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FILING RECEIPT

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Date Mailed: 08/20/2008

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Applicant(s)

Eurica Califorrniaa, Haleiwa, HI;

Power of Attorney: None

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

Method of watering the Moon

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	
	Filing Date	
	First Named Inventor	Californiaa, Eurica
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

	1	Yoe, J.H. "Efficiency of Drying Agents." Handbook of Chemistry and Physics. 72nd ed. Boca Raton, FL: CRC Press, 1991. p. 15-22.	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

EFFICIENCY OF DRYING AGENTS

Compiled by John H. Yoe

A. Drying agents depending upon chemical action (absorption) for their efficiency:*

Substance	Residual water, mg per liter of dry air**	Reference
P_2O_5	<1 mg in 40,000 liters	Morley, Am. J. Sci., 34, 199 (1887); J.A.C.S., 26, 1171 (1904).
$Mg(ClO_4)_2$ anhyd.	"Unweighable" in 210 liters	Willard and Smith, J.A.C.S., 44, 2255 (1922).
BaO	0.00065	Bower, Bur. Std. J. Res., 12, 241 (1934).
KOH fused	0.002	Baxter and Starkweather, J.A.C.S., 38, 2038 (1916).
CaO	0.003	Bower, loc. cit.
H_2SO_4	0.003	Baxter and Starkweather, loc. cit.
$CaSO_4$ anhyd.	0.005	Bower loc. cit.
Al_2O_3	0.005	Ibid.
KOH sticks	0.014	Ibid.
NaOH fused	0.16	Baxter and Starkweather, loc. cit.
$CaBr_2$	0.18	Baxter and Warren, J.A.C.S., 33, 340 (1911).
$CaCl_2$ fused	0.34	Baxter and Starkweather, loc. cit.
NaOH sticks	0.80	Bower loc. cit.
$Ba(ClO_4)_2$	0.82	Ibid.
$ZnCl_2$	0.85	Baxter and Warren, loc. cit.
$ZnBr_2$	1.16	Ibid.
$CaCl_2$ granular	1.5	Bower, loc. cit.
$CuSO_4$ anhyd.	2.8	Ibid.

B. Drying agents depending upon physical action (adsorption) for their efficiency:* Alumina (low temperature fired), asbestos, charcoal, clay and porcelain (low temperature fired), glass wool, kieselguhr, silica gel, refrigeration.

* It should be noted that the efficiency of some drying agents (e.g. Al_2O_3 and anhydrous $CaCl_2$, and probably also BaO, anhydrous $Mg(ClO_4)_2$, $Mg(ClO_4)_2 \cdot 3H_2O$, anhydrous $Ba(ClO_4)_2$, and $CaSO_4$) depends upon both adsorption and absorption.

** 30°C. for Bower's values; others 25°C. or room temp.

INVENTION TITLE

Method of Watering the Moon

DESCRIPTION

PROPERTY RIGHTS STATEMENT TO NASA

[Para 1] The invention was not made under nor is there any relationship of the invention to the performance of any work under any contract of the National Aeronautics and Space Administration (NASA).

BACKGROUND OF THE INVENTION

[Para 2] 1. Field of the Invention

[Para 3] My invention relates to a method of watering the Moon.

[Para 4] 2. Prior Art

[Para 5] The prior art teaches that water must be brought to the Moon in the form of bulk parcels, e.g., manually by spacecraft or celestially by comet, or that conversion of lunar matter into water is required, e.g., by combination of hydrogen and oxygen after evolution from lunar matter.

[Para 6] 3. Statement of the Necessity

[Para 7] The uses of water are well known. In order to further lunar development, a large supply of water is desirable on the Moon.

[Para 8] But bringing water to the Moon manually by spacecraft is impractical in large quantities due to the weight of water and the cost of space travel from Earth to the Moon. Relying on comets to bring water to the Moon is impractical due to the rarity and unpredictability of comets. Conversion of lunar matter into water requires specialized chemical and mineral processing equipment, and, depending on the conversion method, large amounts of energy may be required.

[Para 9] In contrast to the limitations imposed by prior art methodologies, it would be desirable to have a means of supplying water to the Moon that does not require water parcel delivery or conversion of lunar matter into water.

[Para 10] What is needed is a method of watering the Moon.

BRIEF SUMMARY OF THE INVENTION

[Para 11] My invention satisfies the above-stated needs.

[Para 12] In a preferred embodiment, the invention comprises depositing a deliquescent substance such as magnesium chloride ($MgCl_2$) on a surface of the Moon to collect ambient moisture from outer space.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[Para 13] FIG. 1 is a diagram of Earth and Moon orbits.

[Para 14] FIGS. 2A-C are perspective views of a watering of the Moon according to the invention. FIG. 2C is most descriptive of the invention.

[Para 15] FIGS. 3A-D are side cross-sectional views showing a process of geopooling taking place on the Moon according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[Para 16] My invention is a method of watering the Moon. The invention may be appreciated in view of a theory of operation.

[Para 17] 1. Theory of Operation

[Para 18] In this disclosure, the Earth is classified as a tropical planet (or, to borrow from the Köppen climate classification system, a tropical rain forest planet). As an example of contrast, Mars is classified as a semitropical planet (or, to borrow from the Köppen climate classification system, a tropical wet and dry or savanna planet). The basis for these distinctions is that outer space contains a faint quantity of moisture, called solar moisture. Earth orbits in a tropical (rain forest) region of solar moisture. This means that in relative terms the Earth is always in a "wet" region of space. In contrast, Mars orbits in a semitropical region of space. Over geologic time, this means Mars experiences "wet" and "dry" seasons. In other words, the pattern of solar moisture shifts seasonally—meaning, over geologic time—and right now Mars is in its "dry" season.

[Para 19] Even though solar moisture is extremely faint, the Earth sweeps out an immense toroidal volume in its yearly journey around the Sun. In doing so, the Earth acts like a big catcher's mitt, sweeping out solar moisture in its orbital path. A state of equilibrium called hydrostasis is achieved when an amount of solar moisture encountered equals an amount of moisture escaping from Earth. Over geologic time, seasonal variations in equilibrium occur. In other words, the Earth's moisture content is not a fixed value, but depends on a contrast between the moisture content of space encountered in the Earth's orbital path and the amount of moisture escaping from the Earth. Importantly, in addition to gravity, salt helps the Earth to retain its moisture.

[Para 20] In this disclosure, the term "geopooling" (geo-pooling) is coined to mean the process by which a celestial body forms a body of water from collected solar moisture. To explain this process, first a deliquescent substance (e.g., magnesium chloride, $MgCl_2$) collects solar moisture and forms a pool of water on the surface. Although substances that can bind water that are not deliquescent can collect water, an ability to form a pool of water is necessary so that fluidic communication can be established with a salt deposit consisting of a water soluble salt (e.g., sodium chloride, NaCl). Accordingly, the pool of water leaches salt from the deposit by dissolution. Salt plays two roles in geopooling. As a deliquescent substance (e.g., $MgCl_2$), salt initiates the collection of solar moisture. As an abundant and highly soluble substance (e.g., NaCl), salt dissolves into the water and lowers the vapor pressure. This is why the sea has salt in it. For if it was not for having salt, the Earth would not be able to retain its water.

[Para 21] Once geopooling is initiated, the water content of the celestial body will increase until hydrostasis is achieved. Over geologic time, the water content will fluctuate based on equilibrium considerations, particularly variations in solar wetness. With respect to variations in solar wetness, the Earth orbits in a tropical region of space. The topical solar wetness enables the Earth to constantly maintain a large body of water, unlike Mars, which periodically "dries out" in a semitropical orbit.

[Para 22] The invention may be appreciated as a discovery of the principles of nature governing the Earth's hydrostasis, as described above, combined with an inventive application of this discovery to the watering of the Moon, as described below.

[Para 23] The Moon orbits in substantially the same tropical region of solar wetness as the Earth. But the Moon is unable to initiate geopooling on its own due to salt deficiencies. It is this problem, more so than a difference in gravity, that explains why the Moon remains substantially dry, in contrast to the Earth. The invention solves this "dryness" problem by means of depositing a deliquescent substance having predetermined deliquescent properties on a surface of the Moon to collect ambient moisture from outer space. An exemplary deliquescent substance is magnesium chloride ($MgCl_2$). The collected water can then be desalinated or used in saline form.

[Para 24] 2. Preferred Embodiment

[Para 25] Substances that readily absorb ambient water moisture from a surrounding environment are called hygroscopic, also known as drying agents or desiccants. A deliquescent substance is one that not only absorbs water from the surroundings (i.e., is hygroscopic) but also dissolves into the absorbed water to form a pool.

[Para 26] Some drying agents work to remove water by hydration and others work by chemical conversion. Some drying agents are not only hygroscopic but are also deliquescent. A large number of drying agents are known to chemists that are able to remove ambient water in a high vacuum environment. A large number of deliquescent substances are also known to chemists. The invention is not limited to a particular deliquescent substance, hygroscopic substance, drying agent, or desiccant. Candidate substances may be selected for various chemical and physical properties, such as binding affinity for water, usefulness in high vacuum, saltwater vapor pressure, solubility in water, light weight (for transport), non-toxicity, and ease of desalination.

[Para 27] For the purposes of the preferred embodiment, magnesium chloride ($MgCl_2$) is a preferred deliquescent substance. Calcium chloride ($CaCl_2$), lithium chloride (LiCl), and magnesium perchlorate $Mg(ClO_4)_2$ are notable alternatives, among many others. Although these substances exhibit their deliquescent properties in hydrated forms, anhydrous forms also bind the water of hydration.

[Para 28] Substances such as magnesium chloride, calcium chloride, and lithium chloride, that give up water reversibly, are preferable from the perspective of ease of regeneration (e.g., by reverse osmosis) compared to substances such as phosphorous pentoxide (P_2O_5) or barium oxide (BaO), that undergo chemical transformation when binding water; either type may be advantageously employed to collect some amount of water. Hygroscopic substances that are insoluble in water, e.g., calcium sulfate ($CaSO_4$), are also notable.

[Para 29] According to the invention, a mixture may be made of any combination of a hygroscopic substance, deliquescent substance, and water soluble salt. Mixtures of highly soluble salts (e.g., NaCl) and deliquescent substances are preferred.

[Para 30] A table compiled by John H. Yoe lists drying agents relying “on chemical action (absorption) and for their drying action” according to their efficiency; he also lists drying agents relying on physical action (adsorption) for their drying action; he notes that some drying agents relying on chemical action may also rely on physical action. (Yoe, J.H. "Efficiency of Drying Agents." Handbook of Chemistry and Physics. 72nd ed. Boca Raton, FL: CRC Press, 1991. p. 15-22.)

[Para 31] FIG. 1 shows the Earth **E** in orbit **A** around the Sun **S**, and the Moon **M** in orbit **B** around the Earth **E**. Referring to FIG. 1, a preferred lunar site for depositing the magnesium chloride on the surface of the Moon is found on a surface of the Moon facing the Moon's trajectory, called the Moon's trajectory face 1. Although other surfaces of the Moon may be advantageously selected, a particular advantage of depositing the preferred deliquescent substance on the Moon's trajectory face 1 is that this surface faces forward in the direction of the Moon's course in orbit as the Moon encounters solar moisture from outer space (as the Moon **M** travels its orbital path **B**). In other words, the trajectory face serves as the palm side of a catcher's mitt formed by the Moon as it sweeps out a toroidal volume along its orbital path. In effect, depositing the preferred deliquescent substance on the surface of the Moon enables the encountered solar moisture to stick to the glove, meaning, to the surface of the Moon.

[Para 32] Referring to FIG. 2A, a preferred means of depositing the preferred deliquescent substance **$MgCl_2$** on a preselected surface **2** of the Moon **M** is by rocket **R**. Delivery of the preferred deliquescent substance **$MgCl_2$** to the surface **2** of the Moon **M** by rocket **R** is completed by any means of distributing the preferred deliquescent substance **$MgCl_2$** on the preselected surface 2. Referring to FIG. 2A, an exemplary means of distribution is by detonating the rocket **R** over the surface **2** of the Moon **M**, so that the detonated rocket **D** emits a shower **3** of the preferred deliquescent substance **$MgCl_2$** onto the preselected surface **2** of the Moon **M**. Other means include rocket impact, robotic distribution, and manual distribution by astronauts after landing on the Moon **M**.

[Para 33] Referring to FIG. 2B, the preferred deliquescent substance **$MgCl_2$** is shown distributed on the preselected surface **2** of the Moon **M**. Referring to FIG. 2C, according to the invention's theory of operation as described above, the preferred deliquescent substance **$MgCl_2$** waters the Moon **M** by collecting solar moisture **W** from outer space and forming a pool of saltwater **$MgCl_2 + H_2O$** on the surface **2** of the Moon **M**.

[Para 34] 3. Geopooling on the Moon

[Para 35] In theory, an ocean of water on the Moon could support an Earth-like atmosphere and temperature on the Moon by retaining dissolved gasses. It would be impractical, however, to transport an ocean's worth of salt to the Moon in order to collect and retain a lunar ocean.

[Para 36] Though presenting an alternative to transport, mining a preferred deliquescent substance on the Moon or forming it chemically from lunar matter would not be practical on an oceanic scale.

[Para 37] To overcome this limitation in ocean formation, the principle of geopooling may be employed advantageously. Referring to FIG. 3A, a lunar salt deposit **4** of a water soluble salt (e.g., **NaCl**) is located geologically near the surface **5**. Referring to FIG. 3B, a deliquescent substance (e.g., **$MgCl_2$**) is deposited on the surface **5** above the lunar salt deposit **4**. Referring to FIG. 3C, the deliquescent substance collects solar moisture from outer space, forming a small pool of saltwater (e.g., **$MgCl_2 + H_2O$**) on the surface **5**. Referring to Fig. 3D, fluidic communication **6** is established between the pool of saltwater on the surface **5** and the lunar salt deposit **4** underneath. Fluidic communication **6** can be established by means of digging, drilling, blasting, pumping, or by seepage of surface water. As a consequence of fluidic communication **6**, a larger pool of water ("ocean") (e.g., **$NaCl + MgCl_2 + H_2O$**) is formed as fluid on the surface **5** leaches salt from the lunar salt deposit **4** underneath. The growing pool will continue to collect more and more ambient water from outer space until hydrostasis is achieved.

[Para 38] 4. Other Considerations

[Para 39] In order for a deliquescent substance to optimally collect solar moisture from outer space on a surface of the Moon, it is preferable that the surface temperature should not exceed the boiling point of saltwater. It is also preferable that the surface temperature should not fall below the freezing point of saltwater. For this reason, it is preferable to locate a lunar surface such that temperatures will fall within predetermined ranges during the collection of solar moisture. Another alternative is to employ a shelter or insulation to guard against extremes of temperature.

[Para 40] A saltwater liquid of low vapor pressure is desirable for optimal collection of ambient solar moisture. It is therefore preferable to maintain a high concentration of salt to maintain a low vapor pressure. In other words, as a pool of water is collected, keeping the pool salty helps to maintain a low vapor pressure. According to Raoult's law, the vapor pressure of water decreases as the number of salt ion molecules dissolved in the water increases; the freezing point of the water also decreases, and the boiling point increases. Salt is excluded when water freezes or boils.

[Para 41] According to the invention, a deliquescent substance functions to initiate water collection, with formation of a pool of water. However, once a pool or atmosphere is formed, these too will collect solar moisture as long as outer space is wet enough. For this reason, depositing saltwater on the lunar surface will also aid in moisture collection. But saltwater having a high concentration of a deliquescent substance may advantageously have a lower vapor pressure than observed for other solutes and than predicted for an ideal solution by Raoult's law; a low vapor pressure is advantageous in initially collecting a net amount of solar moisture from outer space, when the atmospheric vapor pressure is lowest. In view of the invention, it will be a matter of ordinary skill for one skilled in the art of physical chemistry to select candidate substances based on their saltwater vapor pressure at lunar temperatures at given concentrations.

[Para 42] The efficiency of candidate substances can be tested by one of ordinary skill in view of the invention by measuring the efficiency of water collection, including with the aid of monitoring sensors placed on the Moon. Sensors on the Moon can also be employed to detect locations on the lunar surface encountering a greater flux of solar moisture. It will be obvious to one of ordinary skill to try various mixtures and preparations of substances for their water-collecting ability in view of the invention. For example, it is found that calcium chloride has a greater efficiency as a drying agent when prepared in fused form compared to in granular form. (See Yoe, J.H. Ibid.) Therefore, it will be obvious to one of ordinary skill to try various preparations and to test them for their efficiency.

[Para 43] Desalinated water can be stored in a reservoir and the deliquescent substance reused to collect more water from outer space. In this manner a small quantity of deliquescent substance transported to the Moon can be used over and over again to collect a relatively large amount of water.

[Para 44] Moisture sensors, whether placed on celestial bodies or in orbit, can be used to collect meteorological data concerning solar moisture.

[Para 45] 5. Comparison to NASA's Theory

[Para 46] NASA teaches that billions of years ago water-bearing comets and asteroids pummeled the Earth and Moon, leaving an abundance of water, but that the Moon did not retain water as the Earth did, due to a weaker gravity. Today, some scientists believe remnants of water delivered to the Moon in this fashion may remain in shadowy recesses at the poles of the Moon, where it is freezing cold and the Sun's light does not shine.

[Para 47] In contrast, the theory of the invention is that the Earth's water is maintained in relation to an ambient process of hydrostasis with respect to solar moisture in the Earth's orbital path. Importantly, unlike the theory adopted by NASA, this theory relies on principles of equilibrium to explain the Earth's water balance. Similarly, with regard to the speculation that ice may be present in polar recesses on the Moon, the present teaching is more likely attribute the possibility of such ice to a solid state condensation of solar moisture, based on equilibrium principles, rather than to delivery by comets.

[Para 48] 6. Other Embodiments

[Para 49] The invention is titled a method of watering the Moon to emphasize the preferred embodiment. But a more general title for the invention is a method of wetting a space bound body with ambient moisture from outer space. Exemplary bodies include celestial bodies, spacecraft, and artificial satellites. Importantly, the invention is not limited to a use of deliquescent substances to effectuate a wetting of the body.

[Para 50] For example, one skilled in the art of nanotechnology will appreciate that surfaces of a body may be coated with a nanocoating or nanostructures to collect solar moisture encountered in the body's path when traveling through space. The surfaces are preferably oriented in the direction of travel. Additionally, one skilled in the art of microfluidics will appreciate that microfluidics can be integrated with nanotechnology to channel amounts of collected moisture to reservoirs.

[Para 51] 7. Note on Related Art

[Para 52] According to Wikipedia: "In 1960 Robert W. Bussard proposed the Bussard ramjet, in which a huge scoop would collect the diffuse hydrogen in interstellar space, "burn" it using a proton-proton fusion reaction, and expel it out of the back." The Bussard ramjet is related in that it teaches a catcher's mitt type collection of an ambient molecule from outer space, in this case hydrogen. Known as a "ram scoop", the mitt in this case is formed by an electromagnetic field.

[Para 53] According to Lunarpedia: "At the lunar poles there are believed to be regions which never receive direct sunlight. If they don't receive significant warming from higher elevation surfaces that are in direct sunlight, they would be equilibrated only with the thermal background radiation of deep space at 2-3 K (-270 degrees C), and would likely form cold traps holding volatile materials."

What is claimed is:

[Claim 1] A method of watering the Moon, comprising:

(a) depositing a deliquescent substance having predetermined deliquescent properties on a preselected lunar surface; and,

(b) collecting ambient moisture from outer space by means of the deliquescent properties of the deliquescent substance.

[Claim 2] The method of Claim 1 wherein the deliquescent substance is selected from the group consisting of calcium chloride ($CaCl_2$), lithium chloride ($LiCl$), magnesium chloride ($MgCl_2$), magnesium perchlorate $Mg(ClO_4)_2$, and phosphorous pentoxide (P_2O_5).

[Claim 3] The method of Claim 1 wherein the preselected lunar surface faces forward with respect to the Moon's course in orbit around the Earth.

[Claim 4] A method of watering the Moon, comprising:

(a) locating a deposit of a water soluble salt near a lunar surface;

(b) seeding the lunar surface above the deposit with a deliquescent substance;

(c) collecting solar moisture from outer space by means of the deliquescent substance to form a pool of saltwater on the lunar surface;

(d) establishing fluidic communication between the pool of saltwater on the lunar surface and the deposit of salt underneath; and,

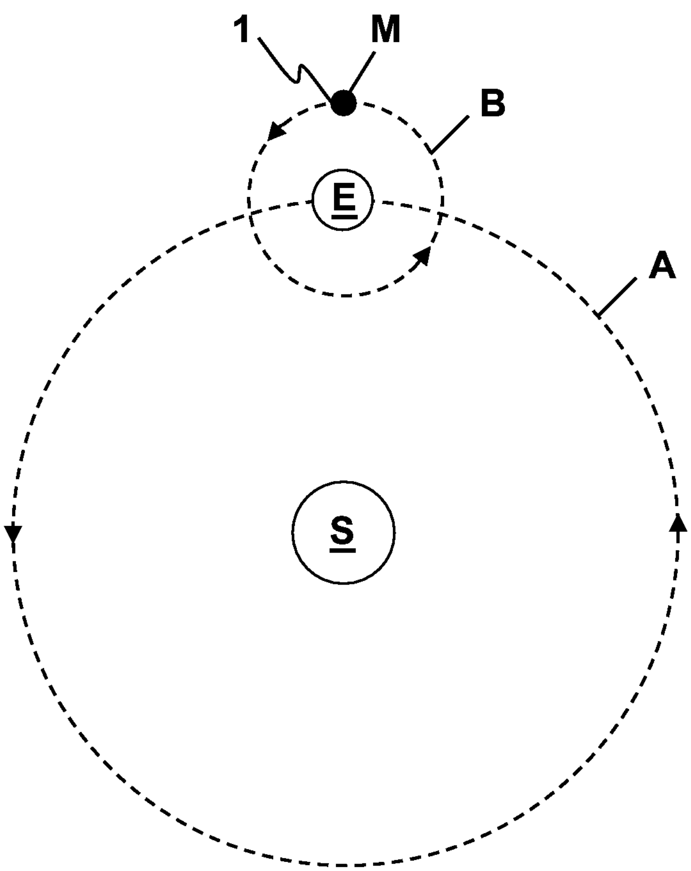
(e) leaching salt from the deposit by means of fluidic communication with the pool of saltwater,

whereby salt from the deposit maintains a saltiness and low vapor pressure of the pool to help sustain a continued growth of the pool.

[Claim 5] The method of Claim 4 wherein the water soluble salt is selected from the group consisting of sodium chloride ($NaCl$) and potassium chloride (KCl).

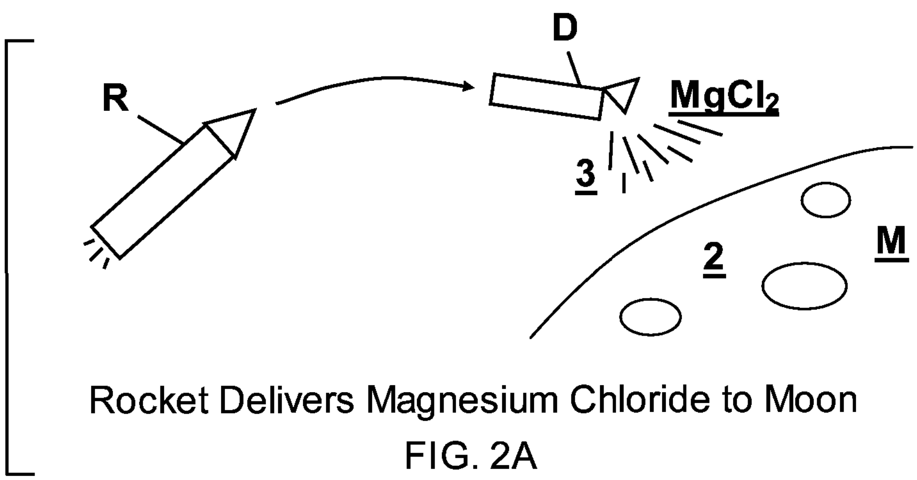
ABSTRACT

To water the Moon, faint ambient water moisture contained by outer space is collected on a preselected surface of the Moon by means of depositing a deliquescent substance thereon that is suitable for use as a drying agent in high vacuum.



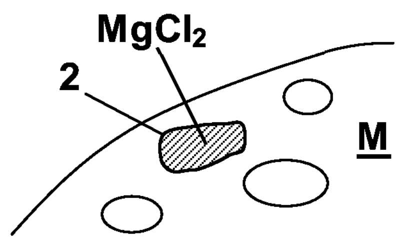
Earth and Moon Orbits

FIG. 1



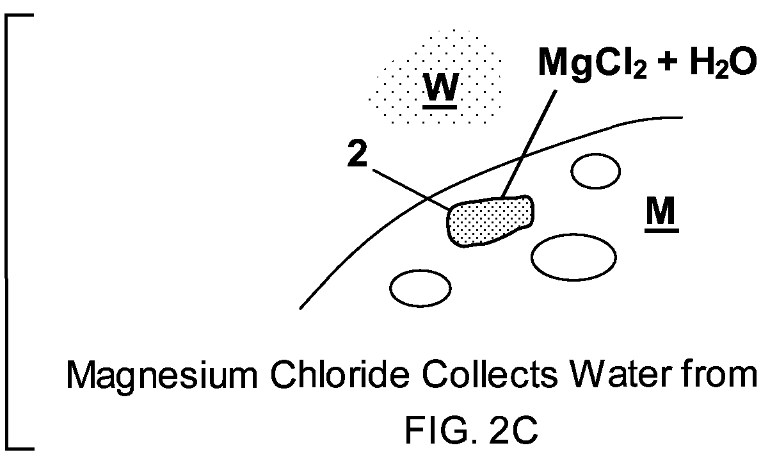
Rocket Delivers Magnesium Chloride to Moon

FIG. 2A



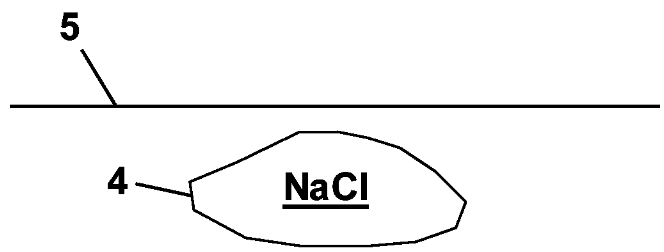
Magnesium Chloride Deposited on Lunar Surface

FIG. 2B



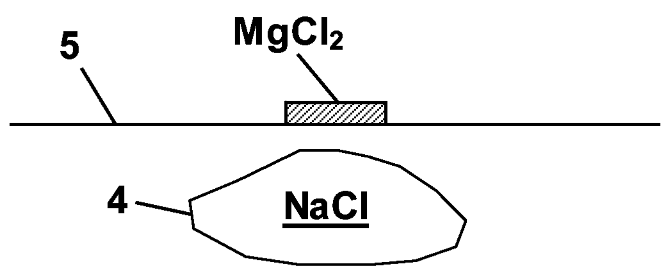
Magnesium Chloride Collects Water from Space

FIG. 2C



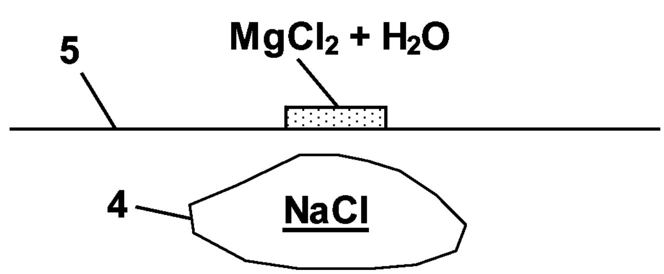
Water Soluble Salt Located Near Lunar Surface

FIG. 3A



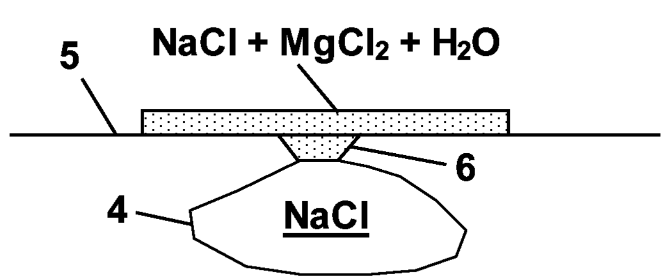
Surface Seeded with Deliquescent Substance

FIG. 3B



Surface Collects Solar Moisture

FIG. 3C



Surface Water Leaches Salt Underneath

FIG. 3D