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(54) Method and device of conducting a closed cycle of the bath for plating of coatings.

(57) The device for conducting a closed cycle of the electroplating bath, especially in the process of electroplating, comprising an electrolytic tank, an evaporation device connected with the electrolytic tank through a device feeding the electroplating bath, is characterized in that in the electrolytic tank or in the vicinity thereof heating devices (17) are comprised and in the evaporation chamber of the evaporation device (10) there are no heating devices, the evaporation chamber (2) of the evaporation device is horizontal and comprises a partition (3), the inlet (1) of the bath to the evaporation chamber is situated on the opposite side in relation to the partition (3), the evaporation chamber (2) comprises a perforated conduit (6) or conduits and/or conduits having porous walls, the evaporation chamber (2) is connected from the side of the partition (3) with a separator (4), the upper part of the separator (4) comprises a drop catcher (7), and the lower part of the separator (4) comprises a conduit (5) taking off the concentrated bath to the electrolytic tank (9), the heating device (17) in the tank being connected to a temperature-control system (14, 15, 16) for control of the temperature of the bath.

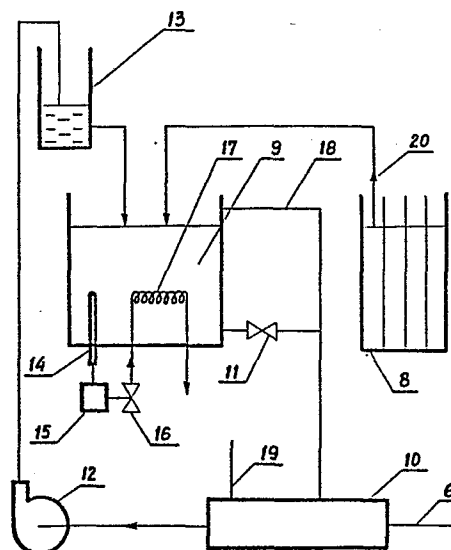


Fig. 1

Instytut Mechaniki Precyzyjnej

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Method and Device of conducting a closed cycle
of the bath for plating of coatings

The subject of the invention is a method of
conducting a closed cycle of the bath for plating
5 of coatings, especially in the process of electro-
plating, and devices for conducting a closed cyc-
le of the bath for plating of coatings, especial-
ly in the process of electroplating.

The known methods of conducting a closed cyc-
10 le of the bath in the process of electroplating
consist usually in conducting the evaporative pro-
cess. It is most often aimed at evaporation of wa-
ter used for rinsing and at obtaining a concen-
trated solution of the composition corresponding
15 to the composition of electroplating bath, after
which rinsing follows.

The known evaporative processes applied for
this purpose are usually conducted at lowered pres-
sure and indirect heating, most often at a rais-
20 ing film of the liquid. The application of vacuum

is aimed at lowering the temperature of the process and at increasing the intensity thereof. This increases, however, the degree of difficulty of conducting the process and raises the cost of the process. Those skilled in the art know also vacuum processes with forced circulation, of still higher degree of complication and additionally increased costs of conducting the process.

Another method of conducting the evaporative process is direct evaporation at atmospheric pressure. The feed is heated in an external heat exchanger, supplied upward to a column with a packing, wherein it evaporates, flowing down in the counter-current in relation to the flowing air.

It should be indicated that in all presently applied methods of evaporation the solution to be evaporated is heated in the evaporation zone.

Known devices for conducting the closed cycle of bath in the process of electroplating comprise usually an evaporator. This is most often aimed at evaporation of water used for rinsing and at obtaining a concentrated solution of the composition corresponding to the composition of electroplating bath, after which rinsing follows.

The known evaporators are, as a rule, vacuum devices, with an external heating chamber (indirect evaporators). Most often they are the so-called evaporators with a raising film of the

liquid (of the companies Pfaudler, Corning, Cosmos). The application of vacuum is aimed at lowering the temperature of the process and at increasing the intensity thereof. This raises, however, the cost of the device. Known also are vacuum circulating evaporators (of the Simex company).

Another group of the applied evaporators are direct evaporators, in which evaporation proceeds at atmospheric pressure (evaporators of the Lancy company).

The feed is heated in the external heat exchanger, supplied upward to a column with a packing, wherein while flowing down in the counter-current in relation to the flowing air it evaporates.

In all presently applied methods of evaporation the heating chamber is an integral part of the evaporator.

The cost of hitherto applied methods and devices is considerable, especially in the case of chemically aggressive baths, e.g. the chromium plating bath. In the case of aggressive baths, heating elements of the evaporator should be made of special borosilicate glass (Simex company) or of special materials, e.g. titanium, tantalum. Auxiliary equipment must be of special design (e.g. pumps) etc.

For example, the cost of the evaporator of Corning company, of the yield of Q=67 l of evaporated liquid/hr is of the order of US \$ 20,000 (1977).

Such a considerable investment cost, in spite of economic management of the whole enterprise and obvious effects of environmental protection, sets back the progress of the new technique of utilization of wastes.

The task of the invention is to work out a method and a device for pumping off the bath, comprising an appropriate evaporation device, so that it is possible to achieve the required evaporation of water from the system at the minimum costs.

The method of conducting a closed cycle of the bath for plating of castings, especially in the process of electroplating, consists in feeding the bath from the electrolytic machining zone to the evaporation zone, and from the evaporation zone - after concentration of the bath in the evaporation zone - back to the electrolytic machining zone, and according to the essence of the invention it is characterized by that the electroplating bath is heated in the electrolytic machining zone and is introduced to the evaporation zone in which the bath is conducted in a flow in a thin layer horizontally, whereby in the whole evaporation zone or only in a part thereof through the horizontally conducted bath air is conducted from below upwards by barbotage, eventually, the conducted air is heated and afterwards wet air conducted through the bath is taken off outside from the circulation after previous separation of entrained particles by the

inertie method, and the concentrated solution from the evaporation zone is fed back to the electrolytic machining zone, the electroplating bath being made up in a continuous way by washings from
5 a water washer for rinsing of objects after the said electroplating bath.

According to the invention it is preferable that the electroplating bath is heated in the electrolytic machining zone, supplying in the said
10 zone at least 25% of heat necessary for evaporation in the evaporation zone. In this case the remaining amount of necessary heat is supplied to air which passes through the bath in the evaporation zone. by barbotage.

15 According to the invention it is advisable to introduce to the evaporation zone at least 55% of the volume of the electroplating bath.

It is preferable, according to the invention, to introduce to the electroplating bath at least
20 55% of the volume of washings after rinsing of objects treated in the said electroplating bath.

According to the invention it is advisable that the air taken off outside from the circulation is used for mixing the rinsing water in wash-
25 ers for washing the objects after the said electroplating bath.

It is preferable, according to the invention, that the air taken off outside from the circulation, after adding water vapour thereto, is used
30 for washing the objects after the said electroplating bath.

According to the invention it is advisable that from wet air conducted through the bath, taken off outside from the circulation, water is condensed off and said condensed-off water is used as washing water in washers.

The device for conducting a closed cycle of the bath for plating of coatings, especially in the process of electroplating, comprising an electrolytic tank, an evaporation device connected with the electrolytic tank through a device feeding the electroplating bath, preferably an air lift pump, according to the essence of the invention is characterized by that in the electrolytic tank heating devices are comprised, and in the evaporation chamber of the evaporation device there are no heating devices, the evaporation chamber of the evaporation device is horizontal and comprises a partition whose height establishes the thickness of the layer of the liquid, the bath inlet to the evaporation chamber is at the opposite side in relation to the partition, the evaporation chamber comprises a perforated conduit or conduits and/or conduits with porous walls, through which air is supplied to the evaporated bath, eventually heated air, the evaporation chamber is from the side of the partition connected with a separator, the upper part of the separator comprises a drop catcher through which wet air is taken off, and the lower part of the separator comprises a conduit taking off the concentrated

bath to the electrolytic tank, whereby the heating device in the tank is connected to the temperature-control system to control the temperature of the bath.

5 It is preferable that the constructional material for building the evaporation device is polyvinyl chloride.

10 It is advisable that the drop catcher is of a labyrinth type and comprises air-flow guide vanes.

15 According to the invention only the bath is evaporated, and heat necessary to heat the liquid is supplied, in principle, only to the bath in the electrolytic tank or in the vicinity thereof, with the use of the heating element being the standard equipment of the said tank, or only the air introduced to the evaporation zone is heated. When the evaporator is assembled with the already operating electroplating equipment, we use the heating element already existing in the electrolytic machining zone. Due to this, in newly designed lines we avoid doubling the heating elements.

20 The method according to the invention reduces also the number of devices necessary for automatic control of the working parameters of the bath.

25 If necessary for power reasons, additional heating is employed, with the supply of heat power being the complement between the heat power of the already existing equipment and the heat power

necessary to conduct evaporation with the required yield.

According to the invention, evaporation is effected directly, by letting the air pass through the bath being evaporated flowing in a closed channel, being in the phase of dynamic foam.

The solution according to the invention is described in the example of realisation by means of the drawing of the exemplary device, which serves for realisation of the method. Fig.1 presents a schematic device together with a washer and a feeding tank, and fig.2 presents schematically a single evaporation module applied for realisation according to the invention and marked in fig.1 with number 10. The feed is supplied by a stub pipe 1, it flows by a flow pipe 2, overflows through a partition 3, and from a separator 4 is taken off by a stub pipe 5. In the evaporated solution, parallel to the axis of the pipe 2, a supply pipe 6 of air is immersed, said air, passing through the solution, causes barbotage and evaporation thereof. The drop catcher 7 arrests particles of the solution entrained by air. As materials for building the device polyvinyl chloride pipes are usually used.

Such a solution has a number of advantages in relation to the existing devices.

The device and the method are characterized by big design simplicity, easiness of execution, simple operation and failure-free work during use.

On the basis of one standard module, such as shown in the example in fig.1, it is possible to build to the device according to the invention multi-module evaporators of the required yield, usually to about 100 l/hr of the evaporated liquid. Such evaporators require little space and can be easily compiled with the already operating electroplating line. In laboratory conditions the operation of one module of the evaporator presented in fig.1, of the length of the pipe 2 of $D=70$ mm and the length of the evaporation zone $l=0.25$ m.

In the second experiment two modules of the evaporator were used for closing the material circulation after chromium plating in a small electroplating plant working in a semi-technical scale. Parameters of a single module: $D=110$ mm, $l=1200$ mm.

As shown in fig.2, washings from washers 8 are directed as a whole by a conduit 20 to an electrolytic tank 9. The rate of flow of the bath through the evaporator 10 is controlled by the valve 11. The device has an emergency overflow whose overflow conduit is marked in fig.2 with number 18. After evaporation, the bath is supplied by the pump 12 to the feeding tank 13 wherefrom it flows to the tank 9. The temperature in the tank is controlled by a temperature-control system consisting of elements 14, 15, 16, 17. The outlet of air from the evaporation module is marked with number 19. Total evaporation from two modules connected parallelly was 10 l/hr. It enables closing the material circulation of the electroplating plant.

Fig.2 does not show ion-exchange columns
through which washings flow in order to eliminate
impurities, mainly ions Cr^{3+} , Fe^{3+} .

Patent Claims

1. A method of conducting a closed cycle of the bath for plating of coatings, especially in the process of electroplating, consisting in feeding the bath from the electrolytic machining zone to the evaporation zone, and from the evaporation zone after concentration of the bath in the evaporation zone back to the electrolytic machining zone, characterized in that the electroplating bath is heated in the electrolytic machining zone and is introduced to the evaporation zone in which the bath is conducted in the flow in a thin film horizontally, whereby in the whole evaporation zone or only in a part thereof through the horizontally conducted bath from below upwards air is conducted by barbotage, eventually, the air being conducted is heated, and afterwards wet air conducted through the bath is taken off outside from the circulation after previous separation of entrained particles by the inertia method, and the concentrated solution from the evaporation zone is introduced back to the electrolytic machining zone, and thereafter the electroplating bath is made up in a continuous way with washings from the water washer for washing the objects after said electroplating bath.

2. A method according to claim 1, characterized in
that the electroplating bath is heated in the e-
lectrolytic machining zone, at least 25% of heat
necessary for evaporation in the evaporation zo-
ne being supplied in the said zone.
5
3. A method according to claim 1, characterized in
that to the evaporation zone at least 55% of the
volume of the electroplating bath is fed.
4. A method according to claim 1, characterized in that
10 to the electroplating bath at least 55% of the vo-
lume of washings after washing of objects treated
in the said electroplating bath is fed.
5. A method according to claim 1, characterized in
that air taken off outside from the circulation
15 is used for mixing of washing water in washers
for washing the objects after the said electropla-
ting bath.
6. A method according to claim 1, characterized in
that air taken off outside from the circulation
20 is, after adding water vapour thereto, used for
washing the objects after the said electroplating
bath.
7. A method according to claim 1, characterized in
that from wet air conducted through the bath, ta-
25 ken off outside from the circulation, water is
condensed off and said condensed-off water is used
as washing water in washers.

8. A device for conducting a closed cycle of the bath for plating of coatings, especially in the process of electroplating, comprising an electrolytic tank, an evaporation device connected with the electrolytic tank through a device feeding the electroplating bath, preferably an air lift pump, characterized in that the electrolytic tank comprises heating devices (17) and in the evaporation chamber of the evaporation device (10) there are no heating devices, the evaporation chamber (2) of the evaporation device is horizontal and comprises a partition (3) whose height establishes the thickness of the horizontal layer of the bath, the inlet (1) of the bath to the evaporation chamber is at the opposite side in relation to the partition (3), the evaporation chamber (2) comprises a perforated conduit (6) or conduits and/or conduits having porous walls, through which to the evaporated bath air is fed, eventually heated air, the evaporation chamber (2) is connected from the side of the partition with a separator (4), the upper part of the separator (4) comprises a drop catcher (7) through which wet air is taken off, and the lower part of the separator (4) comprises a conduit (5) taking off the concentrated bath to the tank (9), the heating device (17) being connected to the temperature-control system (14, 15, 16) for controlling the temperature of the bath.
9. A device according to claim 8, characterized in that the constructional material to build the evaporation device is polyvinyl chloride.
10. A device according to claim 8, characterized in that the drop catcher (7) is of the labyrinth type and comprises air-flow guide vanes.

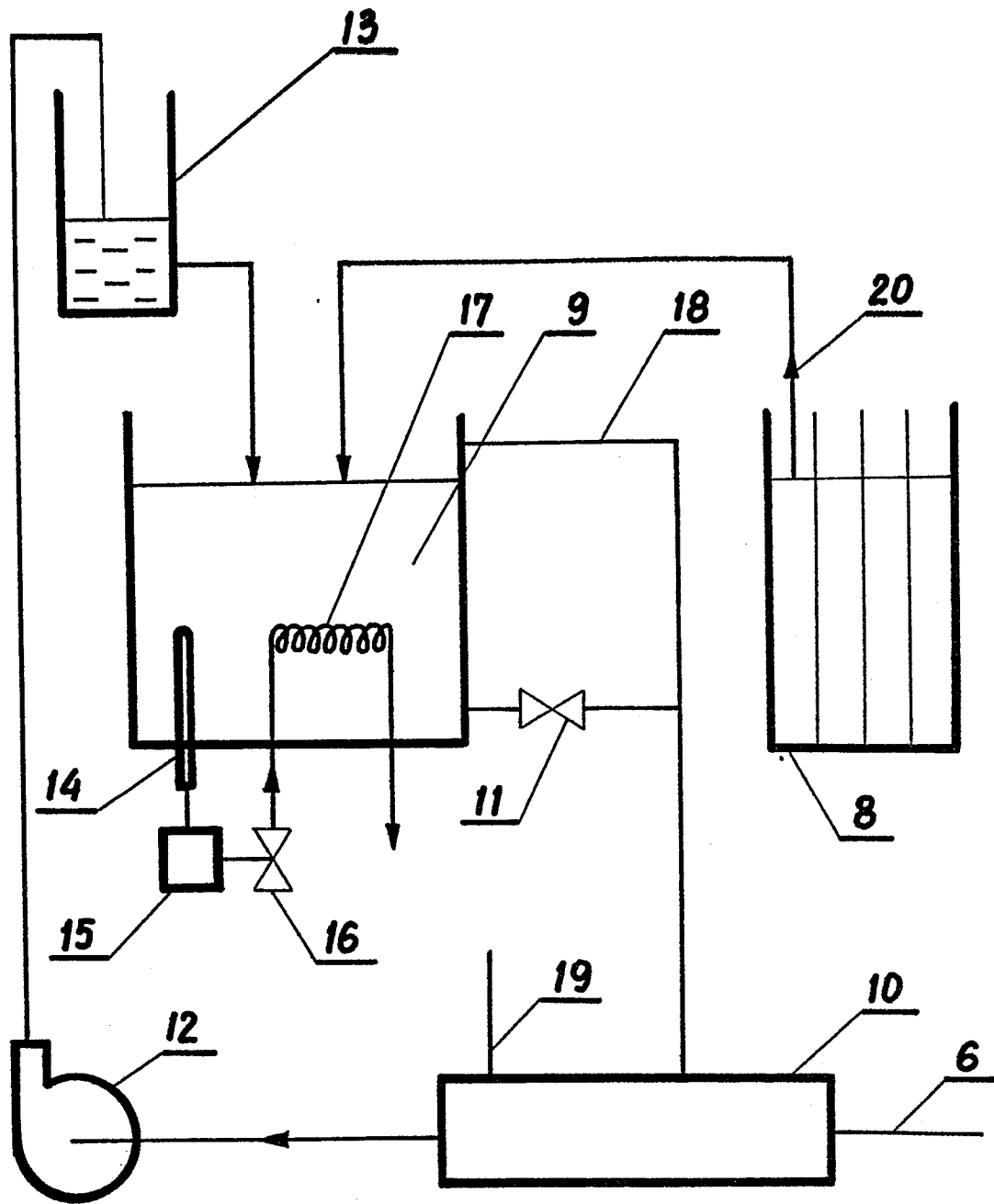


Fig. 1

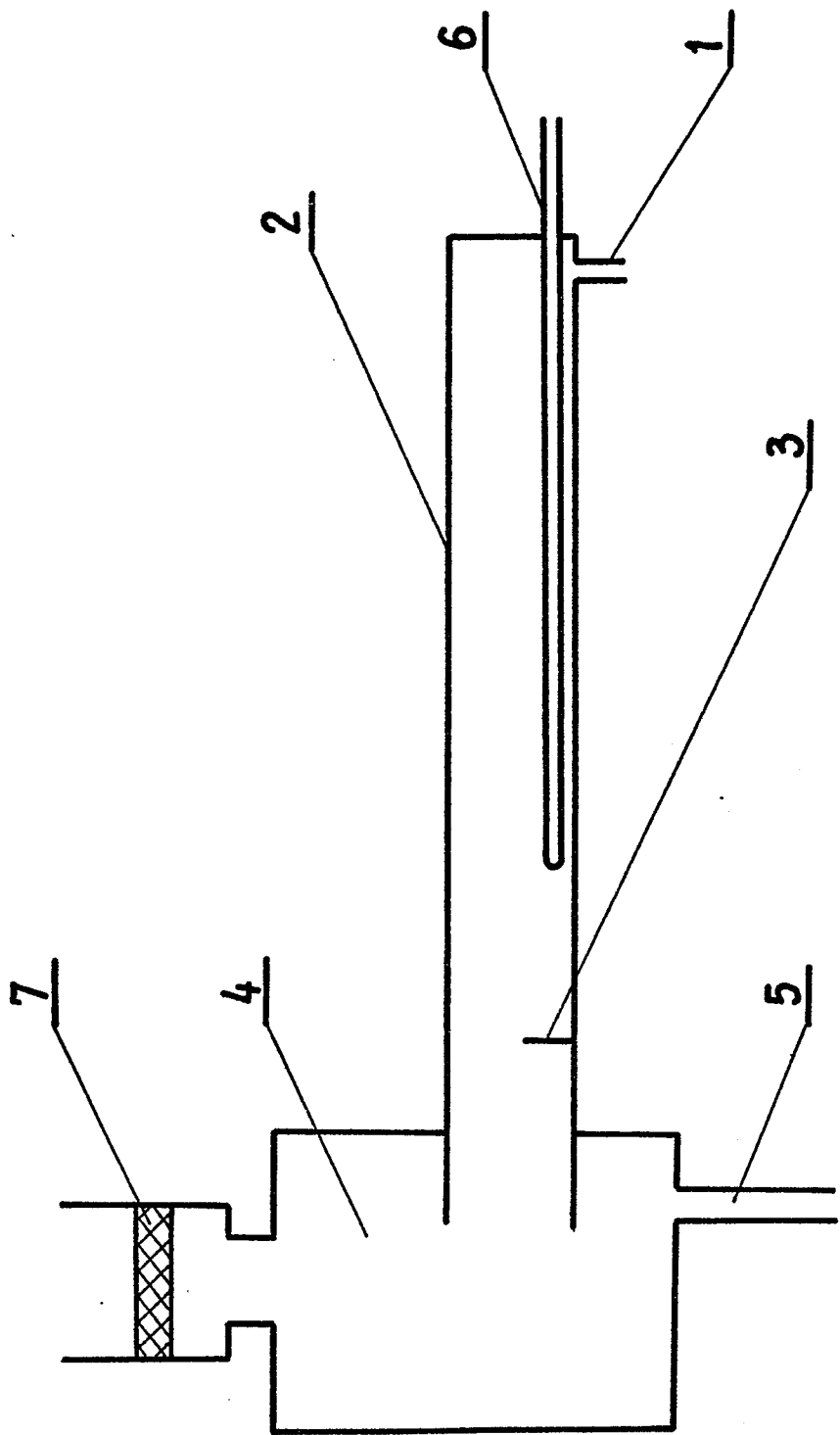


Fig. 2



EP 84108238.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
A	DE - A1 - 3 033 479 (RECON VERFAHRENSTECHNIK GMBH FISCHER UND TSCHERWITSCHKE) * Claims; fig. * --	1,8	C 25 D 21/00 C 25 D 21/10 C 25 D 21/18 C 25 D 17/00
A	DE - B2 - 2 729 270 (H. STOLLE) * Claim; fig. * --	1	C 25 D 19/00 C 23 G 1/36
A	DE - B2 - 1 962 249 (NORDNERO AB) * Claims; fig. * --	1	
A	US - A - 3 623 962 (L.C. BEALE) * Claims; fig. 2 * --	1,8	
A	EP - A1 - 0 079 987 (KABUSHIKI KAISHA SANSHIN SEISAKUSHO) * Claims; fig. 2-4 * ----	1,8	TECHNICAL FIELDS SEARCHED (Int. Cl. 4) C 25 D C 23 G
The present search report has been drawn up for all claims			

Place of search

VIENNA

Date of completion of the search

04-10-1984

Examiner

SLAMA

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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