



(11)

EP 2 575 142 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
01.04.2015 Bulletin 2015/14

(51) Int Cl.:
G21G 1/00 (2006.01)

(21) Application number: **11401600.9**

(22) Date of filing: **27.09.2011**

(54) Method of Improving Purity and Yield of Chemical Product in an Automatic Radioactive Medicine Synthesis System

Methode zum Verbessern der Reinheit und der Ausbeute eines chemischen Produktes in einem automatischen radioaktiven Medizin-Synthese-System

Méthode d'améliorer la pureté et le rendement d'un produit chimique dans un système automatique de synthèse de médecine radioactif

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

- **Liao, Mei-Hsiu**
325 Taoyuan County (TW)
- **Shen, Lie-Hang**
325 Taoyuan County (TW)

(43) Date of publication of application:
03.04.2013 Bulletin 2013/14

(74) Representative: **Lang, Christian et al**
LangPatent
Anwaltskanzlei
Rosenheimer Strasse 139
81671 München (DE)

(73) Proprietor: **Atomic Energy Council - Institute of
Nuclear
Energy Research**
Taoyuan County 325 (TW)

(56) References cited:
EP-A1- 1 772 157 WO-A1-03/000376
US-A- 5 368 736 US-A1- 2008 035 542

(72) Inventors:

- **Chang, Chia-Jung**
325 Taoyuan County (TW)

EP 2 575 142 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

Technical Field of the Invention

[0001] The present invention relates to a radioactive medicine synthesis system; more particularly, relates to improving purity and yield of chemical product in an automatic radioactive medicine synthesis system.

Description of the Related Arts

[0002] Nuclear medicine uses affinitive column for adhesion of target medicine to obtain product after washing and eluting. However, iodine isotope would process radioiodination in a buffer containing an oxidant. Hence, yield of target and purity of radioactive chemical medicine are affected by the volume of solution; time for oxidation; and arrangement of adhesion, washing and eluting processes. Thus, the yield and purity may become bad with high cost and the product obtained may become useless. For increasing production, the source has to be increased. But, following the increase in source, its volume is increased too. As a result, the yield and purity are still not increased or even decreased.

[0003] A prior art separates the adhesion process and the washing process to reduce pollution of impurities. To avoid operators being seriously polluted by the radioactive source during the processes, the prior art is automated. The operators only have to take the column manually for washing at the final stage. However, the activity of the column may be still high, the pollution may happen to the operators or there may be a chance for operation mistake in the time before washing.

[0004] Another prior art, *Automated system for formulating radiopharmaceuticals*, automates the purification of isotope washed from a germanium (Ge) / gallium (Ga) generator. The product obtained from the generator is a water solution and is not radioactively synthesized. It does not have buffer tubes having different sizes; have simple adhesion and washing processes; and detects purity of nuclei instead of purity of radioactive chemical medicine.

[0005] In theory, the easiest way for increasing the chemical production is to increase the volume of the reactants. But, in fact, it is not so simple. For example, the total volume for the reactions is critical. The

[0006] reaction of radioiodination is processed in a liquid state and some reaction solutions can not be condensed, so that the yield may not be increased following the increase of the total reaction volume. Besides, radioiodination may contains some incomplete reactions so that some unreacted iodine will be left over. Purification has to be done to the product through processes of adhesion (of the product), washing and elution with an affinitive column, where the adhesion process includes processes of repeated back-and-forth flowing through the column to increase efficiency of adhesion. However, the reaction solution filled in the column has a volume

smaller than the total reaction volume, some problems may occur in the automatic system, even though an adhesion batch may be designed in theory. Because the column has a small diameter and the liquid has surface tension, incomplete adhesion may happen during the repeated flowing processes and some waste solution may be generated and discharged.

[0007] Hence, the prior arts do not fulfill all users' requests on actual use.

[0008] EP 1 772 157 A describes a synthesis method for manufacturing radiopharmaceuticals and nuclides in a module with a syringe pump unit. The method comprises formation and/or introduction of a radioactive substance, processing the radioactive substance in at least one production facility, and ejection of the produced radiopharmaceuticals or nuclides. The method is carried out by means of pumping and suction operations of the syringe pump unit.

Summary of the Invention

[0009] The main purpose of the present invention is to increase a number of target reaction containers from one into many for increasing reaction volume coordinated with increased reaction times and, by modifying an affinitive column of an automatic synthesis system, to increase production in a single batch conformed to quality check specifications.

[0010] The main purpose of the present invention is provide an automatic way to separate adhesion process and washing process by switching electromagnetic valves coordinated with different sizes of buffer tubes for increasing production and reducing cost

[0011] To achieve the above purposes, the present invention is a method of improving purity and yield of chemical product in an automatic radioactive medicine synthesis system, comprising steps of: (a) washing by: inputting a total solution of total solution by nitrogen gas to be flown through a second electromagnetic valve, a first electromagnetic valve and a fourth electromagnetic valve to enter into a first buffer tube; flowing said total solution through a sixth electromagnetic valve to enter an adhesion column to process adhesion; flowing said total solution through an eighth electromagnetic valve and a seventh electromagnetic valve to enter a second buffer tube; flowing a waste gas through a fifth electromagnetic valve and a third electromagnetic valve to be discharged; and staying said total solution in said second buffer tube; (b) backwashing by: flowing nitrogen gas through said second electromagnetic valve, said third electromagnetic valve and said fifth electromagnetic valve to push out said total solution in said second buffer tube; flowing said total solution through said seventh electromagnetic valve and said eighth electromagnetic valve to enter said adhesion column to process adhesion; flowing said total solution through said sixth electromagnetic valve to enter said first buffer tube; and flowing a waste gas through said fourth electromagnetic valve and said first electro-

magnetic valve to be discharged; (c) discharging reaction solution by: flowing nitrogen gas through said second electromagnetic valve, said first electromagnetic valve and said fourth electromagnetic valve to push out said total solution stayed in said first buffer tube; flowing said total solution through said sixth electromagnetic valve, said eighth electromagnetic valve and a ninth electromagnetic valve to be discharged; (d) backwashing by: flowing a cleaning fluid through said second electromagnetic valve, said third electromagnetic valve and said fifth electromagnetic valve to enter a fourth buffer tube; flowing said cleaning fluid through said seventh electromagnetic valve and said eighth electromagnetic valve to enter said adhesion column to wash out impurities; flowing said cleaning fluid through said sixth electromagnetic valve to enter a third buffer tube; and flowing said cleaning fluid through said fourth electromagnetic valve and said first electromagnetic valve to be discharged; (e) washing by: flowing a cleaning fluid through said second electromagnetic valve, said first electromagnetic valve and said fourth electromagnetic valve to enter said third buffer tube; flowing said cleaning fluid through said sixth electromagnetic valve to enter said adhesion column to wash out impurities; and flowing said cleaning fluid through said eighth electromagnetic valve and said ninth electromagnetic valve to be discharged; and (f) eluting out product by: flowing an eluting fluid through said second electromagnetic valve, said first electromagnetic valve and said fourth electromagnetic valve to enter said third buffer tube; flowing an eluting fluid through said sixth electromagnetic valve to enter said adhesion column to elute out a product; and flowing said product through said eighth electromagnetic valve and said ninth electromagnetic valve to flow out said product. Accordingly, a novel method of improving purity and yield of chemical product in an automatic radioactive medicine synthesis system is obtained.

Brief Descriptions of the Drawings

[0012] The present invention will be better understood from the following detailed description of the preferred embodiment according to the present invention, taken in conjunction with the accompanying drawings, in which

- FIG. 1 is the structural view showing the devices used in the preferred embodiment according to the present invention;
- FIG. 2 is the view showing the process of washing with adhesion;
- FIG. 3 is the view showing the process of backwashing with adhesion;
- FIG. 4 is the view showing the process of discharging the total solution;
- FIG. 5 is the view showing the process of backwashing;
- FIG. 6 is the view showing the process of washing; and
- FIG. 7 is the view showing the process of eluting out

product.

Description of the Preferred Embodiment

[0013] The following description of the preferred embodiment is provided to understand the features and the structures of the present invention.

[0014] Please refer to FIG.1, which is a structural view showing devices used in a preferred embodiment according to the present invention. As shown in the figure, the present invention is a method of improving purity and yield of chemical product in an automatic radioactive medicine synthesis system, where an original chemical reaction are divided into multiple reactions with adhesions processed after the multiple reactions; and where the adhesions have a total solution flowing back and forth along an adhesion column 1 several times for enhancing adhesion efficiency. Since the total solution has a big volume, the adhesion column 1 is separately added with a buffer tube 21,22 at each end of the adhesion column 1 for guiding the flowing of the total solution coordinated with a plurality of three-way electromagnetic valves 31~39.

[0015] For removing unreacted radioactive iodine, the column must be cleaned. In an automatic synthesis system, the present invention added two more buffer tubes 23,24 for washing and backwashing to separate processes of adhesion and washing for improving washing effect with the coordination of the three-way electromagnetic valves 31~39.

[0016] Please refer to FIG.2 to FIG.7, which are views showing processes of washing with adhesion, backwashing with adhesion, discharging reaction solutions, backwashing, washing and eluting out product. As shown in the figures, the present invention comprises the following steps:

(a) Washing for adhesion: A total solution of reaction solutions is flown for adhesion with column. In FIG. 2, a total solution of reaction solutions is pushed by nitrogen gas to be flown through a second electromagnetic valve 32, a first electromagnetic valve 31 and a fourth electromagnetic valve 34 to enter into a first buffer tube 21. Then, the total solution is flown through a sixth electromagnetic valve 36 to enter an adhesion column 1 to process adhesion. Then, the total solution is flown through an eighth electromagnetic valve 38 and a seventh electromagnetic valve 37 to enter a second buffer tube 22. Then, a waste gas is flown through a fifth electromagnetic valve 35 and a third electromagnetic valve 33 to be discharged. The total solution is stayed in the second buffer tube 22.

(b) Backwashing for adhesion: The total solution stayed in the second buffer tube 22 is flown for backwashing for adhesion with column. In FIG.3, nitrogen gas is flown through the second electromagnetic valve 32, the third electromagnetic valve 33 and the

fifth electromagnetic valve 35 to push out the total solution stayed in the second buffer tube 22. Then, the total solution is flown through the seventh electromagnetic valve 37 and the eighth electromagnetic valve 38 to enter the adhesion column 1 for processing adhesion. Then, the total solution is flown through the sixth electromagnetic valve 36 to enter the first buffer tube 21. Then, a waste gas is flown through the fourth electromagnetic valve 34 and the first electromagnetic valve 31 to be discharged.

(c) Discharging reaction solution: Nitrogen gas is flown through the second electromagnetic valve 32, the first electromagnetic valve 31 and the fourth electromagnetic valve 34 to push out the total solution stayed in the first buffer tube 21. Then, the total solution is flown through the sixth electromagnetic valve 36, the eighth electromagnetic valve 38 and a ninth electromagnetic valve 39 to be discharged.

(d) Backwashing: A cleaning fluid is flown through the second electromagnetic valve 32, the third electromagnetic valve 33 and the fifth electromagnetic valve 35 to enter a fourth buffer tube 24. Then, the cleaning fluid is flown through the seventh electromagnetic valve 37 and the eighth electromagnetic valve 38 to enter the adhesion column 1 to wash out impurities. Then, the cleaning fluid is flown through the sixth electromagnetic valve 36 to enter a third buffer tube 23. Then, the cleaning fluid is flown through the fourth electromagnetic valve 34 and the first electromagnetic valve 31 to be discharged.

(e) Washing: A cleaning fluid is flown through the second electromagnetic valve 32, the first electromagnetic valve 31 and the fourth electromagnetic valve 34 to enter the third buffer tube 23. Then, the cleaning fluid is flown through the sixth electromagnetic valve 36 to enter the adhesion column 1 for washing out impurities. Then, the cleaning fluid is flown through the eighth electromagnetic valve 38 and the ninth electromagnetic valve 39 to be discharged.

(f) Eluting: An eluting fluid is flown through the second electromagnetic valve 32, the first electromagnetic valve 31 and the fourth electromagnetic valve 34 to enter the third buffer tube 23. Then, the eluting fluid is flown through the sixth electromagnetic valve 36 to enter the adhesion column 1 for eluting out a product. Then, the product is flown through the eighth electromagnetic valve 38 and the ninth electromagnetic valve 39 to be flown out.

[0017] The first to the ninth electromagnetic valves 31~39 are three-way electromagnetic valves; and, the first and the second buffer tubes 21,22 have diameters and volumes bigger than the third and the fourth buffer tubes 23,24.

[0018] The present invention increases a number of target reaction containers from one into many (e.g. three) for increasing reaction volume coordinated with in-

creased reaction times. An affinitive column of an automatic synthesis system is modified for increasing production in a single batch conformed to quality check specifications.

[0019] Hence, the present invention separates a chemical reaction into many reactions for repeatedly processing original reactions to avoid reducing yield on increasing reaction volume. Besides, the present invention adds two plastic tubes at head and tail ends of the column to be used as buffer tubes for not only processing adhesion several times but also for solving the problem of incomplete adhesion for reaction solution owing to surface tension (i.e. waste solution). Furthermore, the present invention adds two empty columns at head and tail ends of the column to be used as buffer tubes to separate adhesion process and washing process with coordination of electromagnetic valves for controlling to obtain products conformed to quality check specifications.

[0020] To sum up, the present invention is a method of improving purity and yield of chemical product in an automatic radioactive medicine synthesis system, where, in an automatic way, adhesion process and washing process are separated by switching electromagnetic valves coordinated with different sizes of buffer tubes for increasing production and reducing cost.

[0021] The preferred embodiment herein disclosed is not intended to unnecessarily limit the scope of the disclosure. Therefore, simple modifications or variations belonging to the equivalent of the scope of the claims and the instructions disclosed herein for a patent are all within the scope of the present invention.

Claims

1. A method of improving purity and yield of chemical product in an automatic radioactive medicine synthesis system, comprising steps of:

(a) washing by: inputting a total solution of reaction solutions by nitrogen gas to be flown through a second electromagnetic valve (32), a first electromagnetic valve (31) and a fourth electromagnetic valve (34) to enter into a first buffer tube (21); flowing said total solution through a sixth electromagnetic valve (36) to enter an adhesion column (1) to process adhesion; flowing said total solution through an eighth electromagnetic valve (38) and a seventh electromagnetic valve (37) to enter a second buffer tube (22); flowing a waste gas through a fifth electromagnetic valve (35) and a third electromagnetic valve (33) to be discharged; and staying said total solution in said second buffer tube (22);

(b) backwashing by: flowing nitrogen gas through said second electromagnetic valve (32),

said third electromagnetic valve (33) and said fifth electromagnetic valve (35) to push out said total solution in said second buffer tube (22); flowing said total solution through said seventh electromagnetic valve (37) and said eighth electromagnetic valve (38) to enter said adhesion column (1) to process adhesion; flowing said total solution through said sixth electromagnetic valve (36) to enter said first buffer tube (21); and flowing a waste gas through said fourth electromagnetic valve (34) and said first electromagnetic valve to be discharged;

(c) discharging reaction solution by: flowing nitrogen gas through said second electromagnetic valve (32), said first electromagnetic valve (31) and said fourth electromagnetic valve (34) to push out said total solution stayed in said first buffer tube (21); flowing said total solution through said sixth electromagnetic valve (36), said eighth electromagnetic valve (38) and a ninth electromagnetic valve (39) to be discharged;

(d) backwashing by: flowing a cleaning fluid through said second electromagnetic valve (32), said third electromagnetic valve (33) and said fifth electromagnetic valve (35) to enter a fourth buffer tube (24); flowing said cleaning fluid through said seventh electromagnetic valve (37) and said eighth electromagnetic valve (38) to enter said adhesion column (1) to wash out impurities; flowing said cleaning fluid through said sixth electromagnetic valve (36) to enter a third buffer tube (23); and flowing said cleaning fluid through said fourth electromagnetic valve (34) and said first electromagnetic valve (31) to be discharged;

(e) washing by: flowing a cleaning fluid through said second electromagnetic valve (32), said first electromagnetic valve (31) and said fourth electromagnetic valve (34) to enter said third buffer tube (23); flowing said cleaning fluid through said sixth electromagnetic valve (36) to enter said adhesion column (1) to wash out impurities; and flowing said cleaning fluid through said eighth electromagnetic valve (38) and said ninth electromagnetic valve (39) to be discharged; and

(f) eluting out product by: flowing an eluting fluid through said second electromagnetic valve (32), said first electromagnetic valve (31) and said fourth electromagnetic valve (34) to enter said third buffer tube (23); flowing said eluting fluid through said sixth electromagnetic valve (36) to enter said adhesion column (1) to elute out a product; and flowing said product through said eighth electromagnetic valve (38) and said ninth electromagnetic valve (39) to be flown out.

2. The method according to claim 1, wherein said first to said ninth electromagnetic valves (31-39) are three-way electromagnetic valves.
3. The method according to claim 1, wherein said first and said second buffer tubes (21, 22) have diameters and volumes bigger than said third and said fourth buffer tubes (23, 24).

Patentansprüche

1. Verfahren zur Verbesserung der Reinheit und Ausbeute eines chemischen Produktes in einem automatischen Synthese - System für radioaktive Arzneimittel, welches die nachfolgenden Schritte umfasst:

(a) Waschen durch Einleiten einer Gesamtlösung der Reaktionslösungen mit Stickstoffgas, welche durch ein zweites Elektromagnetventil (32), ein erstes Elektromagnetventil (31) und ein viertes Elektromagnetventil (34) in ein erstes Pufferrohr (21) hineinströmen, wobei die besagte Gesamtlösung durch ein sechstes Elektromagnetventil (36) weiterfließt und in eine Adhäsionssäule (1) eintritt, wo eine Adhäsion erfolgt, wobei die besagte Gesamtlösung durch ein achtes Elektromagnetventil (38) und ein siebtes Elektromagnetventil (37) weiterfließt und in ein zweites Pufferrohr (22) eintritt, wobei ein Abgas durch ein fünftes Elektromagnetventil (35) und ein drittes Elektromagnetventil (33) strömt, um abgeführt zu werden, und wobei die besagte Gesamtlösung in dem besagten zweiten Pufferrohr (22) verbleibt,

(b) Rückspülung durch Einleiten von Stickstoffgas durch das besagte zweite Elektromagnetventil (32), das besagte dritte Elektromagnetventil (33) und das besagte fünfte Elektromagnetventil (35), um die besagte Gesamtlösung aus dem besagten zweiten Pufferrohr (22) zu verdrängen, wobei die besagte Gesamtlösung durch das besagte siebte Elektromagnetventil (37) und das besagte achte Elektromagnetventil (38) strömt und in die besagte Adhäsionssäule (1) gelangt, wo Adhäsion erfolgt, wobei die besagte Gesamtlösung durch das besagte sechste Elektromagnetventil (36) strömt und in das besagte erste Pufferrohr (21) gelangt, wobei das Abgas durch das besagte vierte Elektromagnetventil (34) und das besagte erste Elektromagnetventil strömt, um abgeführt zu werden,

(c) Entladen der Reaktionslösung durch Einleiten von Stickstoffgas durch das besagte zweite Elektromagnetventil (32), das besagte erste Elektromagnetventil (31) und das besagte vierte

Elektromagnetventil (34), um die besagte Gesamtlösung, welche in dem besagten ersten Pufferrohr (21) verblieben ist, herauszudrücken, wobei die besagte Gesamtlösung durch das besagte sechste Elektromagnetventil (36), das besagte achte Elektromagnetventil (38) und ein neuntes Elektromagnetventil (39) strömt, um abgeführt zu werden,

(d) Rückspülung durch Einleiten einer Reinigungsflüssigkeit durch das besagte zweite Elektromagnetventil (32), das besagte dritte Elektromagnetventil (33) und das besagte fünfte Elektromagnetventil (25), sodass diese in ein viertes Pufferrohr (24) eintritt, wobei die besagte Reinigungsflüssigkeit durch das besagte siebte Elektromagnetventil (37) und das besagte achte Elektromagnetventil (38) in die besagte Adhäsionssäule (1) einströmt, um Verunreinigungen auszuwaschen, wobei die besagte Reinigungsflüssigkeit durch das besagte sechste Elektromagnetventil (36) in ein drittes Pufferrohr (23) eingeleitet wird, und wobei die besagte Reinigungsflüssigkeit durch das besagte vierte Elektromagnetventil (34) und das besagte erste Elektromagnetventil (31) strömt, um abgeführt zu werden,

(e) Waschen durch Einleiten einer Reinigungsflüssigkeit durch das besagte zweite Elektromagnetventil (32), das besagte erste Elektromagnetventil (31) und das besagte vierte Elektromagnetventil (34), sodass diese in das besagte dritte Pufferrohr (23) gelangt, wobei die besagte Reinigungsflüssigkeit durch das besagte sechste Elektromagnetventil (36) in die besagte Adhäsionssäule (1) einströmt, um Verunreinigungen auszuwaschen, und wobei die besagte Reinigungsflüssigkeit durch das besagte achte Elektromagnetventil (38) und das besagte neunte Elektromagnetventil (39) strömt, um abgeführt zu werden, und

(f) Ausspülen des Produkts durch Einleiten einer eluierenden Flüssigkeit durch das besagte zweite Elektromagnetventil (32), das besagte erste Elektromagnetventil (31) und das besagte vierte Elektromagnetventil (34), sodass diese in das besagte dritte Pufferrohr (23) gelangt, wobei die besagte eluierende Flüssigkeit durch das besagte sechste Elektromagnetventil (36) in die besagte Adhäsionssäule (1) eingeleitet wird, um ein Produkt herauszulösen, und wobei das besagte Produkt durch das besagte achte Elektromagnetventil (38) und das besagte neunte Elektromagnetventil (39) strömt, um abgelassen zu werden.

2. Verfahren nach Anspruch 1, wobei besagte erste bis neunte Elektromagnetventile (31-39) jeweils ein Drei - Wege - Elektromagnet-

ventil sind.

3. Verfahren nach Anspruch 1, wobei das besagte erste und das besagte zweite Pufferrohr (21, 22) jeweils einen Durchmesser und ein Volumen aufweisen, die größer sind als die des besagten dritten und des besagten vierten Pufferrohrs (23, 24).

Revendications

1. Procédé pour améliorer la pureté et le rendement d'un produit chimique dans un système automatique de synthèse de médicaments radioactifs, comprenant les étapes de :

(a) lavage par introduction d'une solution totale de solutions réactionnelles, grâce à de l'azote gazeux devant s'écouler par une deuxième électrovanne (32), une première électrovanne (31) et une quatrième électrovanne (34) pour pénétrer dans un premier tube tampon (21) ; écoulement de ladite solution totale par une sixième électrovanne (36) pour pénétrer dans une colonne d'adhérence (1) pour permettre l'opération d'adhérence; écoulement de ladite solution totale par une huitième électrovanne (38) et une septième électrovanne (37) pour pénétrer dans un deuxième tube tampon (22) ; écoulement d'un effluent gazeux par une cinquième électrovanne (35) et une troisième électrovanne (33) pour évacuation ; et maintien de ladite solution totale dans ledit deuxième tube tampon (22) ;

(b) rinçage en retour, par : écoulement d'azote gazeux par ladite deuxième électrovanne (32), ladite troisième électrovanne (33) et ladite cinquième électrovanne (35) pour déplacer ladite solution totale dans ledit deuxième tube tampon (22) ; écoulement de ladite solution totale par ladite septième électrovanne (37) et ladite huitième électrovanne (38) pour pénétrer dans ladite colonne d'adhérence (1) pour permettre l'opération d'adhérence ; écoulement de ladite solution totale par ladite sixième électrovanne (36) pour pénétrer dans ledit premier tube tampon (21) ; et écoulement d'un effluent gazeux par ladite quatrième électrovanne (34) et ladite première électrovanne pour évacuation ;

(c) évacuation de la solution réactionnelle par : écoulement d'azote gazeux par ladite deuxième électrovanne (32), ladite première électrovanne (31) et ladite quatrième électrovanne (34) pour déplacer ladite solution totale maintenue dans ledit premier tube tampon (21) ; écoulement de ladite solution totale par ladite sixième électrovanne (36), ladite huitième électrovanne (38) et

une neuvième électrovanne (39) pour évacuation ;

(d) rinçage en retour par : écoulement d'un fluide de nettoyage par ladite deuxième électrovanne (32), ladite troisième électrovanne (33) et ladite cinquième électrovanne (25) pour pénétrer dans un quatrième tube tampon (24) ; écoulement dudit fluide de nettoyage par ladite septième électrovanne (37) et ladite huitième électrovanne (38) pour pénétrer dans ladite colonne d'adhérence (1) pour éliminer les impuretés par lavage ; écoulement dudit fluide de nettoyage par ladite sixième électrovanne (36) pour pénétrer dans un troisième tube tampon (23) ; et écoulement dudit fluide de nettoyage par ladite quatrième électrovanne (34) et ladite première électrovanne (31) pour évacuation ;

(e) lavage par : écoulement d'un fluide de nettoyage par ladite deuxième électrovanne (32), ladite première électrovanne (31) et ladite quatrième électrovanne (34) pour pénétrer dans ledit troisième tube tampon (23) ; écoulement dudit fluide de nettoyage par ladite sixième électrovanne (36) pour pénétrer dans ladite colonne d'adhérence (1) pour éliminer les impuretés par lavage ; et écoulement dudit fluide de nettoyage par ladite huitième électrovanne (38) et ladite neuvième électrovanne (39) pour évacuation ;

et

(f) élution du produit par : écoulement d'un fluide d'élution par ladite deuxième électrovanne (32), ladite première électrovanne (31) et ladite quatrième électrovanne (34) pour pénétrer dans ledit troisième tube tampon (23) ; écoulement dudit fluide d'élution par ladite sixième électrovanne (36) pour pénétrer dans ladite colonne d'adhérence (1) pour éliminer un produit par élution ; et écoulement dudit produit par ladite huitième électrovanne (38) et ladite neuvième électrovanne (39) pour écoulement en sortie.

2. Procédé selon la revendication 1, dans lequel lesdits première à neuvième électrovannes (31-39) sont des électrovannes à trois voies.

3. Procédé selon la revendication 1, dans lequel lesdits première et deuxième tubes tampons (21, 22) ont des diamètres et des volumes supérieurs à ceux dudit troisième et dudit quatrième tubes tampons (23, 24).

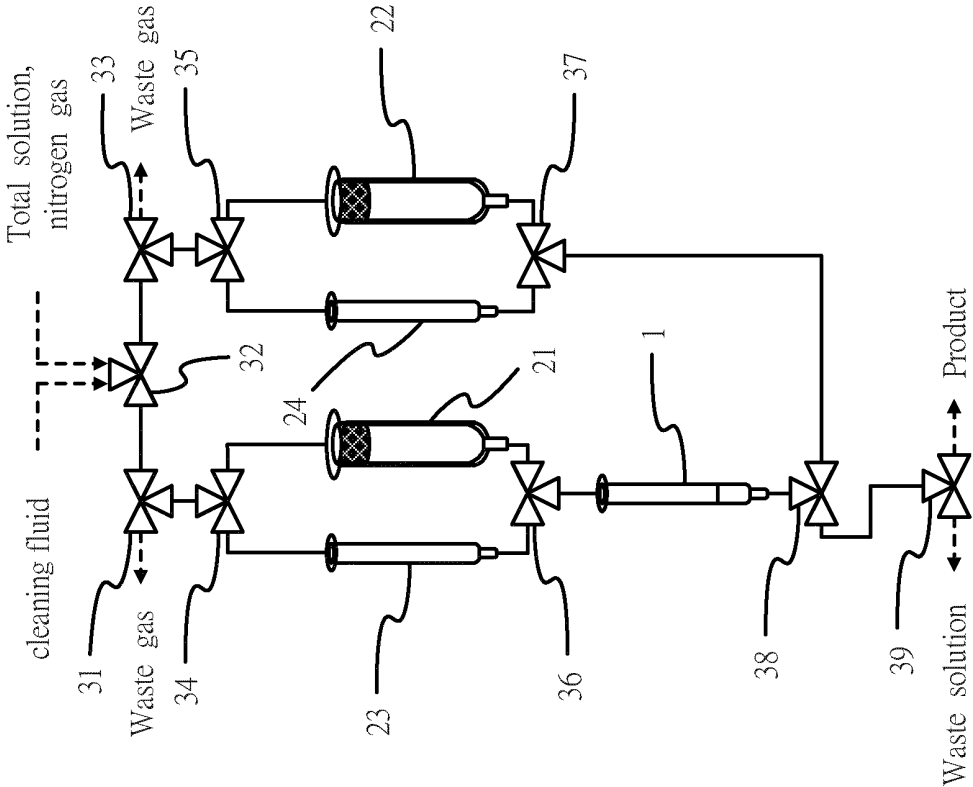


FIG.1

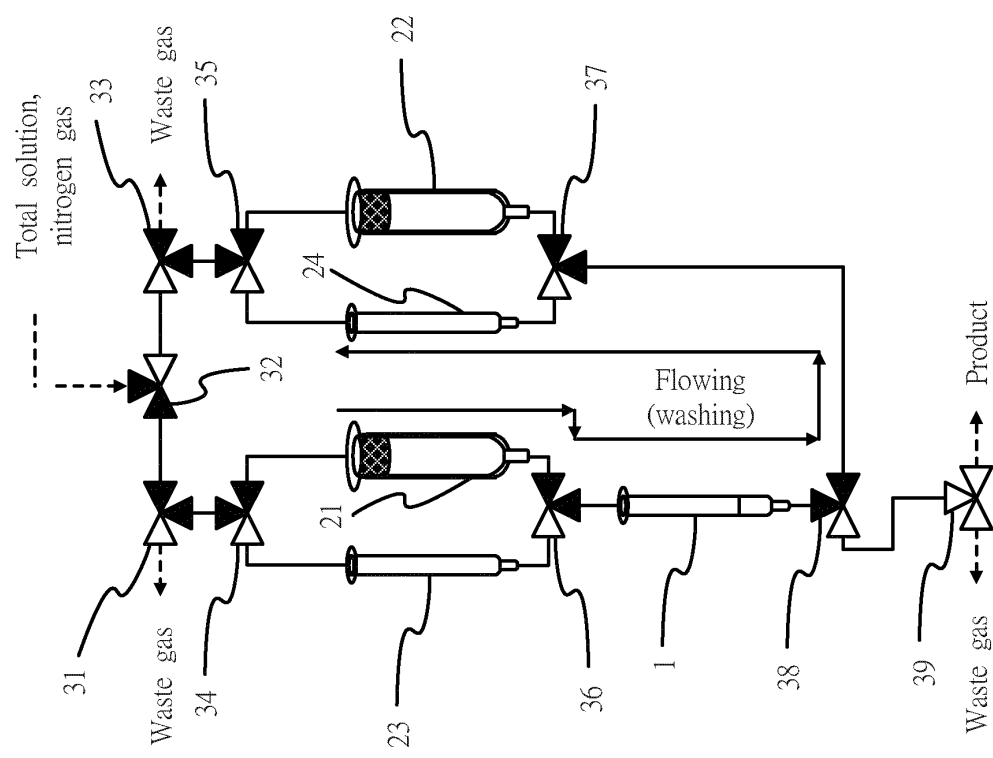


FIG.2

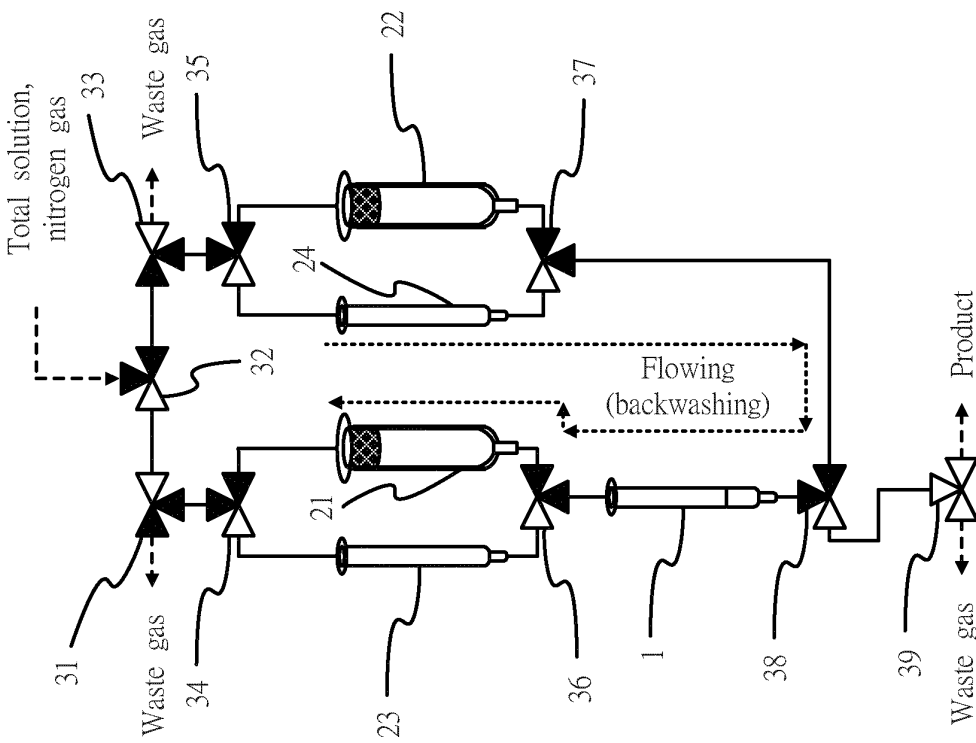


FIG.3

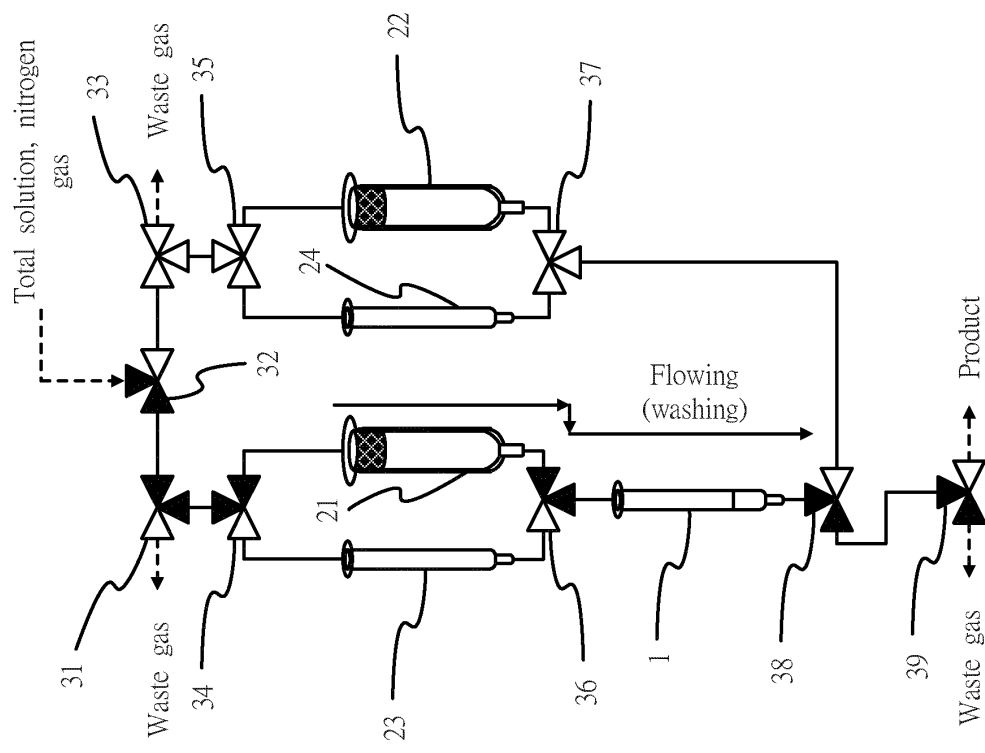


FIG.4

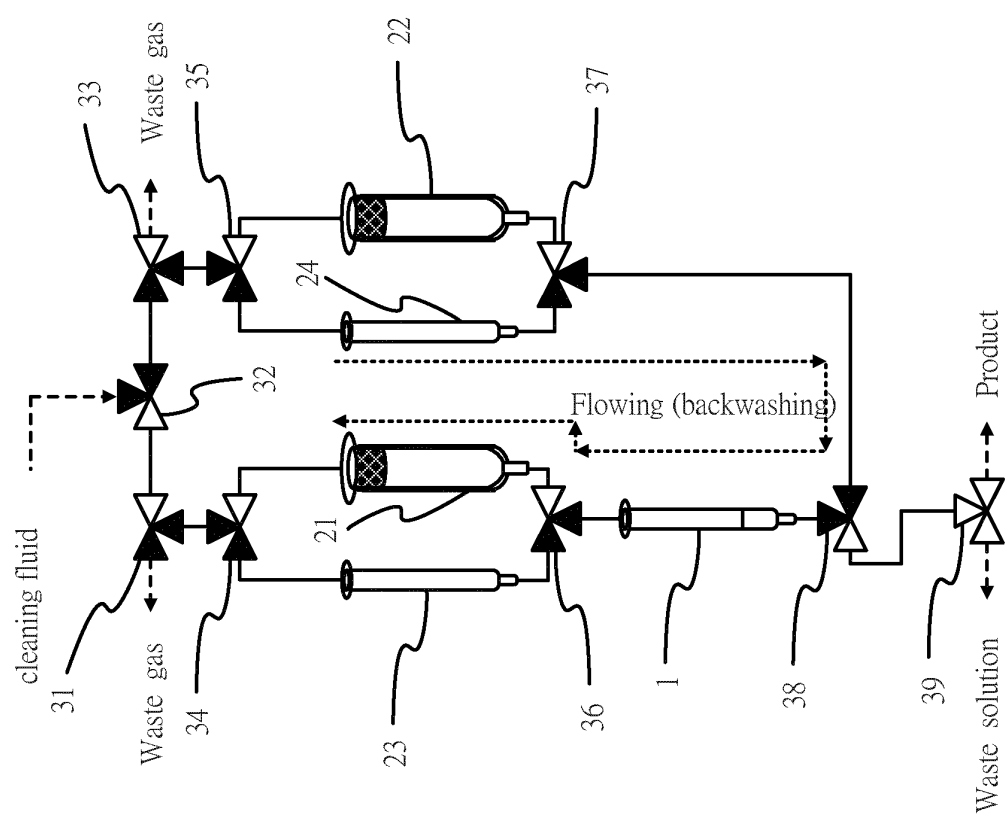


FIG.5

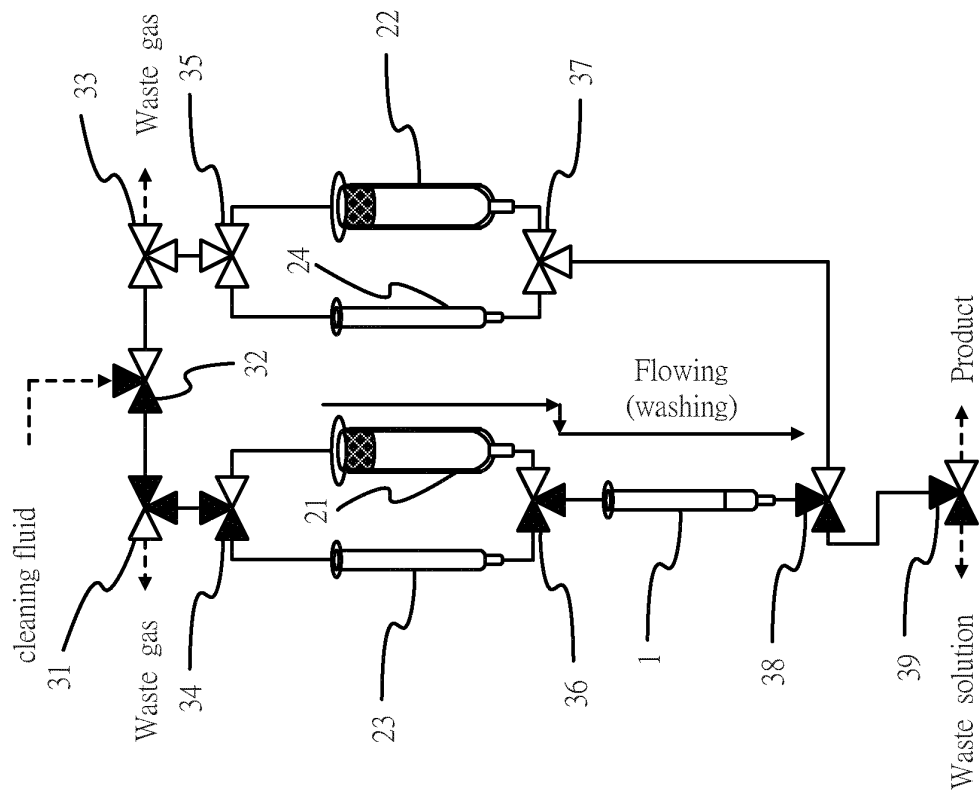


FIG.6

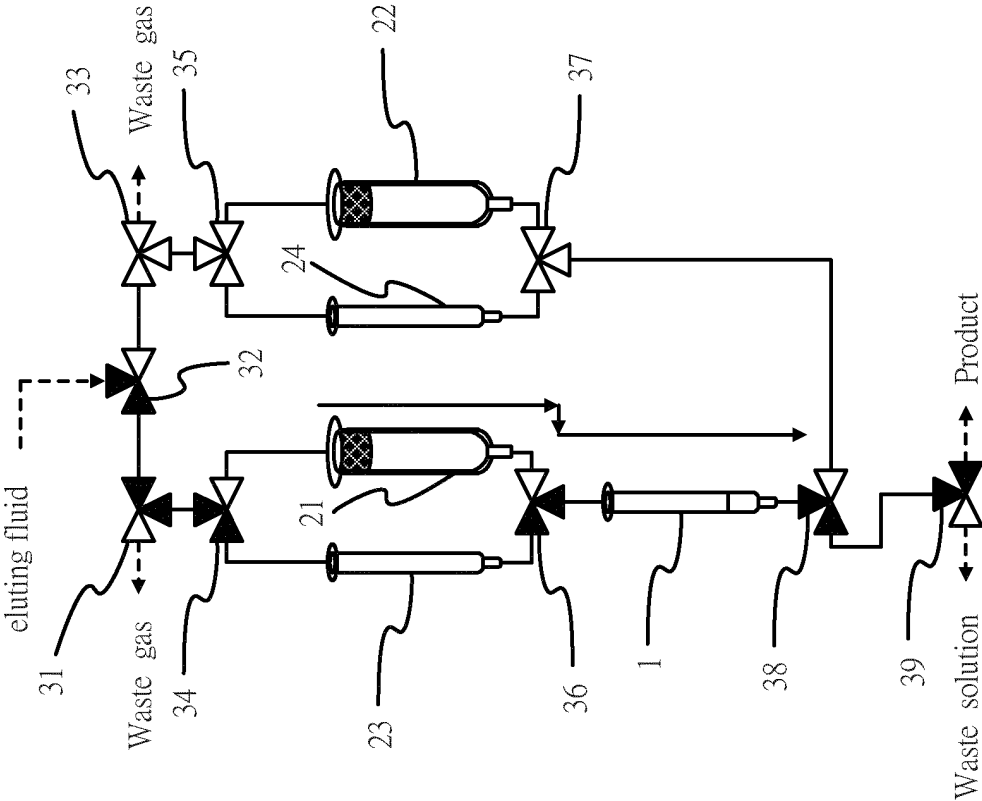


FIG.7

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 1772157 A [0008]