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<u>NOTICE</u>

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OFFICE OF NAVAL RESEARCH DEPARTMENT OF THE NAVY CODE OOCC ARLINGTON VA 22217-5660

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1 Navy Case No. 77,495 PATENTS 2 SPINNING FILTER SEPARATION SYSTEM FOR OIL 3 SPILL CLEAN-UP OPERATION 4 This invention relates in general to the clean up of ocean water oil spills. 5 **BACKGROUND OF THE INVENTION** 6 According to current technology, effective clean up of oil spills from the surface of ocean 7 water is performed by an oil sweeper vessel within which oil contaminated water is collected for 8 9 transport to remotely located on-shore equipment within which oil separation and disposal is 10 performed. The processing of large quantities of oil polluted ocean water is accordingly time 11 consuming as well as costly. 12 It is therefore an important object of the present invention to provide a less costly oil spill 13 clean up system involving more rapid processing of large quantities of oil polluted ocean water. 14 SUMMARY OF THE INVENTION 15 1.6 In accordance with the present invention, oil polluted ocean water is processed at an oil spill 17 location by continuous separation during pressurized flow of the water through at least two 18 separator devices within which successive reduction in oil concentration is effected with respect 19 to a separated portion of the water by filtered flow through porous membrane walls to 20 correspondingly increase the oil concentration within the other remaining portion of water being 21 22 processed. The first portion of the processed water when sufficiently reduced in oil 23 concentration is discharged for return to the oil spill location, while the remaining portion is 24 collected until a sufficient level of oil concentration therein is achieved to permit disposal thereof 25 by burning at the oil spill site. 26 27 28 1

BRIEF DESCRIPTION OF THE DRAWING FIGURES 2 A more complete appreciation of the invention and many of its attendant advantages will be 3 readily appreciated as the same becomes better understood by reference to the following detailed 4 5 description when considered in connection with the accompanying drawing wherein: 6 FIG. 1 is a side elevation view with parts shown in section, of apparatus associated with the 7 oil clean up system of the present invention; and 8 FIG. 2 is a block diagram of the oil clean-up system embodying the apparatus shown in FIG. 9 1. 10 11 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS 12 Referring now to the drawing in detail, FIG. 1 illustrates two separator devices 10A and 10B 13 of similar construction associated with one embodiment of the present invention through which 14 an oil spill clean up operation is performed. As shown, the separator devices are arranged in 15 vertical parallel relation to each other for rotation about axes 12 extending centrally through outer 16 cvlindrical housings 14 of the separator devices. An inner axial flow chamber 16 aligned with 17 18 axis 12 is formed within each separator device to which axial flow of water under pressure as the 19 fluent material being processed is conducted. Inflow to the inner chamber 16 of separator device 20 10A is conducted by conduit section 18 at the lower axial end of housing 14. Fluent material 21 conducted through such axial flow chamber 16 is discharged from the upper axial end of housing 22 14 of separator device 10A through a conduit section 20. 23 The inner axial flow chamber 16 in each of the separator devices 10A and 10B is enclosed 24 25 by a radially inner cylindrical porous wall 22 of a filtering arrangement. An annular chamber 24 26 is enclosed in surrounding relation to inner chamber 16 by a second cylindrical porous wall 26 27 28 2

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radially spaced inwardly from the outer imperforate wall of the housing 14 to form a radially outer chamber 28 therein. Outflow from the bottom of chamber 28 in separator device 10A is 3 transferred by conduit section 30 to the lower end of the inner axial flow chamber 16 of separator 4 5 device 10B from which axial outflow is discharged at its upper axial end through conduit section 6 32. A continuous radial outflow through the filtering walls 22 and 26 in each of the separator 7 devices 10A and 10B is thus established through conduit section 30 between chamber 28 in 8 device 10A and the inner chamber in device 10B to its radially outer chamber so as to effect a 9 successive reduction in concentration of a filter separated contaminant within the fluent material 10 discharged from the lower end of the outer chamber of device 10B through conduit section 34, as 11 12 shown in FIG. 1.

13 The radially inner filtering wall 22 of each separator device according to one embodiment is 14 formed by a fluortex hydrophobic separation membrane with 50 µm pores therein which serves 15 to prevent inflow of droplets of oil as the contaminant, larger than 50 µm, into the annular 16 17 chamber 24 so as to thereby reduce oil concentration within the water being processed. A further 18 reduction in oil concentration is then effected by inflow of the water being processed to chamber 19 28 through filtering wall 26 formed by a hydrophilic separation membrane with 2µm pores 20 therein. The water so processed by radial outflow through the porous separation membranes of 21 filtering walls 22 and 26 in separator device 10A is again so processed by radial outflow through 22 23 comparable separation membranes within separator device 10B to supply a portion of the 24 processed water to discharge conduit section 34 with a desired reduced concentration of oil 25 therein. In order to maintain a proper continuous radial outflow through the separation 26 membranes of the filtering walls 22 and 26 without clogging, the separator devices 10A and 10B 27

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are rotated about the axes 12 thereof to centrifugally enhance the radial outflow through the filtering walls. The portions of the processed water mixtures respectively leaving the separator devices 10A and 10B through conduit sections 20 and 32 are correspondingly increased in oil concentration to an extent accommodating on-site disposal thereof by burning within a furnace after being collected within a reservoir tank or the like.

The oil spill clean up operation hereinbefore described in connection with the apparatus illustrated in FIG. 1, is summarized by reference to FIG. 2 diagramming the separator devices 10A and 10B rotated by spin motors 36A and 36B as part of a system for clean-up of water polluted at an oil spill site or location 38. The polluted water from such location 38 is fed under pressure by pump 40 to the separator device 10A through conduit section 18 for axial flow through chamber 16 therein. The successively reduced concentration of oil within the portion of the processed water delivered through conduit section 34 from separator device 10B is discharged, as denoted in FIG. 2 by reference numeral 42, for return of sufficiently purified water to the oil spill site 38. The other portion of the processed water is continuously fed by conduit sections 20 and 32 from the inner chambers 16 of the separator devices for a sufficient period of time to a collection reservoir 44 within which the increased concentration of oil therein becomes high enough to permit on-site furnace combustion thereof.

Obviously, other modifications and variations of the present invention may be possible in light of the foregoing teachings. It is therefore to be understood that

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the invention may be practiced otherwise than as specifically described.

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•	Navy Case No. 77,495
3	SPINNING FILTER SEPARATION SYSTEM FOR OIL SPILL CLEAN-UP OPERATION
4	ABSTRACT OF THE DISCLOSURE
5	Oil spill polluted water is conducted under pressure in sequence through separator devices to
6	collect and hum a polluted water mixture having its oil concentration increased her set as the
7	contect and built a polluted water mixture having its on concentration increased by extraction of
8	water therefrom during axial flow through the separator devices. Such water extraction is
9	effected by sequential radial outflow through oil flow blocking filter walls of the separator
10	devices in response to rotation thereof.
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· DECLARATION AL POWER OF ATTORNE	M TY Case No. 77,495 EY FOR PALENT APPLICATION
* As a below named inventor, I hereby declare that: My residence, post office 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 origin subject matter which is claimed and for which a patent is sought on the invention entitle	nal, first and joint inventor (if plural names are listed below) of the
SPINNING FILTER SEPARATION SYSTEM OPERATION the specification of which (check one) I is attached hereto was filed on as Application Serial No.	FOR OIL SPILL CLEAN-UP
I hereby state that I have reviewed and understand the contents of the above identified specific above.	ation, including the claims as amended by any amendment referred to
l acknowledge the duty to disclose information which is material to the examination of this app $\$1.56(a)$.	plication in accordance with Title 37, Code of Federal Regulations
I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign also identified below any foreign application for patent or inventor's certificate having a filing Prior Foreign Application(s)	application(s) for patent or inventor's certificate listed below and have date before that of the application on which priority is claimed: Priority Claimed
(Number) (Country) Day/Month/Year Filed	Yes No
I hereby claim the benefit under Title 35, United States Code, §120 of any United States applied claims of this application is not disclosed in the prior United States application in the manner acknowledge the duty to disclose material information as defined in Title 37, Code of Federal I application and the national or PCT international filing date of this application:	cation(s) listed below and, insofar as the subject matter of each of the provided by the first paragraph of Title 35, United States Code §112, I Regulations, §1.56(a) which occurred between the filing date of the prior
(Application Serial No.) (Filing date)	Status)
POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and Patent and Trademark Office connected therewith. (list name and registration number), and he irrevocable right to prosecute this application:	(patented, pending, abandoned) d/or agent(s) to prosecute this application and transact all business in the ereby certify that the Government of the United States has the
John L. Forrest, Jr., Reg. No. 29,378; Roger D. Johnson, Reg. No. 26,745; Jacob Gary G. Borda, Reg. No. 35,455	b Shuster, Reg. No. 19,660; Howard Kaiser, Reg. No. 31,381;
SEND CORRESPONDENCE TO: Office of Counsel (Patents), Code 004 Carderock Division Naval Surface Warfare Center Bethesda, MD 20084-5000	DIRECT TELEPHONE CALLS TO: Jacob Shuster (301) 394-2174
I hereby declare that all statements made herein of my own knowledge are true and that all stat further that these statements were made with the knowledge that willful false statements and th Section 1001 of Title 18 of the United States Code and that such willful false statements may j	tements made on information and belief are believed to be true; and he like so made are punishable by fine or imprisonment, or both, under jeopardize the validity of the application or any patent issued thereon.
Full name of sole or first inventor JOHN WEHRLE	
Inventor's signature John V. Wehnle Residence 233 Lastner Avenue, Greenbelt, Maryland 2077 Citizenship U.S.A.	Date 9/9/96
Post Office Address 233 Lastner Avenue, Greenbelt, Maryla	and 20770
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Inventor's signature <u>Cuckul</u> <u>Cuschul</u> Residence <u>241</u> Shipping Greek Drive, Stevensville, Mary Citizenship <u>U.S.A.</u> Post Office Address <u>241</u> Shipping Creek Drive, Stevensvill	Date 8 20 96 yland 21666 le, Maryland 21666
Full name of third inventorWILLIAM P. KENNEY	
Inventor's signature <u>This Annapolis</u> , Maryland (Residence <u>707 Chesapeake Avenue</u> , Annapolis, Maryland (Citizenship U.S.A.	Date 9/5/96 21403
Post Office Address 707 Chesapeake Avenue, Annapolis, Mary	yland 21403

-' DECLARATIO	N A11D POWER OF ATTORN	EY FOR PA	vy Case No. 77,495 A ENT APPLICATION
As a below named inventor. I hereby decla My residence, post office address and citiz	re that: enship are as stated below next to my name.		
I believe I am the original first and sole in subject matter which is claimed and for wh SPINNING FILTER	ventor (if only one name is listed below) or an orig ich a patent is sought on the invention entitled: SEPARATION SYSTEM	inal, first and joint	inventor (if plural names are listed below) of the L SPILL CLEAN-UP
OPERATION the specification of which (check one) D is attached hereto www.	as filed on as Application Serial No.	and	was amended on
I hereby state that I have reviewed and und above.	erstand the contents of the above identified specifi	cation, including th	e claims as amended by any amendment referred to
I acknowledge the duty to disclose informa §1.56(a).	tion which is material to the examination of this ap	plication in accord	ance with Title 37, Code of Federal Regulations
I hereby claim foreign priority benefits und also identified below any foreign applicatio Prior Foreign Applic	er Title 35, United States Code §119 of any foreig n for patent or inventor's certificate having a filing ation(s)	n application(s) for date before that of Priority Cla	patent or inventor's certificate listed below and have the application on which priority is claimed: imed
(Number) (Country	/) Day/Month/Year Filed	Yes N	0
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 cuty 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 Sectal No.)	(Filing date)	5	Status)
POWER OF ATTORNEY: As a named inv Patent and Trademark Office connected the irrevocable right to processing this applicati	entor, I hereby appoint the following attorney(s) as rewith. (list name and registration number), and hon:	(nd/or agent(s) to pr ereby certify that t	patented, pending, abandoned) osecute this application and transact all business in the the Government of the United States has the
John L. Forrest, Jr. Reg. No. 29,378; Roger D. Johnson, Reg. No. 26,745; Jacob Shuster, Reg. No. 19,660; Howard Kaiser, Reg. No. 31,381; Gary G. Borda, Reg. No. 35,455			
SEND CORRESPONDENCE TO:	Office of Counsel (Patents), Code 004 Carderock Division Naval Surface Warfare Center Bethesda, MD 20084-5000	I	Direct telephone calls to: Jacob Shuster (301) 394-2174
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 Section 1001 of True 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.			
Full name of fourth inventor JOS	SEPH F. KORCZYNSKI		
Inventor's signature <u>Deph 2</u> Residence <u>1503</u> <u>Theman Driv</u>	re, Glen Burnie, Maryland 21	Date 91	5 9 6
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Full name of fifth inventor THOMAS D. GRACIK			
Inventor's signature Residence <u>104</u> Chestmut Lane Citizenship <u>11.3.4</u> Post Office Address <u>104</u> Chestr	us	Date 11 SC 061 and 21061	p 1996
Full name of sixth inventor BARBARA F. HOWELL			
Inventor's signature <u>Emlima</u> Residence <u>206 Estrourne</u> D Citizenship <u>U.S.A</u> Post Office Address <u>216 Baybo</u>	A Hamell rive, Arnold, Maryland 2106 urne Drive, Arnold, Maryland	Date 9-1	3-46

DECLARATIO	DN AN POWER OF ATTO	RNEY FOR	N W Case No. 77,495 PA Le NT APPLICATION
As a below named inventor, I hereby decl My residence, post office address and citi	are that: zenship are as stated below next to my name.		
I believe I am the original, first and sole in subject matter which is claimed and for w	nventor (if only one name is listed below) or ar hich a patent is sought on the invention entitle	n original, first and jo d: ENA EOD (Dint inventor (if plural names are listed below) of the
OPERATION the specification of which	SEFARATION S FST		JIL SFILL CLEAN-UP
(check one) \mathbf{X} is attached hereto \mathbf{D}	was filed on as Application Seria	il No	and was amended on
I hereby state that I have reviewed and un above.	derstand the contents of the above identified sp	becification, includir	ng the claims as amended by any amendment referred to
l acknowledge the duty to disclose inform §1.56(a).	ation which is material to the examination of t	his application in ac	cordance with Title 37, Code of Federal Regulations
I hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed: Prior Foreign Application(s) Priority Claimed			
(Number) (Count	ry) Day/Month/Year Filed	Yes	No
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, pending, abandoned) POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number), and hereby certify that the Government of the United States has the irrevocable right to prosecute this application:			
John L. Forrest, Jr. Reg. No. 29,37 Gary G. Borda, Reg. No. 35,455	8; Roger D. Johnson, Reg. No. 26,745;	Jacob Shuster, R	eg. No. 19,660; Howard Kaiser, Reg. No. 31,381;
SEND CORRESPONDENCE TO:	Office of Counsel (Patents), Code 004		DIRECT TELEPHONE CALLS TO:
· .	Carderock Division Naval Surface Warfare Center Bethesda, MD 20084-5000		JACOB SHUSTER (301) 394-2174
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 Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.			
Full name of seventh inventor WII	LIAM KLEMENS		

Inventor's signature William / Elemenn	Date 9/3/96
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Citizenship U.S.A.	
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FIG. 1



FIG. 2