

APPARATUS AND METHOD FOR REMOVING PAINT FROM A SUBSTRATE

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT (1) ANTHONY A. RUFFA, citizen of the United States of America, employee of the United States Government, and (2) SAMEER I. MADANSHETTY, citizen of the United States, and resident of (1) Hope Valley, County of Washington, State of Rhode Island, and (2) Manhattan, County of Riley, State of Kansas, have invented certain new and useful improvements entitled as set forth above, of which the following is a specification.

JAMES M. KASISCHKE, ESQ.
Reg. No. 36562
Naval Undersea Warfare Center
Division, Newport
Newport, RI 02841-1708
TEL: 401-832-4736
FAX: 401-832-1231

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DEPARTMENT OF THE NAVY
OFFICE OF COUNSEL
NAVAL UNDERSEA WARFARE CENTER DIVISION
1176 HOWELL STREET
NEWPORT RI 02841-1708

IN REPLY REFER TO:

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The below identified patent application is available for licensing. Requests for information should be addressed to:

PATENT COUNSEL
NAVAL UNDERSEA WARFARE CENTER
1176 HOWELL ST.
CODE 00OC, BLDG. 112T
NEWPORT, RI 02841

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Inventor Anthony A. Ruffa

If you have any questions please contact James M. Kasischke, Acting Deputy Counsel, at 401-832-4736.

1 Attorney Docket No. 79269

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5 STATEMENT OF GOVERNMENT INTEREST

6 The invention described herein may be manufactured and used
7 by and for the Government of the United States of America for
8 Governmental purposes without the payment of any royalties
9 thereon or therefor.

10

11 CROSS REFERENCE TO OTHER PATENT APPLICATIONS

12 Not applicable.

13

14 BACKGROUND OF THE INVENTION

15 (1) Field of the Invention

16 The invention relates to the removal of coatings, such as
17 paint, from a substrate and is directed more particularly to
18 removal of paint, or other such coatings, in air, without damage
19 to the substrate.

20 (2) Description of the Prior Art

21 It is known to remove paint from substrates by utilizing
22 ultrasonic fields to produce micron-sized vapor (or cavitation)
23 bubbles which impinge against the paint. The microcavitation
24 allows for removal of the paint from the substrate without
25 damaging the substrate. This is taught by U.S. Patent 5,681,396.

1 Inasmuch as micron-sized cavitation bubbles are used to remove
2 the coating, the process works well underwater. However, to
3 adapt the process to surfaces in the air requires the application
4 of water, as by jets of water, to immerse the coated surface. In
5 such procedures, the amount of water required is quite large and
6 the used water is contaminated with the removed paint or other
7 coating material, all hereinafter referred to as "paint".

8 There is thus a need for a method for acoustic cavitation-
9 based paint removal in air, wherein the substrate is not damaged
10 by the cavitation, a relatively small quantity of water is
11 required, and the contaminated water run-off is minimal.

12

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SUMMARY OF THE INVENTION

14 An object of the invention is, therefore, to provide a
15 method for removing paint from a substrate without damage to the
16 substrate.

17 A further object of the invention is to provide such a
18 method wherein an acoustic field causes formation of micron-sized
19 vapor or cavitation bubbles which are impinged upon the paint
20 surface to cause removal of paint therefrom, wherein the process
21 requires relatively small quantities of water and produces a
22 relatively small run-off of contaminated water.

23 With the above and other objects in view, as will
24 hereinafter appear, a feature of the present invention is the
25 provision of an apparatus and method for removing paint from a

1 substrate disposed in air. The apparatus includes a sponge
2 capable of having a fluid therein. The sponge has a first
3 surface that can be placed in contact with the coating. High and
4 low frequency transducers are positioned in contact with the
5 second surface of the sponge. Activation of the transducers
6 generates cavitation at the surface of the coating for removing
7 the coating.

8 The method includes the steps of providing a sponge having a
9 first surface for contact with the substrate, providing ultra
10 sonic transducers in contact with a second surface of the sponge
11 opposite from the first surface, saturating the sponge with water
12 to provide a path of water extending from the transducers to the
13 substrate, and activating the transducers to generate (i) a low
14 frequency acoustic field; and (ii) a high frequency acoustic
15 field; and thereby (iii) micron-sized vapor (or cavitation)
16 bubbles which impinge upon the paint on the substrate to remove
17 the paint from the substrate as taught by U.S. Patent 5,681,396.

18 The above and other features of the invention, including
19 various novel details of construction and combinations of steps,
20 will now be more particularly described with reference to the
21 accompanying drawings and pointed out in the claims. It will be
22 understood that the particular method embodying the invention is
23 described by way of illustration only and not as a limitation of
24 the invention. The principles and features of this invention may

1 be employed in various and numerous embodiments without departing
2 from the scope of the invention.

3

4 BRIEF DESCRIPTION OF THE DRAWING

5 Reference is made to the accompanying drawing in which is
6 shown an illustrative embodiment of the invention, from which its
7 novel features and advantages will be apparent, and wherein

8 FIG. 1 is a diagrammatic side elevational, partly sectional,
9 view illustrating one form of apparatus for effecting an
10 embodiment of the invention.

11

12 DESCRIPTION OF THE PREFERRED EMBODIMENT

13 Referring to FIG. 1, it will be seen that there is provided
14 a sponge 10 having a first surface 12 for contact with a coating
15 14 of paint, or the like, which is desired to be removed from a
16 substrate 16 which is disposed in a non-underwater environment.

17 The sponge 10 can be made from any porous elastic material
18 including but not limited to cellulose, neoprene, foam rubber,
19 natural fiber or the like. While virtually any substrate
20 material may be stripped of a coating by the method presented
21 herein, it will be appreciated that the method finds particular
22 applicability to substrates, such as fiber/epoxy components,
23 which are easily damaged by conventional paint removal methods.

24 An array 20 of transducers is provided in contact with a
25 second surface 18 of the sponge 10 opposite from the sponge first

1 surface 12. The array 20 includes at least one high frequency
2 transducer and at least one low frequency transducer. The high
3 frequency transducer preferably produces an acoustic field of
4 about 25-35 MHz and the low frequency transducer preferably
5 produces an acoustic field of about 1-3 MHz.

6 The sponge 10 is saturated with water to provide a path of
7 water extending from the transducers 20 to the paint 14. The
8 sponge preferably exhibits a specific acoustic impedance
9 substantially equal to the specific acoustic impedance of water.

10 The array of transducers 20 is then activated, preferably in
11 a pulsing fashion, though continuous operation performs
12 acceptably. The simultaneous use of the low and high frequency
13 ultrasonic fields causes the formation of micron-sized cavitation
14 bubbles which live for only a few microseconds, but in that time
15 are caused to impinge upon the paint 14 and dislodge micro
16 particles of paint which are absorbed into the sponge 10 and/or
17 are carried from the sponge in water run-off.

18 Inasmuch as the water run-off is minimal, there is very
19 little water contaminated with paint and requiring disposal.

20 To encourage faster cavitation, the sponge first surface 12
21 may be roughened and/or hardened, and/or may be rendered
22 hydrophobic.

23 To remove paint from an area larger than the surface 12 of
24 the sponge 10, the sponge and transducers 10, 20, may be held
25 together and moved as a unit over the paint surface 14.

1 It will be understood that many additional changes in the
2 details, materials, steps and arrangement of parts, which have
3 been herein described and illustrated in order to explain the
4 nature of the invention, may be made by those skilled in the art
5 within the principles and scope of the invention as expressed in
6 the appended claims.

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5 ABSTRACT OF THE DISCLOSURE

6 The apparatus includes a sponge capable of having a fluid
7 therein. The sponge has a first surface that can be placed in contact
8 with the coating. High and low frequency transducers are positioned
9 in contact with the second surface of the sponge. A method
10 performing the invention includes the steps of providing a sponge
11 having a first surface for contact with the substrate, providing
12 ultrasonic transducers in contact with a second surface of the
13 sponge opposite from the first surface, saturating the sponge
14 with water to provide a path of water extending from the
15 transducers to the substrate, and activating the transducers to
16 generate (i) a low frequency acoustic field; and (ii) a high
17 frequency acoustic field; and thereby (iii) micron-sized vapor or
18 cavitation bubbles which impinge upon the paint on the substrate
19 to remove the paint from the substrate.

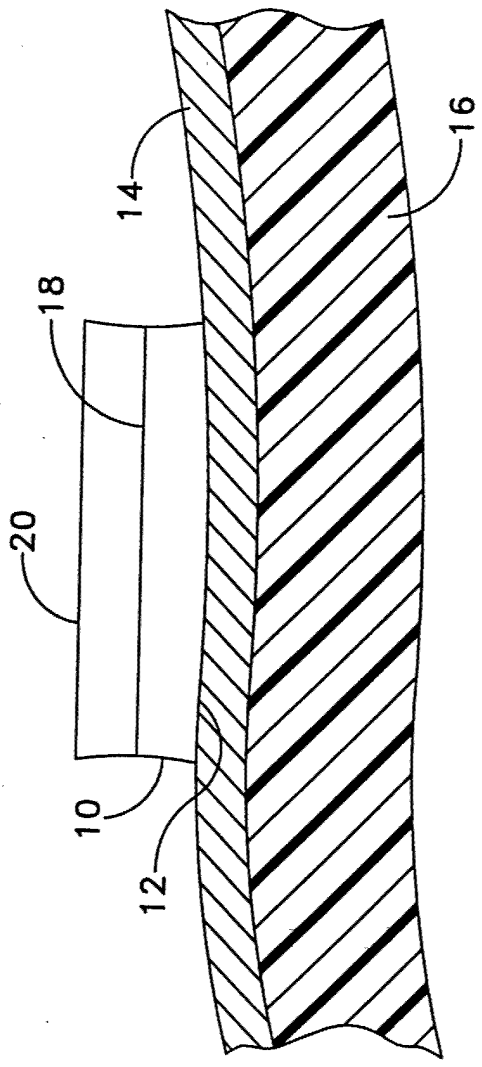


FIG. 1