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A B O G A D O S

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103-108

2961/P.

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO DIVISION DE NUEVAS CREACIONES

E. S. D.

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

Rad: 06-031931- -00001-0000

Fee: 2005-05-24 14:59:13 Dep. 2020 NUECREACIONES

Tra. 2 PATENTES

Eve. 1 REGDEPOSITO

Act 444 RESPUESTA REQUE Folios: 114

Ref.: Expediente No. 06-031.931
Solicitud de Patente a nombre de
Ethicon, Inc.

Yo, JIMENA ESCOBAR URIBE, identificada como aparece al pie de mi firma, domiciliada en la Carrera 11 A No. 94-76, of. 305, obrando como apoderada de la sociedad **Ethicon, Inc.**, domiciliada en Somerville, New Jersey, Estados Unidos de América, solicitante de la patente de la referencia, en respuesta al oficio No. 4553 notificado por fijación en lista el día 27 de abril de 2006, atentamente me permito presentar:

1. Copia certificada de la solicitud de patente número 11/096,050 presentada en Estados Unidos de América el día 31 de marzo de 2005, con la debida traducción de lo pertinente.
2. Artes finales en tamaño 12 x 12 centímetros (por duplicado) de la figura característica.
3. Documento (1) en que consta la cesión del derecho a la patente otorgado por los inventores a favor de mi mandante.

Sobre el particular, es importante resaltar que de conformidad con las normas legales vigentes, artículo 1 de la Resolución 210 de 2001, expedida por el Superintendente de Industria y Comercio y artículo 2 de la Convención de la Haya, el documento en inglés que se pretenda aportar como parte de los trámites de propiedad industrial ante la Superintendencia de Industria y Comercio no requieren traducción. Por otro lado, la legalización consular y/o diplomática de los documentos expedidos en el extranjero no es necesaria. Por lo tanto, el documento de cesión anexo a este memorial es válidamente presentado en idioma inglés y con la correspondiente Apostilla.

Espero con esto haber dado cabal cumplimiento a lo solicitado por ese despacho y de conformidad con lo indicado en los artículos 3º, inciso 3; 35, inciso 2 y 59, inciso 2 del CCA, al analizar este memorial, atentamente ruego se traten todas las cuestiones planteadas con motivo del mismo.

Señor Superintendente,



JIMENA ESCOBAR URIBE

C.C.39.779.452 de Usaquén

T.P. 68228

Cód. 5376

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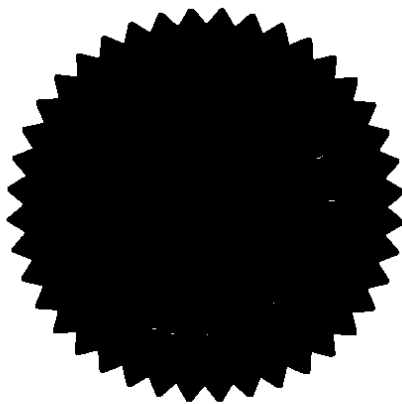
APOSTILLE

(CONVENTION DE LA HAYE DU 5 OCTOBRE 1961)

1. COUNTRY: UNITED STATES OF AMERICA
2. THIS PUBLIC DOCUMENT HAS BEEN SIGNED BY:
CHRISTINA A CLICKNER
3. ACTING IN THE CAPACITY OF:
NOTARY PUBLIC OF NEW JERSEY
4. BEARS THE SEAL/STAMP OF:
CHRISTINA A CLICKNER, NOTARY

CERTIFIED

5. AT TRENTON, NEW JERSEY
6. THE 11TH DAY OF MAY 2006
7. BY: Bradley I. Abelow, NEW JERSEY TREASURER
8. NO. A259615
9. SEAL/STAMP:
10. SIGNATURE



Bradley Abelow

105 + 103

CERTIFICATION

I hereby certify that I have compared the attached document with the original, and that such said document is a true copy of the original Assignment document as filed in the U. S. Patent Office in connection with USSN 11/096,050 filed MARCH 31, 2005.



Christina A. Clickner
(Notary Public of New Jersey)
My Commission Expires:
March 2, 2010

A S S I G N M E N T

Serial No.
Filed March 31, 2005

WHEREAS, Szu-Min Lin, Robert C. Platt and Peter C. Zhu, residing at 26 Trailing Ivy, Irvine, CA 92620, 5 Saint Croix, Laguna Niguel, CA 92677 and 6 Cresthaven, Irvine, CA 92604 respectively (hereinafter called "Assignors"), have made certain new and useful inventions or discoveries relating to

MONITORING OF CLEANING PROCESS

for which they have on the day of , 200 executed an application for Letters Patent of the United States; and

WHEREAS, Ethicon, Inc., a corporation of the State of New Jersey, (hereinafter called "Assignee"), is desirous of acquiring Assignors' entire right, title, and interest therein:

NOW, THEREFORE, BE IT KNOWN that for and in consideration of the sum of One Dollar and other valuable considerations, the receipt of which is hereby acknowledged, Assignors have sold, assigned, and transferred, and do hereby sell, assign and transfer unto said Assignee their entire right, title and interest in and to all said inventions and discoveries disclosed in said application whose identification above by serial number and filing date, when available is hereby authorized, and in and to said application, all substitutions, divisions, and continuations thereof, and in and to all Letters Patent, United States and foreign, that may be granted for said inventions and discoveries, and in and to all extensions, renewals, and reissues thereof, the same to be held and enjoyed by said Assignee, its successors and assigns, as fully and entirely as the same would have been held and enjoyed by Assignors if this Assignment and sale had not been made;

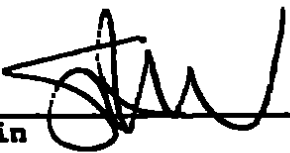
And Assignors hereby authorize and request the Commissioner of Patents of the United States to issue said Letters Patent in accordance with this Assignment;

And for the consideration aforesaid, Assignors covenant and agree with said Assignee that he has a full and unencumbered title to the inventions and discoveries above described and hereby assigned, which title they warrant unto said Assignee, its successors and assigns;

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And for the consideration aforesaid, Assignors further covenant and agree that they will, whenever requested, but without cost to them promptly communicate to said Assignee or its representatives any facts known to them relating to said inventions and discoveries, testify in any interference or legal proceedings involving said inventions and discoveries, and execute any additional papers that may be necessary to enable said Assignee or its representatives, successors, nominees, or assigns to secure full and complete protection for the said inventions and discoveries or that may be necessary to vest in said Assignee the complete title to the said inventions and discoveries and patents hereby conveyed and to enable it to record said title.

IN TESTIMONY WHEREOF, Assignors have hereunto set their hands and seals this 28 day of April, 2005



Szu-Min Lin

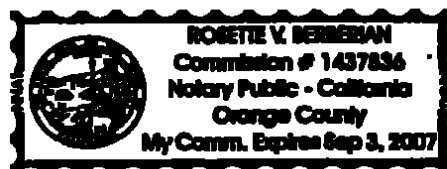
(L.S.)

STATE OF *California*
COUNTY OF *Orange*) ss.

BE IT REMEMBERED, That on this 28th day of April, 2005, before me, a Notary Public, personally appeared Szu-Min Lin, who I am satisfied is the person named in and who executed the foregoing instrument in my presence, and I having first made known to him the contents thereof, he did acknowledge that he signed, sealed, and delivered the same as his voluntary act and deed for the uses and purposes therein expressed.



Notary Public



108 7

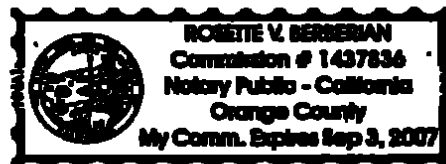
IN TESTIMONY WHEREOF, Assignors have hereunto set
their hands and seals this 28th day of April, 2005

 (L.S.)
Robert C. Platt

STATE OF California
COUNTY OF Orange, ss.

BE IT REMEMBERED, That on this 28th day of April, 2005, before me, a Notary Public, personally appeared Robert C. Platt, who I am satisfied is the person named in and who executed the foregoing instrument in my presence, and I having first made known to him the contents thereof, he did acknowledge that he signed, sealed, and delivered the same as his voluntary act and deed for the uses and purposes therein expressed.


Notary Public



109 7

IN TESTIMONY WHEREOF, Assignors have hereunto set their hands and seals this ~~28~~ day of Apr. , 2005.



(L.S.)

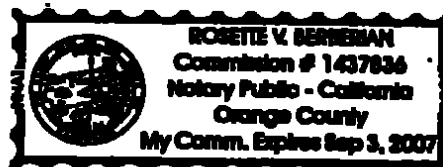
Peter C. Zhu

STATE OF California
COUNTY OF Orange ss.

BE IT REMEMBERED, That on this ~~28~~th day of April, 2005, before me, a Notary Public, personally appeared Peter C. Zhu, who I am satisfied is the person named in and who executed the foregoing instrument in my presence, and I having first made known to him the contents thereof, he did acknowledge that he signed, sealed, and delivered the same as his voluntary act and deed for the uses and purposes therein expressed.



Notary Public



110-8

ESTADOS UNIDOS DE AMERICA
A TODOS AQUELLOS A QUIENES EL PRESENTE LLEGUE:

DEPARTAMENTO DE COMERCIO DE LOS ESTADOS UNIDOS
Oficina de Patentes y Marcas de los Estados Unidos

12 de abril de 2006

La presente es para certificar que el anexo es una copia fiel de los registros de la Oficina de Patentes y Marcas de los Estados Unidos, de los documentos de la solicitud de patente identificada más adelante, que cumplieron con los requerimientos para concederse una fecha de presentación de acuerdo con 35 USC 111.

Número de Solicitud: 11/096,050

Fecha de Presentación: 31 de marzo de 2005

EL CÓDIGO DEL PAÍS Y EL NÚMERO DE SU SOLICITUD DE PRIORIDAD, PARA SER USADA EN LA PRESENTACIÓN EXTRANJERA BAJO EL CONVENIO DE PARÍS ES US11/096,050.

Por la autoridad de
Bajo el Secretario de Comercio para la Propiedad Intelectual y el Director de la Oficina de Patentes y Marcas de los Estados Unidos de América

(fdo) M Tarver
Oficial Certificador
Sello oficial de la Oficina de Patentes y Marcas de los Estados Unidos de América



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THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

April 12, 2006

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

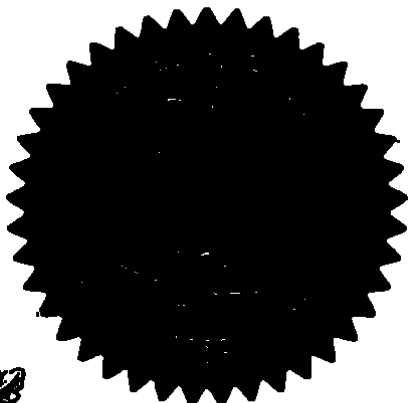
APPLICATION NUMBER: 11/096,050

FILING DATE: March 31, 2005

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS US11/096,050

By Authority of the

**Under Secretary of Commerce for Intellectual Property
and Director of the United States Patent and Trademark Office**



M. Tarver

M. TARVER

Certifying Officer

112 to

UTILITY PATENT APPLICATION TRANSMITTAL Only for new nonprovisional applications under 37 CFR 1.52(b)	Attorney Docket No.	ASP-5026USNP									
	First Inventor	Szu-Min Lin, Paul T. Jacobs, Peter Zhu									
	Title	MONITORING OF CLEANING PROCESS									
	Express Mail Label No.	EL961641678US									
APPLICATION ELEMENTS See MPEP Chapter 600 concerning utility patent application contents.		ADDRESS TO: Commissioner for Patents P.O. Box 1450 Alexandria, VA 22313-1450									
1. ☒ Fee Transmittal Form (e.g., PTO/SB/17) <i>(submit an original and a duplicate for fee processing)</i> 2. ☐ Applicant claims small entity status. 3. ☒ Specification [Total Pages 51] <i>(Preferred arrangement set forth below)</i> - Descriptive Title of the Invention - Cross Reference to Related Applications - Statement Regarding Fed sponsored R&D - Reference to sequence listing, a table, or a computer program listing appendix - Background of the Invention - Brief Summary of the Invention - Brief Description of the Drawings <i>(if filed)</i> - Detailed Description - Claim(s) - Abstract of the Disclosure 4. ☒ Drawing(s) (35 USC 113) [Total Sheets 21] 5. Oath or Declaration [Total Pages 3] a. ☒ unexecuted (original or copy) b. ☐ Copy from a prior application (37 CFR 1.63(d)) <i>(for continuation/divisional with Box 18 completed)</i> i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b). 6. ☐ Application Data Sheet. See 37 CFR 1.76		7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program (Appendix) 8. Nucleotide and/or Amino Acid Sequence Submission (If applicable, all necessary) a. ☐ Computer Readable Form (CRF) b. ☐ Specification Sequence Listing on: i. ☐ CD-ROM or CD-R (2 copies); or ii. ☐ paper c. ☐ Statement verifying identity of above copies ACCOMPANYING APPLICATION PARTS 9. ☐ Assignment Papers (cover sheet & document(s)) 10. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney <i>(when there is an assignee)</i> 11. ☐ English Translation Document <i>(if applicable)</i> 12. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations 13. ☐ Preliminary Amendment 14. ☒ Return Receipt Postcard (MPEP 503) <i>(Should be specifically itemized)</i> 15. ☐ Certified Copy of Priority Document(s) <i>(if foreign priority is claimed)</i> 16. ☐ Request and Certifications under 35 U.S.C. 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent. 17. ☐ Other									
18. ☐ If a CONTINUING APPLICATION, check appropriate box and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76: ☐ Continuation ☐ Divisional ☐ Continuation-in-Part (CIP) of prior application No.: , filed . Prior application information: Examiner Group Art Unit: For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.											
19. CORRESPONDENCE ADDRESS ☒ Customer Number or Bar Code Label 000027777 or ☐ Correspondence Address below Name: Philip S. Johnson, Esq. Address: Johnson & Johnson One Johnson & Johnson Plaza New Brunswick, NJ 08933-7003 USA											
20. TELEPHONE CONTACT Please direct all telephone calls or telefaxes to Andrew C. Farmer at: Telephone: (732) 524-2825 Fax: (732) 524-2808											
21. SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED <table border="1"><tr><td>NAME</td><td>Andrew C. Farmer</td><td>Reg. No. 35,868</td></tr><tr><td>SIGNATURE</td><td colspan="2"></td></tr><tr><td>DATE</td><td colspan="2">March 31, 2005</td></tr></table>			NAME	Andrew C. Farmer	Reg. No. 35,868	SIGNATURE			DATE	March 31, 2005	
NAME	Andrew C. Farmer	Reg. No. 35,868									
SIGNATURE											
DATE	March 31, 2005										

11:029 U.S. PTO
11/096050

FEE TRANSMITTAL	<i>Complete if Known</i>	
	Application Number	
	Filing Date	March 31, 2005
	First Named Inventor	Szu-Min Lin, Paul T. Jacobs, Peter Zhu
	Group Art Unit	
	Examiner Name	
	Attorney Docket Number	ASP-5028USNP

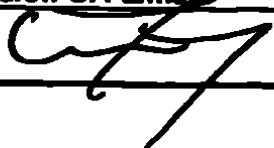
FEE CALCULATION

CLAIMS AS FILED

(1)	(2)	(3)	(4)	(5)
FOR:	NUMBER FILED	NUMBER EXTRA	RATE	BASIC FEE \$300.00
TOTAL CLAIMS	0 - 20 =	0	x 50.00	\$ 0.00
INDEPENDENT CLAIMS	0 - 3 =	0	x 200.00	\$ 0.00
SEARCH FEE	NA	NA	NA	\$ 500.00
EXAMINATION FEE	NA	NA	NA	\$ 200.00
APPLICATION SIZE FEE If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 25 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(e).	0 - 100 =		x 5.00 (for each additional sheet over 100)	\$
MULTIPLE DEPENDENT CLAIMS ☒		N/A	\$360.00	
			TOTAL FEES	\$ 1000.00

METHOD OF PAYMENT

- ☒ Please charge Deposit Account No. 10-0750/ASP-5028USNP/ACF in the amount of \$1,000.00. Three copies of this sheet are enclosed.
- ☒ The Commissioner is hereby authorized to charge any additional fees which may be required in connection with the filing of this communication, or credit any overpayment, to Account No. 10-0750/ASP-5028USNP/ACF. Three copies of this sheet are enclosed.

SUBMITTED BY:		<i>Complete (if applicable)</i>	
Typed or Printed Name	Andrew C. Farmer	Reg. No. 35,868	
Signature		Date: March 31, 2005	Deposit Account No. 10-0750

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DOCKET NO. ASP-5028USNP

**IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE**

Applicant: Szu-Min Lin et al.

For : MONITORING OF CLEANING PROCESS

Express Mail Certificate

"Express Mail" mailing number: EL961541675

Date of Deposit: March 31, 2005

I hereby certify that this complete application, including specification pages, claims, drawings and an unexecuted Declaration and Power of Attorney, is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Laurie Phillips

(Typed or printed name of person mailing paper or fee)

/Laurie Phillips/

(Signature of person mailing paper or fee)

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ASP-5028USNP

MONITORING OF CLEANING PROCESS

Background of the Invention

Field of the Invention

This application relates to soil standards for monitoring of a cleaning process.

Description of the Related Art

Adequate cleaning of contaminated medical instruments and devices is essential for safe disinfection and sterilization. Failure to adequately remove inorganic and organic soil derived from body liquids and tissues can impede the effectiveness of subsequent sterilization procedures resulting in infections. Additionally, remaining foreign materials introduced during subsequent invasive procedures can produce pyrogenic reactions that can impede healing.

It is preferable to use machine processes for cleaning which have been validated for this purpose in a clinical setting and which preferably accomplish sterilization during or after the cleaning cycle. The selected cleaning processes should produce satisfactory results under certain test and field conditions as well as ensure that adequate cleaning is performed under exceptional circumstances and conditions.

It is not only necessary that a high level of cleaning performance be achieved, but also that the cleaning system be capable of adapting to the specific needs of particular medical instruments and devices. The ideal cleaning system will be capable of adequately cleaning medical instruments and devices with long, narrow, inaccessible orifices such as those found on flexible endoscopes as well as the inner surfaces of take-apart, modular instruments. In the case of sophisticated instruments which may no longer be able to be taken apart in the future, adequate cleaning performance must also be achieved.

A variety of cleaning machines and related apparatus have been developed for medical instruments and devices.

U.S. Patent No. 3,640,295 to Peterson describes an ultrasonic cleaner and surgical instrument carrying case, which is useable separately and apart from or in combination with the ultrasonic cleaner, the ultrasonic cleaner including within at least one sink and oscillatable cradle which may carry the instrument case during the ultrasonic cleaning process. A pump and filter are additionally provided as part of the ultrasonic cleaner to

circulate a cleaning fluid within the sink of the ultrasonic cleaner and to remove particles and other matter from the fluid. The Peterson '295 patent does not address standards or quality of cleaning.

5 U.S. Patent No. 3,957,252 to Storz and assigned to Storz-Endoskop GmbH discloses an apparatus for cleaning medical instruments. The apparatus disclosed in the '252 Storz patent pertains to support means provided for mounting an ultrasonic oscillator for engaging washing water in a conventional sink, for use in cleaning medical instruments. The focus of the invention is to eliminate the need for an independent special ultrasonic cleaning tank.

10 U.S. Patent No. 4,064,886 to Hecke and assigned to Riwoplan Medizin-Technische Einrichtungs-Gesellschaft GmbH discloses an apparatus for cleaning endoscopes, comprising a holder device, a cylindrical cleaning container, time control means for placing the holder device under timed control and a rotatable mounting for the holder device. The object of the invention is to enable fast and automatic cleansing and
15 sterilization of endoscopes, which can be carried out without damaging the endoscopes. Again, the invention does not address standards or quality of cleaning.

U.S. Patent No. 4,710,233 to Hohmann et al. and assigned Siemens Aktiengesellschaft discloses a method and apparatus for cleaning, disinfecting, and sterilizing medical instruments with a sequence of method steps performed in a single
20 apparatus. The invention discloses a complicated method and apparatus. The method steps include precleaning the instruments in a container containing a first fluid bath subjected to ultrasonic energy for a period of time T1, subsequently emptying the first fluid bath from the container and replacing it with a second fluid bath containing a cleaning agent and sodium chloride, fine cleaning and disinfecting the instruments by
25 subjecting the second bath to ultrasonic energy for a time period T2 and circulating the second bath through an electrolytic cell having a voltage applied to the electrodes to create an electrolytic disassociation therein, then emptying the second bath and replacing it with a rinse bath, rinsing instruments for a time period T3 by subjecting the rinsing bath to ultrasonic energy and circulating the rinsing bath through the electrolytic cell subsequently
30 emptying the rinse bath, and drying the instruments by means of heated air. Thus, the Hohmann '233 invention is designed to provide adequate cleaning and sterilization of

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medical instruments, however, this is achieved with an expensive and complicated apparatus and method.

U.S. Patent No. 5,032,186 to Childers, et al. and assigned to American Sterilizer Company discloses a method and apparatus for washing and sterilizing hospital or laboratory materials. The invention involves loading a chamber with items to be washed, filling the chamber to a predetermined level with a washing fluid, controllably injecting a steam or an air-steam mixture into the chamber during the filling of a chamber with the washing fluid, the steam being injected in a turbulent manner to create a washing action and to begin heating the washing fluid, and continually injecting steam into the chamber after the chamber is filled to the predetermined level so as to subject the items to a washing action. After the washing phase, the chamber is drained, the items are rinsed and the chamber is drained again. Sensors are employed to monitor the operating parameters of the apparatus. Sensors are utilized for controlling the operation of the spray nozzles and the steam injectors such that steam is controllably injected into the chamber after a certain point during the filling of the chamber with the washing fluid to create a washing action and to begin heating the washing fluid. Again, this invention does not provide means to assure adequacy of cleaning.

U.K. Patent Application No. 2,248,188 A to Parker, et al. and assigned to Keymed Ltd. discloses a method and apparatus for cleaning and disinfecting medical instruments. The method and apparatus of the invention are particularly suited for cleaning and disinfecting endoscopes. The method comprises the steps of placing an instrument in an enclosure and subjecting the instrument to a cleaning phase in which a cleansing solution is applied to the surfaces of the instruments, a disinfection phase in which a disinfectant solution is applied to the surfaces of the instrument, a rinsing phase in which a flushing solution is applied to the surfaces of the instrument, a purging phase in which a volatile liquid is applied to the surfaces of the instruments and a drying phase in which a drying gas is passed over the surfaces of the instrument. The cleaning phase is described as a period sufficient to thoroughly clean the endoscope both externally and internally. Again, the invention does not address means for assuring adequacy of cleaning.

None of the aforementioned apparatus and methods provide the means for assuring adequacy of cleaning of a medical device or instrument. Therefore, a need

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remains for an improved apparatus and method for monitoring cleaning processes for medical devices.

Summary of the Invention

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A cleaning indicator, according to the present invention, for monitoring a cleaning process for a medical instrument, comprises two substantially parallel substrates separated by two substantially equal thickness spacers, wherein a gap is formed between the two substrates. A soil is disposed in the gap and at least one holder secures the two substrates and the two spacers together.

10

Preferably, the soil is dried in the gap. Preferably, the soil is located between the spacers. The soil can comprise organic soil, inorganic soil, or mixtures thereof. The substrates can be formed of a metal, a polymer or other suitable material such as glass. Preferably, the substrates are transparent.

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In one aspect of the invention, the soil is disposed on a sheet, the sheet being disposed between the substrates. The sheet can be flexible.

Preferably, the spacers have a thickness of about 0.05mm.

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In one aspect of the invention the spacers are formed integrally with the substrates. The holder can comprise interlocking portions formed on the substrates, such as a projection on one of the substrates and an opening on the other of the substrates for receiving the projection. Preferably, the interlocking portions snap together. Preferably, one of the substrates, one of the spacers and one of the interlocking portions are formed as one integral piece. Ideally, these pieces are identical so that two identical pieces can be snapped together and soil dried therebetween to form the cleaning indicator. Preferably, the substrates can be separated manually to examine the soil between substrates.

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Brief Description of the Drawings

Figure 1 is a graph of the sodium chloride release rate of sodium chloride inoculated stainless steel blades in deionized water at room temperature.

Figure 2 is a graph of the albumin and sodium chloride release rates of albumin-solution inoculated stainless steel blades in deionized water at room temperature.

Figure 3 is a graph of the sodium chloride and protein release rates of RPMI tissue culture medium+10% fetal bovine serum (FBS) contaminated stainless steel blades in deionized water at room temperature.

Figure 4 is a graph of the sodium chloride and protein release rate of fetal bovine serum inoculated stainless steel blades in deionized water at room temperature.

Figure 5 is a graph of the sodium chloride and protein release rates of bovine whole blood inoculated stainless steel blades in 1% sodium dodecylsulfate solution at 23EC and an agitation speed of 200 RPM.

Figure 6 is a graph of the sodium chloride and protein release rates of bovine whole blood inoculated polytetrafluoroethylene strips in 1% sodium dodecylsulfate solution at 23EC and an agitation speed of 200 RPM.

Figure 7 is a graph of the protein release rates of bovine whole blood contaminated stainless steel blades in 1% sodium dodecylsulfate solution at 21EC, 45EC and different agitation speeds.

Figure 8 is a graph of the protein release rates of bovine whole blood inoculated polytetrafluoroethylene strips in deionized water at different temperatures.

Figure 9 is a schematic diagram of one embodiment of the apparatus of the invention in which the method of the invention can be practiced.

Figure 10 is a schematic diagram of a second embodiment of the apparatus of the invention in which the method of the invention can be practiced.

Figure 11 is a schematic diagram of a third embodiment of the apparatus of the invention in which the method of the invention can be practiced.

Figure 12 is a schematic diagram of a fourth embodiment of the apparatus of the invention in which the method of the invention can be practiced.

Figure 13 is a schematic diagram of a fifth embodiment of the apparatus of the invention in which the method of the invention can be practiced.

Figure 14 is a schematic diagram of the apparatus according to another embodiment of the invention, which has a chemical source to facilitate the detection of soil.

Figure 15a-15d are schematic diagrams of the apparatus according to another embodiment of the invention, which has a standard covered with soil.

Figures 16a-16c are schematic diagrams of a further embodiment of a cleaning indicator according to the invention, which has a controlled gap to simulate mated surgical instruments.

Detailed Description of the Preferred Embodiment

One aspect of the present invention is to determine when a medical device is sufficiently cleaned so that one can insure that a subsequent sterilization process will provide a sterile product, such as one having sterility assurance level (SAL) of 10^{-6} . That is, the probability of having a non-sterile device is less than one in one million. In order to develop technologies capable of accomplishing the above objective, studies were conducted to elucidate some of the important relationships between surface contamination with microorganisms, surface deposit type and subsequent sterilization of medical devices.

The first experiment involved the inoculation of one million Bacillus stearothermophilus (Bst) spores in various concentrations of saline (sodium chloride) in 100 microliters of water onto stainless steel blades. Twenty blades were utilized for each concentration of saline solution evaluated. Following drying overnight, the blades were subjected to a standard sterilization protocol for one cycle of sterilization in a commercially available sterilization apparatus from Advanced Sterilization Products in Irvine, California. The sterilization protocol included double wrapping the blades in CSR wrap and utilizing a full sterilization cycle with 6 mg/liter of hydrogen peroxide in the chamber delivered from a 59% hydrogen peroxide solution. The blades were then placed into a TSB culture medium and incubated at 55E C for 14 days to determine if any viable organisms were remaining. Each concentration of saline was evaluated with three replicates, with a total of 60 blades. The following are the results:

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**Table 1: Range Finding: 10⁶ Bst. spores in various concentrations of saline in Water
100µl inoculated onto stainless steel blades.**

Total % weight of NaCl in water	.85%	.17%	.034%	.0068%
Trial 1	20/20	13/20	4/20	5/20
Trial 2	20/20	16/20	8/20	2/20
Trial 3	20/20	18/20	5/20	4/20
Total	60/60	47/60	17/60	11/60

5 The first number in each column represents the number of blades found to contain viable
organisms following exposure to the sterilization process. The second number in each
column represents the number of blades evaluated in each trial. It can be seen that as the
amount of saline in the surface deposit decreases, the fewer the number of viable
remaining organisms and hence the more efficient the sterilization process. Similar
experiments were conducted with a surface deposit comprised of various concentrations of
10 Fetal Bovine Serum (FBS), which naturally contains approximately 0.75% of salt when
undiluted as well as a surface deposit comprised of various amounts of saline along with
various amounts of Fetal Bovine Serum. The results of those experiments follow:

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Table 2: Range Finding: 10⁶ Bst. spores in various concentrations of Fetal Bovine Serum

100μl inoculated onto stainless steel blades.

% NaCl in FBS	.75%	.15%	.03%	.006%	0%
% FBS in DI water	100%	20%	4%	.8%	0%
Trial 1	1/20	0/20	0/20	0/20	0/10
Trial 2	0/20	0/20	0/20	0/20	0/10
Trial 3	0/20	0/20	0/20	0/20	0/10
Total	1/60	0/60	0/60	0/60	0/30

5 It can be seen that a surface deposit comprised solely of Fetal Bovine Serum provides virtually no interference with subsequent sterilization in this particular experiment protocol even though it contains 0.75% salt when undiluted. It is believed that the presence of protein in the serum prevents the formation of salt crystals during the drying process. These salt crystals may occlude microorganisms and protect them from
10 sterilization processes. Therefore, the presence of salts, such as NaCl, in surface deposits on medical devices, present a special challenge in terms of obtaining a sterile device during a concurrent or subsequent sterilization process. Since it is an objective of the present invention to determine when medical devices are clean enough to be sterilized, the monitoring of salt concentration during the washing process is of great importance.
15 Nevertheless, tap water which contains multiple salts at relatively low concentration presents less of a challenge because uniform crystals are unlikely to form.

Additional experiments simulating rinsing or cleaning processes were conducted on soil-deposited stainless steel (SS) blades or polytetrafluoroethylene (PTFE) plastic strips as models for stainless steel and plastic medical devices and instruments. These
20 experiments elucidate some of the important relationships between surface deposit (or soil) type and release or cleaning rates during a simulated rinsing or cleaning process.

A series of soil-containing solutions were prepared with compositions as illustrated in Table 3.

123 H

Table 3

Solution	NaCl	albumin	proteins, total	Water
NaCl solution	0.74%	0	0	99.26%
Albumin solution	0.73%	4.20%	4.20%	95.07%
RPMI+10% FBS	0.75%		0.35%	
Fetal bovine serum	0.70%	2.20%	3.51%	

5 RPMI tissue culture medium, which is known in the art, when combined with 10% FBS, provides a soil with relatively high salt and low protein content. An aliquot of a solution was deposited and dried on either a stainless steel surgical blade or small strip of polytetrafluoroethylene plastic. A simulated rinsing or cleaning process was then performed and the soil release rate was monitored via a chloride ion specific electrode for sodium chloride (NaCl) or a spectrophotometric technique based upon the o-phthalic dialdehyde (OPA) assay for total protein. The specific conditions and results for these experiments follow.

10 In the first experiment, 100 microliters of sodium chloride solution was inoculated on each SS blade. Eight blades were utilized for the experiment. Each blade was dried for 70 minutes in the oven at 35E C, followed by 30 minutes at room temperature. Eight glass vials were used for soaking the blades, one for each blade. Each vial contained 20 ml of deionized water. Soak times ranged from 0-60 seconds. The amount of sodium chloride released into the deionized water was monitored with a chloride ion selective electrode. Figure 1 illustrates the results of the experiment. Figure 1 is a graph of the sodium chloride release rate of sodium chloride inoculated stainless steel blades in deionized water at room temperature.

15 In the second experiment, 100 microliters of albumin solution was inoculated on each of eight SS blades. Each blade was dried for 70 minutes in the oven at 35E C, followed by an additional 30 minutes at room temperature. Eight glass vials were utilized to soak the blades, one for each blade. Each vial contained 20 ml of deionized water. Blades were soaked for between 0-300 seconds and the amount of protein and sodium chloride released into the deionized water from each of the blades was monitored with the appropriate technology described above. Figure 2 is a graph of the albumin and

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sodium chloride release rates of albumin-solution inoculated stainless steel blades in deionized water at room temperature.

In the third experiment, 100 microliters of RPMI tissue culture medium with 10% FBS was inoculated on each of eight SS blades. Each blade was dried for 70 minutes in the oven at 35E C, followed by an additional 30 minutes at room temperature. Eight glass vials were used for soaking the blades, one for each blade. Each vial contained 20 ml of deionized water. The sodium chloride and protein release rates into the deionized water from the blades was monitored with the appropriate technology described above. Figure 3 is a graph of the sodium chloride and protein release rates of RPMI tissue culture medium + 10% FBS contaminated stainless steel blades in deionized water at room temperature.

In the fourth experiment, 100 microliters of fetal bovine serum was inoculated on each of eight SS blades. Each blade was dried for 70 minutes in the oven at 35E C, followed by an additional 30 minutes at room temperature. Eight glass vials were used for soaking the blades, one for each blade. Each vial contained 20 ml of deionized water. Sodium chloride and protein release rates into the deionized water from the blade were monitored with the appropriate technology described above. Figure 4 is a graph of the protein and sodium chloride release rates of fetal bovine serum inoculated stainless steel blades in deionized water at room temperature.

The results of the first four release experiments indicate that in all cases, the sodium chloride soil was removed from the SS blades prior to the protein-containing soil. Additionally, in all cases, the amount of time required to remove the protein-containing soil was not more than two times the time required to remove sodium chloride. Also, in all cases, a simple soak in 20 ml of deionized water cleaned all the blades in less than five minutes.

The next series of experiments explored the relationships between cleaning rates, cleaning solution composition, cleaning conditions and type of surface. In experiments 5-8, the blood solution used was the fresh recalcified bovine blood, which was prepared by gently mixing 20 parts of citrated bovine whole blood with 1 part of 0.5 molar calcium chloride solution at room temperature.

In the fifth experiment, the release rate of blood from a set of blades was measured. Each set of blades contained 12 SS surgical blades (Bard Parker, size #10). Five drops of blood solution were deposited on each blade. Each drop was 10 microliters. Blades were dried as in previous experiments. When starting the release rate measurement, the blades were placed at the bottom of a glass beaker (150 ml capacity) with the soaking solution in it. The soaking solution comprised 100 ml of 1% SDS (sodium dodecyl sulfate) solution and 0.2 ml of 5 M NaNO_3 at 23EC, with an agitation speed of 200 RPM. The agitation was generated by using a small Teflon stirring paddle (blade size = 2" x 2", 1/16" wide) which rotated at a constant speed by a mixer. Sodium chloride and protein release rates from the blades were monitored with the appropriate technology described above. Figure 5 is a graph of the sodium chloride and protein release rates of the blood solution inoculated stainless steel blades in 1% SDS solution at 23EC and an agitation speed of 200 RPM.

In the sixth experiment, the release rate of blood from twelve PTFE strips was measured. Five drops of blood solution were deposited on each strip (35 mm x 6mm x 2 mm). Each drop was 10 microliters. Strips were dried as in previous experiments. When starting the release rate measurement, the strips were placed at the bottom of a glass beaker (150 ml capacity) with soaking solution in it. The soaking solution comprised 100 ml of 1% SDS solution and 0.2 ml of 5 M NaNO_3 at 23EC, with an agitation speed of 200 RPM. Sodium chloride and protein release rates from the PTFE strips were evaluated with the appropriate technology described above. Figure 6 is a graph of the sodium chloride and protein release rates of the blood solution inoculated PTFE strips in 1% SDS solution at 23EC and an agitation speed of 200 RPM.

The results of the above two experiments once again show that the sodium chloride soil is released more readily than the protein soil. Moreover, the time required to remove the protein soil is not significantly longer than the amount of time required to remove the sodium chloride soil. Also, the whole blood deposit is more difficult to remove than the previous deposits, despite the use of a 1% SDS solution and agitation of the solution at 200 RPM. Also, there is some difference between the two surfaces, SS blades versus PTFE strips.

The next experiments explored the effects of cleaning solution agitation speed and temperature.

In the seventh experiment, the release of blood from a set of blades at different agitation speed was measured. Each set of blades contained 12 SS surgical blades (size #10). Five drops of blood solution were deposited on each blade. Each drop was 10 microliters. Blades were dried as in previous experiments. When starting the experiment, one set of blades was placed in 100 ml of soaking solution at room temperature, and exposed to different agitation speeds (0, 350, 700, and 1400 RPM). Additionally, one set of blades was exposed to 1400 RPM at 45EC. The soaking solution comprised 100 ml of 1% SDS solution and 0.2 ml of 5 M NaNO_3 . Figure 7 is a graph of the protein release rates of the blood solution inoculated stainless steel blades in 1% SDS solution at 23EC and 45EC and different agitation speeds.

In the eighth experiment, the release rate of blood from a set of PTFE strips at two different temperatures was measured. Each set contained 12 PTFE strips. Five drops of blood solution were deposited on each strip. Each drop was 10 microliters. Strips were dried as in previous experiments. When starting the release rate measurement, the strips were placed at the bottom of a glass beaker (150 ml capacity) with 100 ml soaking

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solution in it. One set of strips was utilized for an experiment conducted at 45EC and the other set was utilized for an experiment conducted at 23EC. No agitation was applied for both batches. Protein release rates from the PTFE strips were evaluated with the appropriate technology described above. Figure 8 is a graph of the protein release rates of the blood solution inoculated PTFE strips in 1% SDS solution at 23EC and 45EC.

The preceding two experiments show that increasing solution agitation speed or temperature will result in a shorter cleaning time or faster release rate.

In summary, it has been discovered from the results of the above release rate experiments that by correlating the release rate of various soils, one can monitor the release of a selected soil to ensure that adequate cleaning has taken place. In most situations, one can employ a cleaning time of not more than two to three times the amount of time required to remove the inorganic soil to be assured that adequate protein soil removal has occurred. Additionally, temperatures up to about 45EC can be effectively employed to increase the cleaning rate. Also, agitation can be employed to increase cleaning effectiveness. Cleaning solution composition will affect cleaning rate, but in many cases, warm water (e.g. 30-50 °C) will adequately remove all soils.

One aspect of the present invention provides an apparatus for monitoring a cleaning process for a medical device. Preferably, the apparatus is capable of determining when the device is sufficiently cleaned so that the device can be sterilized. The apparatus comprises a soil detector, capable of detecting inorganic and/or organic soil on a medical device or in a liquid utilized in a cleaning or cleaning monitoring process or on a soil-covered standard which can serve as a surrogate indicator of cleanliness for the medical device.

Inorganic soils include electrolytes such as sodium chloride, potassium chloride, calcium chloride and other alkaline and alkaline earth salts, inorganic metal-containing compounds such as iron salts and all other inorganic compounds known to be present in the body and which may come in contact with a medical device which requires sterilization following use.

Organic soils include proteins, glycoproteins, lipoproteins, mucins, amino acids, polysaccharides, sugars, lipids, glycolipids and all other organic compounds known to be present in the body and which may come in contact with a medical device which requires sterilization following use. Organic soils also include whole, part, live, attenuated or dead microorganisms which may come in contact with a medical device. Microorganisms include all gram positive, gram negative, enteric and non-enteric microorganisms, yeasts, fungi and viruses.

The apparatus of the invention is suitable for monitoring a cleaning process for a wide variety of medical devices, including critical items that enter sterile tissues such as surgical instruments, semi-critical items that contact broken skin or mucous membranes such as endoscopes, arthroscopes, dental instruments and some anaesthetic equipment and non-critical items that contact intact skin.

Liquids utilized in cleaning processes include cleaning and rinsing liquids. A separate liquid utilized solely for the purpose of monitoring cleaning may also be employed and may thus be utilized in an apparatus comprising a soil detector. Cleaning processes include free-standing washing processes, integrated systems which include cleaning processes comprising a washing step followed by a sterilizing step and integrated systems which include cleaning processes in which cleaning and sterilization occur simultaneously.

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The apparatus for monitoring cleaning can be integrated with a cleaning system for medical devices or a cleaning and sterilization system.

The soil detector of the apparatus of the invention may utilize a variety of detection technologies for monitoring cleaning, alone or in combination. Data obtained from one analyzer can be used to verify the reliability of data obtained from other analyzers. Soil detection technologies can be divided into two basic soil categories: (1) detection technologies suitable for detecting inorganic soils; and (2) detection technologies suitable for detecting organic soils. In many cases, however, a soil detection technology may be suitable for detecting both inorganic and organic soils.

The following are possible methods of detection. It should be understood that there are other suitable soil detection technologies not listed here. The following are illustrative of useful technologies which can be employed in the present invention.

Inorganic soil (e.g., NaCl)

Ion-selective electrodes

Chloride electrode method

Principle: A chloride electrode is composed of a glass body, reference solution, and a silver chloride/silver sulfide membrane. When the membrane is in contact with a chloride solution, an electrode potential develops across the membrane. This electrode potential is measured against a constant reference potential using a pH/mV/ion meter. The concentration of chloride ions, corresponding to the measured potential, is described by the Nernst equation:

$$E = E_0 - S \log X$$

where:

E = measured electrode potential (mV)

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E_o = reference potential (mV)

S = electrode slope

X = chloride ion concentration (M)

The detection range of common chloride electrodes is from 1M to 5.0×10^{-5}

M.

Sodium electrode method

Principle: A sodium electrode is composed of a glass body, reference solution, and a sensing membrane. The sensing membrane has a liquid internal filling solution in contact with a gelled organophilic membrane, which contains a sodium selective ion exchanger. When the membrane is in contact with a sodium solution, an electrode potential develops across the membrane. this electrode potential is measured against a constant reference potential with a pH/mV/ion meter. The concentration of sodium ions, corresponding to the measured potential, is described by the Nernst equation.

$$E = E_o - S \log X$$

where:

E = measured electrode potential (mV)

E_o = reference potential (mV)

S = electrode slope

X = sodium ion concentration (M)

The detection range of common sodium electrodes is from saturated to 1.0×10^{-6} M.

When utilized as a soil detector, the electrode probe would be placed either directly inside the washing chamber in contact with a washing or rinsing liquid or inside a

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liquid conduit which is separate from the washing chamber and which is used for sampling a washing, rinsing or cleaning monitoring liquid. Additionally, more than one electrode probe may be utilized at the same time. In this latter case, one probe would be placed in continuous or intermittent or single contact with the fresh washing, rinsing or cleaning monitoring liquid. This probe would serve to provide the control potential reading for a soil-free liquid. A second probe would measure the potential of the wash, rinse or cleaning monitoring liquid which has been exposed to the soiled medical device. The potential readings of the two probes would be compared and the device could be considered sufficiently cleaned when the two potential readings are substantially equivalent or within a few percent (e.g., 3%) of one another.

Conductivity method

Principle: Ions or electrolytes in solution can be determined and quantitated by measuring the electrical conductivities of electrolyte solutions. The conductivity of a solution depends on the number of ions present and the mobilities of the ions. Sodium chloride (NaCl) is a strong electrolyte and is completely ionized in solution. As a result of its complete ionization, the conductivity of a NaCl solution is proportional to the concentration of NaCl in the solution. Weak electrolytes, such as acetic acid, are not completely ionized in solution and thus have low conductance and large increases in conductance on dilution, where more ionization occurs. The molar conductivity (Λ) is defined as

$$\Lambda = k/c$$

where:

c: the molar concentration of added electrolyte

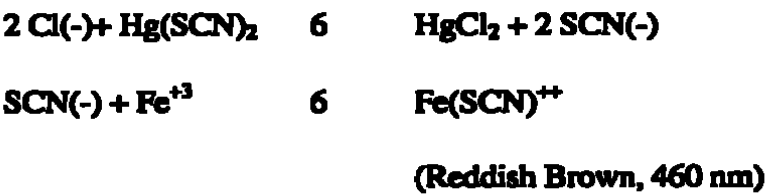
k: the conductivity

The conductivity of a solution is generally measured with a probe containing two electrodes along with suitable electrical circuitry such as a Wheatstone Bridge for measuring the current between the electrodes. The conductivity of a solution is derived from the total numbers of ions in solution derived from all of the strong and weak electrolytes present.

When utilized as a soil detector, the conductivity probe would be placed either directly inside the washing chamber in contact with a washing or rinsing liquid or inside a liquid conduit which is separate from the washing chamber and which is used for sampling a washing, rinsing or cleaning monitoring liquid. Additionally, more than one conductivity probe may be utilized at the same time. In this latter case, one probe would be placed in continuous or intermittent or single contact with the fresh washing, rinsing or cleaning monitoring liquid. This probe would serve to provide the control conductivity reading for a soil-free liquid. A second probe would measure conductivity of the wash, rinse or cleaning monitoring liquid which has been exposed to the soiled medical device. Conductivity readings of the two probes would be compared and the device could be considered sufficiently cleaned when the two conductivity readings are substantially equivalent or within a few percent (e.g., 3%) of one another.

Spectrophotometer method

Chloride ions reagent



Principle: Chloride ions react with chloride reagent to form $\text{Fe}(\text{SCN})^{++}$ ions (reddish brown color) with a maximum absorbance at 460 nm.

Preferably, an automatic colorimeter or photometric autotitrator is employed with spectrophotometric techniques based upon the generation of a colored species from the soil compound analyzed.

. **Ion Chromatography**

5 **Principle:** Refers to the separation of substances by their differential migration on an ion-exchange column or on a sheet impregnated with an ion exchanger. Ions (anions or cations) are separated on the basis of ion-exchange reactions that are characteristic of each type of ion. The common detectors for ion chromatography are conductometric, UV and electrochemical detectors. Ion chromatography can detect dissolved chloride ions in water
10 where concentrations range from a detection limit of 0.02 mg/L to 80 mg/L.

Preferably, an automatic ion chromatograph is employed when using ion chromatography for soil detection.

. **Capillary electrophoresis**

15 **Principle:** Electrophoresis is the movement of a charged species in an electric field. Capillary electrophoresis utilizes capillary tubes. A key advantage in the use of capillary tubes for electrophoresis is an enhanced heat dissipation that permits the use of high potentials for separation. The use of high-potential fields leads to extremely efficient separations with a dramatic decrease in analysis time.

. **High-performance liquid chromatography (HPLC)**

20 **Principle:** Refers to the separation of the components of a solution following different migration of the solutes in a liquid flowing through a column packed with specific solid particles. Among the separations possible are peptides (by reversed phase chromatography), proteins and enzymes (hydrophobic and size exclusion modes of chromatography), amino acids, and inorganic and organometallic compounds. There are

several detectors that can be selected for a HPLC system. They are: UV-VIS absorption, IR absorption, fluorometry, refractive index, conductometric, electrochemical, and radioactivity detectors. According to the sample and stationary phase type, several separation columns can be selected. The common columns are affinity, gel-filtration, and ion-exchange columns.

0 Affinity media:

A successful affinity separation requires that a biospecific ligand is covalently attached to a chromatographic bed material, the matrix.

0 Gel filtration

The separation is based on differences in the size and/or shape of the analyte molecules, which governs the analytes' access to the pore volume inside the column packing particles.

0 Ion-exchange

This method involves solute interactions with charged groups of the packing material, followed by elution with an aqueous buffer of higher ionic strength or a change in pH.

7. Conclusion

Any of a number of different techniques can be used to monitor inorganic soil. One convenient product for electrolyte testing is the "MultiPLY" integrated multisensor available from Daile International of Newark, DE.

Organic soil (e.g., proteins)

Spectrophotometer (Vis to UV, wave length 190nm-900nm)

OPA method

Proteins-NH₂+o-phthalic dialdehyde+Thiol6l-alkylthio-2-alkylisoindol

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(OPA)

(Fluorescent, 340 nm)

Principle: The amino groups of proteins react with the aldehyde groups of OPA in the presence of a thiol component (N,N-dimethyl-2-mercaptoethylammonium-chloride) to form a fluorescent compound (1-alkylthio-2-alkylisoindol). The fluorescent compound has a maximum absorbance at 340 nm.

Albumin reagent method

Albumin + Bromcresol purple 6 Stable complex

(C₂₁H₁₆Br₂O₃S₉FW=540.24)

(610

nm)

Principle: Bromcresol purple binds quantitatively with serum albumin forming a stable complex, which can be detected at 610 nm. The amount of the complex produced is linearly proportional to the albumin concentration in the solution.

Lowry micro method

Principle: Dilute biuret reagent reacts with peptide bonds to yield a purple-blue complex. The color of this complex can be further intensified by the addition of phenol reagent. The increase in absorbance, read at 550-750 nm, is used to determine the protein concentration in the sample.

Microprotein-PR6 method

Principle: When the pyrogallol complex (in the MicroproteinXPR reagent) binds amino groups of proteins, the absorbance of the reagent is shifted. The increase in absorbance at 600 nm is directly proportional to protein concentration in the sample.

Liquid Chromatography or High-performance liquid chromatography (HPLC)

Principle: Same as in the measurement of inorganic species.

Cyclic voltammetry

Principle: When materials (metals, polymers, etc.) are brought into contact with blood protein, a layer of protein (mostly fibrinogen) is formed at the interface within a few seconds. As a result of protein adsorption, addition of proteins into protein-free solution will change the behavior of the current density X potential (I vs. V) of metal electrodes in a cyclic voltammetry measurement. For example, the I-V behavior of a high copper alloy (2% zinc) is modified by the addition of proteins (albumin, fibrinogen, etc) to a supporting phosphate-saline electrolyte.

Radioactivity

Principle: Proteins are labeled with a radioactive isotope such as Technicium 99 or Iodine 125 and the radioactivity of the solution is measured to determine the amount of protein present. For example, the protein fibrinogen is labeled with ¹²⁵I using a twofold molar excess of iodine monochloride. The biological properties of labeled fibrinogen are unaffected by this labeling method. The concentration of fibrinogen in a solution is directly proportional to the radioactivity (or intensity of gamma radiation) of a solution containing labeled fibrinogen.

Quartz crystal microbalance (QCM) method

Principle: The quartz crystal microbalance is a mass-sensitive detector based on an oscillating quartz wafer. The response of the QCM is extremely sensitive to mass changes at the solid-solution interface. When gold coated quartz crystals are brought into contact with blood protein, a layer of protein is formed at the interface within a few

seconds. This small mass change can be easily detected by the QCM. The increase of mass (or decrease of frequency of oscillation) on the quartz crystal is directly proportional to the protein concentration in a solution.

. **FTIR spectroscopy(transmission and ATR)**

5 Fourier transform infra-red (FTIR) spectroscopy can be used to identify and quantitate proteins in mixtures, both in solutions as well as on surfaces. Transmission FTIR studies of aqueous protein solutions indicate the identity and amounts of proteins present. Attenuated total reflectance (ATR) FTIR studies of protein-deposited surfaces can determine the identity and amounts of proteins on surfaces.

10 . **Electrophoresis**

Principle: Electrophoresis is the movement of a charged species in an electric field. In general, protein molecules pick up hydrogen ions in acid solution to become positively charged. By varying the pH of the electrophoretic medium, the velocity of a protein can be altered. If for a given protein the pI (pH at which the protein is electrically
15 neutral) is smaller than the pH, its charge will be negative and movement will be towards the positive electrode. Protein components with $pI > pH$ will be positively charged and move in the opposite direction.

. **Capillary electrophoresis**

Principle: Same as in the measurement of inorganic species.

20 Additional technologies for detecting both inorganic and organic soils include potentiometry, particularly potentiometric autotitrators, and technologies for detecting particles in solution or the clarity of a solution. The clarity of a solution can be measured with a turbidimeter, comprised of a turbidity sensor with a flow cell. Turbidimeters

operate typically with a photocell and provide an electrical signal which is easily integrated with other systems, such as a cleaning control system. Alternatively, the clarity of a solution can be determined through a measurement of the color, reflectance, absorbance, transmittance etc. of the liquid. Laser systems utilizing optical fibers for transmission from the laser and to the detector from the sample can also be employed for evaluation of solution clarity or many other properties.

Preferably, the apparatus of the invention employs detection technology for detecting soils wherein the detection technology is suitable for detecting the presence of the soils in a liquid utilized in the cleaning process. Preferably, the liquid is selected from the group consisting of a cleaning and rinsing liquid used during the cleaning process.

The apparatus of the invention may also employ detection technology wherein the detection technology is suitable for detecting the presence of the soil on a surface of a medical device. Preferably, the detection technology which is suitable for detecting the presence of soil on a surface of a medical device operates without contacting the surface of the device. For example, utilizing fiber optic technology, combined with reflectance spectrophotometry, one can directly monitor surface cleaning. Alternatively, detection technology suitable for detecting the presence of soil on the surface of a medical device may operate via direct surface contact. In other words, a probe from the detection technology may physically contact the surface of the medical device and thereby sense the amount of soil present on the surface in order to determine and quantitate the state of cleanliness of the medical device. In most cases, the physical contact of the probe with the device is transient. A technology suitable for this particular application is attenuated total reflectance (ATR) spectroscopy. ATR methods employ crystals which transmit the sensing radiation directly to the surface of the sample to be monitored. The crystal

physically contacts the surface of the sample. ATR spectroscopy can be utilized with ultraviolet (UV) absorption spectrophotometry as well as infra-red spectroscopy technologies. ATR-UV technologies employ sapphire crystals as sampling probes. Fourier transform infra-red spectroscopy can be employed with a suitable ATR crystal as well.

Alternatively, an indirect detection technology may also be employed. This approach employs the same physical-chemical detection technologies and methods previously mentioned for other approaches. However, the medical device itself is not monitored for the degree of cleaning. Rather, a soil-deposited standard is inserted in the apparatus and monitored in place of the medical device itself.

The soil detector may employ continuous sampling of a liquid or of a surface of a medical device or soil-covered standard or may employ periodic or single sampling of the aforementioned liquid or device or standard. Periodic sampling may be carried out in uniform or nonuniform (i.e., random) intervals. The number of intervals can be as few as one as in single sampling. A single sampling interval is viable under the situation wherein the cleaning process takes place over a sufficient period of time such that there is a high degree of assurance that sufficient cleaning has taken place such that the device can be sterilized thereafter. However, preferably two or more sampling intervals are utilized by the soil detector to assess the amount of cleaning which has taken place. More preferably, three or more sampling intervals are utilized. Even more preferably four or more sampling intervals are utilized by the detection technology.

The ion-selective electrode method is preferred for use in a soil detector due to its sensitivity and specificity for measuring relevant electrolytes such as sodium and chloride as well as the relatively compact probe, durability of the probe, ease of use, real time

measurement capability and electrical basis of operation. Electrode potential measurements may be taken continuously or intermittently and can be easily integrated with a control system for a cleaning or cleaning and sterilization apparatus. A control system for controlling the cleaning process may also be a part of the present invention.

5 The conductivity method is also preferred for use in a soil detector for the same reasons given for the ion-selective electrode method.

Another aspect of the present invention provides a method for monitoring a cleaning process for a medical device, comprising the step of measuring the soil removed from a medical device with the apparatus of the invention comprising a soil detector.

10 Preferably, the method comprises the further step of determining when the device is sufficiently cleaned so that it can be sterilized.

Preferably, the device is selected from the group consisting of critical items that enter sterile tissues, semi-critical items that contact broken skin or mucous membranes and noncritical items that contact intact skin. More preferably, the critical items that enter
15 sterile tissues are surgical instruments. More preferably, the semi-critical items that contact broken skin or mucous membranes include endoscopes, arthroscopes, dental instruments and anaesthetic equipment.

Preferably, the method of the invention employs an apparatus comprising a soil detector, wherein the soil detector utilizes detection technology capable of detecting
20 inorganic and/or organic soil. The inorganic soil is selected from the group consisting of inorganic electrolytes, alkaline and alkaline earth salts, inorganic metal-containing compounds and other inorganic compounds present in the human body which may come in contact with a medical device. The organic soil is selected from the group consisting of proteins, glycoproteins, lipoproteins, mucous, amino acids, polysaccharides, sugars, lipids,

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glycolipids, other organic compounds present in the human body which may come in contact with a medical device, microorganisms and viruses.

The detection technology utilized in the method of the invention is selected from the group consisting of ion-selective electrodes, conductivity, spectrophotometry, ion chromatography, capillary electrophoresis, high performance liquid chromatography, liquid chromatography, radioactivity, gravimetry, infra-red spectroscopy, potentiometry and turbidimetry.

The cleaning process monitored in the method of the invention is selected from the group consisting of an independent cleaning process comprising one or more cleaning steps, a cleaning process comprising one or more cleaning steps followed by a sterilization step and a cleaning process in which cleaning and sterilization occur simultaneously.

The apparatus comprising the soil detector utilized in the method of the invention measures soil removed from the device by detecting soil on the device or in a liquid utilized in the cleaning process or a cleaning monitoring process or on a soil-covered standard which is an indicator of cleanliness for the device. Preferably, the liquid utilized in the cleaning process is a cleaning liquid.

The method of the invention wherein the liquid is a cleaning liquid and the detecting is of the soil in the liquid comprises the steps of:

- (a) detecting the soil in the liquid prior to the cleaning process; and
- (b) detecting the soil in the liquid during or after the cleaning process.

The aforementioned method preferably further comprises the step of determining if the soil in step (b) is substantially equal to the soil in step (a), wherein if the soil detected in step (b) is substantially equal to the soil detected in step (a), the device is considered to be sufficiently cleaned so that it can be sterilized.

The amount of soil detected in one step may be considered to be substantially equal to the amount of soil detected in another step if the two values are within an acceptable range. In many instances, an acceptable range would be up to a 10% difference, more preferably within 3-5%.

5 If the soil determined in the aforementioned method in step (b) is not substantially equal to the soil determined in step (a), either the cleaning step or rinsing step or all steps of the cleaning process are repeated until the soil determined in step (b) is substantially equal to the soil determined in step (a).

10 One embodiment of an apparatus for monitoring a cleaning process for a medical device or instrument comprising a ion-selective electrode-based soil detector is illustrated in Figure 9. Figure 9 illustrates an apparatus 10 which contains a washing chamber 20 for washing medical devices and instruments such as a medical device 22 with a lumen and surgical instrument 24. The washing chamber 20 may also be utilized for sterilization. Washing chamber 20 has a liquid outlet 40 with valve 41 and liquid inlet 45 with valve 46. 15 Liquid outlet 40 and liquid inlet 45 are utilized to transport a washing or rinsing liquid out of washing chamber 20 and back into chamber 20. Liquid outlet 40 is connected through valve 41 to liquid conduit 50 which in turn is connected to liquid pump 60. Liquid conduit 50 transports a washing or rinsing liquid to pump 60 from the washing chamber 20. Pump 60 pumps the washing or rinsing liquid from washing chamber 20 through 20 liquid outlet 40, valve 41 and liquid conduit 50 into liquid conduit 55. Liquid conduit 55 returns the liquid through valve 46 and liquid inlet 45 to the washing chamber 20. Liquid conduit 55 is also connected to liquid conduit 58 which contains a valve 57 and liquid inlet 56. Liquid inlet 56 is used for the inlet of any of the liquids utilized in the washing or rinsing process. Liquid inlet 56 allows, for example, the inlet of a fresh wash, rinse or

cleaning monitoring liquid into conduit 55 so that a potential reading may be taken by electrode probe 70 which is positioned inside conduit 55. Washing chamber 20 also contains a liquid outlet 44 which is connected to valve 47. Valve 47 is connected to conduit 54 which in turn is connected to drain outlet 59. Liquid outlet 44 and the
5 aforementioned connected parts are utilized for draining chamber 20 after a wash or rinse cycle.

The electrode probe 70 is utilized for soil detection within the washing or rinsing liquid. Electrode probe 70 contains a first electrode 72 and second electrode 74. Liquid flowing through conduit 55 passes by both the first electrode 72 and the second electrode
10 74. The ions in the liquid produce a current which is transmitted via electrical cable 76 and electrical cable 78 to the electrical circuitry 80 for the electrode detector. The electrical circuitry 80 is connected via an electrical connection 90 to the washing control system 30. The washing control system 30 is directly connected to the washing chamber 20 and controls all aspects of the washing process.

The method of the invention for monitoring a cleaning process for a medical device, utilizing the apparatus of the invention illustrated in Figure 9, operates as follows: All valves are initially in the closed position. Valve 57 is opened and fresh, clean wash or rinse water is allowed to flow into inlet 56 from a wash or rinse water source (not shown). Electrode potential readings are taken initially by the electrode probe 70 of the clean wash
20 or rinse liquid which does not contain any soil. Preferably, in this embodiment of the method, a potential reading is taken of the clean wash liquid. This represents the time 0 potential reading. Thereafter, valve 46 is opened allowing wash water to enter chamber 20, filling it to prepare for the wash cycle. Alternatively, valves 46 and 57 can be opened simultaneously, so that a time 0 reading may be taken during filling of the chamber 20. A

time 0 reading may also be taken during the washing cycle, if desired. Valves 46 and 57 are then closed and the wash cycle is initiated. The wash cycle is run over a time period determined by the type of medical devices and instruments present. Generally, this time period is less than about one hour. Preferably, this time period is less than about 30 minutes. Even more preferably, this time is less than about 15 minutes. At the end of the wash cycle, valve 47 is opened and the dirty wash water is allowed to flow out of the chamber through outlet 59. Valve 47 is closed after the chamber is emptied. Valves 45 and 57 are once again opened, allowing fresh rinse water to enter chamber 20. After chamber 20 is filled, valves 45 and 57 are once again closed. A rinse cycle is then performed. This cycle generally is of a fraction of or is equal to the duration of the wash cycle. One or more potential readings are taken of the rinse liquid during or at the end of the rinse cycle. This is performed by simultaneously opening valves 41 and 46 and turning pump 60 on to pump the rinse liquid into conduits 50 and 55 until the rinse liquid contacting the electrode probe 70 is equivalent to the rinse liquid inside the chamber 20. If the potential of the rinse liquid following the wash cycle is substantially equal to the time 0 potential reading, adequate cleaning has been achieved. If not, either the rinse cycle or wash and rinse cycle are repeated until the potential reading of the rinse solution attains the desired value. At this stage, the medical device 22 and instrument 24 inside the chamber can be sterilized in the second step of a two step sequential cleaning and sterilization process.

20 Another embodiment of an apparatus for monitoring a cleaning process for a medical device or instrument comprising an ion-selective electrode-based soil detector is illustrated in Figure 10. Figure 10 illustrates an apparatus 11 which contains a washing chamber 20 for washing medical devices and instruments such as a medical device 22 with a lumen and surgical instrument 24. Washing chamber 20 can also be utilized for

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both cleaning and sterilization. The cleaning and the sterilization can take place simultaneously or sequentially. Preferably, the cleaning step is performed prior to the sterilization step inside chamber 20. Washing chamber 20 has a water inlet 53 which is connected to a water source (not shown) and also through valve 52 and conduit 51 to valve 43. Valve 43 is connected directly to inlet 42 leading directly to the inside of washing chamber 20. Washing chamber 20 also has water outlets 44 and 48. Water outlet 44 is connected to valve 47 and thereafter to conduit 54 which leads to the water drain outlet 59. The water drain outlet 59 is a dirty water outlet used primarily to purge the washing chamber 20 of dirty water. Water outlet 48 is connected to valve 49 and thereafter to conduit 61 which leads to valve 62. Valve 62 leads to the rinsing water outlet 63. Conduit 51 in the water inlet line contains a first electrode probe 64 with a first electrode 65 and a second electrode 66. The first electrode 65 is connected to electrical cable 67 and the second electrode 66 is connected to electrical cable 68. Electrical cables 67 and 68 lead from the electrode probe 64 to electrical circuitry 31 which comprises the ion-selective electrode electrical circuitry as well as the washing or washing and sterilization control circuitry. Similarly, a second electrode probe 71 is positioned in the rinsing water outlet conduit 61 between valves 49 and 62. Electrode probe 71 has a first electrode 73 and a second electrode 75. Electrodes 73 and 75 are connected to electrical cables 77 and 79, respectively. Electrical cables 77 and 79 are connected directly to electrical circuitry 31.

The method of the invention for monitoring a cleaning process for a medical device utilizing the apparatus of the invention illustrated in Figure 10, operates as follows: valves 52 and 43 in the water inlet conduit 51 are opened and water is allowed to flow through water inlet 42 into the washing chamber 20 until chamber 20 is sufficiently filled

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for a cleaning cycle. This water is fresh, clean water with no soil. A potential reading is taken of this water with the electrode probe 64 and the electrical circuitry 31 stores this reading. Valves 52 and 43 are then closed. A first cleaning cycle is performed within the washing chamber 20. This cleaning cycle is generally less than about one hour.

5 Preferably, the cleaning cycle is less than about 30 minutes. More preferably, the cleaning cycle is less than about 15 minutes. Valve 47 opens at the end of this first cleaning cycle. The dirty wash water is expelled from chamber 20 through an outlet 44 after valve 47 opens. Valve 47 is closed after all of the dirty wash water is expelled from the washing chamber 20. Thereafter, valves 53 and 43 are once again opened and clean, fresh rinse

10 water is allowed to flow into the washing chamber 20 through the inlet port 42. A second potential reading of the clean, fresh rinse water coming into the chamber may be taken with the first electrode probe 64. Valves 52 and 43 are then closed and a rinsing cycle within chamber 20 is initiated. This rinsing cycle is generally less than about one hour. Preferably, the rinsing cycle is less than about 30 minutes. More preferably, the rinsing

15 cycle is less than about 15 minutes. At the end of the rinse cycle, valves 49 and 62 in the rinsing water outlet line 61 are opened allowing the rinsing water to flow out of the washing chamber 20 past the second electrode probe 71. A potential reading is taken by electrode probe 71 and transmitted to electrical circuitry 31. A comparison is made by electrical circuitry 31 of the potential of the rinsing water taken by electrode probe 71 and

20 the potential of the fresh, clean rinsing water taken by electrode probe 64. If these two values are substantially equivalent, meaning that they are identical or within a few percent of one another, then no further washing and rinsing is required. Valves 49 and 63 are closed once all of the rinse liquid has been expelled from chamber 20. However, if the two readings are not substantially equal in absolute value, then additional rinsing is initiated

147 45

and performed as before. The second rinse cycle may be either a fraction of the duration of the first rinse cycle or may be equivalent in duration to the first rinse cycle. Potential readings are taken as before during the first rinse cycle and the potential reading of the rinse liquid after it has contacted the medical devices and instruments is compared once again to the potential reading of the fresh clean rinse liquid. Once these two readings are substantially equivalent, then adequate cleaning has taken place and no further washing and rinsing is required. At this stage, the medical device 22 and instrument 24 inside the chamber can be sterilized in the second step of a two step sequential cleaning and sterilization process. The chamber 20 may then be opened via a door (not shown) and device 22 and instrument 24 removed for use.

Another embodiment of the apparatus for monitoring a cleaning process for medical devices or instruments comprising an ion-selective electrode-based soil detector is illustrated in Figure 11. Figure 11 illustrates an apparatus 12 which contains a chamber 20 for washing medical devices and instruments such as a medical device 22 with a lumen and surgical instrument 24. Washing chamber 20 may also be utilized for sterilization. The sterilization may occur simultaneously with cleaning or may take place following the cleaning step. Apparatus 12 contains all of the components of apparatus 11 illustrated in Figure 10, with the exception of outlet 48, valve 49, valve 62, conduit 61 and rinsing water outlet 63. Apparatus 12 operates in much the same manner as apparatus 11 illustrated in Figure 10. In the case of apparatus 12 illustrated in Figure 11, however, all of the washing and rinsing liquid exits washing chamber 20 through the outlet 44. Otherwise, all of the steps of the method of the invention for monitoring the cleaning process described previously and which are utilized for apparatus 11 as illustrated Figure 10 apply to apparatus 12 illustrated in Figure 11. Once again, the second electrode probe

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71 will take potential readings of the rinsing liquid after it has contacted the medical device and instrument 24 during or at the end of a rinse cycle following a wash cycle. In this particular embodiment, however, these readings are taken inside the washing chamber 20, rather than inside conduit 61 as in apparatus 11 illustrated in Figure 10. The principal advantage of apparatus 11 as illustrated in Figure 10, is with the placement of the second electrode probe 71 inside conduit 61. The placement of the second electrode probe 71 inside conduit 61 allows for the complete protection of the second electrode probe 71 from becoming over-contaminated by soils. This ensures that the electrode probe 71 will repeatedly perform the potential readings accurately and precisely. In some instances, however, it is not necessary to place the second electrode probe 71 inside a separate conduit 61. Thus, the apparatus 12 illustrated in Figure 11 is useful for some washing applications, particularly wherein it is known that soil contamination of the electrode probe 71 is not a problem.

The apparatus illustrated in Figs. 10 and 11 can be further modified, for example, to include a detector which detects inorganic soil and a detector which detects organic soil. The apparatus can have a second chamber in controllable fluid communication with the chamber 20, and the detectors can be placed in the second chamber. A soiled standard can also be provided, for example, in the second chamber, and the cleaning condition and the soil coverage on the soiled standard are so determined that the degree of cleanness of the standard serves as an indication of the completeness of the cleaning of the device to be cleaned.

Figure 12 illustrates another embodiment of an apparatus for monitoring a cleaning process for a medical device or instrument comprising an ion-selective electrode-based soil detector. Figure 12 illustrates an apparatus 13 which contains a washing

chamber 20 for washing medical devices and instruments such as a medical device 22 with a lumen and surgical instrument 24. As with other embodiments, washing chamber 20 can also be utilized for sterilization. Washing chamber 20 has a water inlet 42 which is connected through valve 43 to a water inlet conduit 51. The water inlet conduit 51 is connected to the water inlet 53. Water inlet 53 is connected to a water source (not shown). Washing chamber 20 also has components 44, 47, 54 and 59 which have the same placement, connections and water drain functions as seen in Figures 10 and 11. This embodiment of the apparatus of the invention illustrated in Figure 12 has a single electrode probe 70 with a first electrode 72 and a second electrode 74. Electrodes 72 and 74 are connected to electrical cables 76 and 78, respectively. Electrical cables 76 and 78 are connected directly to electrical circuitry 31. Electrical circuitry 31 performs the same function as described with the apparatus of the invention illustrated in Figures 10 and 11. Electrode probe 70 is positioned inside a small water reservoir 81 which is positioned directly underneath the water inlet 42. Water reservoir 81 is designed to catch the first small volume of water which is let into washing chamber 20. This allows a potential reading to be taken of the fresh clean wash water prior to its contact with the medical device 22 and instrument 24. Reservoir 81 has a reservoir outlet and inlet 82 which is connected to reservoir outlet and inlet conduit 83. Reservoir outlet and inlet conduit 83 contains a reservoir outlet and inlet valve 84 and reservoir drain outlet and inlet 85.

The method of the invention for monitoring a cleaning process for a medical device, utilizing the apparatus that the invention illustrated in Figure 12 operates as follows: Valve 43 is opened and fresh clean water, or other washing or rinsing liquid, is allowed to flow into washing chamber 20 through the inlet 42. The water reservoir 81 fills up allowing a potential reading to be taken of the fresh clean water by the electrode

150 48

probe 70. This potential reading is stored in electrical circuitry 31 as the control potential reading. Water continues to flow inside washing chamber 20 through inlet 42 and fills reservoir 81. Reservoir valve 84 is opened. Water then flows from the reservoir 81 through reservoir conduit 83 and reservoir drain outlet and inlet 85 into washing chamber 20. Washing chamber 20 is filled sufficiently with the washing water so that a washing cycle may begin. Reservoir valve 84 is closed and the washing cycle is initiated as described in the method of the invention utilizing the apparatus of the invention illustrated in Figures 10 and 11. Prior to the initiation of the washing cycle, valves 43 and 47 are closed so that no liquid may flow into or drain from the washing chamber 20.

At this point, the electrode probe 70 can be isolated, totally or partially, from the dirty washing liquid in chamber 20. This can be achieved by numerous ways. For example, reservoir 81 is filled with fresh washing liquid and the electrode probe 70 is immersed in the fresh washing liquid while the cleaning is conducted in the chamber 20, so that the electrode probe is protected from the contamination caused by the dirty washing liquid. In another example, the electrode probe 70 can be moved into and out of contact with the liquid. Alternatively, reservoir 81 can be covered with a movable cap 91 during the cleaning process. An enclosure or a second chamber can be provided, which is made in controllable fluid communication with chamber 20, and a detector can be placed in the enclosure. Thus, during a cleaning process the fluid communication between the chamber 20 and the enclosure is cut off, for example, with a valve, and when measuring the soil concentration in the washing liquid the fluid communication is reestablished.

At the end of the washing cycle, the dirty wash water is allowed to flow out of washing chamber 20 through outlet 44 and drain outlet 59 through valve 47 which is opened for that purpose. Valve 47 is then closed and fresh rinse liquid is allowed to flow

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inside washing chamber 20 through inlet 53 and inlet 42 through valve 43 which is opened for that purpose. Once again, the rinse liquid flows into the reservoir 81, filling it and thereafter filling chamber 20 for the rinse cycle in the same process as previously described. Valve 43 is closed and a rinsing cycle takes place as previously described in the method of the invention utilizing the apparatus of the invention illustrated in Figures 10 and 11. Valve 84 is opened and rinse liquid is allowed to flow into reservoir 81. Alternatively, the level of the rinse liquid inside chamber 20 may be higher than the top of the sides of reservoir 81, allowing rinse liquid to fill reservoir 81. In this manner, an accurate potential reading can be taken of the rinsing liquid inside the reservoir 81 such that it is representative of the rinsing liquid inside the washing chamber 20. This second potential reading is compared to the potential reading taken of the fresh clean rinse liquid. The comparison in potential readings is done exactly as described before herein and a determination is made if sufficient rinsing and/or cleaning has taken place and an additional rinse or wash and rinse cycle are necessary.

Figure 13 illustrates another embodiment of an apparatus for monitoring a cleaning process for a medical device or instrument comprising an ion-selective electrode-based soil detector. Figure 13 illustrates an apparatus 14 which once again contains a washing chamber 20 for washing or washing and sterilizing medical devices and instruments as previously described. All components of apparatus 14 illustrated in Figure 13 are the same as described with identically-numbered components in apparatus 13 illustrated in Figure 12, with the exception of components 30, 80 and 90.

Components 30, 80 and 90 are the same and have the same connections and functions as components 30, 80 and 90 illustrated in Figure 9. Component 30 is the washing control system. Component 80 is the electrical circuitry for the electrode detector.

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Electrical circuitry 80 is connected via an electrical connection 90 to the washing control system 30. Component 31 illustrated in Figure 12 performs the same function as components 30, 80 and 90 illustrated in Figures 9 and 13.

Reservoir 81, reservoir outlet and inlet 82, reservoir outlet and inlet valve 84, reservoir outlet and inlet conduit 83 and reservoir drain outlet and inlet 85 illustrated in Figure 12 are also not utilized in apparatus 14 illustrated in Figure 13. Apparatus 14 carries out the method of the invention in the same manner as apparatus 13 in Figure 12, with the exception that reservoir 81 and associated outlet and inlet components 82-85 are not employed to hold a small volume of wash or rinse liquid to take a potential reading and subsequently release it. All potential readings are directly taken of the liquid inside chamber 20 instead. A second probe 99 or more probes can also be used to monitor additional soils.

Figure 14 illustrates an apparatus 15 which contains a washing chamber 20 for washing or washing and sterilizing medical devices 24 and instruments 22 as previously described. Apparatus 15 also has an enclosure 102 coupled to chamber 20. Enclosure 102 is in controllable fluid communication with chamber 20. Preferably, chamber 20 and enclosure 102 is separated by a valve 104. Enclosure 102 is equipped with another valve 106 which can be connected to a drainage. A chemical source 108 is coupled to enclosure 102 through a valve 110. A chemical suitable for reacting with the soil in the washing liquid to generate a detectable signal, such as color, is stored in the chemical source. Examples of such chemical include, but not limited to, chloride ions reagent ($\text{Hg}(\text{SCN})_2$), OPA, albumin reagent, biuret reagent, and Microprotein-PR.

In use, valve 104 is opened and the washing, cleaning, or rinsing liquid in chamber 20 is allowed into enclosure 102 when a measurement is to be conducted. The amount of

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the washing liquid introduced into enclosure 102 can be controlled. Then valve 104 is closed and valve 110 is opened so that the chemical is introduced into enclosure 102. Once the chemical is introduced into the enclosure 102, chamber 20 and enclosure 102 should be totally isolated from each other so that no chemical will enter chamber 20.

5 After the measurement is finished, the liquid in enclosure 102 is drained through valve 106. Enclosure 102 may have another clean washing liquid inlet (not shown) for introducing fresh washing liquid to clean enclosure 102. The amount of the chemical added to enclosure 102 is controlled. Preferably, concentration of the chemical in the washing liquid in the enclosure 102 is about the same in different measurements, so that
10 intensity of the signal generated by the reaction between the chemical and the washing liquid will reflect only the content of soil in the washing liquid, but not affected by the chemical concentration itself.

A spectrophotometer 100 having a detector 112 and a light source 114 is provided to detect the signal generated by the chemical. The detector 112 and light source 114 can
15 be placed inside or outside enclosure 102. In case they are located outside enclosure 102 as shown in Figure 14, at least a portion of the wall of enclosure 102 should be transparent to the light from the light source 114 so that the light can travel through the body of the washing liquid in the enclosure and reach to detector 112. When the generated signal is a color, it can be observed visually, thus, human eyes can serve as a detector.

20 The structures as described previously with figures 9-13 can be combined with the apparatus 15 of figure 14. Optionally, chamber 20 can be also connected to a vacuum pump or a vacuum source 116. When the cleaning is completed, vacuum can be applied to chamber 20 to facilitate the drying of the cleaned items 22 and 24. A sterilizing system can be also provide so that chamber 20 can be used as a sterilizing chamber. After the

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cleaning, sterilization can be conducted in the same chamber 20 without removing the instruments to be cleaned and sterilized. There are no limitations on the sterilization system to be used with the cleaning process of the present invention. Thus, any proper sterilization system can be used in combination with the cleaning process. If desired, cleaning and sterilization can be conducted simultaneously by using a combined cleaning and sterilizing solution, such as one with dissolved ozone or chlorine dioxide. Figs.

15a-15d show various apparatus according to other embodiments of the present invention. In these embodiments, a standard 120 covered with soil is provided. The purpose of the soil covered standard is to provide a standardized indication of the cleanness of the items to be cleaned during a cleaning process. In other words, the soiled standard 120 will be cleaned simultaneously with the item or items to be cleaned, and the cleanness of the soil covered standard 120 will be monitored. A correlation between the cleanness of the item to be cleaned and the cleanness of the soil covered standard 120 for a particular apparatus configuration can be established through experiments. Thus, when the standard is cleaned to a certain degree, that will indicate a complete cleaning of the items to be cleaned has been achieved.

There are several advantages associated with the use of a soiled standard. For example, by using a soiled standard, one can focus on the standard for monitoring and the detection of soil removed from or remaining on the standard during a cleaning process, thus the monitoring procedure can be standardized. The soil level and the cleaning efficiency of the standard 120 can be controlled. The standard 120 can be exposed to a cleaning environment which is equally efficient as or less efficient than that the items to be cleaned are exposed to, or standard 120 can be soiled more heavily than the items 22 and 24, so that when the standard is completely cleaned the items to be cleaned is

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guaranteed to be cleaned completely. Another option is to soil the standard 120 less heavily than the items 22 and 24 (here it means that the standard is covered with less soil), but put the standard 120 in a considerably less efficient cleaning environment, so that before the standard is cleaned the items to be cleaned will be completely cleaned. This option allows to reduce the soil level to which the detector exposes, thus, reducing the potential problems associated with the contamination of the detector surface by the soil. In general, conditions can be set up such that when the standard 120 is cleaned to certain level, the items 22 and 24 will be cleaned completely. This will allow the use of less sensitive detectors. The standard 120 can be covered with any proper soils such as those mentioned previously, or their combinations. Preferably, standard 120 is covered with the same soils as those contained in the items 22 and 24 to be cleaned. However, if desirable, the standard 120 can be covered with soil different from that of the items 22 and 24 to be cleaned. This will allow the use of certain soil on the standard and a preferred type of detection technology particularly suitable to that type of soil. Many other options are available as long as a proper correlation between the cleaning of the standard 120 and the cleaning of the items to be cleaned is established through experiments associated with particular apparatus configurations.

Fig. 15a illustrates an apparatus 16 with an soil covered standard 120 and a soil detector 122 positioned in an enclosure 102. Standard 120 can be any suitable surface covered with soil. For example, standard 120 can be a plate or a piece of suitable material preferably removably coupled to a support. Preferably, the connection between the standard 120 and the support 124 is made in such a way that the contact area of the standard is not soiled. There are several ways for controlling the cleaning efficiency of the standard 120 relative to that of the items 22 and 24. For example, valve 104 can be

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adjusted at different levels to control the fluid communication between chamber 20 and enclosure 102. A larger valve 104 will provide a better fluid communication, thus, the cleaning efficiency in chamber 20 and enclosure 102 will be closer to each other. Another option is to provide an adjustable agitation system in enclosure 102, or chamber 20, or both. By adjusting the agitation level, the cleaning efficiency in enclosure 102 or chamber 20 can be adjusted to a predetermined level. Detector 122 can be any suitable type, for example, it can be an electrode. Other parts of the apparatus 16 are similar to those of Fig. 14. In one embodiment, valve 104 is opened at a predetermined level during a cleaning process, and the soil level in the washing solution in the enclosure 102 is monitored with detector 122.

In another embodiment, an apparatus similar to that shown in Fig. 14 is used, the only difference is that a soil covered standard 120 is placed in enclosure 102. In this case standard 120 is made of material transparent to a predetermined wave length range. Preferably, standard 120 has a flat surface covered with soil which reacts with the chemical contained in the chemical source 108 (see Fig. 14) producing certain compound that absorbs light in a certain range of wave length. It is also possible to use light source 114 and spectrophotometer 112 alone without a chemical source.

Fig. 15b shows another embodiment, in which standard 120 is not placed in an enclosure, instead it is placed in an indentation. As shown in this figure, standard 120 is removably coupled to a support 122. Preferably, standard 120 is a flat plate with its surface covered with soil on one side or both sides. Support 122 is mounted on the wall of the indentation 130. Preferably, support 122 is movable, or standard can be coupled to support 122 at several positions, so that the position of standard 120 in the indentation 130 can be adjusted. Indentation 130 may have different shapes. For example, it can be an

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inclined gap with its two side walls 132 divergent from the wall of chamber 20 as shown in Fig. 15b. The two side walls 132 can also be made parallel to each other. If desired, indentation 130 may also have a surrounded side wall with only one end open to chamber 20. Because of the limited space, the cleaning efficiency in indentation 130 is lower than the area where the items 22 and 24 are placed, and the deeper and narrower the indentation 130, the less the cleaning efficiency is. Thus, the relative cleaning efficiency of standard 120 can be adjusted by placing it in different positions in the indentation 130. Agitation level in chamber 20 can also be used to adjust the cleaning efficiency.

A light source 114 and a detector 112 are provided at two opposite sides of indentation 130. Side walls 132 are made of material transparent to the light from light source 114. Standard 120 is also made of material transparent to the light from light source 114. Thus, quartz is a suitable material for both the side walls 132 and the standard 120. Figs 15c and 15d illustrate two other configurations of the indentation 130. In the arrangement shown in Fig. 15c, indentation 130 is located at a corner of the chamber 20. Light source 114 is placed outside chamber 20 in a space next to indentation 130. In the arrangement shown in Fig. 15d, indentation 130 is also located at a corner of the chamber 20, but extruding outwardly. Light source 114 and detector 112 are placed outside chamber 20 in a space next to indentation 130. If the standard 120 to be used has a flat surface, the surface can be put in any proper orientation, vertical, horizontal, or with an angle. The light beam from the light source 114 can be vertical, horizontal, or any other angle.

The apparatus illustrated in Figs 15a-15d can be easily adapted to further include one or more other detectors of proper type, a vacuum pump or vacuum source for vacuum drying the items after cleaning, a sterilization system.

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Generally, the embodiments of the apparatus of the invention illustrated in Figures 9-15d can employ one or more additional soil detectors. Soil detectors suitable for detecting protein are particularly useful additions. In such embodiments, it is preferable to use one more detectors for detecting inorganic soil in combination with an ultraviolet-visible spectroscopy detector suitable for detecting protein and other organic species. An example of the latter type of detector is a spectrophotometer employing a detection wavelength of 220 nm, one of the principle ultraviolet absorption wavelengths common to all proteins and many organic molecules found in the body. Many other wavelengths are also suitable, including 260, 265, and 280 nm. Another preferred soil detector combination employs one or more detectors along with a colorimetric autotitrator for detecting protein. Another preferred detector combination employs an ion-selective electrode detector and a turbidimetry detector. Combinations of detectors other than those listed may also be employed. All the apparatus illustrated in Figures 9-15d can employ a chamber 20 which also serves as a vacuum chamber, so that vacuum drying can be conducted in the chamber with a vacuum source. Various sterilization systems for liquid phase or vapor phase sterilization can be combined into the apparatus of the present invention illustrated in Figures 9-15d. When a long and narrow lumen device is to be cleaned and/or sterilized, chamber 20 can be further divided into two sub-chambers separated by a sealable interface with two open ends of the lumen positioned in the two sub-chambers separately. A pressure difference can be generated between the two sub-chambers, so that cleaning or sterilant fluid flows through the lumen. Thus, the lumen can be cleaned and sterilized more efficiently.

Proper cleaning is essential for the following disinfection or sterilization process. Hospital workers visually inspect all manual-cleaned or machine-cleaned medical

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instruments before placing them into a disinfectant or sterilizer. For an integrated washer/disinfectant or washer/sterilizer, workers suppose not to interrupt the cycle by removing and examining the cleanliness of instruments between washing phase and disinfection or sterilization phase. Therefore, the ability to determine the cleanliness of medical instruments for an automated washer/disinfectant or washer/sterilizer is very critical. Especially, the instruments have areas that are difficult to clean.

Mated surfaces of joints, hinges, and box locks are considered to be the most challenging areas to be cleaned. The gap of mated surfaces of forceps, scissors, hemostats, and clamps can be as small as about 0.05mm. A proper cleaning indicator to simulate the mated area is needed to determine the cleaning efficiency of a washer, washer/disinfectant, and washer/sterilizer.

Figures 16a, 16b and 16c show a cleaning indicator, standard, 138 according to the present invention. This cleaning indicator can be used with the above-mentioned cleaning apparatus and methods and many other cleaning methods and systems. In simple form (Figure 16a) it comprises two substrates 140 and 142 held in parallel and separated a discrete distance from each other by a pair of spacers 144. The spacers 144 can be formed from feelers or other materials having a thickness of controlled tolerance. Soil 146 sits between the substrates 140 and 142. Preferably, the soil is dried into place to get good adhesion between the soil 146 and the substrates 140 and 142. A holder 148 holds the substrates 140 and 142, and spacers 144 together.

The overall shape of the standard 138 can be rectangular, circular, or any other appropriate shape. Preferably, it has a rectangular shape of about 0.5" (W) by 1.5" (L) in size. The substrates 140, and 142 may be the same in shape or material, or different. The two substrates may have different thicknesses. An additional substrate 150 (Figure 16b)

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can be employed to form a standard 138b to mimic certain real world conditions. For instance, it may be desirable to model soil trapped between a silicone surface and a stainless steel surface. As silicone is flexible, the substrate 150 can be formed of silicone and supported by the rigid substrate 142b with the soil 146b trapped between the substrate 150 and the substrate 140b and located between spacers 144b. Holders 148b hold all of the pieces together, with one of the holders 148b having a locating pin 152 for interfacing with a cleaning apparatus (not shown in Figure 16b).

The substrates 140, 142 and 150 can be transparent, semi-transparent, or opaque, with transparent materials being preferred for easy inspection. The substrate can be stainless steel, aluminum, Teflon, polyethylene, polypropylene, polystyrene, polycarbonate, silicone, glass, quartz, and many other suitable metals and polymers. Preferably, the substrate is rigid material. More preferably, the substrate is transparent. The soil 146 can be any artificial test soil or animal blood. The soil can be any of the organic soil, inorganic soil and combination of organic soil and inorganic soil. Preferably, the soil is dried in place between the substrates and located between the spacers 144.

The spacers 144 create a defined gap between the substrates 140 and 142. The spacers can be any rigid material with defined thickness. They can be formed of the same material as the substrates 140 and 142, and can be formed as an integral part thereof. Preferably, the spacers 144 have a thickness of about 0.05mm.

The holder 148 can be a clamp, clip, tape, screw, rubber band, snap-on cap, or any other holding method to hold all of the pieces together. Rather than two separate holders 148 a single holder design can be employed. The holders 148 can be removable or permanent. The holder 148 can be glue or adhesive. The holder 148 can be a mechanism

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by welding, binding, melting, snapping substrates together, or any other means to hold the substrates 140 and 142 together.

Figure 16c shows a cleaning indicator 138c in which a substrate 140c and spacer 144c are formed as one part, two of which fit together to form the indicator 138c. A
5 projection 156 protrudes from the spacer 144c and snaps into an opening 154 of another identical substrate 140c. Locating pins 152c are provided.

During a cleaning cycle, the cleaning indicator 138 can be located in a wired cage. It can also be fixed or suspended in a cleaning apparatus.

The cleaning efficiency can be determined visually or via an instrument.
10 Preferably, for an integrated washer/disinfector or washer/sterilizer, the cleaning efficiency is determined with a spectrophotometer.

The foregoing examples are provided by way of illustration only and are not intended as a limitation of the present invention, many variations of which are possible without departing from the spirit and scope thereof.

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NOVEDAD DE LA INVENCION**REIVINDICACIONES**

- 5 1.- Un indicador de limpieza para monitorear un procedimiento de limpieza para un instrumento médico, que comprende: dos substratos sustancialmente paralelos separados por dos separadores de grosor sustancialmente igual, en donde se forma una brecha entre los dos substratos; suciedad en la brecha; y por lo menos un sujetador para asegurar
- 10 los dos substratos y los dos separadores juntos.
- 2.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque la suciedad se seca en la brecha.
- 3.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque la suciedad se localiza entre los dos
- 15 separadores.
- 4.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque la suciedad se selecciona del grupo que consta de suciedad orgánica, suciedad inorgánica, y sus mezclas.
- 5.- El indicador de limpieza de conformidad con la reivindicación
- 20 1, caracterizado además porque los substratos se forman de un metal.
- 6.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque los substratos se forman de un polímero.

7.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque los substratos son transparentes.

8.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque la suciedad se coloca en una hoja, la hoja se
5 coloca entre los substratos.

9.- El indicador de limpieza de conformidad con la reivindicación 8, caracterizado además porque la hoja es flexible.

10.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque los separadores tienen un grosor de
10 aproximadamente 0.05 mm.

11.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque los separadores se forman de manera integral con los substratos.

12.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque el sujetador comprende porciones de
15 interbloqueo formadas sobre los substratos.

13.- El indicador de limpieza de conformidad con la reivindicación 12, caracterizado además porque comprende una proyección sobre uno de los substratos y una abertura sobre el otro de los substratos para recibir la
20 proyección.

14.- El indicador de limpieza de conformidad con la reivindicación 12, caracterizado además porque las porciones de interbloqueo se ajustan en conjunto a presión.

15.- El indicador de limpieza de conformidad con la reivindicación 12, caracterizado además porque uno de los substratos, uno de los separadores y una de las porciones de interbloqueo se forman como una pieza integral.

- 5 16.- El indicador de limpieza de conformidad con la reivindicación 1, caracterizado además porque los substratos se pueden separar manualmente para examinar la suciedad entre ellos.

165 67

WHAT IS CLAIMED IS:

1. A cleaning indicator for monitoring a cleaning process for a medical instrument, comprising:

two substantially parallel substrates separated by two substantially equal thickness
5 spacers, wherein a gap is formed between the two substrates;
a soil in the gap; and
at least one holder to secure the two substrates and the two spacers together.

2. A cleaning indicator according to claim 1 wherein the soil is dried in the
10 gap.

3. A cleaning indicator according to claim 1 wherein the soil is located
between the spacers.

4. A cleaning indicator according to claim 1 wherein the soil is selected
15 from the group consisting of organic soil, inorganic soil, and mixtures thereof.

5. A cleaning indicator according to claim 1 wherein the substrates are
formed of a metal.

6. A cleaning indicator according to claim 1 wherein the substrates are
20 formed of a polymer.

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7. A cleaning indicator according to claim 1 wherein the substrates are transparent.

8. A cleaning indicator according to claim 1 wherein the soil is disposed on a sheet, the sheet being disposed between the substrates.

9. A cleaning indicator according to claim 8 wherein the sheet is flexible.

10. A cleaning indicator according to claim 1 wherein the spacers have a thickness of about 0.05mm.

11. A cleaning indicator according to claim 1 wherein the spacers are formed integrally with the substrates.

12. A cleaning indicator according to claim 1 wherein the holder comprises interlocking portions formed on the substrates.

13. A cleaning indicator according to claim 12 wherein the comprise a projection on one of the substrates and an opening on the other of the substrates for receiving the projection.

14. A cleaning indicator according to claim 12 wherein the interlocking portions snap together.

167 68

15. A cleaning indicator according to claim 12 wherein one of the substrates, one of the spacers and one of the interlocking portions are formed as one integral piece.

5 16. A cleaning indicator according to claim 1 wherein the substrates can be separated manually to examine the soil between substrates.

168 48

Abstract of the Disclosure

5 A soil standard for monitoring a cleaning process for a medical instrument, includes two substantially parallel substrates separated with two substantially equal thickness spacers, wherein a gap is formed between the two substrates with soil in the gap. The substrates and spacers can be formed as integral pieces and snapped together.

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PTO/SB/01 (10-03)
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16967

DECLARATION AND POWER OF ATTORNEY FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63) ☒ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (Surcharge (37 CFR 1.16(e)) required)	Attorney Docket Number	ASP-5028USNP			
	First Named Inventor	Szu-Min Lin			
	COMPLETE IF KNOWN				
	Application Number				
	Filing Date	March 31, 2005			
	Group Art Unit				
	Examiner Name				
As a below named inventor, I hereby declare that: My residence, mailing address, and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:					
MONITORING OF CLEANING PROCESS (Title of the invention)					
the specification of which ☒ is attached hereto OR ☐ was filed on (MM/DD/YYYY) as United States Application Number or PCT International Application Number and was amended on (MM/DD/YYYY)					
I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above. I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.58, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT International filing date of the continuation-in-part application.					
I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or any PCT International application having a filing date before that of the application on which priority is claimed.					
Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES NO	
			☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:					

17068

DECLARATION - Utility or Design Patent Application		
I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.		
Application Number(s)	Filing Date (MM/DD/YYYY)	☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.
I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:		
Application Serial No.	Filing Date	Status
		Patented Patented Patented
I hereby appoint:		
☒ Practitioners at Customer Number 000027777 --		Place Customer Number Bar Code Label Here
AND		
☐ Practitioner(s) named below: Name _____ Registration Number _____		
as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the United States Patent and Trademark Office connected therewith.		
Address all telephone calls to Andrew C. Farmer at telephone number (732) 524-2825.		
Direct all correspondence to: ☒ Customer Number 000027777 OR ☐ Correspondence address below		
Name:		
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City:	State:	ZIP
Country	Telephone:	Fax:

171-69

I hereby declare that all statements made herein of my own knowledge are true 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 so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.			
NAME OF SOLE OR FIRST INVENTOR:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any)) Szu-Min		Family Name or Surname Lin	
Inventor's Signature		Date	
Residence: City Irvine	State CA	Country USA	Citizenship USA
Mailing Address 28 Trailing Ivy			
City Irvine	State CA	ZIP 92620	Country USA
I hereby declare that all statements made herein of my own knowledge are true 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 so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.			
NAME OF THIRD INVENTOR:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any)) Robert C.		Family Name or Surname Platt	
Inventor's Signature		Date	
Residence: City Laguna Niguel	State CA	Country USA	Citizenship USA
Mailing Address 5 Saint Croix			
City Laguna Niguel	State CA	ZIP 92677	Country USA
I hereby declare that all statements made herein of my own knowledge are true 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 so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.			
NAME OF THIRD INVENTOR:		☐ A petition has been filed for this unsigned inventor	
Given Name (first and middle (if any)) Peter		Family Name or Surname Zhu	
Inventor's Signature		Date	
Residence: City Irvine	State CA	Country USA	Citizenship USA
Mailing Address 6 Cresthaven			
City Irvine	State CA	ZIP 92604	Country USA

70
172

Figura 1

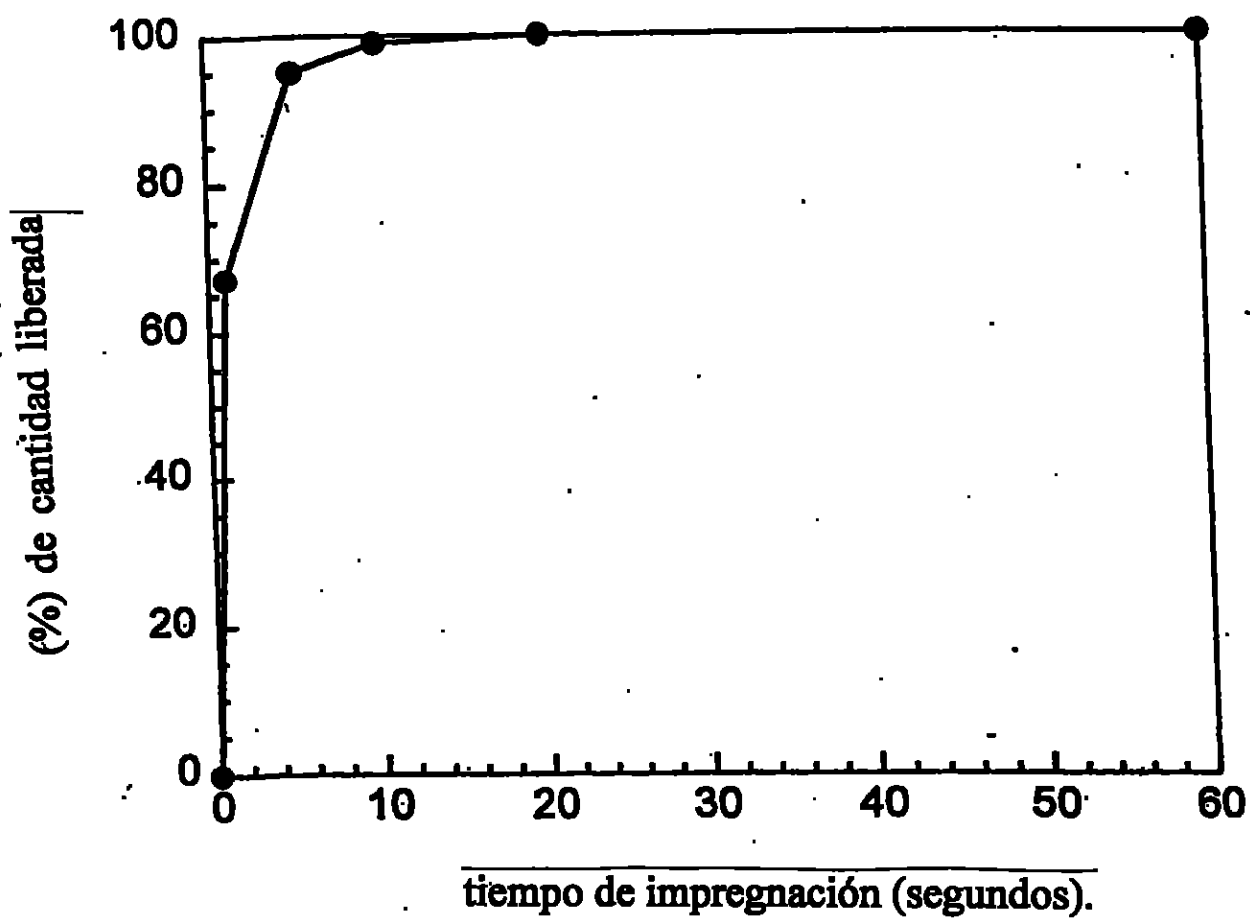
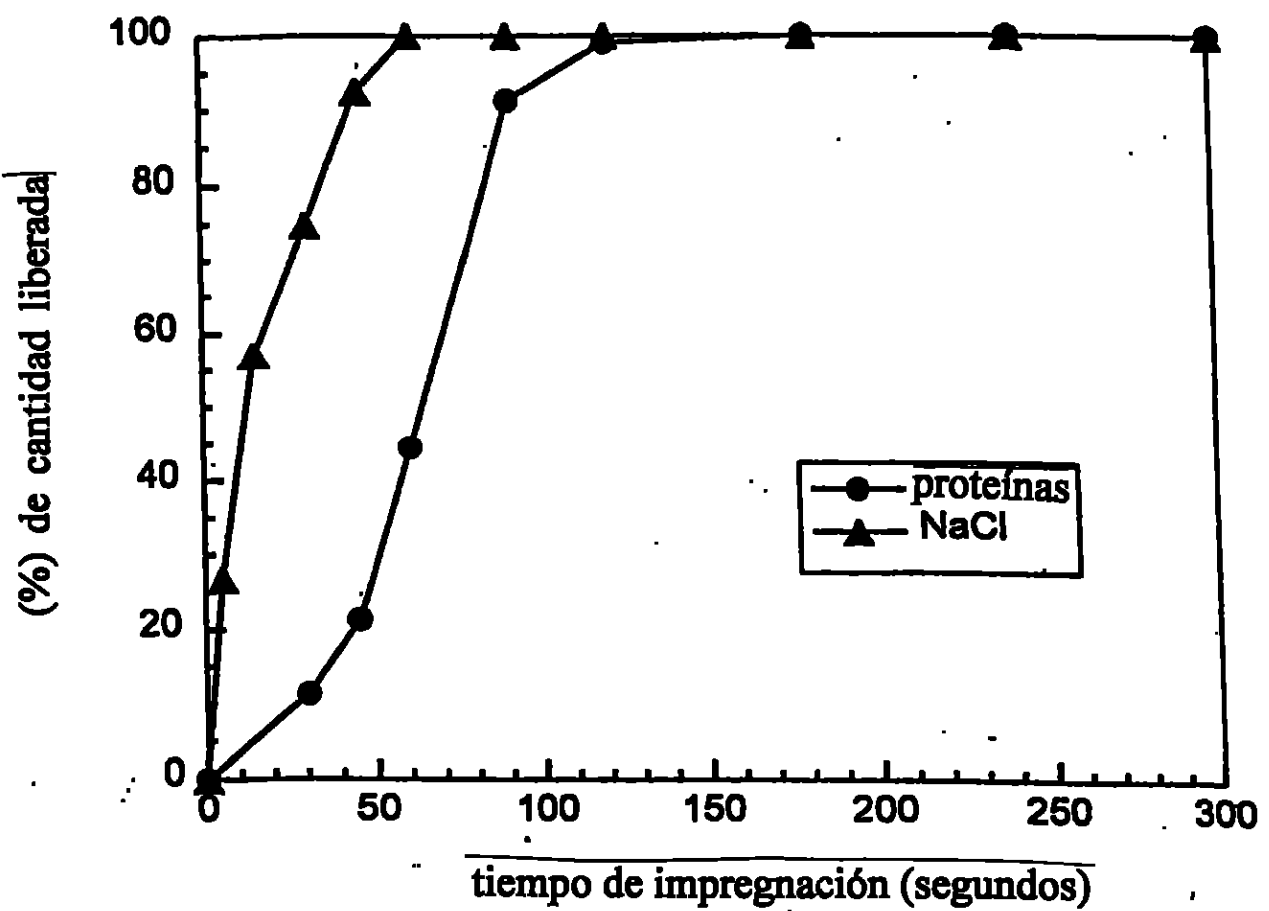
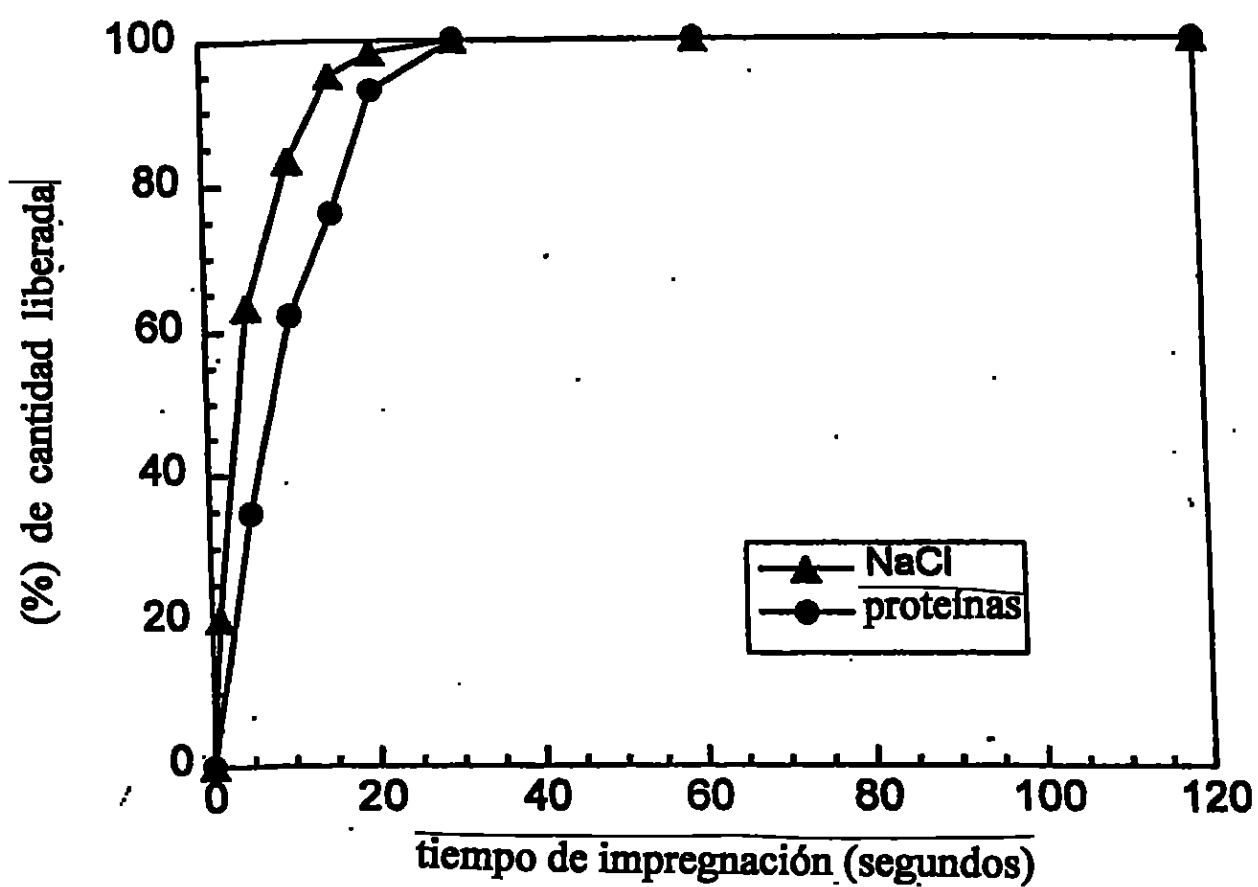


Figura 2.



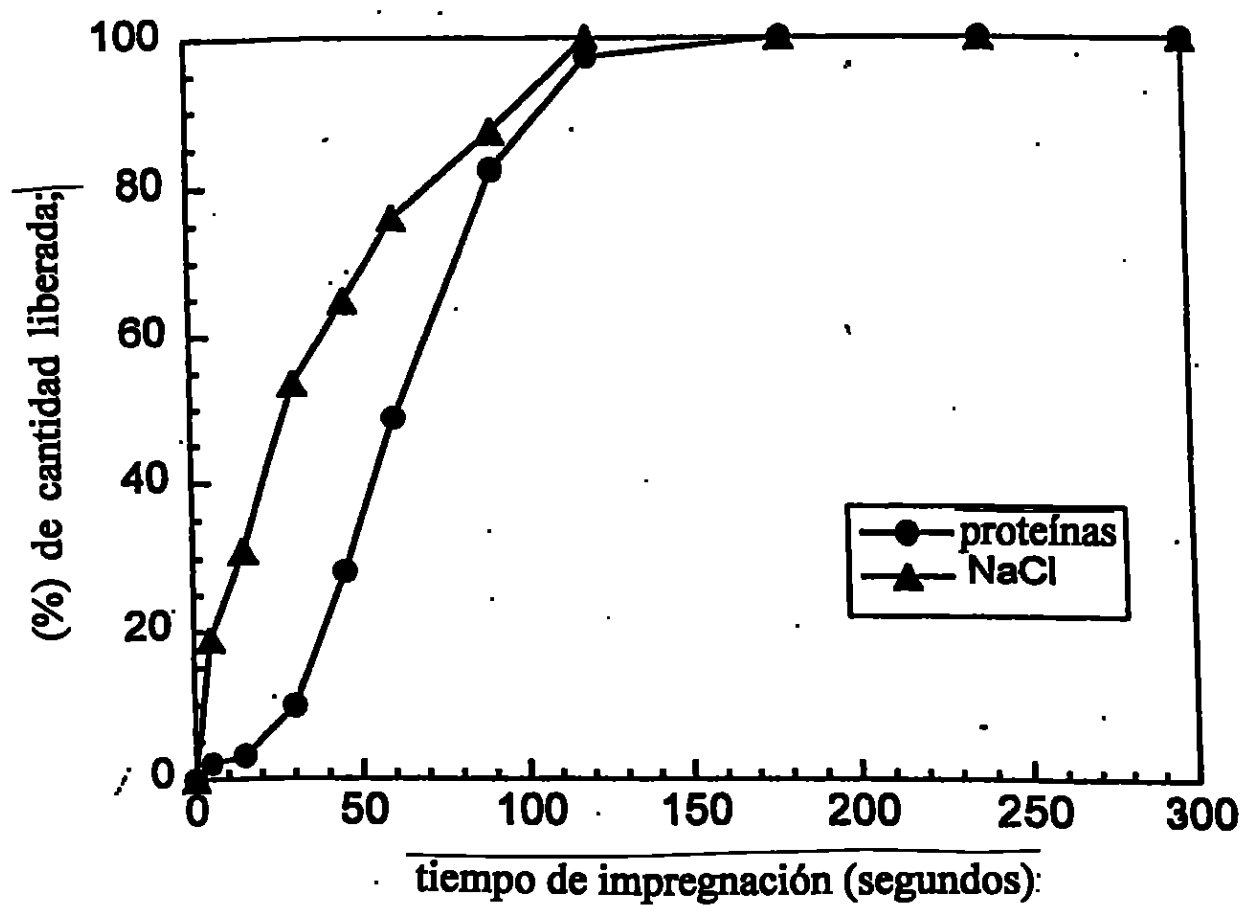
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Figura 3



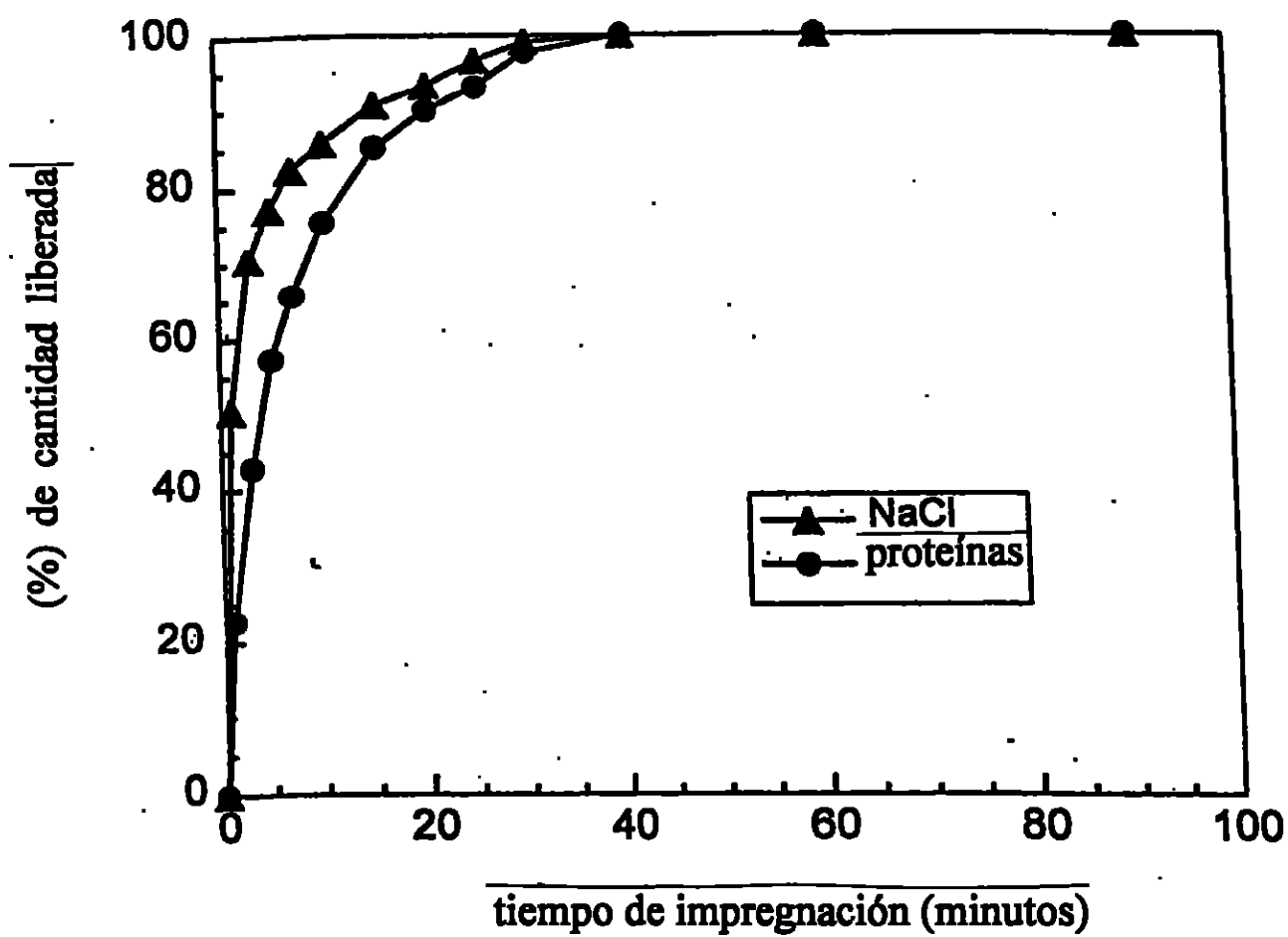
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Figura 4:



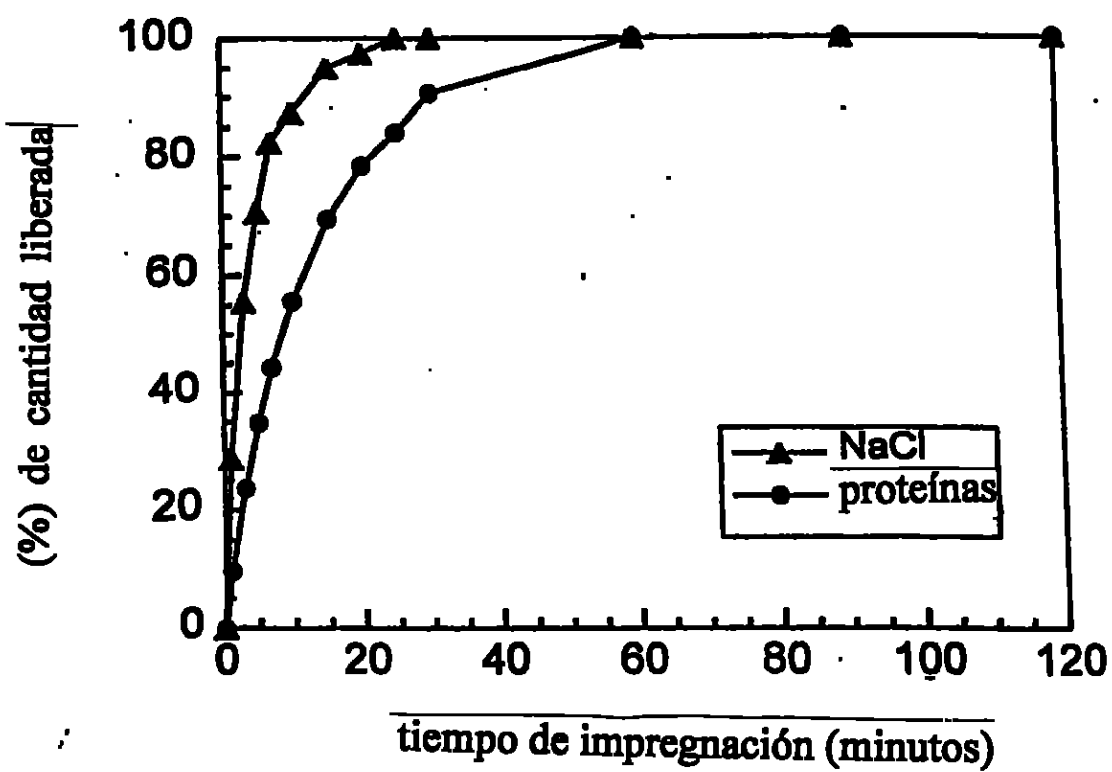
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Figura 5



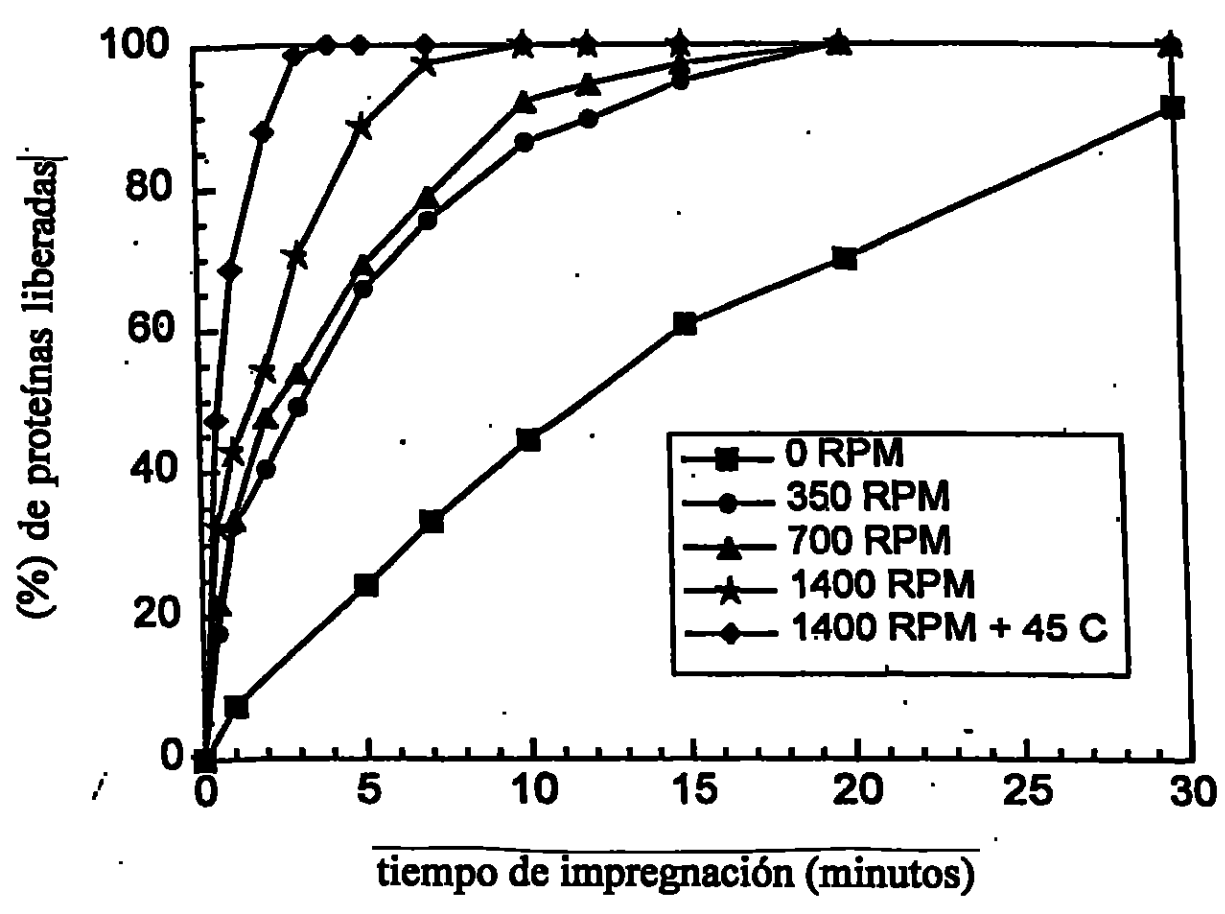
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Figura 6



76
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Figura 7



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Figura 8:

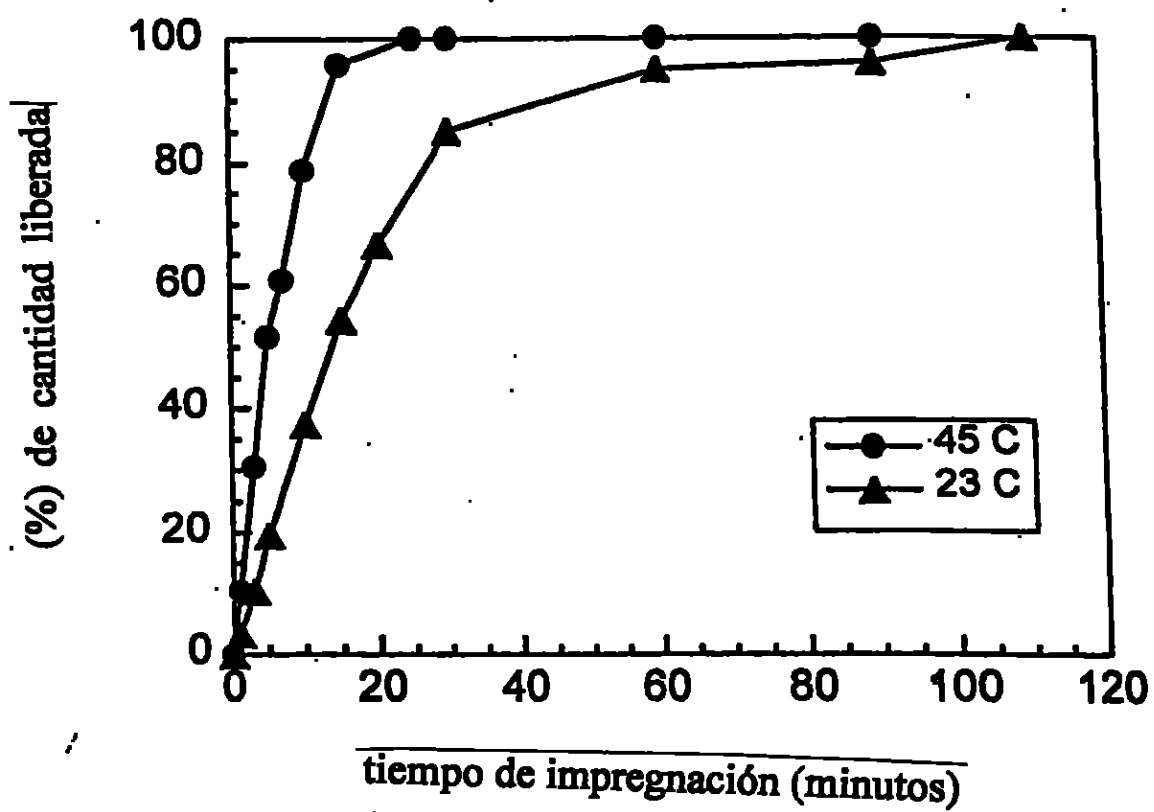
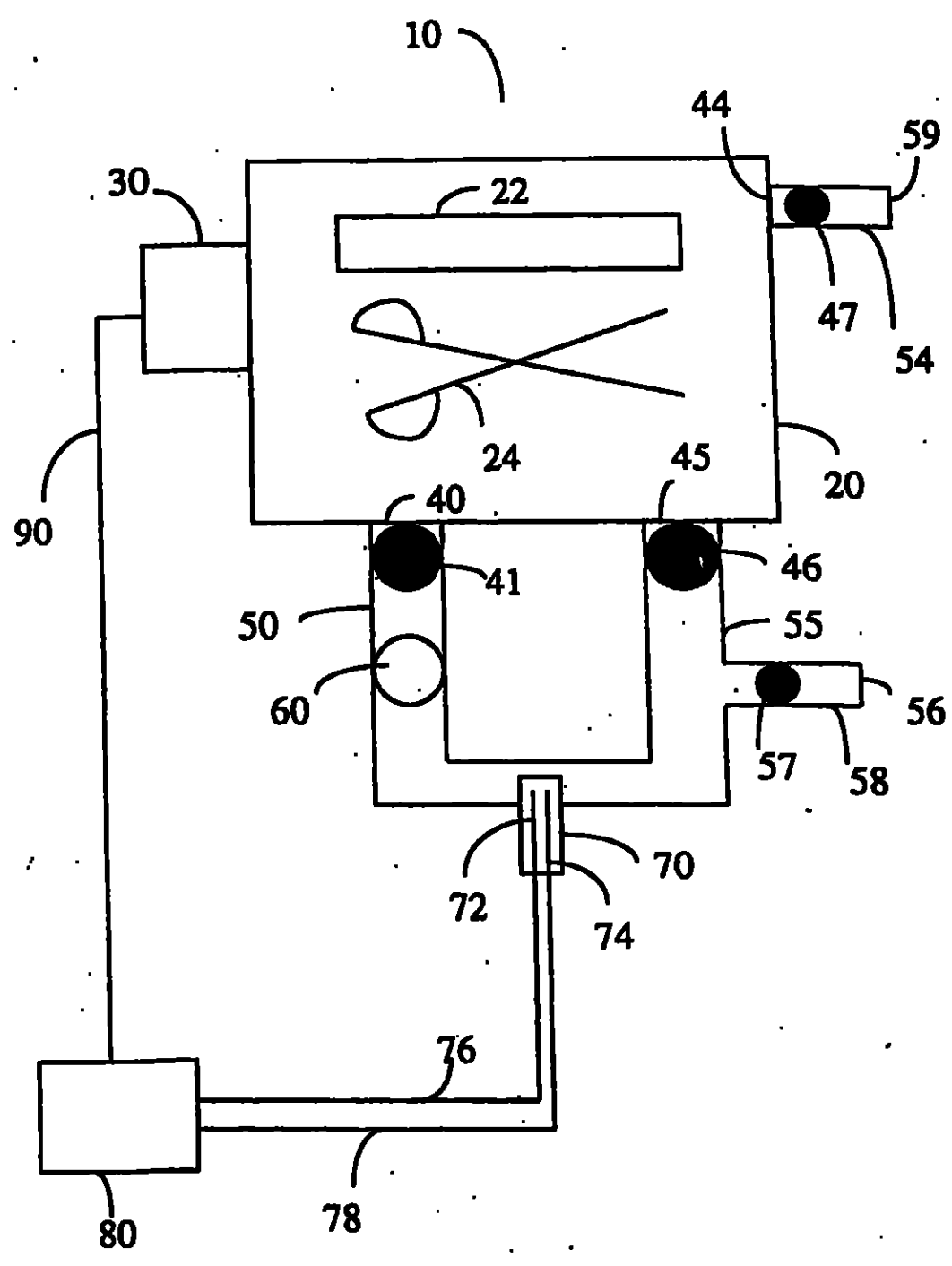


Figura 9



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Figura 10

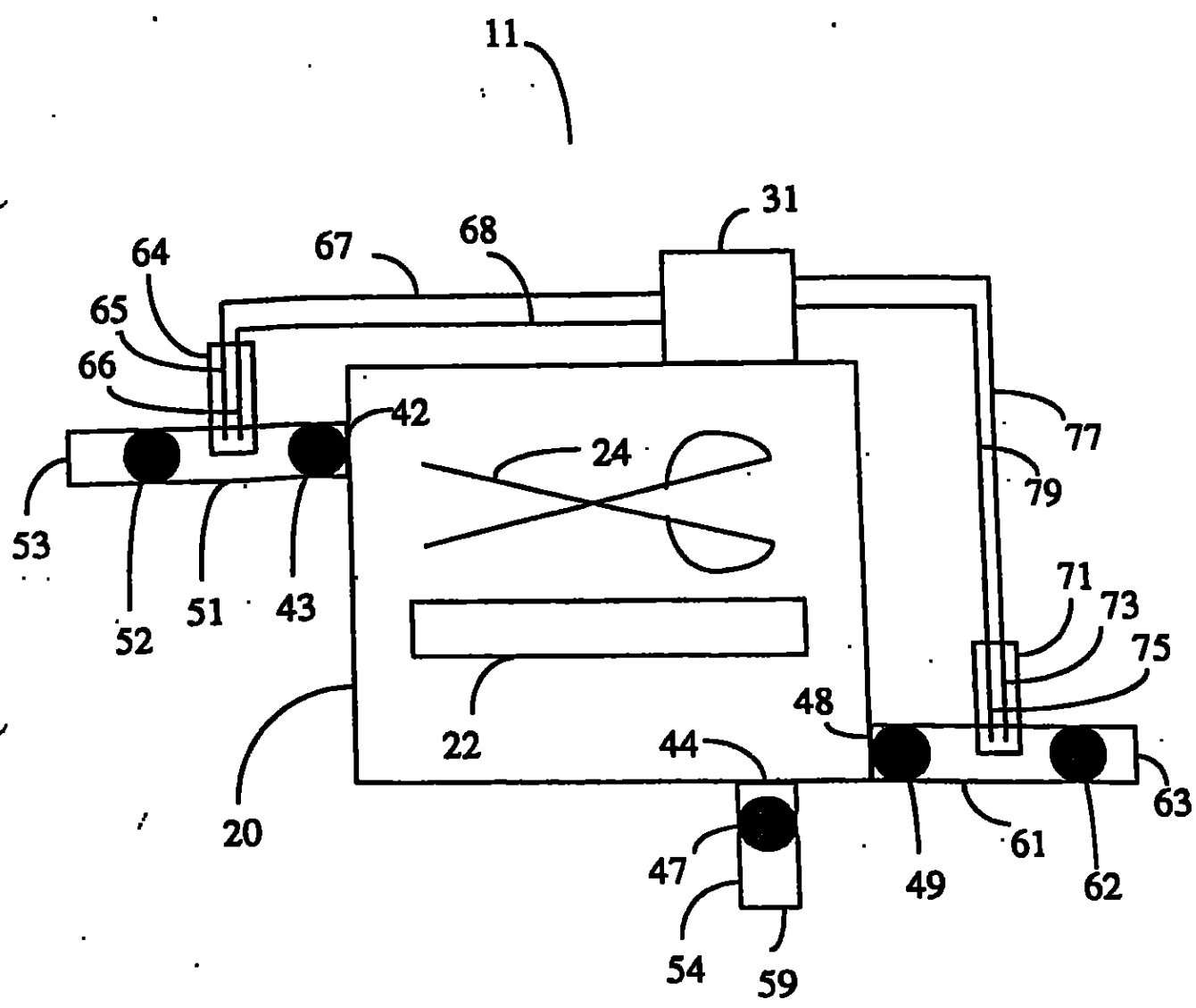
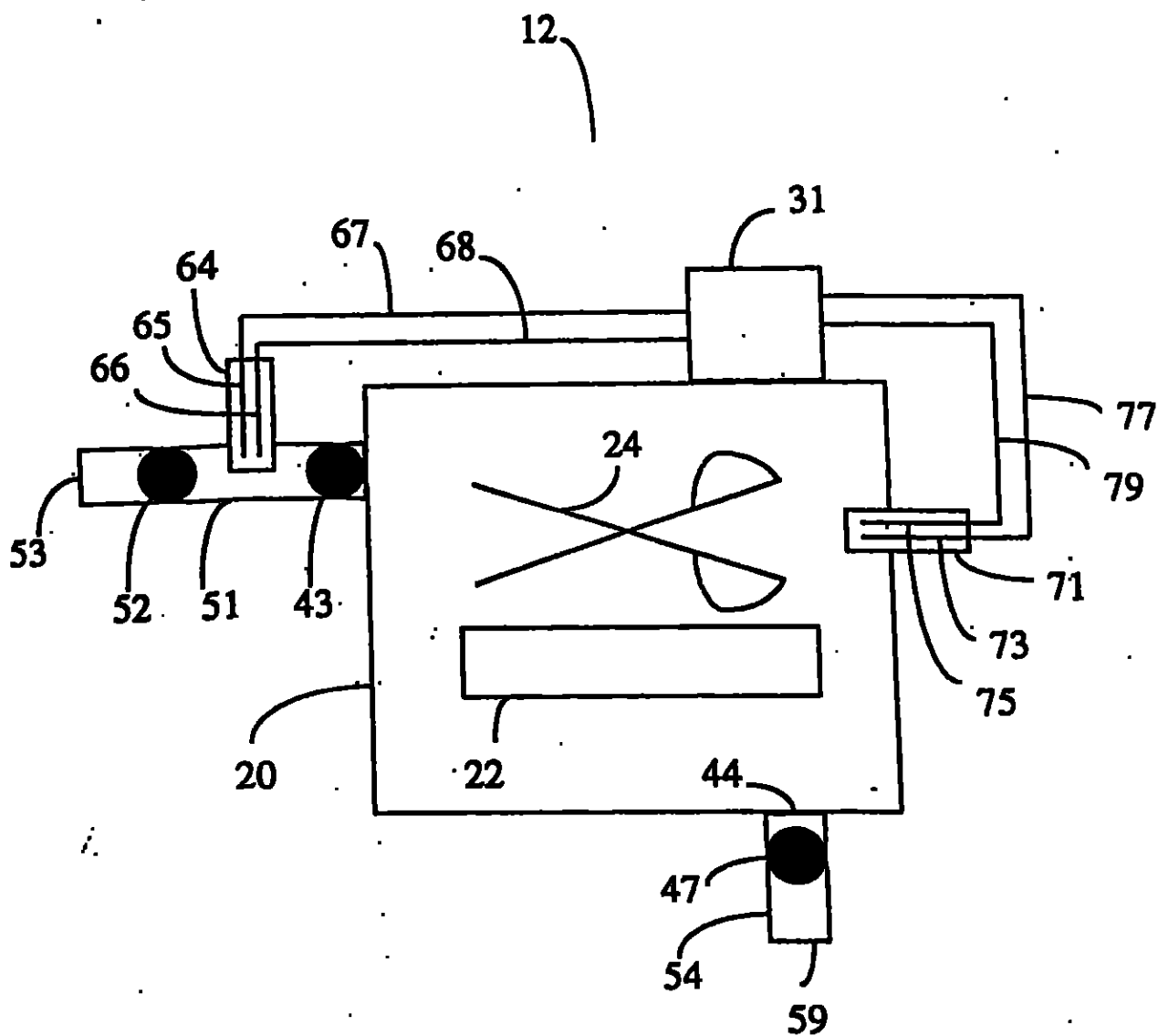
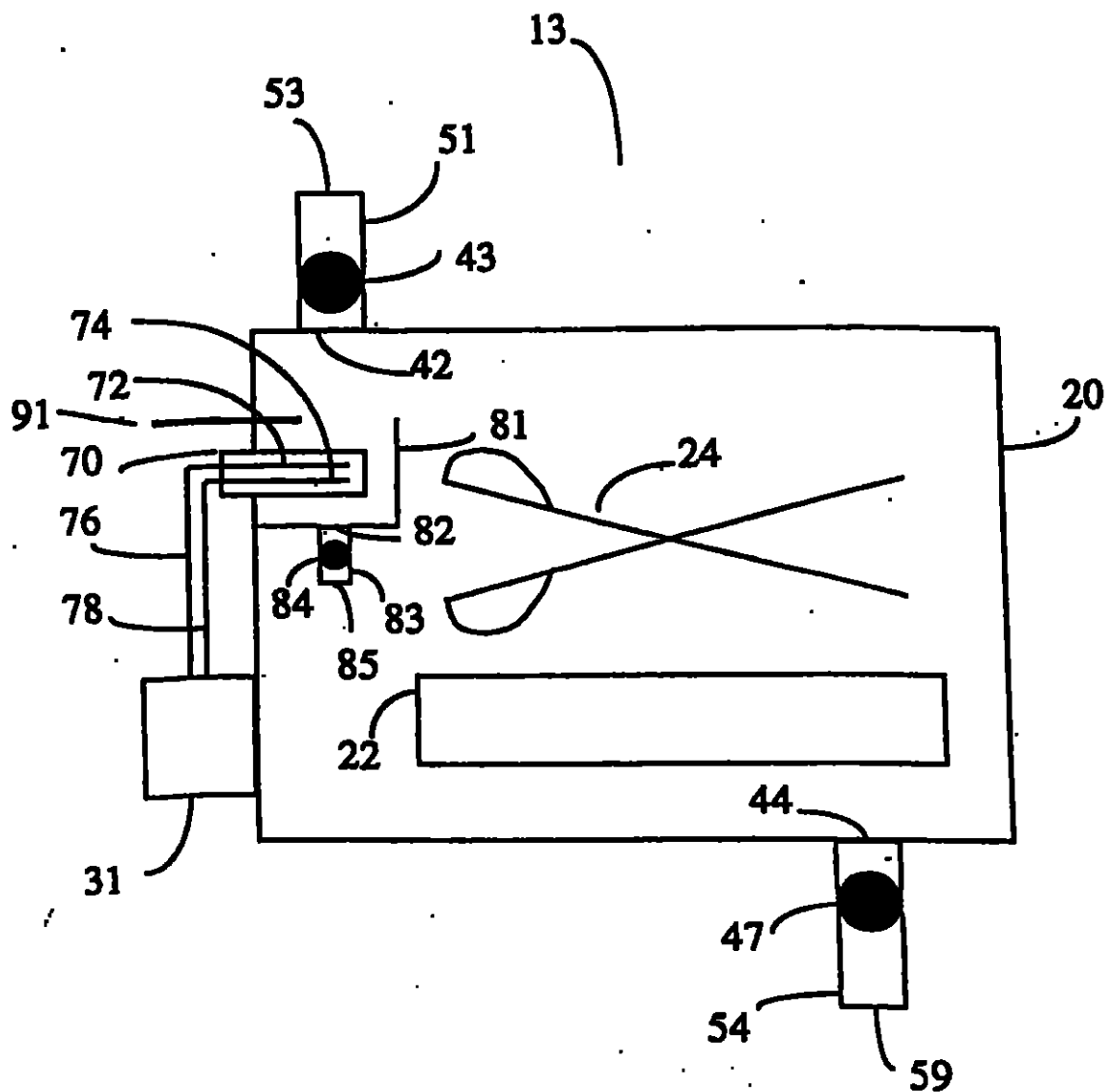


Figura 11



81
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Figura 12



82
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Figura 13

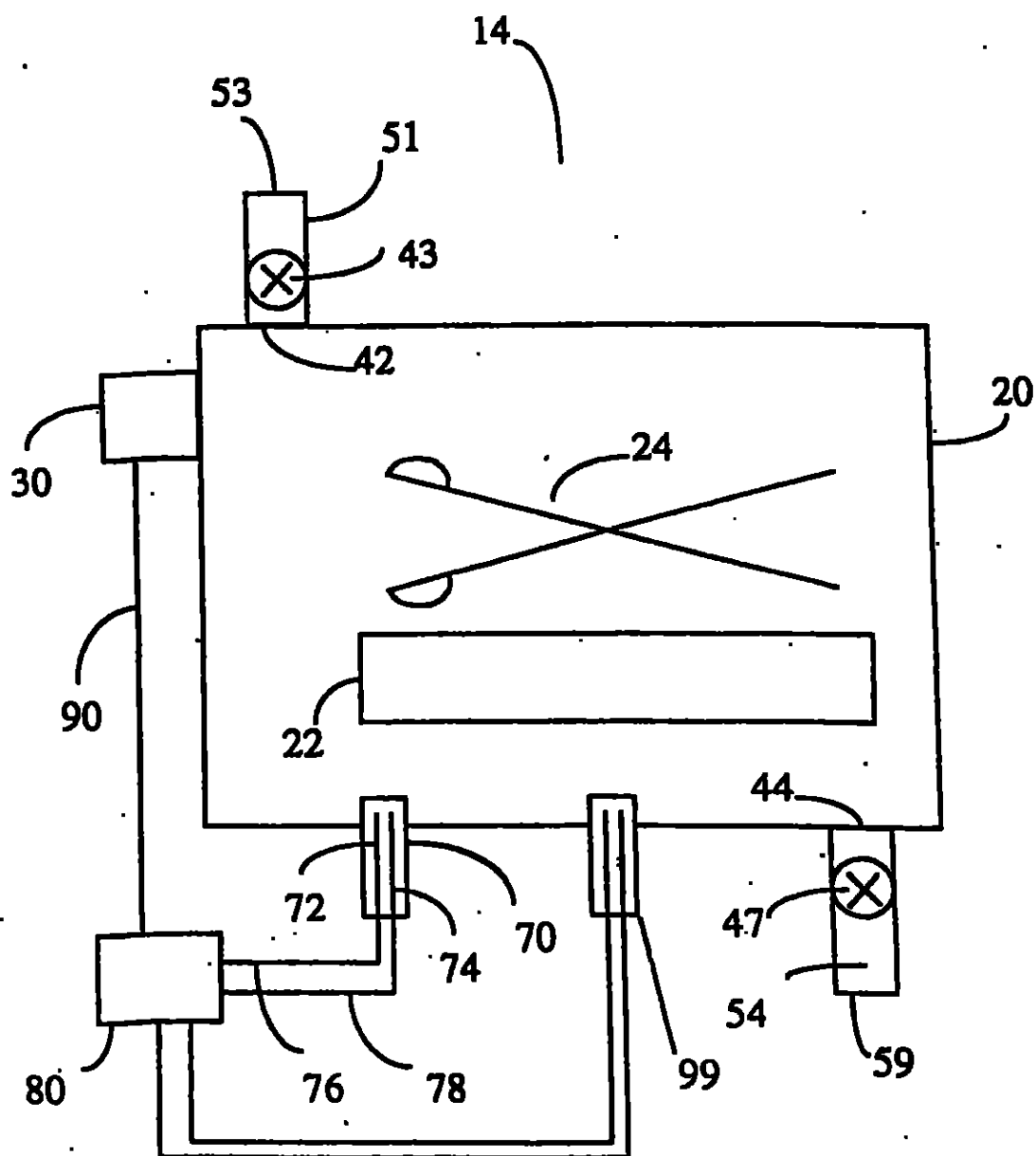
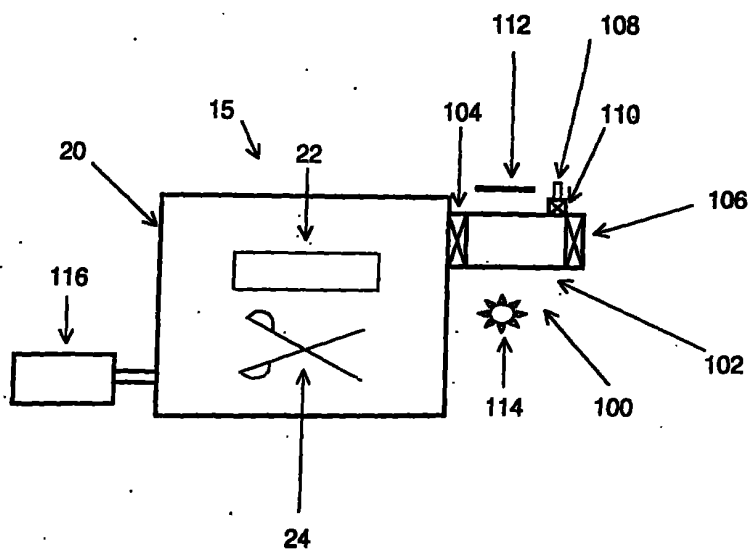
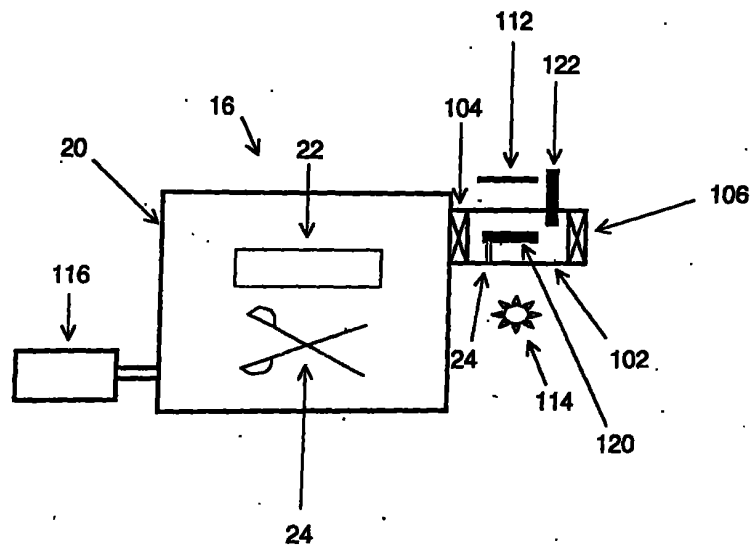


Figura 14



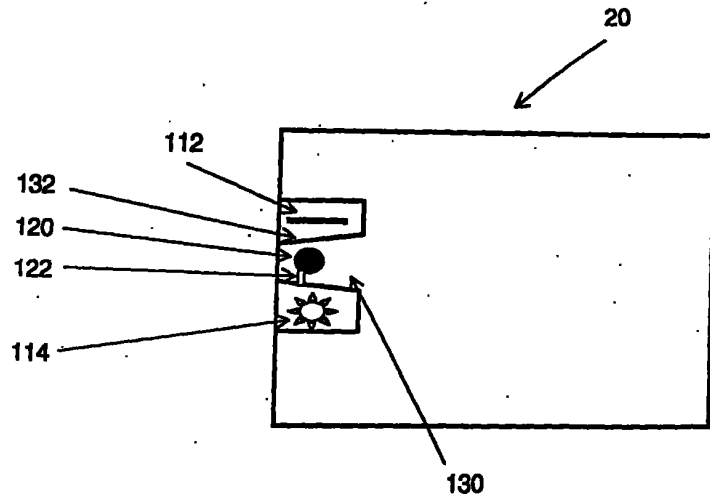
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Figura 15A



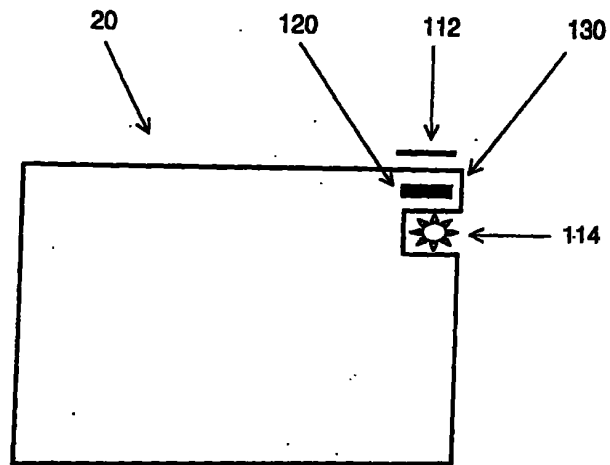
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Figura 15B



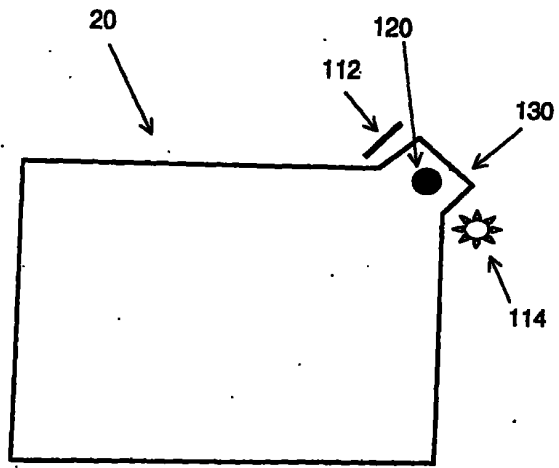
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Figura 15C



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Figura 15D



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Figura 16a

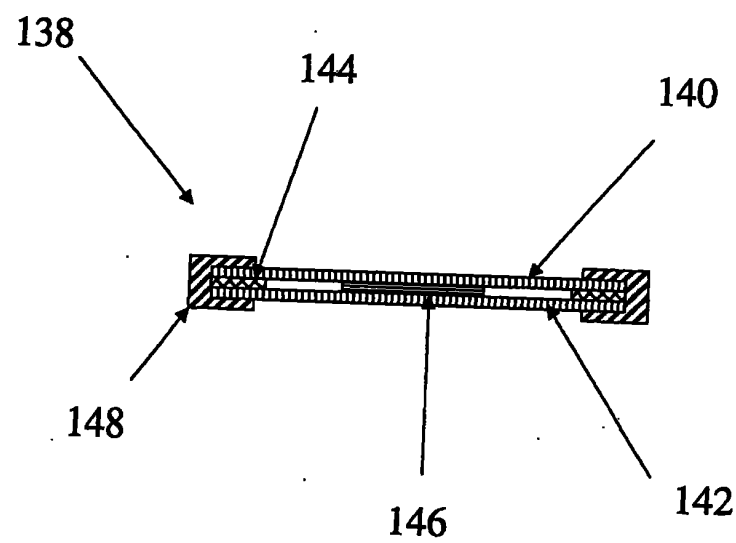
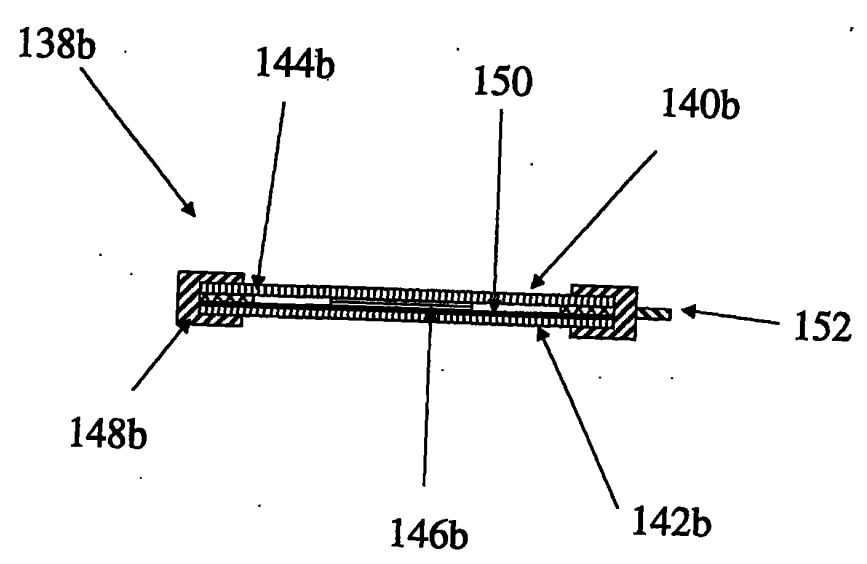


Figura 16b



87

Figura 16c

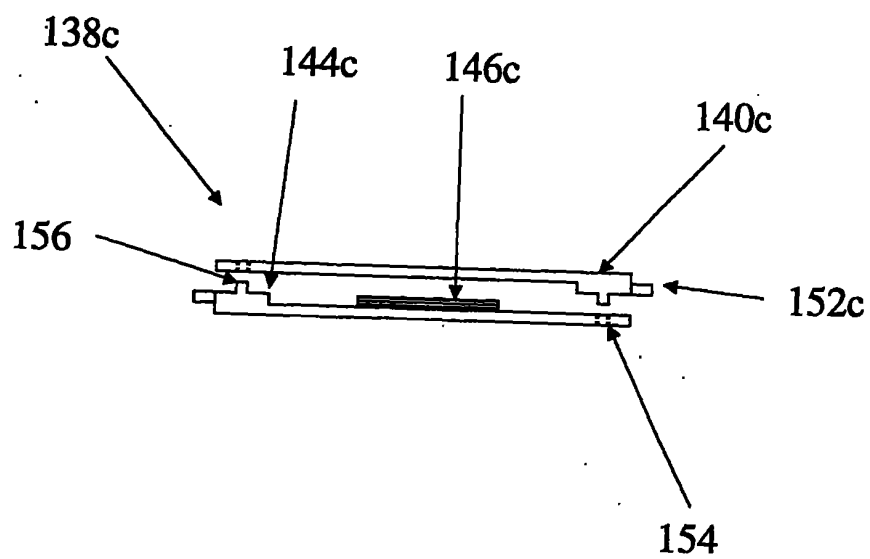
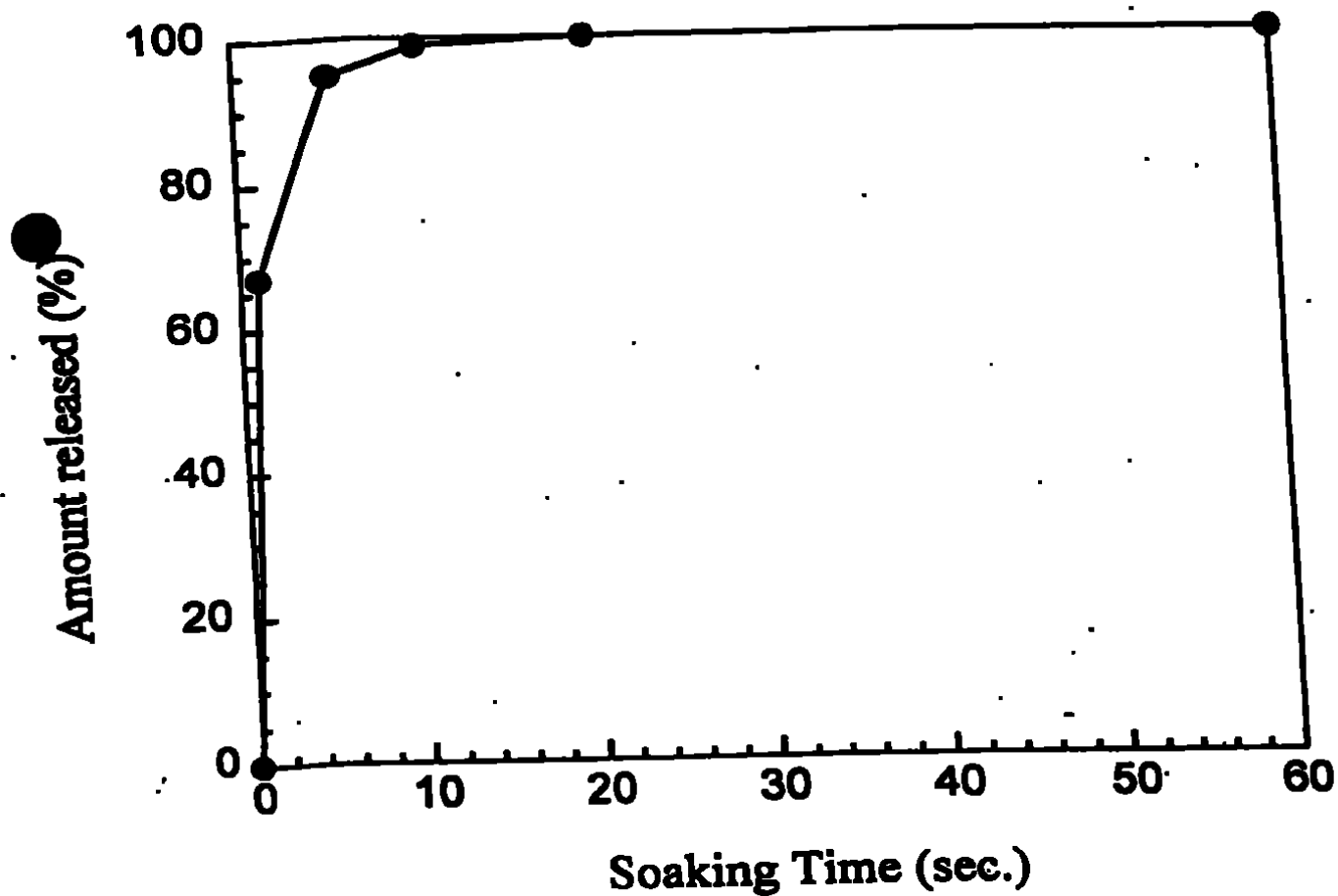
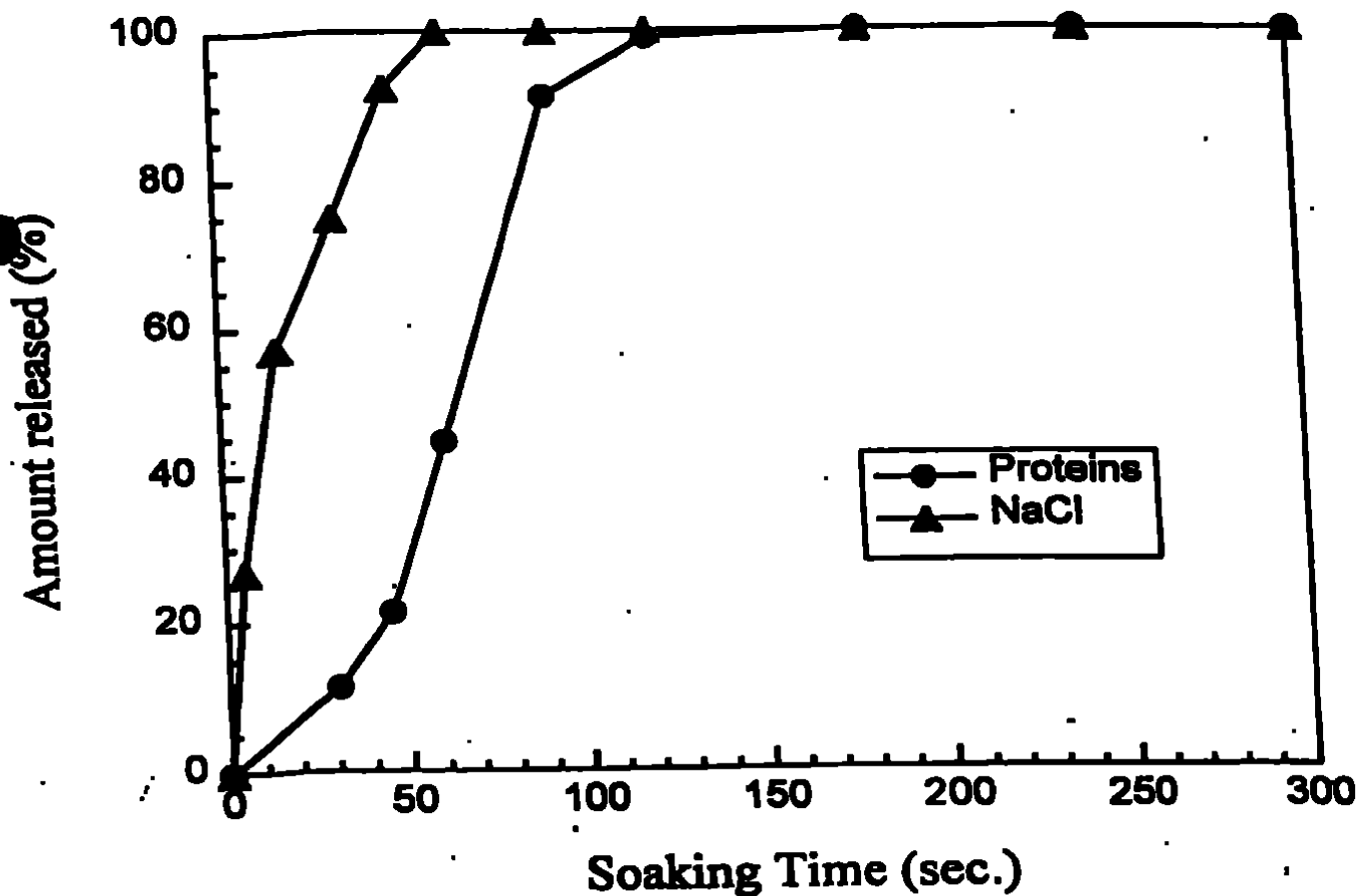


Figure 1



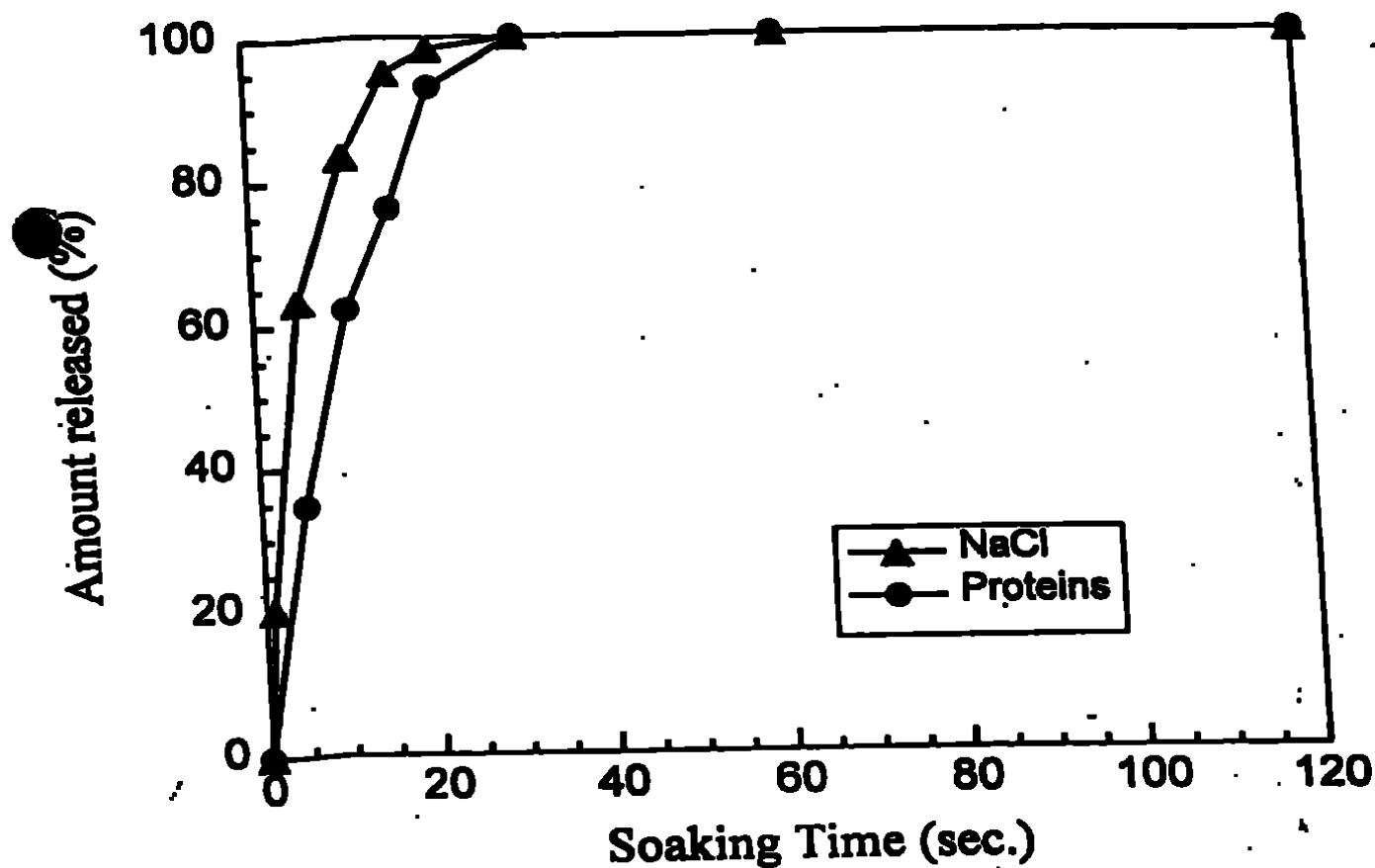
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Figure 2



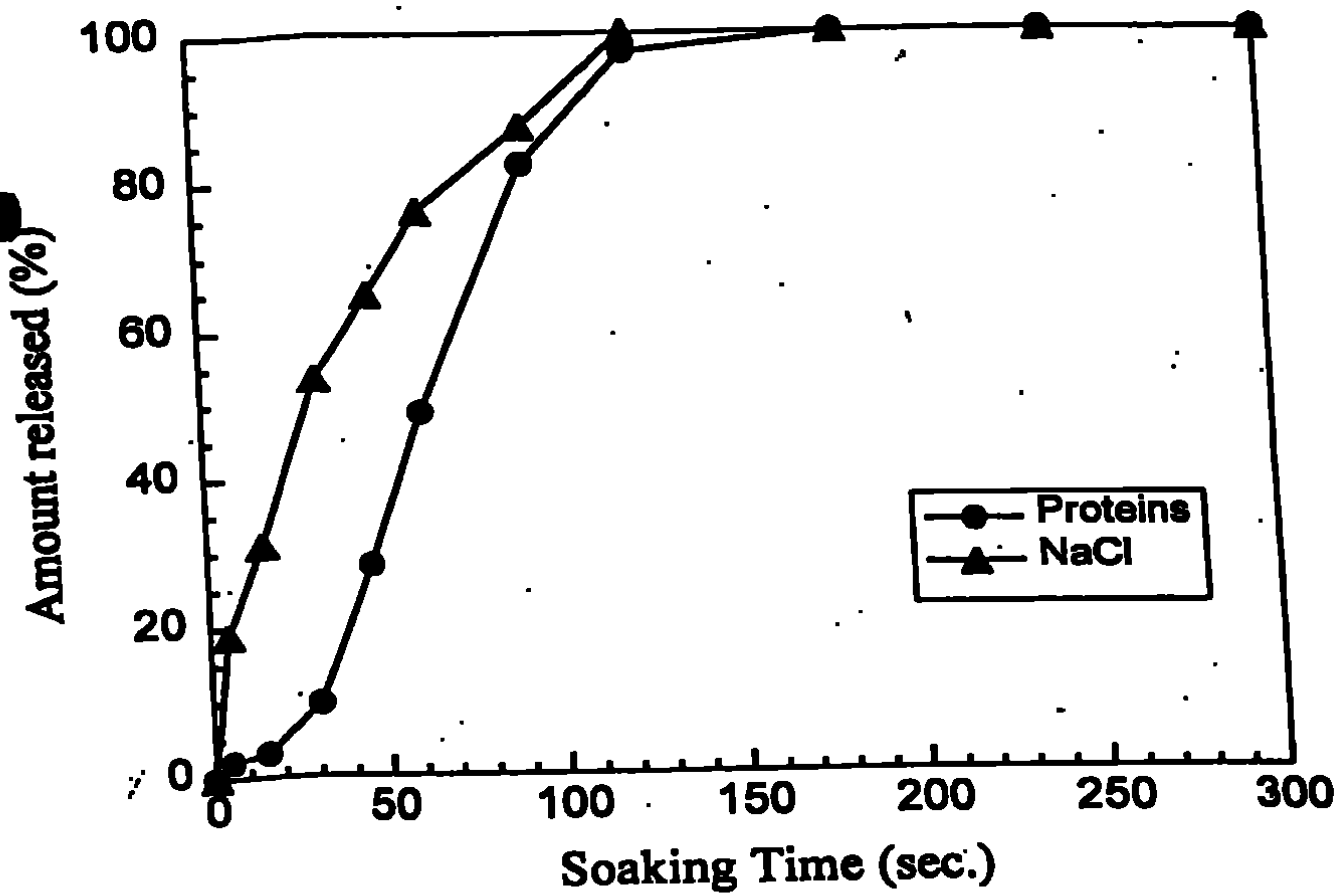
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Figure 3



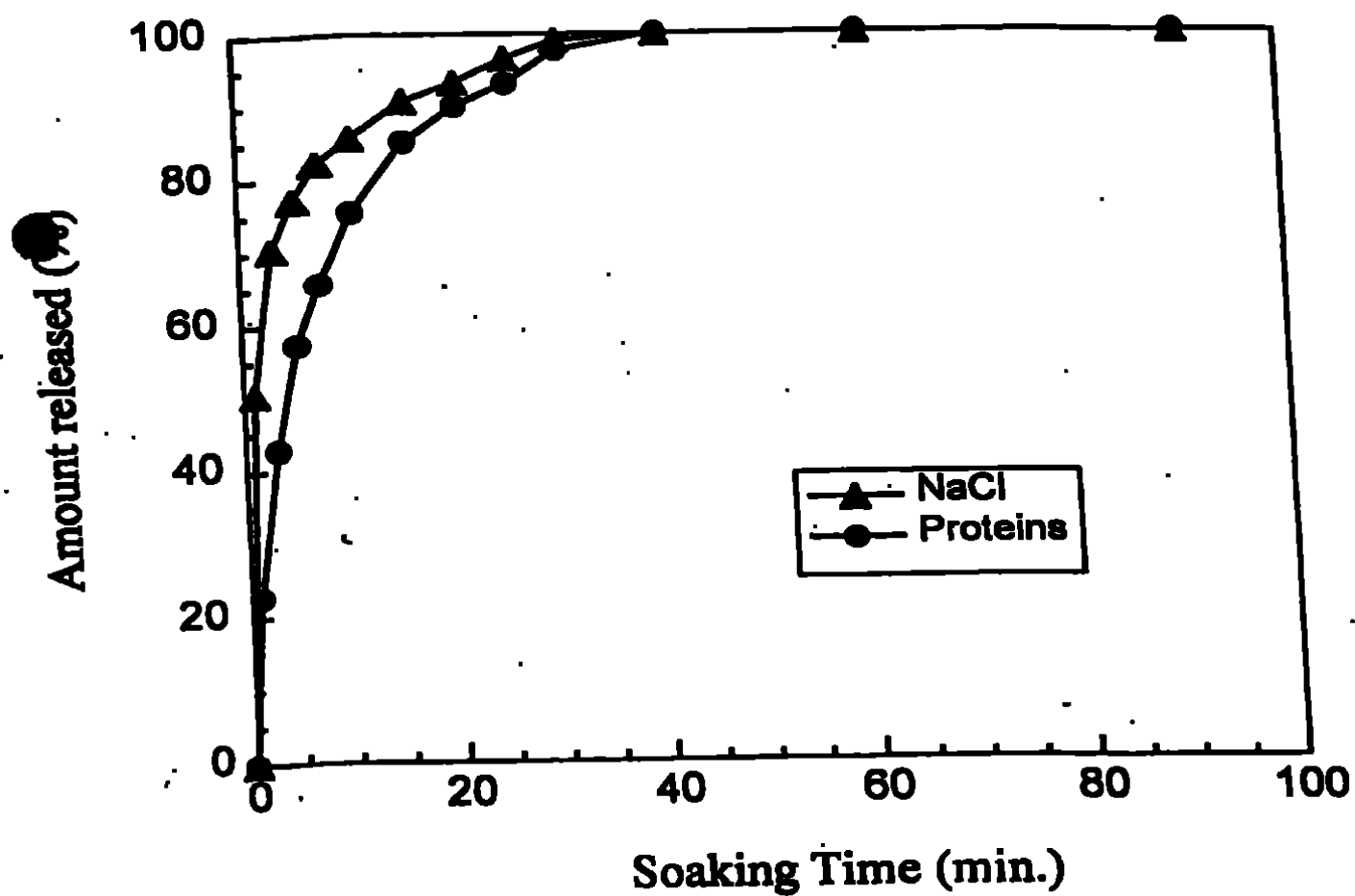
94
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Figure 4



93
200
197

Figure 5



198 ~~287~~

Figure 6

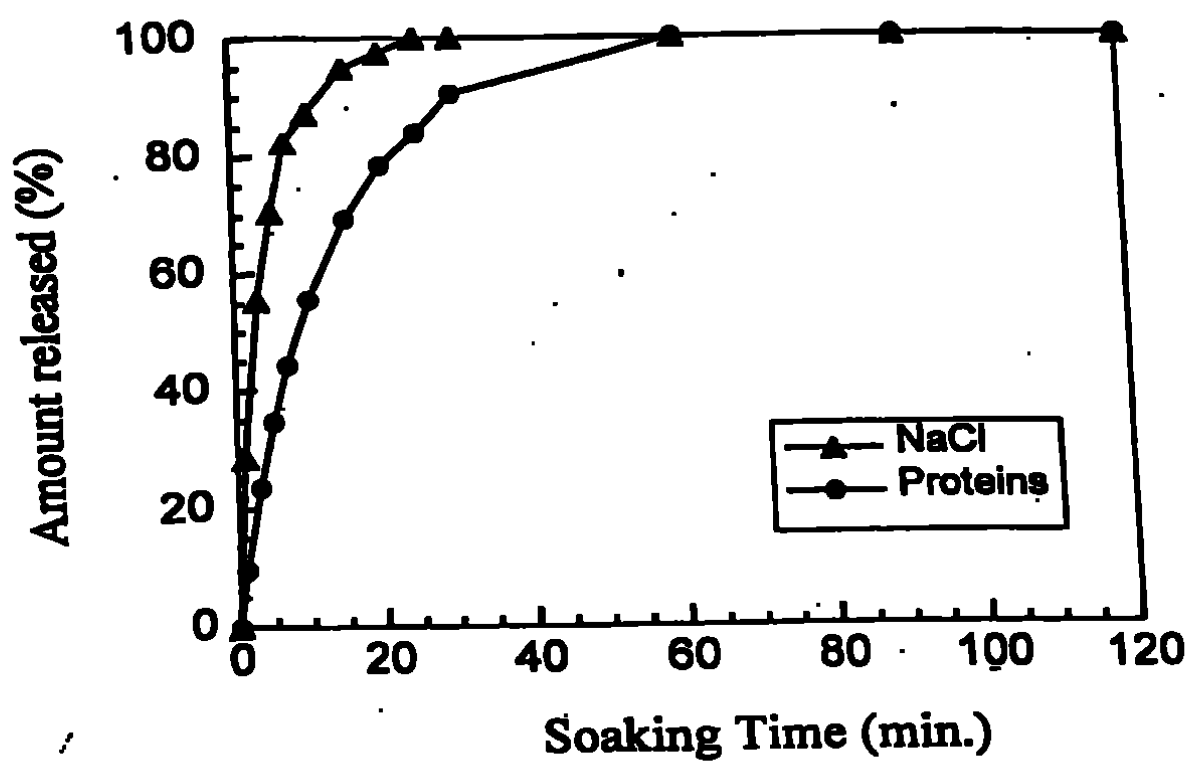
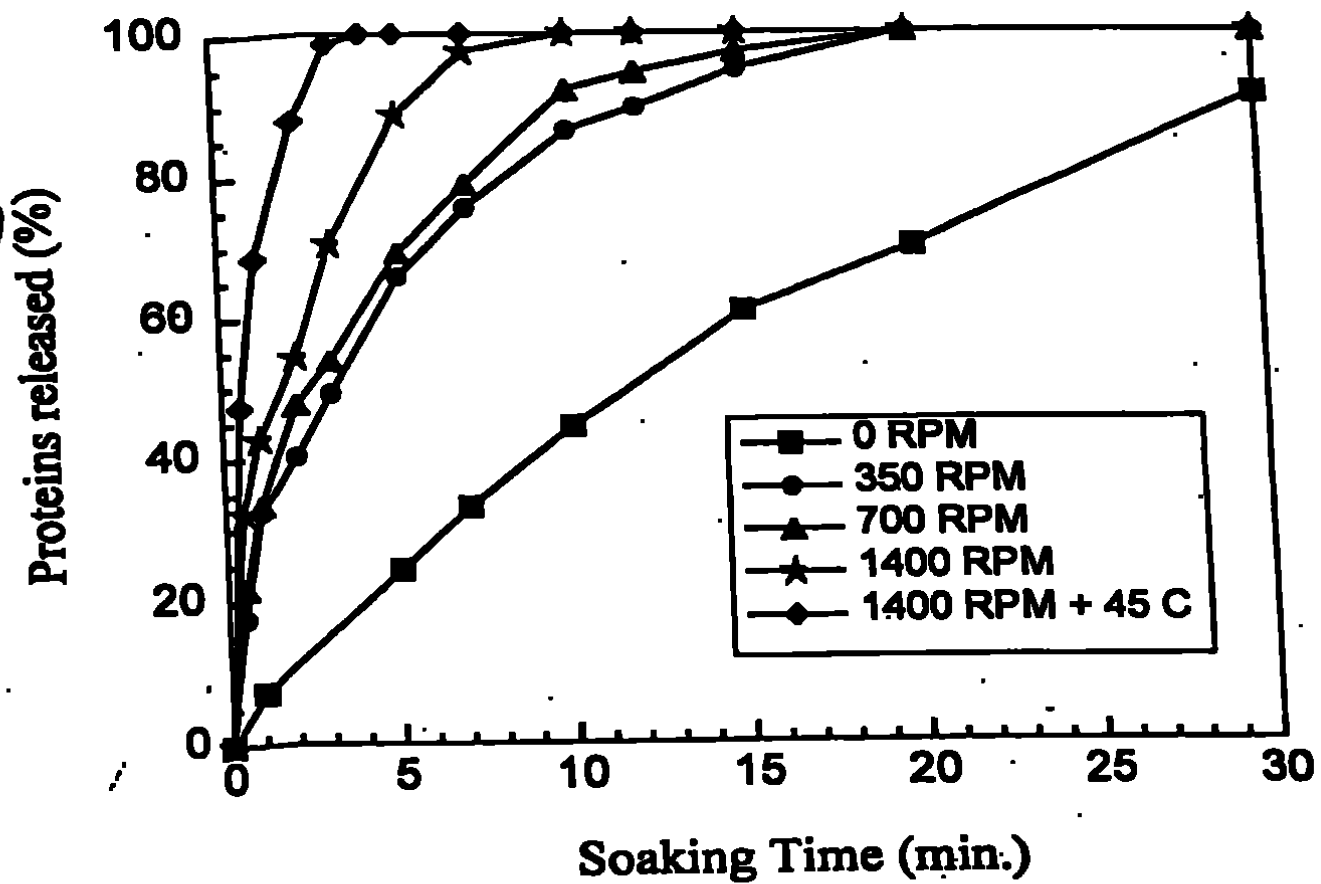
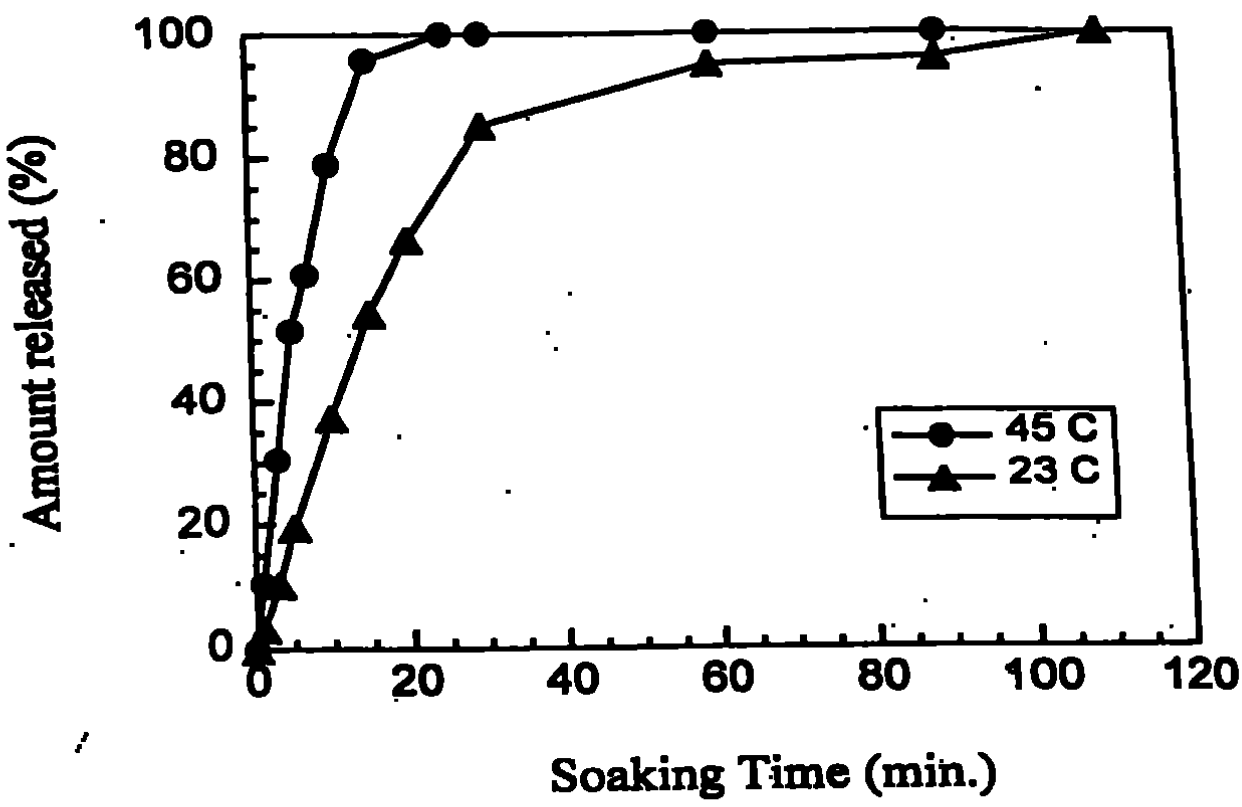


Figure 7



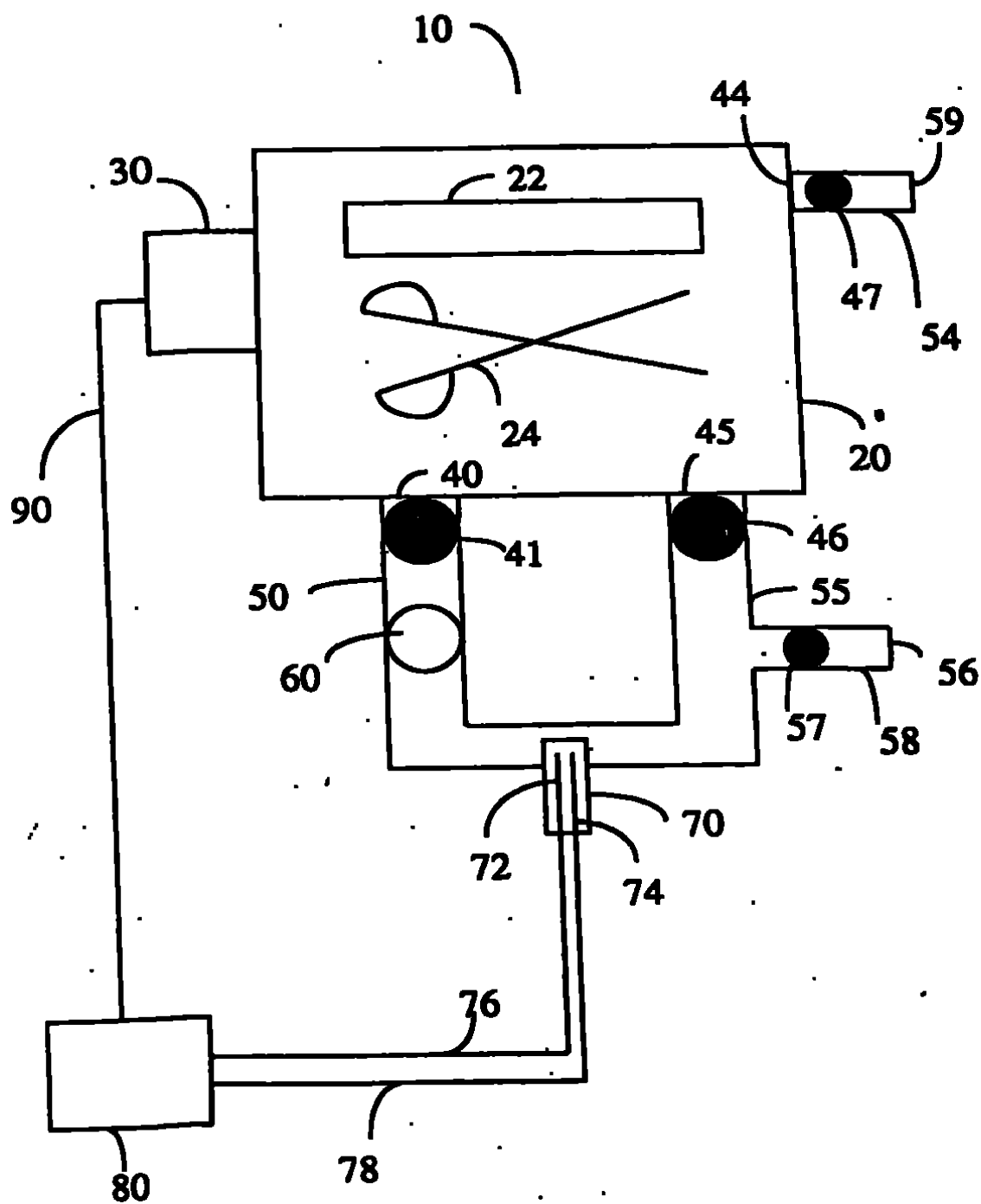
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Figure 8



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Figure 9



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Figure 11

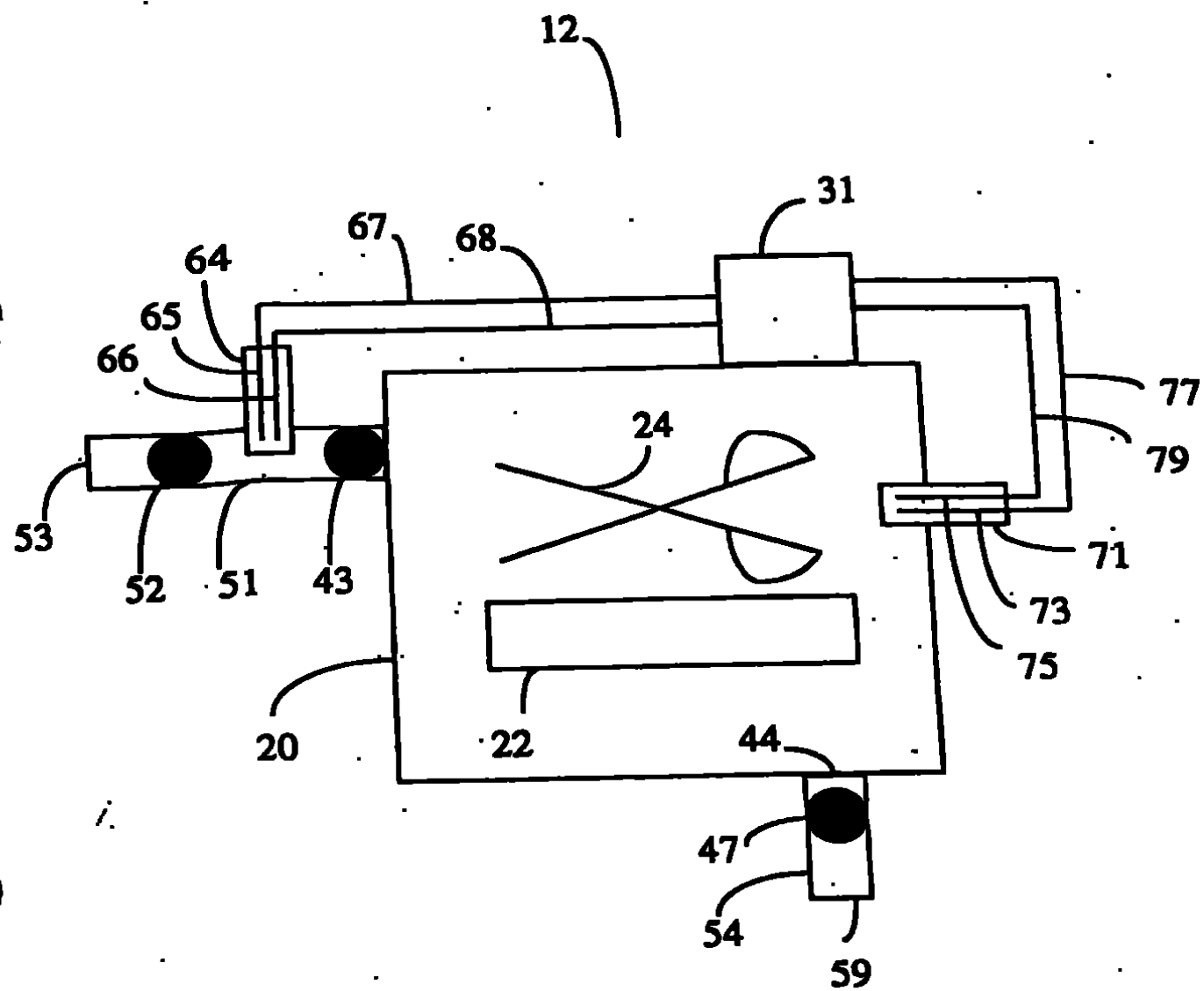
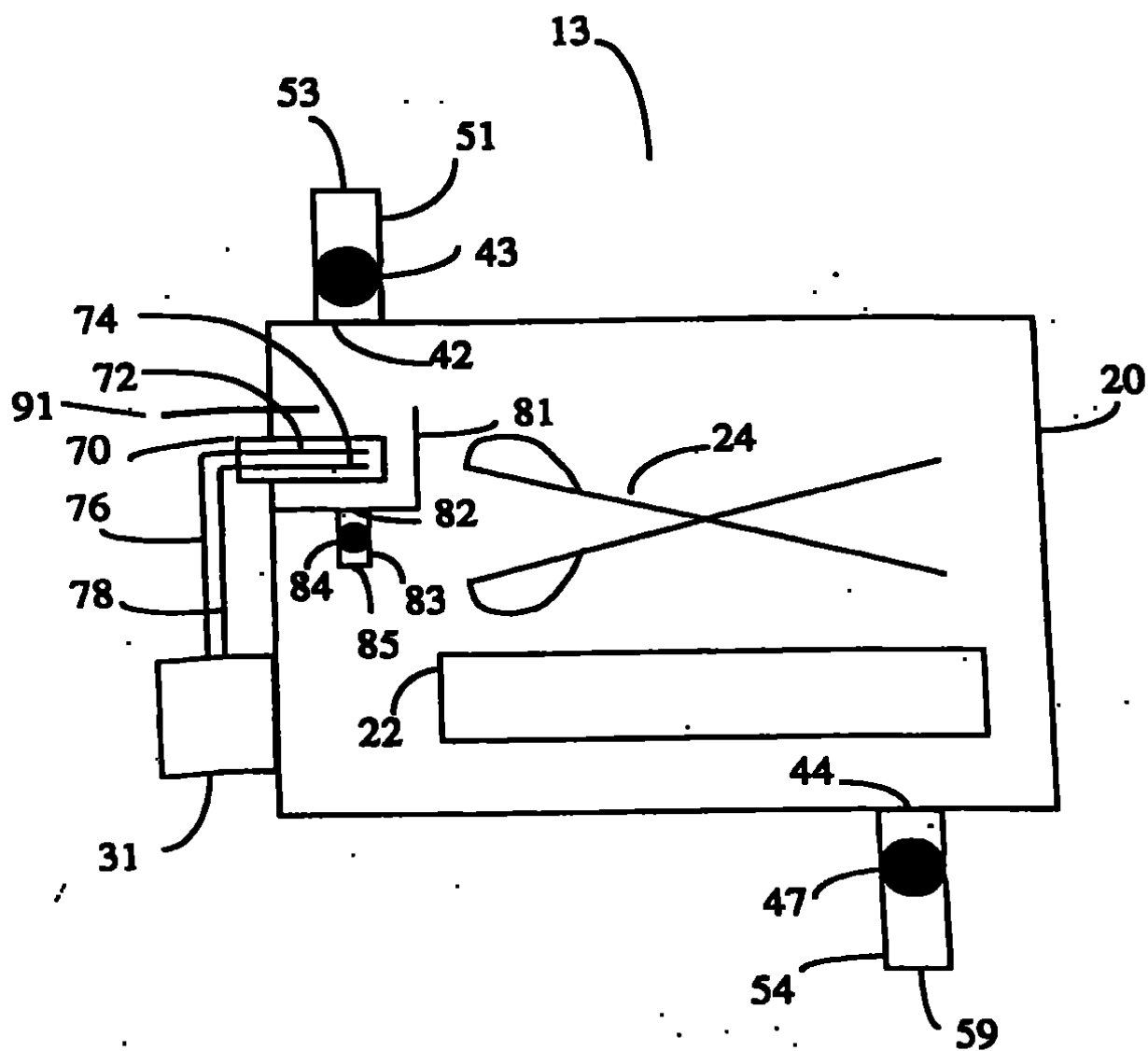


Figure 12



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Figure 13

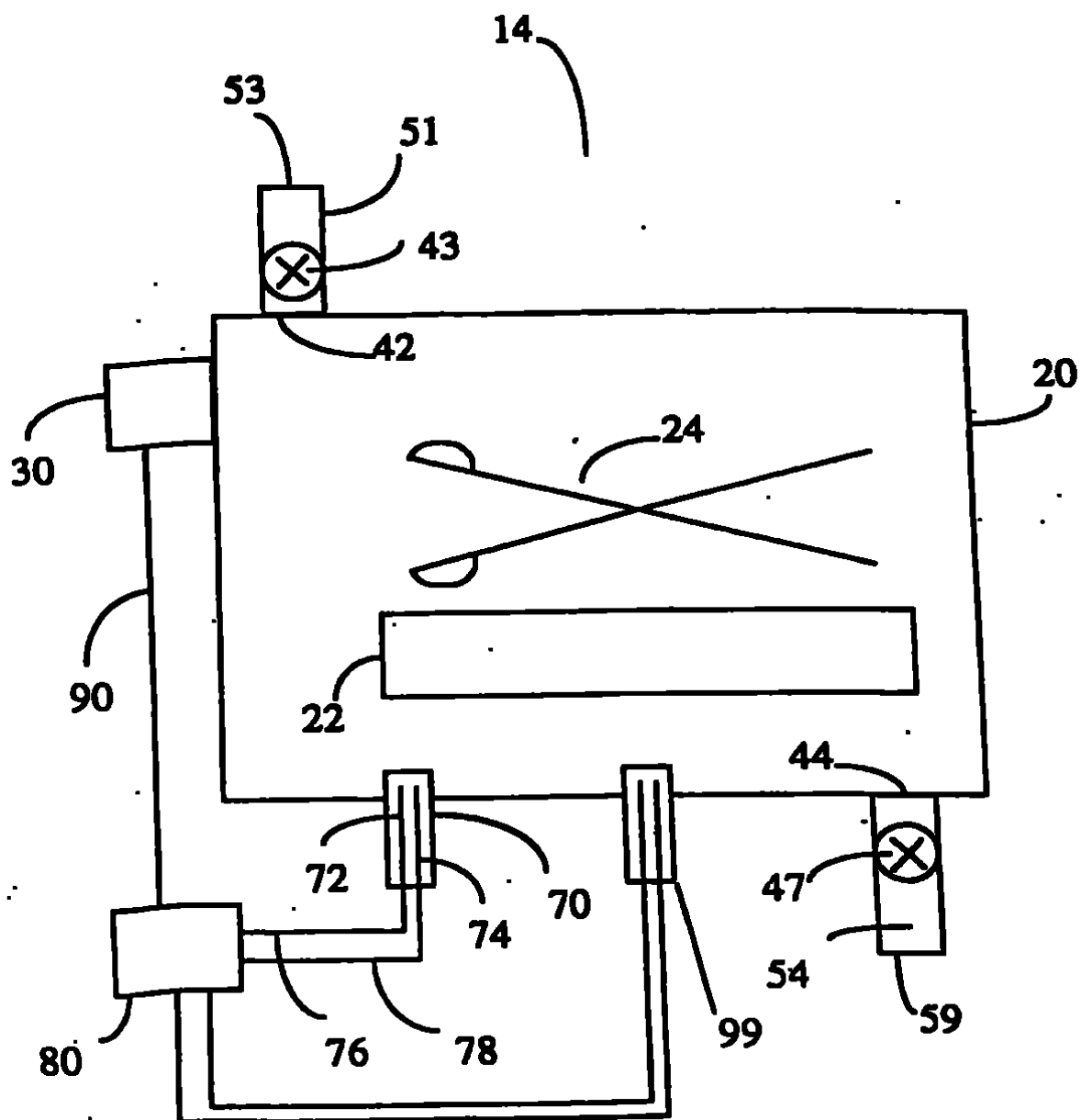
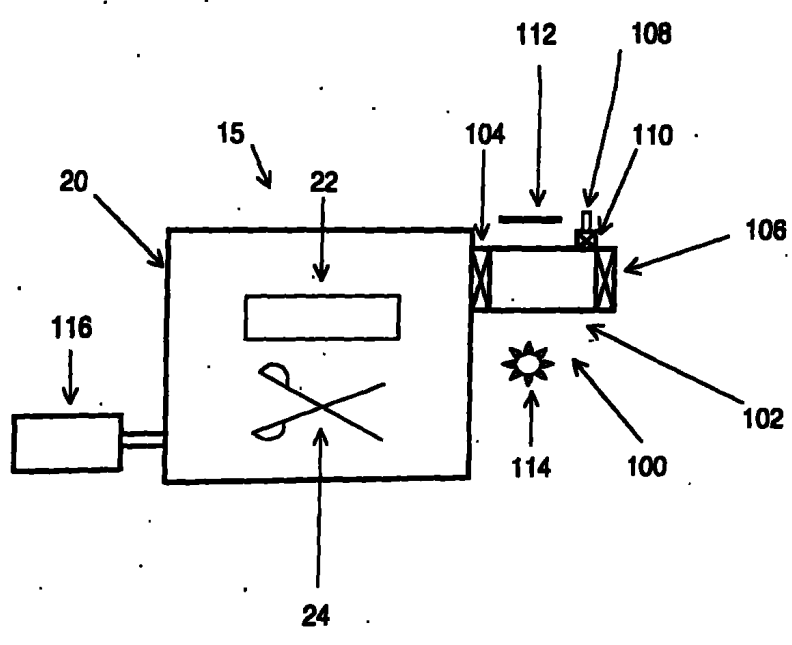


Figure 14

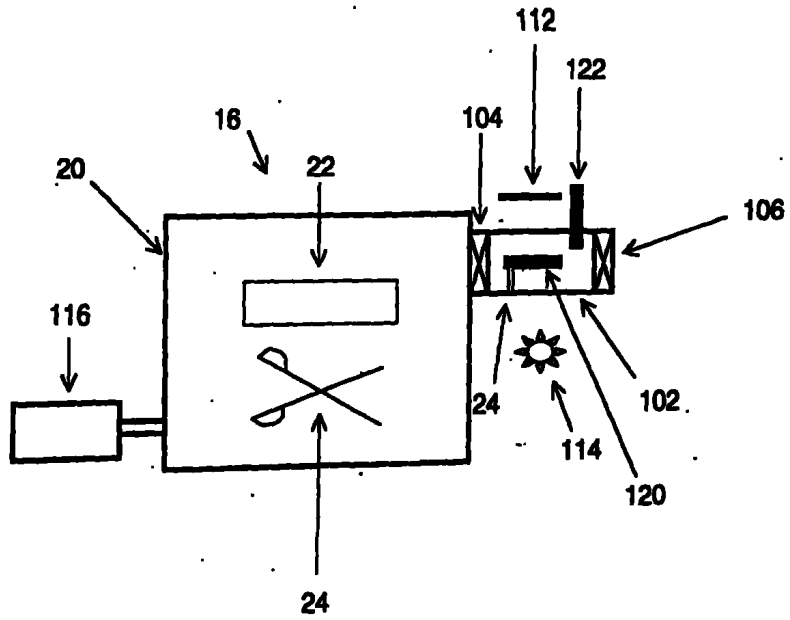
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Figure 15A

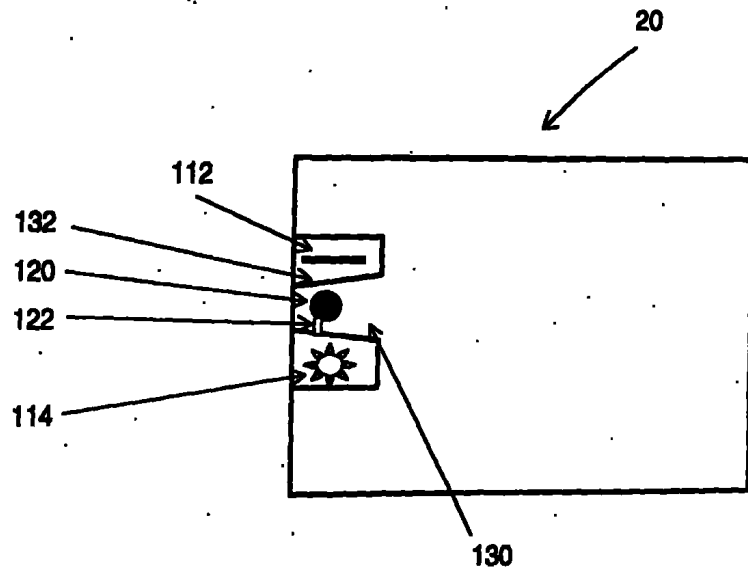
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Figure 15B

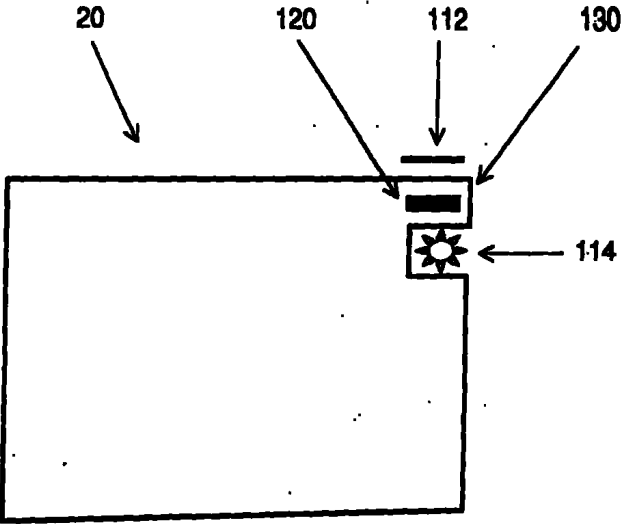
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Figure 15C

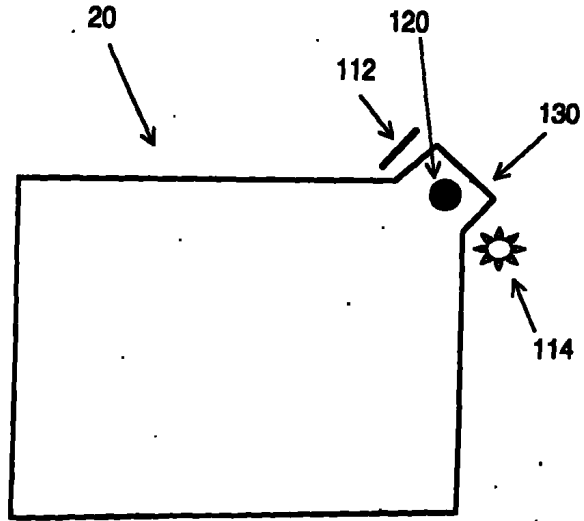
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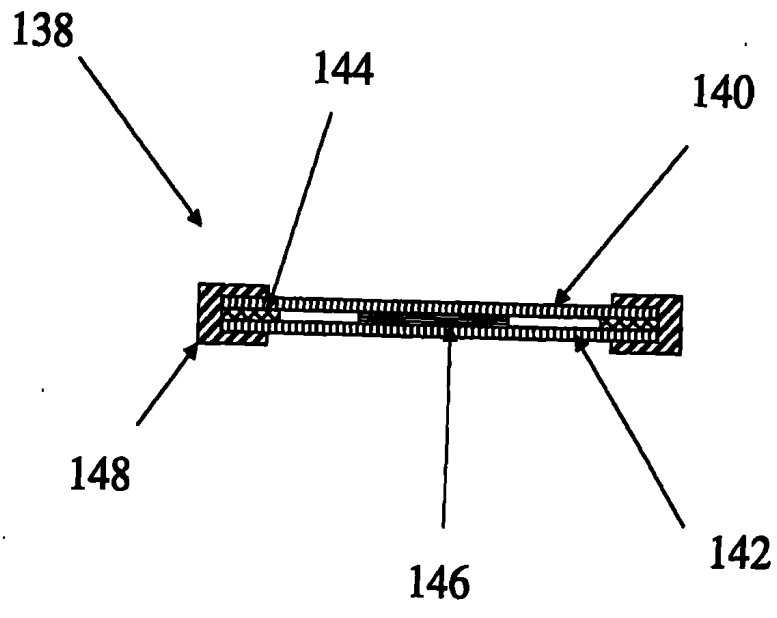
Figure 15D

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Figure 16a



Handwritten signature or initials.

Figure 16b

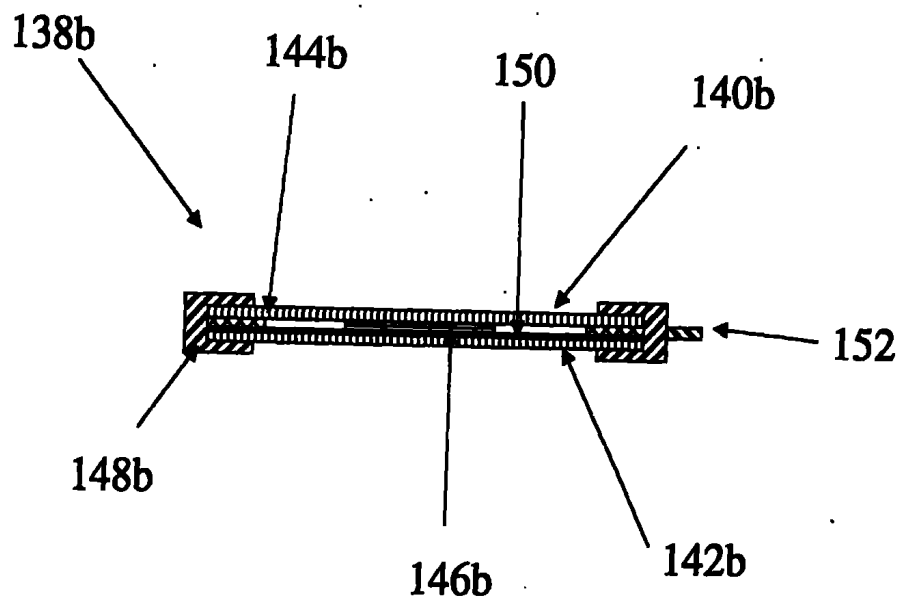
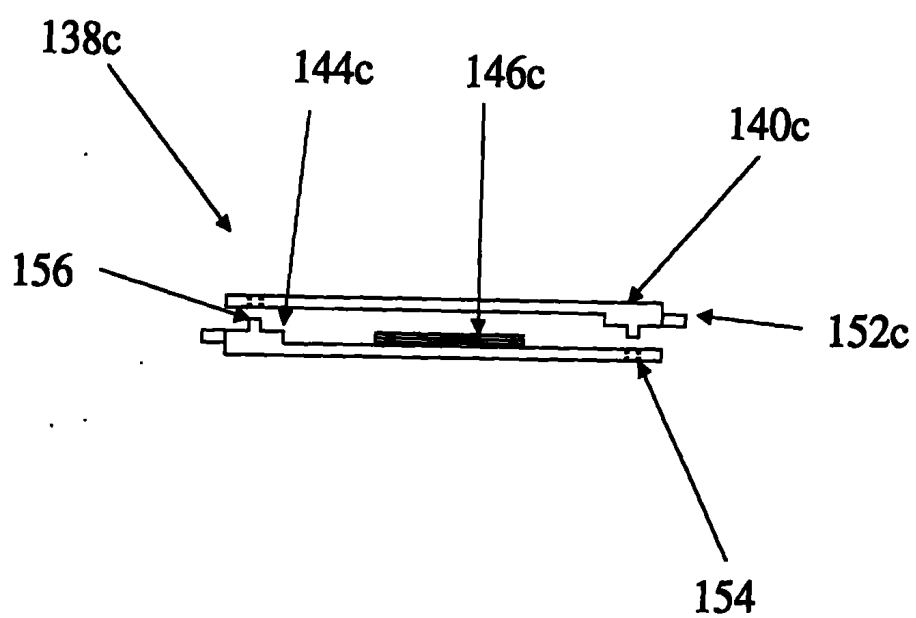


Fig 16b

Figure 16c



214 #2
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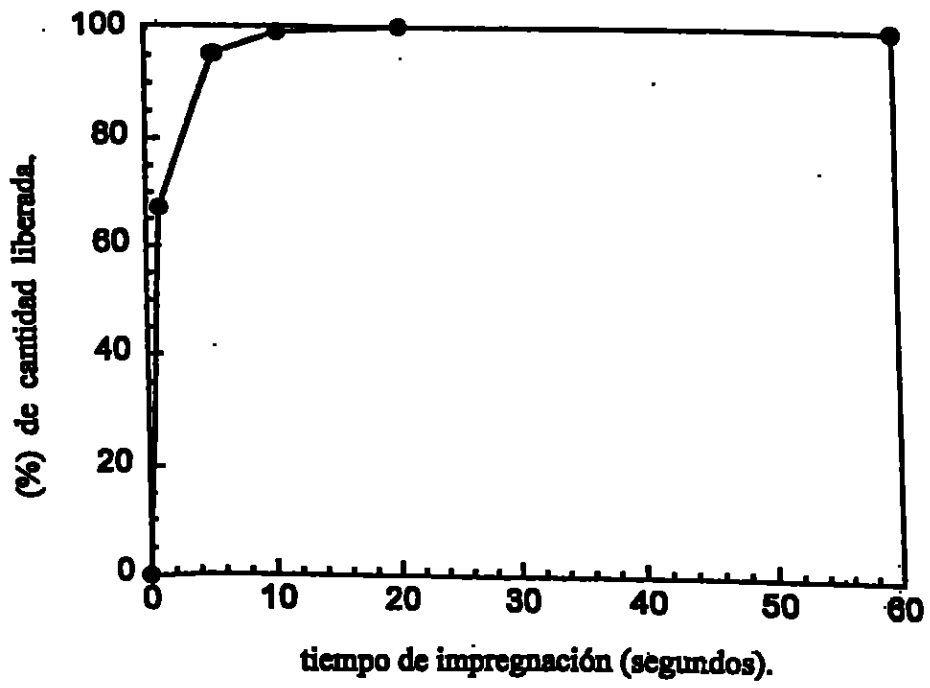
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Note final folio 219.

FIGURA 1



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REPUBLICA DE COLOMBIA
SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

Folio 220

2020
Bogotá D.C.,

Doctor(a)
ESCORAR URIBE JIMENA
Apoderado(a) y/o Representante de
ETHICON INC

REFERENCIA	Radicación No. 06 31931
	Trámite 2
	Evento 1
	Actuación 416
	Oficio No. 3026
	Folios 1

Teniendo en cuenta que la solicitud de privilegio de patente que se tramita bajo el expediente indicado en la referencia, reúne los requisitos de forma establecidos en los artículos 26 y 27 de la Decisión 486 de la Comisión de la Comunidad Andina, y en las demás disposiciones vigentes sobre la materia, se envía el extracto de la solicitud a la Oficina de Comunicaciones para efecto de su publicación en la Gaceta de Propiedad Industrial, conforme lo establece el artículo 40 de la misma Decisión.

Siendo manifestación expresa del interesado de efectuar la publicación "inmediato", está se realizará en la próxima gaceta de Propiedad Industrial.

Cúmplase
Dado en Bogotá DC,

15 MAYO 2007

ALIX CARMENZA CESPEDES DE VERGEL
Jefe de la división de Nuevas Creaciones

adpa10