92の接続は、分岐管の一端を多岐管本体91の壁に設けた孔91bに合わせ接続することでなされている。ところがこのような従来型多岐管では、多岐管本体内部の全長における各所で液圧が均一に作用せず、特にろ過器におけるろ過圧力が不純物除去に伴って上昇してきたときには、たとえそのろ過圧力がろ過器自体では許容範囲にあるときでも各所で液圧が均一に作用せず、例えばポンプによって

主開口部91aから正圧力下に多岐管本体91内に液体を導入したとすると、主開口部91aに近い分岐管には多くの液が流出し、主開口部91aから順次遠くなる各位置では、それより前の位置での分岐管への液流出により液圧が低下して、その位置での分岐管にはより少ない量の液しか流出しない。

【0082】一方、ポンプによる吸液圧力（負圧力）下において分岐管92に外部から液を流入させ、これを主開口部91aから吸引する場合は、主開口部91aに近い分岐管からは多くの液を吸引できるが、主開口部91aから順次遠くなるに従ってポンプの液吸引作用が低下してその位置での分岐管92からはより少ない量の液しか吸引できない。

【0083】このような多岐管を処理液のろ過のための液体回路、後述する複数の液槽における処理液を均質に維持するための液体回路、各液槽における液面位置を制御するための液体回路等に採用すると、所望のろ過処理、処理液質の維持、液面制御に支障をきたすことになる。このような問題を解決するには、各分岐管に流量調整弁90を設けなければならないが、それではコスト高となるうえに、不純物のろ過除去量に応じて日時の経過とともに減量していくろ過量、さらに配管抵抗による各吸、送液管毎の通液量の減少等を均一化するについて、流量調整弁90の開き度乃至絞り度の調整に著しく手間を要する。

【0084】この点、図9に示す構造の多岐管によると、各分岐管において、図15に示すような流量調整のための流量調整弁90を設ける必要はなく、その液流通断面積に応じた通液量を簡単、容易に、安価に得ることができる。次に以上説明したろ過装置等について、説明の都合上、ろ過装置4Aから説明する。

【0085】循環ろ過装置4Aによると、通常の循環ろ過においては、前記の弁v41～v45が開けられ、温度制御回路45における弁va'、vb'、Vはそれぞれ任意の所定の開度に設定され（常に開いたままでもよい）、あけ換え装置51へ通じる手動開閉弁v51、v52は閉じられる。

【0086】そして循環ポンプ（本例では遠心ポンプ）42を運転することで、弁v43を介して液槽12、13の各内底溝102から第1吸引ヘッド104にて主として沈殿性不純物を含むメッキ液を吸引し、また図3に鎖線で示すように液槽内底の他の部位に第3吸引ヘッド108も設置してあるときは該第3吸引ヘッドからも液槽内底部及びその近傍の不純物を含むメッキ液を吸引し、一方、液槽12、13のそれぞれにおけるオーバーフローボックスB1、B2へ堰部21、22を越えてメッキ液とともに流れ込み、該ボックスB2へ集まる浮遊性不純物をボックスB2内のメッキ液とともに第2吸引ヘッド106にて吸引し、これら不純物をろ過器41でろ過し、ろ過後のメッキ液を再び各液槽12、13の2

箇所へ還流することができる。このようにろ過後の液を各液槽の1箇所ではなく複数箇所に戻すので、それだけ該液槽の各部において液の清浄度が向上する。

【0087】この循環ろ過中、メッキ液は温度制御回路45における熱交換器451にて所定温度に制御される。連休や休日あけ等においてメッキ処理装置を運転開始する際、メッキ液の温度が所定の温度から大きく外れているようなときには、所定の温度又はそれに近くなるまで、温度制御回路45における流量調整弁Vを絞るか閉じて、メッキ液を熱交換器451に集中的に流すことで、速やかに所定のメッキ液作業温度を得ることができる。

【0088】ところで、一般に物品処理液槽の場合、処理液中には、被処理物に当初から付着して持ち込まれる不純物、被処理物の前処理工程中に発生する不純物であって被処理物に付着して持ち込まれる不純物、そして処理液内での被処理物の処理過程において電解、劣化等により発生する不純物等が相乗して不純物が日々積増していき、このためにコスト高を招くろ過器のろ過床の頻繁な洗浄還元及び液槽あけ換えろ過を行わなければならない。

【0089】物品メッキ処理液槽を例にとると、メッキ処理液中には、被処理物に当初から付着して持ち込まれる不純物、被処理物の前処理工程中に発生する不純物であって被処理物に付着して持ち込まれる不純物、そしてメッキ処理液槽内での被処理物の処理過程におけるアノードの電解、処理液の劣化等により発生する不純物、外部から液槽内へ落下することがある不純物等が相乗して不純物が日々積増していき、このためにろ過器内のろ過床の頻繁な洗浄還元作業、そして液槽あけ換えろ過を行わなければならない。さらにこれら作業のために、メッキ製品の生産中断、残業の増加、これに伴う人件費の増加、高価なメッキ液の損失、諸薬品や排液の管理費の増加、電気等のエネルギーの過大な消耗を招き、ひいてはメッキ製品の高騰を招く。

【0090】あけ換えろ過を例にとると、あけ換えろ過実施の周期は液質、生産品種等によって大きく左右されるが、概ね1ヶ月から3ヶ月の間である。あけ換えろ過によって無機、有機不純物の除去のための活性炭処理及びろ過等の処理を行って液組成を再生還元し、その還元液を再び元の液槽に還流させる。いま説明しているメッキ処理液槽11～15においては次のようにあけ換えろ過処理を行う。

【0091】すなわち、液槽12内メッキ液のあけ換えろ過を行うときは循環ろ過装置4Aにおける、液槽12側の弁v42、液槽13側の弁v41、v42及び温度制御回路45の入口へ通じる弁v44、あけ換え装置51の弁v52を閉じ、液槽12側の弁v41、ポンプ42の吸液口に通じる弁v43と共にあけ換え装置51における弁v51を開き、ポンプ42を運転する。

【0092】これにより、液槽12側の弁v41、多岐管431、ポンプ吸液側の弁v43、ポンプ42、逆止弁v46、ろ過器41、弁v51を経由して液槽12内のメッキ液をあけ換え槽511へ回収することができる。あけ換え槽511に回収した液には活性炭ろ過処理、液組成還元処理等を施す。処理済液のあけ換え槽511から液槽12への還流には、あけ換え装置51の弁v51、ポンプ42の吸液口に通じる弁v43、液槽13側の弁v45を閉じ、あけ換え装置の弁v52、温度制御回路45へ通じる弁v44、温度制御回路45の弁V、液槽12側の弁v45を開き、ポンプ42を運転する。

【0093】これによりあけ換え槽511の底部にあるフート弁v53から還元されたメッキ液は吸入されて、あけ換え装置の弁v52、ポンプ42、逆止弁v46、ろ過器41、弁v44、温度制御回路45の多岐管452、弁V、多岐管433を経由して液槽12側の弁v45から液槽12へ還流する。一方、液槽13内のメッキ液のあけ換えろ過を行うときは、循環ろ過装置4Aにおける、液槽13側の弁v42、液槽12側の弁v41、v42及び温度制御回路45へ通じる弁v44、あけ換え装置51の弁v52を閉じ、液槽13側の弁v41、ポンプ42の吸液口に通じる弁v43と共にあけ換え装置51における弁v51を開き、ポンプ42を運転する。

【0094】これにより、液槽13側の弁v41、多岐管432、多岐管430、ポンプ吸液側の弁v43、ポンプ42、逆止弁v46、ろ過器41、弁v51を経由して液槽13内のメッキ液をあけ換え槽511へ回収することができる。あけ換え槽511に回収した液にはろ過処理等を施す。あけ換え槽511から液槽13への液還流には、あけ換え装置51の弁v51、ポンプ42の吸液口に通じる弁v43、液槽12側の弁v45を閉じ、あけ換え装置の弁v52、温度制御回路45へ通じる弁v44、温度制御回路45の弁V、液槽13側の弁v45を開き、ポンプ42を運転する。

【0095】これにより、あけ換え槽511の底部にあるフート弁v53から還元されたメッキ液が吸入されて、あけ換え装置51の弁v52、ポンプ42、逆止弁v46、ろ過器41、弁v44、温度制御回路45の多岐管452、弁V、多岐管433を経由して液槽13側の弁v45から液槽13へ還流する。このようにここでは液槽12、13のメッキ液のあけ換えろ過は、各槽のメッキ液をそれぞれ一部又は全量あけ換えろ過ができる。

【0096】液槽12、13のメッキ液を個別にあけ換えろ過処理できるようにしたのは、2槽一緒に液交換するとなればあけ換え槽511をそれだけ容量大にしなければならず、それではあけ換え槽511の設置スペースが大きくなってしまい、コスト高につくからであり、

さらに、あけ換えろ過が要求される原因は、各槽毎に生じることが多いからである。

【0097】なお、大容量のあけ換え槽511の設置スペースがある等の場合は2槽について一度にあけ換えろ過作業を行ってもよい。循環ろ過装置4Bにおいても、ろ過装置4Aの場合と同様に液槽14、15のメッキ液を循環ろ過できる。また、メッキ液の温度制御もできる。さらに液槽14、15のメッキ液をそれぞれ一部又は全量あけ換えろ過ができる。

【0098】循環ろ過装置3によると、通常の循環ろ過においては前記の弁v11～v15が開けられ、温度制御回路45における開閉弁及び流量調整弁はそれぞれ所定の開度に設定され、あけ換え装置51へ通じる開閉弁は閉じられる。そして循環ポンプ32を運転することで、液槽11の内底溝102から第2吸引ヘッド104にて主として沈殿性不純物をメッキ液とともに吸引し、また図3に鎖線で示すように液槽内底の他の部位に第3吸引ヘッド108も設置してあるときは該第3吸引ヘッドからも液槽内底部及びその近傍の不純物を含むメッキ液を吸引する。

【0099】一方、液槽11に付設されたオーバーフローボックスB1、B2へ堰部21、22を越えてメッキ液とともに流れ込み、ボックスB2へ集まる浮遊性不純物をボックスB2内の第2吸引ヘッド106にてメッキ液とともに吸引して、これら不純物をろ過器31でろ過し、ろ過後のメッキ液を再び液槽11の2箇所へ還流することができる。このようにろ過後の液を液槽11の1箇所ではなく複数箇所に戻すので、それだけ液槽11の各部において液の清浄度が向上する。

【0100】この循環ろ過中、メッキ液は温度制御装置45において所定温度に制御することもできる。連休及び休日あけ等においてメッキ処理装置を運転開始する際、メッキ液の温度が所定の温度から大きく外れているようなときには、所定の温度又はそれに近くなるまで、温度制御回路45における流量調整弁Vを絞るか閉じて、メッキ液を熱交換器に集中的に流すことで、速やかに所定のメッキ液温度を得ることができる。

【0101】液槽11内メッキ液のあけ換えろ過を行うときは、ろ過装置3において前述の液槽12、13のあけ換え装置51と同様に液槽11側の弁v11を開いてv12を閉じ、さらに温度制御回路45へ通じる弁v44と装置51の弁v52を閉じ、あけ換え槽511への送液用開閉弁v51を開き、ポンプ32の運転によって液槽11内のメッキ液を該あけ換え槽へ回収することができる。

【0102】そして回収されて再生し復元されたメッキ液は、あけ換え装置51によって前述の液槽12、13と同様にして液槽11に還流することができる。以上説明したメッキ処理装置には、さらに、液槽11～15のそれぞれからメッキ液を回収して混合し再び各液槽に戻

しつつ各液槽内の液面位置を所定位置に制御するための液混合及び液面位置制御のための装置6が設けられている。以下これについて説明する。

【0103】前記液混合及び液面位置制御のための装置6は図1に示すように、液循環ポンプ61と、液槽11～15のそれぞれのオーバーフローボックスB2から手動開閉弁v71、液合流用の第1多岐管J1及び液合流用の第2多岐管J2、さらに手動開閉弁v62を介してポンプ61の吸液口へ液を導く回路と、液槽11～15のそれぞれのオーバーフローボックスB2から手動開閉弁v61及び各液槽に対応する液排出用電動弁Va（合計5個ある）を介して液合流用の第3多岐管J3へ、さらに該第3多岐管J3から前記第2多岐管J2及び手動開閉弁v62を介してポンプ61の吸液口へ液を導くことができる回路と、ポンプ61の吐出口から逆止弁Vo及びろ過器60を介して、さらに手動開閉弁v63、液分配用の第4多岐管J4及び液分配用の第5多岐管J5を介して各液槽11、12、13、14、15へ液を導く回路と、ポンプ61の吐出口から前記の逆止弁Vo及びろ過器60を介して、さらに弁v63、前記第4多岐管J4、液分配用の第6多岐管J6及び各液槽に対応する液供給用電動弁Vb（合計5箇ある）、さらに手動開閉弁v64を介して各液槽11、12、13、14、15へ液を導くことができる回路とを備えている。液混合及び液面位置制御のための装置6はさらに各液槽のオーバーフローボックスB2に設置された液面位置検出装置62を含んでいる。

【0104】液排出用電動弁Va、液供給用電動弁Vbはここではないずれも弁開閉駆動モータを備えた弁である。なお、図示のメッキ処理装置は、図11（A）に示すように装置全体の動作を制御する制御部7を備えており、制御部7の一部は、いま説明している液混合及び液面位置制御のための装置6の一部を構成している。

【0105】制御部7には操作盤71が接続されており、それには各ポンプを始動したり、停止したりするスイッチ等が搭載されている。そして、図11（A）に示すように、各ポンプ32、42、42、61は該制御部に接続されていて、該制御部からの指示に基づいて動作するようになっており、液混合及び液面位置制御のための装置6における各液槽に対応する液排出用電動弁Va、液供給用電動弁Vb及び液面位置検出装置62も該制御部に接続されている。

【0106】各液面位置検出装置62はいずれも同構造のものであり、そのうち一つについて図11（B）に概略構成を示すように、オーバーフローボックスB2内に上方から吊り下げ挿入される合計5本の電極棒621～625を含んでいる。これら電極棒は電極棒621、622、623、624の順に長く、この順に深くボックスB2内に挿入されている。電極棒625はアース電極棒であり、電極棒624と略同じかより深くボックスB

2内に挿入されている。

【0107】各液槽のオーバーフローボックスB2内において、電極棒621は異常な液面の上限を検出するための電極棒であり、電極棒622は液面位置が許容範囲の上限に達するとこれを検出するための電極棒であり、電極棒623は液面位置が許容範囲の下限に達するとこれを検出する電極棒であり、電極棒624はそのオーバーフローボックス内が満液状態にあることを検出する電極棒である。

【0108】液槽11～15のいずれの液槽においても、該液槽における堰部21、22を越えてオーバーフローボックス内に収容されている液の液面高さが所定の上限と下限の範囲内にあるときは、即ちボックスB2内の液面位置が電極棒622の下端より下方に、且つ、電極棒623の下端より上方に位置している場合には、該液槽に対応する液排出用電動弁Va、液供給用電動弁Vbはいずれも制御部7の指示のもとに開かれたままで、該液槽について液の排出及び供給が続けられる。

【0109】しかし、該液槽における堰部21、22を越えてボックスB2内に収容されている液の液面高さが所定の範囲を超えて高くなって電極棒622の下端に接触すると、制御部7の指示のもとに、該液槽に弁v64（通常、開けてある）を介して連通している液供給用電動弁Vbは閉じて該液槽への給液は停止される一方、液排出用電動弁Vaは開かれ、弁v61（通常、開けてある）を介して該液槽から液が排出される。

【0110】このとき、電動弁Vaを介しての排出回路とは別に、弁v71（通常開けてある）、多岐管J1を介して排出される液が、多岐管J2内において、電動弁Va及び多岐管J3からの排出液と合流し、これら合流液が弁v62を介してポンプ61に吸引される。また該液槽内の液面位置が降下して電極棒623の下端を離れると、制御部7の指示のもとに、液排出用電動弁Vaが閉じられる一方、液供給用電動弁Vbは開かれ、弁v64を介して該液槽へ送液される。このとき、ポンプ61からの送液は、逆止弁Vo、ろ過器60を経て、多岐管J4の二つの分岐管のうち一方の分岐管により前記の多岐管J6、電動弁Vbへとなされると同時に、多岐管J4の他方の分岐管から多岐管J5へ、さらに液槽への液流出口63へと還流する。

【0111】そして①該循環ろ過装置6において、ポンプ61の吸液回路における弁v61から電動弁Vaを経由する排出液量と、電動弁Vaを経由しないで弁v71から多岐管J1、J2を経て排出される液量との合計排出液量と、②該ポンプの送液回路における電動弁Vb、弁v64を経由して液槽へ還流する送液量と、電動弁Vbを経由しないで多岐管J4、J5を経て液流出口63から液槽へ還流する液量との合計送液量とが略等量となるように当初において設定されている。

【0112】なお、この間、ポンプ61の運転は継続し

ている。オーバーフローボックスB2内において、不測の事態等により処理液の液面高さが所定の高さより低くなって、該液面が電極棒624を離れると、或いは処理液の液面高さが所定の高さより高くなって該液面が電極棒621に接触すると、制御部7の指示のもとに前後者ともにポンプ61のみならず全ポンプが非常停止される。安全管理のためにこの場合に警報を発する警報装置を設けておいてもよい。

【0113】前記の液合流用の多岐管J1～J3、は、吸液のための吸液空間を有するとともに該吸液空間に連通する液流通主開口部を一か所に有する多岐管本体と、該多岐管管本体の前記主開口部位置を除く複数の所定箇所のそれぞれに連設された分岐管とを備えており、液が各分岐管に流入し、多岐管本体内で合流し主開口部から流出するものである。

【0114】また、前記の液分配用の多岐管J4～J6は、送液のための送液空間を有するとともに該送液空間に連通する液流通主開口部を一か所に有する多岐管本体と、前記多岐管本体の前記主開口部位置を除く複数の所定箇所のそれぞれに連設された分岐管とを備えており、液が主開口部に流入し、各分岐管から別れて流出するものである。

【0115】第1多岐管J1及び第3多岐管J3、さらに第5多岐管J5及び第6多岐管J6のそれぞれには、液槽の数と同数（ここでは5本）の分岐管が設けられており、第2多岐管J2及び第4多岐管J4については2本の分岐管が設けられている。装置6で採用されている液合流用の多岐管J2及び液分配用の多岐管J4は、循環ろ過装置で採用した図9に示す構造の多岐管と基本構造を同じくするもので、各分岐管にその液流通断面積に応じた通液量を得ることができるものである。また、装置6で採用される液合流用多岐管J1及びJ3並びに液分配用の多岐管J5及びJ6はいずれも図10に示す多岐管と同構造を有するものであり、製作材質は塩化ビニル樹脂（PVC）によるものである。なおこれら多岐管は処理液質等に応じて他の材料製、例えば他の合成樹脂製や金属製でもよいすなわち、多岐管J1、J3、J5、J6のそれぞれは、図10に示すように、それとは限定されないがここでは断面円形が多岐管本体600とこれに接続された5本の、それとは限定されないがここでは断面円形の分岐管601、602、603、604、605とからなるものである。

【0116】多岐管本体600は一端に他の管を接続するための主開口部600aを有し、他端600bが閉鎖された内径略均一な（液流通断面積が略均一な）閉鎖筒体である。そして分岐管601～605に対する正又は負の同一圧力下における多岐管本体600の開口部600aの断面積は、それぞれ必要とする所定の通液量を与える分岐管601～605の合計断面積に相当する断面積を有している。各分岐管の液流通断面積はここでは同

一である。また多岐管本体600の断面積は該複数分岐管の合計断面積に対して余裕のある断面積として該開口部600aよりは若干大きい断面積を有している。

【0117】分岐管601～605はそれぞれ多岐管本体600の長手方向における5箇所において、多岐管本体の長手方向に直交する方向から該多岐管本体へ突出挿入され、各分岐管の多岐管本体への突出度（突出挿入高さ） β は本体600の内径 R' の略 $1/2$ 以上 $3/5$ 以下である。分岐管601～605のそれぞれの多岐管本体600内への突出挿入高さは、該多岐管本体およびポンプ61の吸液圧力（負圧力）又は送液圧力（正圧力）下において、該多岐管本体内の圧力（負又は正圧力）を均一圧力下におくものである。多岐管本体600は分岐管601～605に対して液密に接着剤、溶接等によって接続されている。

【0118】この構造の多岐管においても、多岐管本体600の主開口部600aにポンプ61の吸液口を連通させて液合流用の多岐管として用いた場合、多岐管本体内の液圧（負圧力）が多岐管本体内部各所で均一化され、従って各分岐管601～605から多岐管本体600内への吸液量は該分岐管の液流通断面積に応じたものとなる。ここでは同じ吸液量となる。

【0119】また、多岐管本体600の主開口部600aにポンプ61の吐出口を連通させて液分配用の多岐管として用いた場合、多岐管本体内部の液圧（正圧力）が多岐管本体内部各所で均一化され、従って各分岐管601～605からの吐出液量は該分岐管の液流通断面積に応じたものとなる。ここでは同じ吐出液量となる。以上説明したように、ここでは、多岐管J1～J6（図1参照）として、各分岐管にその液流通断面積に応じた通液量を得ることができる多岐管を採用しており、それにより、各液槽の相互液混合を継続しつつ行う各液槽11～15における液面位置の制御を、各液槽における液面高さに見合った状態で適切に行うことができ、また、それにより液面位置制御のための各弁Va、Vb（図1参照）の開閉回数を低減させることができ、その開閉サイクルをそれだけ長びかせると共に電動弁Va、Vbの耐久性をも長びかせることができる。

【0120】以上説明した液混合及び液面位置制御のための装置6によると、各液槽のオーバーフローボックスB2における液面が正常位置にあるときは、各弁Va、Vbが開かれ、液循環ポンプ61が運転されることで、複数の液槽11～15のそれぞれのオーバーフローボックスB2から第2吸引ヘッド用の弁v42及び弁v61、v71を介して液が吸引され、各槽の液は液合流用の第1多岐管J1及び第3多岐管J3の各分岐管に至り、それら分岐管から該多岐管の本体へ流入し、合流し、さらに該多岐管本体から液合流用の第2多岐管J2の分岐管へ流れ、該多岐管J2の本体を経て、各槽の液

が混合された状態で液循環ポンプ61へ吸い込まれる。

【0121】そして、液循環ポンプ61に吸い込まれた液体は該ポンプから吐き出され、ろ過器60でろ過されたのち、液分配用の第4多岐管J4の本体へ流入し、さらに該多岐管から液分配用の第5多岐管J5及び第6多岐管J6の本体へ流入し、該多岐管の各分岐管を経て各液槽11～15へ還流する。このように各液槽から吸引されたメッキ液が多岐管J1、J3で合流し、さらに多岐管J2で合流し、液循環ポンプ61に吸い込まれて吐き出され、さらにろ過器60を通過し、第4多岐管J4で分配され、さらに第5多岐管J5及び第6多岐管J6で分配される過程で、複数の液槽11～15からのメッキ液が混合され、これが連続的に実施されることで各液槽のメッキ液組成は、均質に維持される。

【0122】また、前記のとおり各液槽の液面位置が制御される。このようにして各液槽内の処理液を混合して、均一な液組成のもとに生産作業を継続的に実施できる。しかもこれら液混合と液面制御は一つの液循環ポンプ61により達成される。かくして、装置構造の複雑化、大形化、高価格化を抑制しつつ、液槽間において処理液を均質に維持することができるとともに各液槽における液面位置の所定液面位置に対する変動を抑制できる。

【0123】なお、以上説明した液混合及び液面位置制御のための装置6のように、少なくとも液循環ポンプ61へ液を導くための各回路及び液面位置検出装置62をオーバーフローボックスB2に対して設けることで、液槽の堰部を越える前の液を収容している部分で邪魔ものの少なくメッキ処理を行える。また、液槽全体における液量の変動に対して液面の上下変動を大きくとれるオーバーフローボックスにおいて液槽における液面位置の変動をより決め細かく検出して、適切な液面位置制御を行える。

【0124】ろ過器60はオーバーフローボックスに流入する液量に対応できる本来の循環ろ過のためのろ過器31、41よりも小型でよい。しかもろ過器60は既に述べたように1台でも足りる。図1に示すメッキ処理装置におけるメッキ液の循環ろ過装置3、4A、4Bによる循環ろ過は、各液槽についてみると、通例に従い例えば、1時間当たり1液槽の液収容量に対し約3回循環ろ過することができる。すなわちろ過量は該容量の約3倍を標準とすることができる。また、循環ろ過装置6による液混合及び液面制御のための液処理量は、例えば1液槽の液収容量に対し1時間あたり約0.5回循環ろ過する量とできる。すなわちろ過量は該容量の約0.5倍を標準とできる。

【0125】例えば図1に示す五つの液槽のそれぞれにおける正規の液収容量を 5m^3 とすると、1分間あたりのろ過量は次表のように設定できる。

$$\text{ろ過回数} \times \text{液収容量} \times \text{液槽数} \div \text{ろ過時間} = 1 \text{ 分間ろ過量}$$

ろ過装置3	3	×	5 m ³	×	1	÷	60分	=	0.25 m ³ /分
ろ過装置4A	3	×	5 m ³	×	2	÷	60分	=	0.5 m ³ /分
ろ過装置4B	3	×	5 m ³	×	2	÷	60分	=	0.5 m ³ /分
ろ過装置6	0.5	×	5 m ³	×	5	÷	60分	=	0.208 m ³ /分

次に各液槽11～15においてオーバーフローボックスB1、B2に臨む堰部21、22（図4も参照）について説明する。

【0126】堰部21、22はいずれの液槽のものについても同じであるから、ここでは液槽12に設けられているものに代表させて説明する。他の液槽についても堰部の点については以下の説明が当てはまる。堰部21は液槽12とオーバーフローボックスB1との間の仕切り壁w1（図4参照）の上端縁部にオーバーフロー用ノッチ20を形成して設けられている。堰部22は液槽12とオーバーフローボックスB2との間の仕切り壁w2（図4参照）の上端縁部にオーバーフロー用ノッチ（切欠部）20を形成して設けられている。ここでは堰部21、22における各オーバーフロー用ノッチ20は同じ形状、サイズである。

【0127】各ノッチ20はここでは逆三角形形状であり、堰部21、22のいずれについても複数形成されている。このように液オーバーフロー用ノッチ20を形成した堰部21、22を採用して該ノッチ20からオーバーフローボックスB1、B2へ液がオーバーフローするようにしたので、該堰部21、22から液を浮遊性不純物とともにオーバーフローボックスB1、B2へ流入させて、それらを前述のとおり該ボックスからポンプで吸引でき、これら吸引した液をろ過に供することができる。

【0128】そして液オーバーフロー用ノッチ20を形成した堰部21、22を採用して該ノッチ20からオーバーフローボックスB1、B2へ液がオーバーフローするようにしたので、液槽12内の液面が望ましい液オーバーフローのための液面位置より少しぐらい上昇しても、その上昇液面位置がノッチ20に臨んでいる限り、従来の矩形堰のように堰の上端縁の全長にわたり一斉にオーバーフロー量が急激に増加し、そのために全体のオーバーフロー量が著しく増加してしまうということはなく、該ノッチ20における液面の上昇による液流通断面積の増加分だけオーバーフロー量が増加するだけである。

【0129】また、液槽12内の液面が下降しても、その下降液面位置がノッチ20に臨んでいる限り、従来の矩形堰のように堰部上端縁の全長にわたり一斉にオーバーフロー量が減少し、そのため全体のオーバーフロー量が著しく減少してしまうということはなく、該ノッチ20における液面の下降による液流通断面積の減少分だけオーバーフロー量が減少するだけである。

【0130】従って、液槽12における液面の上下変動があっても、従来の矩形堰に比べると、オーバーフロー

量はごく緩やかに増大又は減少する。換言すれば、液槽12における液面の上下変動があっても、従来の矩形堰に比べると、オーバーフロー量の変動はごく小さく抑制される。かくして液の適切なろ過のために、ろ過用ポンプ能力に見合った循環ろ過の液量に応じて設定される液槽12底部からの吸液量（例えば循環ろ過液量の略70％）とオーバーフローボックスからの吸液量（例えば循環ろ過液量の略30％）を維持して、液の適切なろ過が達成される。

【0131】また、液オーバーフロー用ノッチ20を形成した堰部21、22を採用して、該ノッチ20からオーバーフローボックスB1、B2へ液がオーバーフローするようにしてあり、該ノッチ20は堰部21、22を越える前の液の深さ方向に延びているから、液槽12内の液面に浮上し易い浮上性不純物だけでなく、それより下層に浮遊し易い不純物も該ノッチ20からオーバーフローボックスB1、B2へ流入しやすく、かかる液面より下層に浮遊する不純物についても回収してろ過することができる。

【0132】さらに、ノッチ20の形状（ここでは特にノッチの逆三角形形状の下端頂角の角度とノッチの深さ）や数を選んで、オーバーフロー量をたやすく設定できるという利点もある。なお、図示のノッチ20は逆三角形形状であるが、矩形状、U字形状など他の形状であってもよい。図示のように逆三角形形状ノッチを採用するばあい、その逆三角形形状の下端頂角として、それには限定されないが、40°～90°、より好ましくは50°～60°程度を例示できる。

【0133】図12（A）に示すように、幅500mmの従来の矩形堰200があり、液槽の標準液位が該矩形堰200の上端よりh＝10mm上昇した位置にあり、このとき堰200を越えてオーバーフローする標準液量（所定液量）は略55.2リットル／分であり、液槽の液面がh＝15mm、20mm、25mmとそれぞれ上昇したとすると、矩形堰200をオーバーフローする液量は次表に示すように、101.4リットル／分、156.1リットル／分、218.2リットル／分となる。

【0134】ここで矩形堰200に代えて、図12の（B）、（C）、（D）に示すような幅40mmの矩形ノッチN1、逆三角形形状の下端頂角90度のノッチN2、逆三角形形状の下端頂角60度のノッチN3をそれぞれ有する堰部201、202、203を採用した場合、矩形堰200と同じ標準オーバーフロー液量55.2リットル／分を得ようとする、次表に示すように、堰部201については、ノッチN1の個数Pを5個とすると、各ノッチN1の液流通断面の高さh1を18.4m

mとすればよい。

【0135】堰部202については、ノッチN2の個数Pを5個とすると、各ノッチN2の液流通断面の高さh2を28mmとすればよい。堰部203については、ノッチN3の個数Pを4個とすると、各ノッチN3の液流通断面の高さh3を38.1mmとすればよい。すなわち、液オーバーフロー用のノッチを有するいずれの堰部201、202、203においても該ノッチは液の深さ方向へ延びているから、矩形堰200の上端より液面までの高さh=10mmより深く切れ込んでいる。これにより液面に浮上し易い浮上性不純物だけでなく、それより下層に浮遊し易い不純物も該ノッチからオーバーフローさせ得ることがわかる。

【0136】また、液槽の液面が前記のように矩形堰200の上端よりh=15mm、20mm、25mmとそれぞれ上昇したときの該堰200を越えるオーバーフロ

ー液量と同じオーバーフロー液量を得ようとする、各ノッチ付き堰部201、202、203におけるノッチの個数Pとノッチにおける液流通断面の高さh1、h2、h3は次表ようになる。すなわち次表より、液面の高さが通常液面位置より5mm（h=15mmの場合）、10mm（h=20mmの場合）、15mm（h=25mmの場合）と変動しても、ノッチ付き堰部201、202、203においては、オーバーフロー液量の変動を矩形堰200より小さく抑制できることがわかる。

【0137】次表においてMは矩形堰200におけるオーバーフロー液量リットル／分を示し、mは各ノッチにおけるオーバーフロー液量リットル／分を示し、Pはノッチの数を示す。h、h1、h2、h3の単位は〔mm〕である。

幅500mmの 矩形堰200			幅40mmの矩形ノッ チN1付堰部201			下端頂角90度のノッ チN2付堰部202			下端頂角60度の ノッチN3付き 堰部203		
h	M		h1	m	P	h2	m	P	h3	m	P
10	55.2	10	18.4	11.0	5	28.0	11.0	5	38.1	13.8	4
15	101.4	15	27.6	20.3	5	39.0	25.2	4	48.6	25.2	4
20	156.1	20	36.8	31.2	5	46.5	39.2	4	57.9	39.2	4
25	218.2	25	46.0	43.6	5	53.0	54.3	4	66.0	54.3	4

さて、従来の上端縁が水平一直線に延びる所謂矩形堰によると、液槽の底部から吸液する量とオーバーフローボックスから吸液する量とをろ過用ポンプの能力に応じて所定の割合に設定してあっても、液槽内液面の僅かの上昇によってもオーバーフロー量が大きく増し、それによりオーバーフローボックス内液量が、ポンプ能力のうちオーバーフローボックスからの吸液能力を超えて多くなりすぎ、次第に液槽内の液面とオーバーフローボックス内の液面とが同位置近くになって落差が小さくなり、遂には浮遊性不純物をオーバーフローボックスに充分回収

できなくなることがあることは、既に述べた。この点についてもう少し説明する。

【0138】例えば物品の電気メッキ液処理において、メッキ処理液槽内のメッキ液の循環ろ過量は、被メッキ物によって異なるが、概ね1時間当たり液槽内処理液量の3倍のろ過量を標準とみている。そこで、従来の所謂矩形堰からメッキ処理液をオーバーフローさせる前記のようなオーバーフローボックスB1、B2を備える液槽の循環ろ過量を例にとると次のようになる。

【0139】

	液槽内幅	液槽内長さ及び 堰の長さ	液高さ (液深さ)	液 槽 内液量
液 槽	1.0m	10m	1.1m	液 槽 内液量 11 m ³
ボックスB1	0.2m	10m	0.3m	ボックスB1液量 0.6 m ³
ボックスB2	0.4m	1m	0.5m	ボックスB2液量 0.2 m ³
合計 11.8 m ³				

上記液量11.8m³についての1時間当たりの循環総ろ過量は、

11.8m³ × 3倍 = 35.4m³ /hr となる。

液槽内液のろ過量	35.4m ³ /hr × 70% = 24.8m ³ /hr
オーバーフローボックス 内液のろ過量	35.4m ³ /hr × 30% = 10.6m ³ /hr

合 計 35.4m³ /hr

然るに従来の矩形堰によるオーバーフロー量は、堰上端

から液面までの高さh（図12（A）参照）を一般平均

的な $h=10\text{ mm}$ とすると、つぎのようになる。

【0141】 $h=10\text{ mm}$ のとき、堰幅を前記のように 500 mm とすると、オーバーフロー量は既述のとおり概ね 55.2 リットル/分 となり、堰幅がボックスB1の長さ 10 m とボックスB2の長さ 1 m の合計 11 m であるから、 $55.2\text{ リットル/分} \div 500\text{ mm} \times 11\text{ m} \times 60\text{ 分} = 72.86\text{ m}^3/\text{hr}$ となり、前記のオーバーフローボックスについて設定された循環ろ過流量 $10.6\text{ m}^3/\text{hr}$ を大幅に上回ってしまう。

【0142】このことは、オーバーフローボックス内液量が、ポンプ能力のうちオーバーフローボックスからの吸液能力を超えて多くなりすぎ、急速に液槽内の液面とオーバーフローボックス内の液面とが同位置近くになって落差が無くなり、浮遊性不純物をオーバーフローボックスに充分回収できなくなることを意味する。その結果、液ろ過が不充分となり、被メッキ物表面に不純物が付着してザラ付き等が発生するなど、不良品が多発するという重大問題が生じる。

【0143】そして、液槽内液面位置は、被処理物の前処理工程で被処理物に付着した液の持ち込み、被処理物による処理液の汲み出し、前記熱交換器による液加温に際しての水分の蒸発等によって、時々刻々変動するので、各液槽内液面位置の調節、オーバーフローボックス内への液流入量の調節は頻繁にして、厄介、且つ、重要な作業となっていた。

【0144】この点本願発明では、前記のような液オーバーフロー用ノッチを設けた堰部を採用することで、液槽内液面の上下変動があっても、従来の矩形堰に比べると、オーバーフロー量の変動は小さく抑制され、それによりろ過用ポンプ能力に見合った循環ろ過の流量に応じて設定される液槽底部からの吸液量とオーバーフローボックスからの吸液量を維持して、液の適切なる過が達成され、ひいては不良品の発生を大幅に低減させることができる。

【0145】前記の堰部21、22は液槽とオーバーフローボックスB1、B2との間の仕切り壁w1、w2の上端縁部にノッチ20を形成して固定的に設けられたものであるが、液の適切なる過をより一層簡単容易に行うために、堰部として、液槽とオーバーフローボックスとの間の仕切り壁の上端縁部に取り外し可能に設置できる堰部材を採用することもできる。図13はそのような着脱可能の堰部材の1例を示しており、図14は同じく着脱式の堰部材の他の例を示している。

【0146】図13(A)は堰部材8の斜視図である。図13(B)は該堰部材の使用状態を示しており、図13(A)のX-X線に沿う断面で示している。堰部材8は、液オーバーフロー用の矩形ノッチ80を四つ形成した板体81に断面門形状(乃至U字形状)の壁差し込み部分800を一体的に形成し、ノッチ80を避けて補強リブ83も一体的に形成したものである。

【0147】それには限定されないが、ここでの壁差し込み部分800は凹所の形態のもので、板体81の片面の途中部分に倒立L字形状の屈曲板部82を一体的に設けて形成してある。屈曲板部82とそれに重なる位置にある板体81の下部には、上下方向に長いボルト貫通用の長孔82aをそれぞれ設けてある。この堰部材8は、それには限定されないが、ここでは液槽内処理液に対し耐蝕性の合成樹脂(処理液が電気メッキ液の場合は例えば塩化ビニル樹脂)で全体を一体的に形成してある。

【0148】この堰部材8は、液槽11(12、13、14、15)とオーバーフローボックスB1、B2との仕切り壁に上方から差し込まれる。図13(A)は堰部材8を液槽11とオーバーフローボックスB2との間の仕切り壁w2に、前記の壁差し込み部分800で、上方から差し込んだ状態を示している。堰部材8は、液槽内の液量、ノッチ80の大きさ等の兼ね合いで、1又は2以上が使用される。2以上を使用する場合、隣り合う堰部材8は互いに接触させて仕切り壁w2に差し込む。図示を省略しているが、堰部材8と同様の堰部材が液槽とオーバーフローボックスB1との間の仕切り壁w1にも差し込み配置される。

【0149】図13(A)に示すように、堰部材8を仕切り壁w2に差し込み配置するとき、必要に応じ、前記の壁差し込み部分800の上端奥に高さ調節用のライナーLNを配置することができ、堰部材8は直接或いはこのライナーLNを介して仕切り壁w2の上端に載置される。そしてこのように仕切り壁w2に差し込まれた堰部材8には、例えば前記の倒立L字形状の屈曲板部分82側から、そのボルト貫通用長孔82a、予め壁w2に設けたボルト84が丁度貫通できる内径のボルト孔及び板体81のボルト貫通用長孔82aにボルト84が通され、ナットで緊締される。このとき必要に応じ、ボルト84に嵌合させた液シール材840を屈曲板部分82及び板体81のそれぞれの外面に当てがい、これによりボルト貫通用長孔82aの開いた部分を液密に閉じる。

【0150】かくして堰部材8は液槽とオーバーフローボックスとの間の仕切り壁に所定高さで、換言すれば、ノッチ80の高さ位置を、所定の液オーバーフロー量を得る高さ位置に設定して取り付けられる。この堰部材8によると、液オーバーフロー用ノッチ80を形成してあるから、先に説明した、ノッチ20を形成した堰部21や22と同様の利点がある。

【0151】さらにこの堰部材8によると、オーバーフロー量を各種に設定した堰部材8のうちから適切な堰部材を選択採用して容易にオーバーフロー量を設定でき、また、前記ライナーLNを高さの異なるものに変更する等して堰部材8の取付け高さを変更したり、堰部材8を交換することにより、オーバーフロー量を容易に変更することもできる。

【0152】仕切り壁w2やw1が処理液に対し耐蝕性

に劣る、例えば金属材からなるもので、その表面に耐蝕性合成樹脂等がコーティングしてあるときは、前記ボルト 84 を通すための孔を設けると露出する金属材等の部分は、該ボルト孔に耐蝕性のシール剤を入れる等して保護すればよい。図 14 (A) は堰部材 8' の斜視図である。図 14 (B) は該堰部材の使用状態を示しており、図 14 (A) の Y-Y 線に沿う断面で示している。堰部材 8' は前記の堰部材 8 の変形例であり、次の点が堰部材 8 と異なる。その他の点は堰部材 8 と同様であり、堰部材 8 と同じ部分には同じ参照符号を付してある。

【0153】この堰部材 8' では、液オーバーフロー用の矩形ノッチ 80 を形成した板体 81 の上部にもボルト貫通用の長孔 82a が形成してある。かかる長孔 82a はここでは板体 81 の両端部の上部に形成してある。そして、倒立 L 字形の屈曲板部 82 は板体 81 の両端部にある補強リブ 83 の外側位置で上部の水平部分が削除されている。

【0154】この堰部材 8' も堰部材 8 と同様に、図 14 (B) に示すように壁差し込み部 800 で仕切り壁 w2 に差し込まれる。但しそのとき、倒立 L 字形の屈曲板部 82 の前記上部水平部分の削除部位に、それに対応して予め仕切り壁 w2 の上端から上方へ一体的に延ばした立ち上がり壁 W' が貫通し、板体 81 両端部の上部に重なる。図示を省略しているが、堰部材 8' と同様の堰部材が液槽とオーバーフローボックス B1 との間の仕切り壁 w1 にも差し込み配置される。

【0155】そして堰部材 8' は、堰部材 8 の場合と同様に板体下部において仕切り壁 w2 にボルトナット留めされるだけでなく、板体 81 の上部においても立ち上がり壁 W' にボルトナット留めされる。すなわち、立ち上がり壁 W' に予め設けた、ボルト 84' が丁度貫通できる内径のボルト孔及び板体 81 上部のボルト貫通用長孔 82a にボルト 84' が通され、ナットで緊締される。このときも必要に応じ、ボルト 84' に嵌合させた液シール材 840 を板体 81 に当てがい、これによりボルト貫通用長孔 82a の開いた部分を液密に閉じる。かくして堰部材 8' は液槽とオーバーフローボックスとの間の仕切り壁に所定高さで、換言すれば、ノッチ 80 の高さ位置を、所定の液オーバーフロー量を得る高さ位置に設定して取り付けられる。

【0156】この堰部材 8' においても堰部材 8 と同様の利点がある。さらに、堰部材 8' では、その一部に仕切り壁 w2 の一部に相当する壁 W' が重ね固定されるから、堰部材 8 ならば液槽内の大きい液圧が加わって破損する恐れのあるときでも、堰部材 8' ではその恐れがない。図 13、図 14 を参照して説明した堰部材 8、8' では液オーバーフローのためのノッチ 80 は矩形ノッチであるが、堰部材 8、8' においても液オーバーフローのためのノッチは、既述の堰部 21、22 における逆三

角形状ノッチでもよく、或いはさらに他の形状のノッチでもよい。

【0157】また堰部材 8、8' を仕切り壁 w1、w2 に固定するのに前記の貫通ボルト 84 に代えて、堰部材 8、8' に螺合して仕切り壁 w1、w2 の壁面に当接することで該堰部材を仕切り壁に固定するものを採用してもよい。

【0158】

【発明の効果】以上説明したように本発明によると、液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部からオーバーフローさせるための 1 又は 2 以上のオーバーフローボックスを有する液槽であって次の利点を有する液槽を提供することができる。

(1) 液槽中の液面位置が上下変動しても、従来矩形堰のように堰部を越えてオーバーフローボックスへ流入する液量の著しい変動を招くことがない。

(2) 液槽内液面に浮上し易い浮上性不純物だけでなく、それより下層に浮遊し易い不純物もオーバーフローボックスへ流入させて効率よく回収できる。

(3) 従ってまた、それだけ液槽内に残留する不純物量を減らすことができる。

(4) これらにより液槽底部及びオーバーフローボックスの双方からポンプで吸液して該液をろ過処理する際には、そのろ過処理を効率よく行うことができる。

(5) 従ってまた、液槽内処理液により物品処理を行うときには、不純物の影響を少なくして処理後物品の品質を向上させることができる。

(6) オーバーフローボックスへ流入する液量の設定をたやすくなし得る。

【0159】また本発明によると、液槽内に貯留される液中の上層部に浮遊する不純物を液とともに堰部からオーバーフローさせるための 1 又は 2 以上のオーバーフローボックスを有する液槽の該堰部を提供するための堰部材であって、以下の利点を有するものを提供することができる。

(1) 液槽に取り付けて堰部として用いた場合において、液槽中の液面位置が上下変動しても、オーバーフローボックスへ流入する液量の著しい変動を招くことがない。

(2) 液槽内液面に浮上し易い浮上性不純物だけでなく、それより下層に浮遊し易い不純物もオーバーフローボックスへ流入させて効率よく回収できる。

(3) 従ってまた、それだけ液槽内に残留する不純物量を減らすことができる。

(4) これらにより液槽底部及びオーバーフローボックスの双方からポンプで吸液して該液をろ過処理する際には、そのろ過処理を効率よく行うことができる。

(5) 従ってまた、液槽内処理液により物品処理を行うときには、不純物の影響を少なくして処理後物品の品質を向上させることができる。

(6) オーバーフローボックスへ流入する液量の設定、変更を簡易になし得る。

【図面の簡単な説明】

【図1】本発明に係る液槽を採用した、液体による物品処理装置の1例であるメッキ処理装置の概略平面図である。

【図2】一部の液槽とその周辺部分の拡大平面図である。

【図3】図2に示す液槽のうち一つの液槽とその周辺部分の拡大側面図である。

【図4】液槽の一部の斜視図である。

【図5】図(A)はアノードケース等の斜視図、図(B)はアノードバッグの斜視図、図(C)は陰極棒、ハンガー及び引っ掛け部材等の斜視図である。

【図6】図(A)は第1吸引ヘッドの平面図、図(B)は第1吸引ヘッドの側面図、図(C)は液槽内底溝及びオーバーフローボックス底部とそれらに関連する部品の断面図である。

【図7】第2吸引ヘッドの側面図である。

【図8】第2吸引ヘッドの他の例の斜視図である。

【図9】分岐管を2本有する多岐管の、一部を断面で示す側面図である。

【図10】分岐管を5本有する多岐管の、一部を断面で示す側面図である。

【図11】図(A)は図1に示すメッキ処理装置の制御回路のブロック図、図(B)は液面位置検出装置の概略構成を示す図である。

【図12】図(A)は従来型の矩形堰部材の例を示す図、図(B)は液オーバーフロー用の矩形ノッチを有する堰部材例を示す図、図(C)及び(D)はそれぞれ液オーバーフロー用の逆三角形ノッチを有する堰部材例を示す図である。

【図13】図(A)は本発明に係る着脱式堰部材の1例の斜視図であり、図(B)は同堰部材の使用状態を示す図(A)のX-X線に沿う断面図である。

【図14】図(A)は本発明に係る着脱式堰部材の他の例の斜視図であり、図(B)は同堰部材の使用状態を示す図(A)のY-Y線に沿う断面図である。

【図15】従来の多岐管例を一部断面で示す側面図である。

【図16】従来の液槽とその周辺部分の概略斜視図である。

【符号の説明】

11、12、13、14、15 メッキ処理液槽(物品処理液槽の例)

16 前処理水洗槽

L メッキ液

W 洗浄水

D1、D2、D3、D3、D4 作業デッキ

101 液槽の内底

102 液槽に設けた内底溝

103 エアレーション装置

103a 気泡

104 第1吸引ヘッド

104a 管接続口部

104b 吸液孔

105 エア遮断壁板

105a 支持片

105b 支持板

106 第2吸引ヘッド

106a 管接続口部

106b 吸液孔

106c 支持片

106d 支持板

107 吸引ヘッド

107a 管接続口部

107b 吸液孔

107c 足

108 第3吸引ヘッド

B1、B2 オーバーフローボックス

w1、w2 液槽とオーバーフローボックスとの間の仕切り壁

21、22 堰部

20 堰部のノッチ

A 陽極ブスバー

C 陰極ブスバー

H ハンガー

S 引っ掛け部材

m' アノード材

CS アノードケース

CSb アノードバッグ

a1、a2 被メッキ物品

3 循環ろ過装置

31 ろ過器

32 循環ポンプ(本例では遠心ポンプ)

33 液合流用の多岐管

v11～v15 手動開閉弁

v16 逆止弁

4A、4B 循環ろ過装置

41 ろ過器

42 循環ポンプ(本例では遠心ポンプ)

430、431、432 液合流用の多岐管

433 液分配用の多岐管

v41～v45 手動開閉弁

v46 逆止弁

45 温度制御回路

451 熱交換器

va'、vb' 手動開閉弁

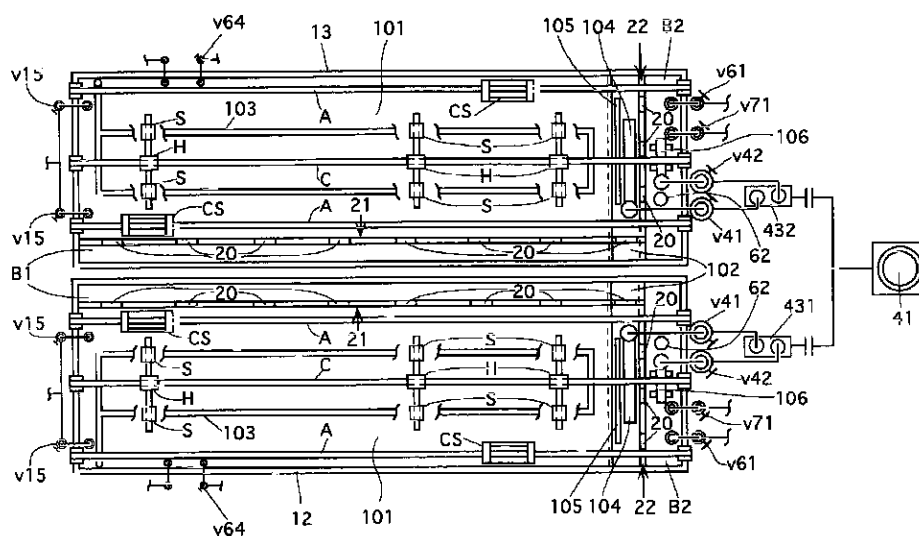
V 流量調整弁

452 液分配用の多岐管

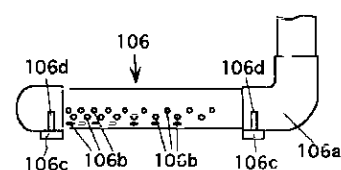
- 51 あけ換え装置
- v51、v52、v61～v64、v71 手動開閉弁
- 511 あけ換え槽
- v53 フート弁
- 401 多岐管本体
- 402、403 分岐管
- 401a 多岐管本体401の主開口部
- 401b 多岐管本体401の他端
- 9 従来の多岐管
- 91 多岐管本体
- 91a 主開口部
- 91b 孔
- 92 分岐管
- 90 流量調整弁
- 6 液混合及び液面位置制御のための装置
- 60 ろ過器
- 61 循環ポンプ（本例では遠心ポンプ）
- 62 液面位置検出装置
- 621～625 電極棒
- 63 液流出口
- Vo 逆止弁
- J1、J2、J3 液合流用の多岐管
- J4、J5、J6 液分配用の多岐管
- Va 液排出用電動弁
- Vb 液供給用電動弁
- 7 制御部
- 71 操作盤
- 600 多岐管本体
- 601～605 分岐管
- 600a 多岐管本体600の主開口部

600b 多岐管本体600の他端
 200 従来の矩形堰
 201～203 堰部
 N1、N2、N3 ノッチ
 8、8' 堰部材
 80 液オーバーフロー用の矩形ノッチ
 81 板体
 82 倒立L字形形状の屈曲板部
 82a ボルト貫通用長孔
 83 補強リブ
 84、84' ボルト
 800 壁差し込み部分
 840 液シール材
 LN ライナー
 W' 立ち上がり壁
 10' 液槽
 L' 液
 B1'、B2'、B3' オーバーフローボックス
 21'、22'、23' 矩形堰
 v1'～v7'、v1"、v7"、v8'、v9' 手動
 開閉弁
 V' フート弁
 Lb、Lb' 通液口
 F ろ過器
 P 循環ポンプ
 H 熱交換器
 100' 液戻し口
 511v フート弁
 511' 液吐出口

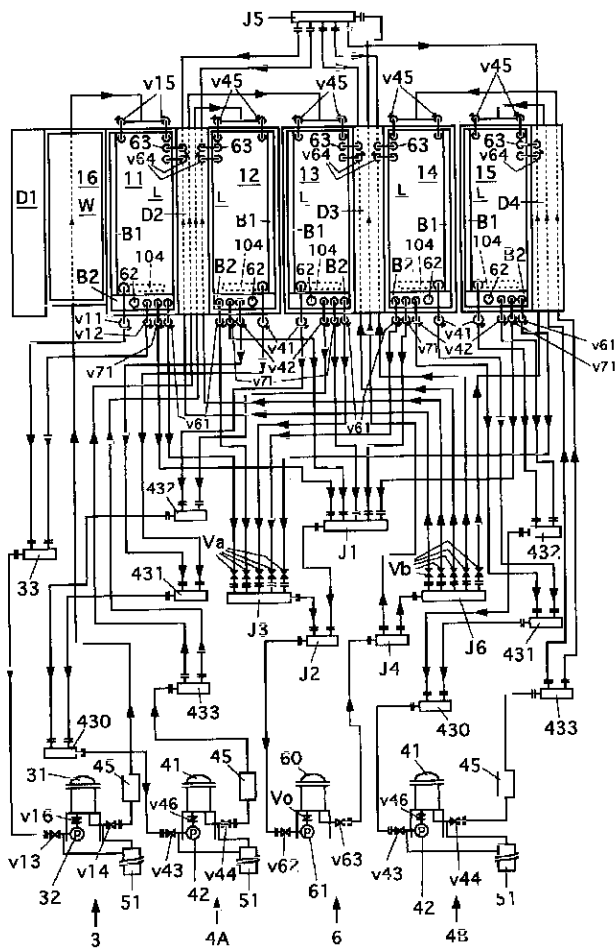
【图2】



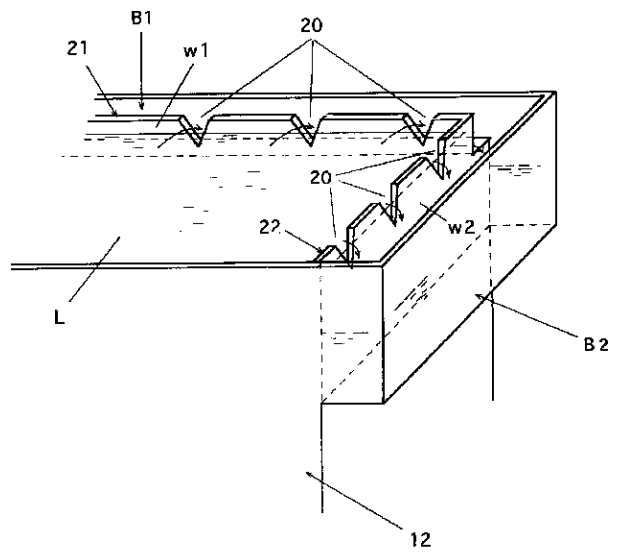
【図7】



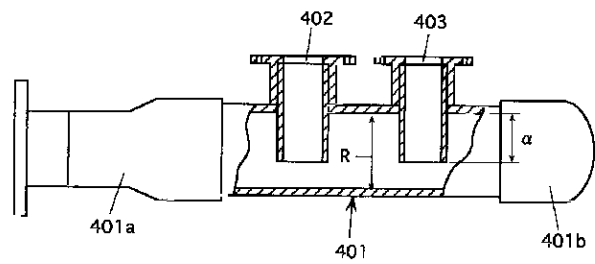
【図1】



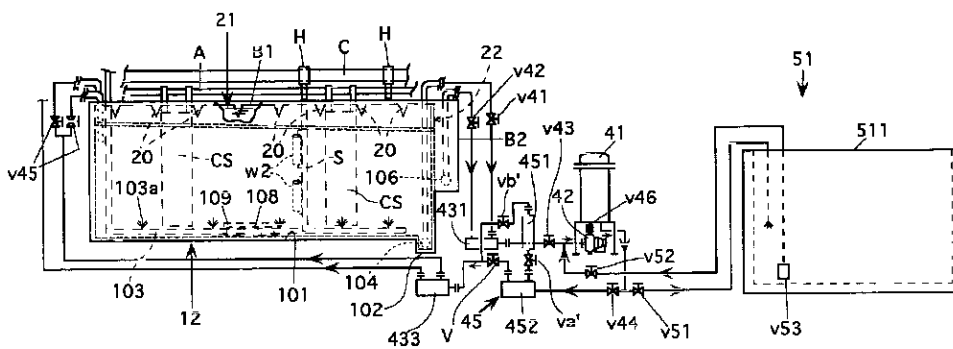
【図4】



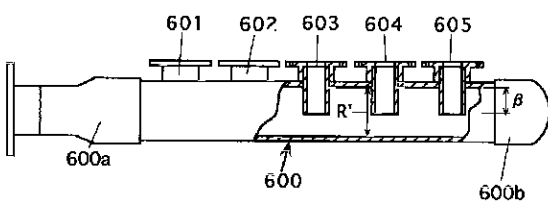
【図9】



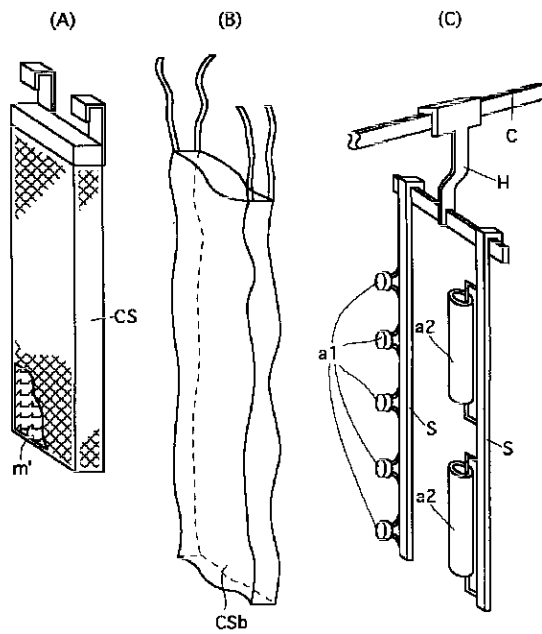
【図3】



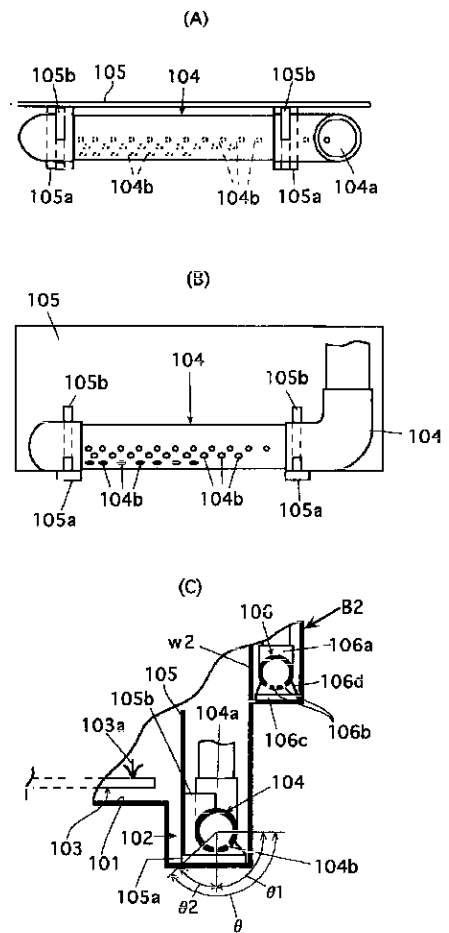
【図10】



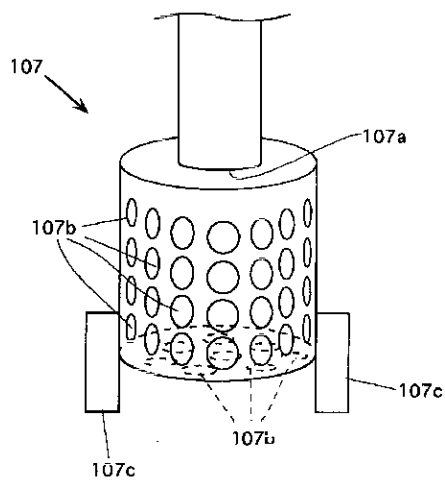
【図5】



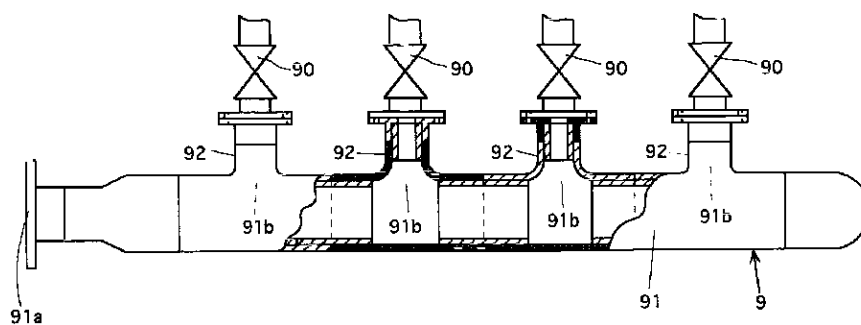
【図 6】



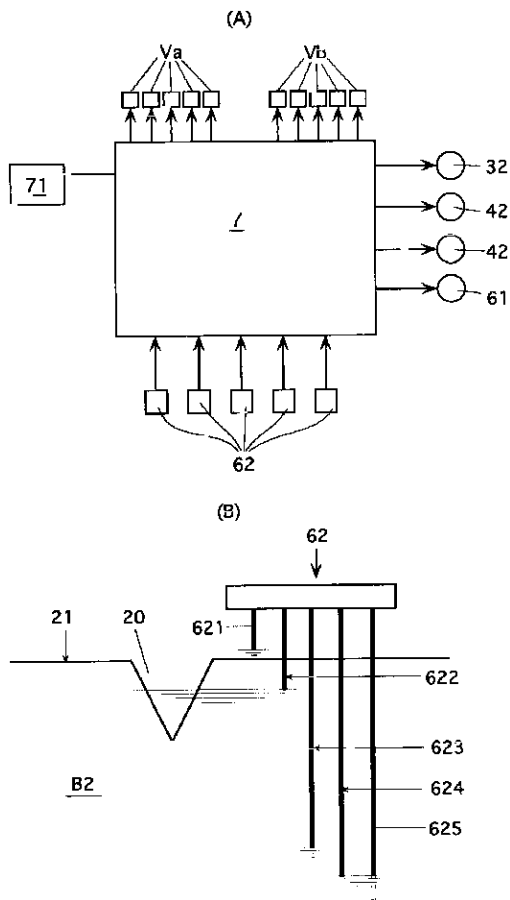
【図8】



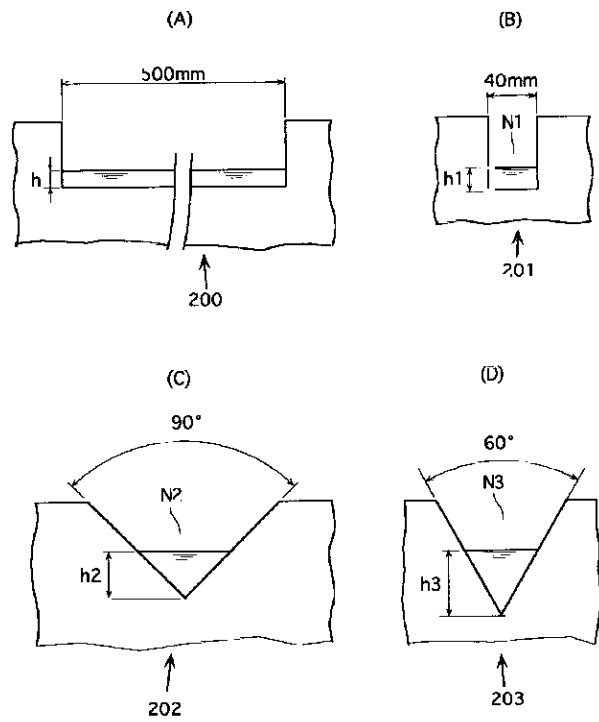
【図15】



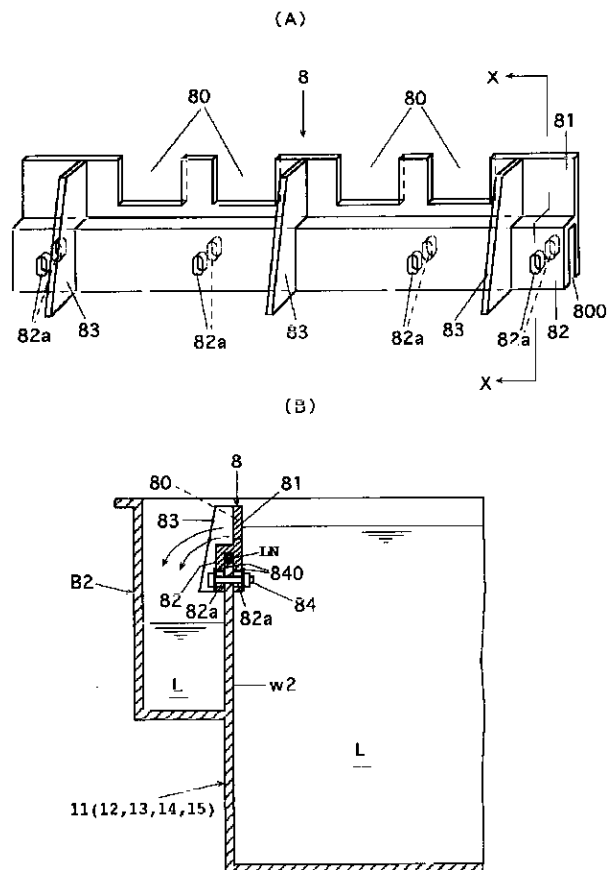
【図11】



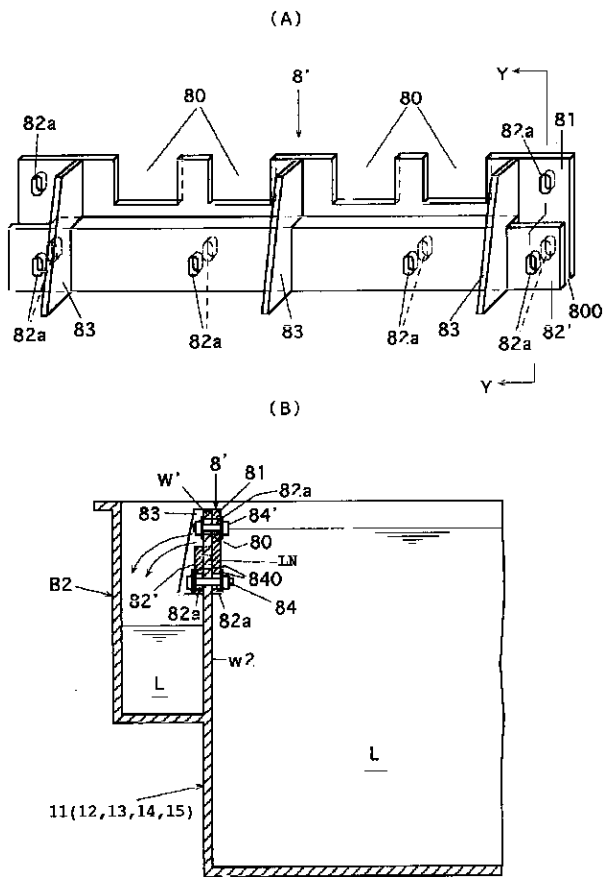
【図12】



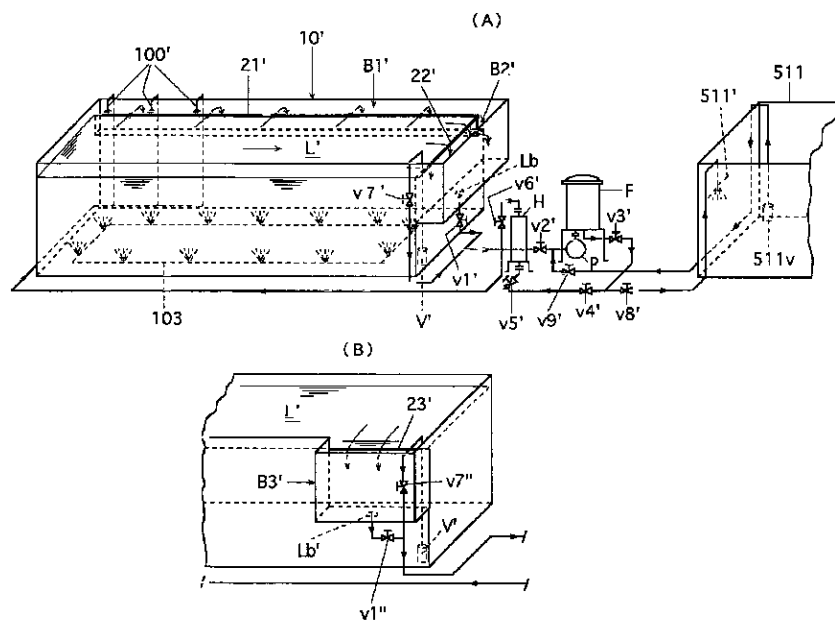
【図13】



【図14】



【例 16】



【手続補正書】

【提出日】平成12年11月2日(2000.11.2)

【手続補正1】

【補正対象書類名】明細書

【補正対象項目名】0041

【補正方法】変更

【補正内容】

【0041】被処理物のメッキ処理には、銅、ニッケル、亜鉛、錫、これらの合金などのメッキのように多くのメッキ処理があるが、ニッケルメッキを施す場合を例にとると、メッキ液Lをニッケルメッキ液とし、アノードケースCSを耐食性チタン籠とし、これにアノード材m'としてニッケルチップを収容する場合を例示できる。

【手続補正2】

【補正対象書類名】明細書

【補正対象項目名】0064

【補正方法】変更

【補正内容】

【0064】第3吸引ヘッド108を採用するときは、これによって吸引される液が最終的には、前記の弁v11、v12を介して吸引される液に混合、合流されてポンプ32へ流入するように弁等を介してポンプ32に配管接続される。送液回路は、ろ過器31の送液口を手動開閉弁v14及び温度制御回路45、さらに二つの手動開閉弁v15を介して液槽11の2箇所に分岐連通させる配管を含んでいる。なお液槽11への連通はこのように2箇所だけでなく、一箇所でも、3箇所以上でもよい。

【手続補正3】

【補正対象書類名】明細書

【補正対象項目名】0067

【補正方法】変更

【補正内容】

【0067】循環ろ過装置4Aと循環ろ過装置4Bとは全く同じ構造、作用のものであるから、装置4Aのみ説明し、装置4Bの説明は省略する。装置4Aと4Bにおいて同じ部品については図中同じ符号を付す。循環ろ過装置4Aは図1に示すように、ろ過器41及び液循環用の循環ポンプ42(ここでは遠心ポンプ)を含んでいる。液槽12、13は吸液回路を介して循環ポンプ42の吸液口に連通できる。ろ過器41は送液回路を介して液槽12、13に連通できる。

【手続補正4】

【補正対象書類名】明細書

【補正対象項目名】0072

【補正方法】変更

【補正内容】

【0072】循環ろ過装置3における温度制御回路45は循環ろ過装置4A、4Bにおけるこの温度制御回路4

5と基本的に同構造である。但し、循環ろ過装置3における温度制御回路45では、弁vb'に相当する弁及び流量調整弁Vに相当する弁の出口は多岐管を介することなく一本の配管に集められ、さらに二つの手動開閉弁v15を介して液槽11の2箇所に分岐連通されている。

【手続補正5】

【補正対象書類名】明細書

【補正対象項目名】0077

【補正方法】変更

【補正内容】

【0077】分岐管402、403は多岐管本体401の長手方向における2箇所において、多岐管本体の長手方向に直交する方向から該多岐管本体内へ突出挿入され、各分岐管402、403の多岐管本体への突出度(突出挿入高さ) α は本体401の内径Rの略 $1/2$ 以上 $3/5$ 以下の範囲にある。

【手続補正6】

【補正対象書類名】明細書

【補正対象項目名】0092

【補正方法】変更

【補正内容】

【0092】これにより、液槽12側の弁v41、多岐管431、多岐管430(図3では図示省略、図1参照)、ポンプ吸液側の弁v43、ポンプ42、逆止弁v46、ろ過器41、弁v51を経由して液槽12内のメッキ液をあげ換え槽511へ回収することができる。あげ換え槽511に回収した液には活性炭ろ過処理、液組成復元処理等を施す。処理済液のあげ換え槽511から液槽12への還流には、あげ換え装置51の弁v51、ポンプ42の吸液口に通じる弁v43、液槽13側の弁v45を閉じ、あげ換え装置の弁v52、温度制御回路45へ通じる弁v44、温度制御回路45の弁V、液槽12側の弁v45を開き、ポンプ42を運転する。

【手続補正7】

【補正対象書類名】明細書

【補正対象項目名】0095

【補正方法】変更

【補正内容】

【0095】これにより、あげ換え槽511の底部にあるフード弁v53から復元されたメッキ液が吸入されて、あげ換え装置51の弁v52、ポンプ42、逆止弁v46、ろ過器41、弁v44、温度制御回路45の多岐管452、弁V、多岐管433を経由して液槽13側の弁v45から液槽13へ還流する。このようにここでは液槽12、13のメッキ液のあげ換えろ過は、各槽のメッキ液をそれぞれ全量あげ換えろ過ができる。

【手続補正8】

【補正対象書類名】明細書

【補正対象項目名】0097

【補正方法】変更

【補正内容】

【0097】なお、大容量のあけ換え槽511の設置スペースがある等の場合は2槽について一度にあけ換えろ過作業を行ってもよい。循環ろ過装置4Bにおいても、ろ過装置4Aの場合と同様に液槽14、15のメッキ液を循環ろ過できる。また、メッキ液の温度制御もできる。さらに液槽14、15のメッキ液をそれぞれ全量あけ換えろ過ができる。

【手続補正9】

【補正対象書類名】明細書

【補正対象項目名】0103

【補正方法】変更

【補正内容】

【0103】前記液混合及び液面位置制御のための装置6は図1に示すように、液循環ポンプ（ここでは遠心ポンプ）61と、液槽11～15のそれぞれのオーバーフローボックスB2から手動開閉弁v71、液合流用の第1多岐管J1及び液合流用の第2多岐管J2、さらに手動開閉弁v62を介してポンプ61の吸液口へ液を導く回路と、液槽11～15のそれぞれのオーバーフローボックスB2から手動開閉弁v61及び各液槽に対応する液排出用電動弁Va（合計5個ある）を介して液合流用の第3多岐管J3へ、さらに該第3多岐管J3から前記第2多岐管J2及び手動開閉弁v62を介してポンプ61の吸液口へ液を導くことができる回路と、ポンプ61の吐出口から逆止弁Vo及びろ過器60を介して、さらに手動開閉弁v63、液分配用の第4多岐管J4及び液分配用の第5多岐管J5を介して各液槽11、12、13、14、15へ液を導く回路と、ポンプ61の吐出口から前記の逆止弁Vo及びろ過器60を介して、さらに弁v63、前記第4多岐管J4、液分配用の第6多岐管J6及び各液槽に対応する液供給用電動弁Vb（合計5箇ある）、さらに手動開閉弁v64を介して各液槽11、12、13、14、15へ液を導くことができる回路とを備えている。液混合及び液面位置制御のための装置6はさらに各液槽のオーバーフローボックスB2に設置された液面位置検出装置62を含んでいる。

【手続補正10】

【補正対象書類名】明細書

【補正対象項目名】0106

【補正方法】変更

【補正内容】

【0106】各液面位置検出装置62はいずれも同構造のものであり、そのうち一つについて図11（B）に概略構成を示すように、オーバーフローボックスB2内に上方から吊り下げ挿入される合計5本の電極棒621～625を含んでいる。これら電極棒は電極棒621、622、623、624の順に長く、この長い順に深くボックスB2内に挿入されている。電極棒625はアース

電極棒であり、電極棒624と略同じかより深くボックスB2内に挿入されている。

【手続補正11】

【補正対象書類名】明細書

【補正対象項目名】0110

【補正方法】変更

【補正内容】

【0110】このとき、電動弁Vaを介しての排出回路とは別に、弁v71（通常開けてある）、多岐管J1を介して排出される液が、多岐管J2内において、電動弁Va及び多岐管J3からの排出液と合流し、これら合流液が弁v62を介してポンプ61に吸引される。また該液槽内の液面位置が降下して電極棒623の下端を離れると、制御部7の指示のもとに、液排出用電動弁Vaが閉じられる一方、液供給用電動弁Vbは開かれ、弁v64を介して該液槽へ送液される。このとき、ポンプ61からの送液は、逆止弁Vo、ろ過器60を経て、多岐管J4の二つの分岐管のうち一方の分岐管により前記の多岐管J6、電動弁Vb、弁V64を経て液槽へ還流すると同時に、多岐管J4の他方の分岐管から多岐管J5へ、さらに液槽への液流出口63へと還流する。

【手続補正12】

【補正対象書類名】明細書

【補正対象項目名】0117

【補正方法】変更

【補正内容】

【0117】分岐管601～605はそれぞれ多岐管本体600の長手方向における5箇所において、多岐管本体の長手方向に直交する方向から該多岐管本体へ突出挿入され、各分岐管の多岐管本体への突出度（突出挿入高さ） β は本体600の内径R'の略 $1/2$ 以上 $3/5$ の範囲にある。分岐管601～605のそれぞれの多岐管本体600内への突出挿入高さは、該多岐管本体におよぶポンプ61の吸液圧力（負圧力）又は送液圧力（正圧力）下において、該多岐管本体内の圧力（負又は正圧力）を均一圧力下におくものである。

【手続補正13】

【補正対象書類名】明細書

【補正対象項目名】0120

【補正方法】変更

【補正内容】

【0120】以上説明した液混合及び液面位置制御のための装置6によると、各液槽のオーバーフローボックスB2における液面が正常位置にあるときは、各弁Va、Vbが開かれ、液循環ポンプ61が運転されることで、複数の液槽11～15のそれぞれのオーバーフローボックスB2から弁v61、v71を介して液が吸引され、各槽の液は液合流用の第1多岐管J1及び第3多岐管J3の各分岐管に至り、それら分岐管から該多岐管の本体へ流入し、合流し、さらに該多岐管本体から液合流用

の第2多岐管J2の分岐管へ流れ、該多岐管J2の本体を経て、各槽の液が混合された状態で液循環ポンプ61へ吸い込まれる。

【手続補正14】

【補正対象書類名】明細書

【補正対象項目名】0124

【補正方法】変更

【補正内容】

【0124】ろ過器60はオーバーフローボックスに流入する液量に対応できる本来の循環ろ過のためのろ過器31、41よりも小型でよい。しかもろ過器60は既に述べたように1台でも足りる。図1に示すメッキ処理装置におけるメッキ液の循環ろ過装置3、4A、4Bによる循環ろ過は、各液槽についてみると、通例に従い例えば、1時間当たり1液槽の液収容量に対し約3回循環ろ過することができる。すなわちろ過量は該容量の約3倍

幅500mmの 矩形堰200			幅40mmの矩形ノッチN1付堰部201			下端頂角90度のノッチN2付堰部202			下端頂角60度の ノッチN3付き 堰部203		
h	M		h1	m	P	h2	m	P	h3	m	P
10	55.2		18.4	11.0	5	28.0	11.0	5	38.1	13.8	4
15	101.4		27.6	20.3	5	39.0	25.2	4	48.6	25.2	4
20	156.1		36.8	31.2	5	46.5	39.2	4	57.9	39.2	4
25	218.2		46.0	43.6	5	53.0	54.3	4	66.0	54.3	4

さて、従来の上端縁が水平一直線に延びる所謂矩形堰によると、液槽の底部から吸液する量とオーバーフローボックスから吸液する量とをろ過用ポンプの能力に応じて所定の割合に設定してあっても、液槽内液面の僅かの上昇によってもオーバーフロー量が大きく増し、それによりオーバーフローボックス内液量が、ポンプ能力のうちオーバーフローボックスからの吸液能力を超えて多くなりすぎ、次第に液槽内の液面とオーバーフローボックス内の液面とが同位置近くになって落差が小さくなり、遂には浮遊性不純物をオーバーフローボックスに充分回収できなくなることがあることは、既に述べた。この点についてもう少し説明する。

【手続補正16】

【補正対象書類名】明細書

【補正対象項目名】0148

【補正方法】変更

【補正内容】

【0148】この堰部材8は、液槽11（12、13、14、15）とオーバーフローボックスB1、B2との

を標準とすることができる。また、循環ろ過装置6による液混合及び液面制御のための液処理量は、例えば1液槽の液収容量に対し1時間あたり約0.5回循環ろ過する量とできる。すなわちろ過量は該容量の約0.5倍を標準とすることができる。

【手続補正15】

【補正対象書類名】明細書

【補正対象項目名】0137

【補正方法】変更

【補正内容】

【0137】次表においてMは矩形堰200におけるオーバーフロー液量リットル／分を示し、mは各ノッチにおけるオーバーフロー液量リットル／分を示し、Pはノッチの数を示す。h、h1、h2、h3の単位は〔mm〕である。

仕切り壁に上方から差し込まれる。図13（B）は堰部材8を液槽11とオーバーフローボックスB2との間の仕切り壁w2に、前記の壁差し込み部分800で、上方から差し込んだ状態を示している。堰部材8は、液槽内の液量、ノッチ80の大きさ等の兼ね合いで、1又は2以上が使用される。2以上を使用する場合、隣り合う堰部材8は互いに接触させて仕切り壁w2に差し込む。図示を省略しているが、堰部材8と同様の堰部材が液槽とオーバーフローボックスB1との間の仕切り壁w1にも差し込み配置される。

【手続補正17】

【補正対象書類名】明細書

【補正対象項目名】図5

【補正方法】変更

【補正内容】

【図5】図（A）はアノードケース等の斜視図、図（B）はアノードバッグの斜視図、図（C）は陰極ブスバー、ハンガー及び引っ掛け部材等の斜視図である。