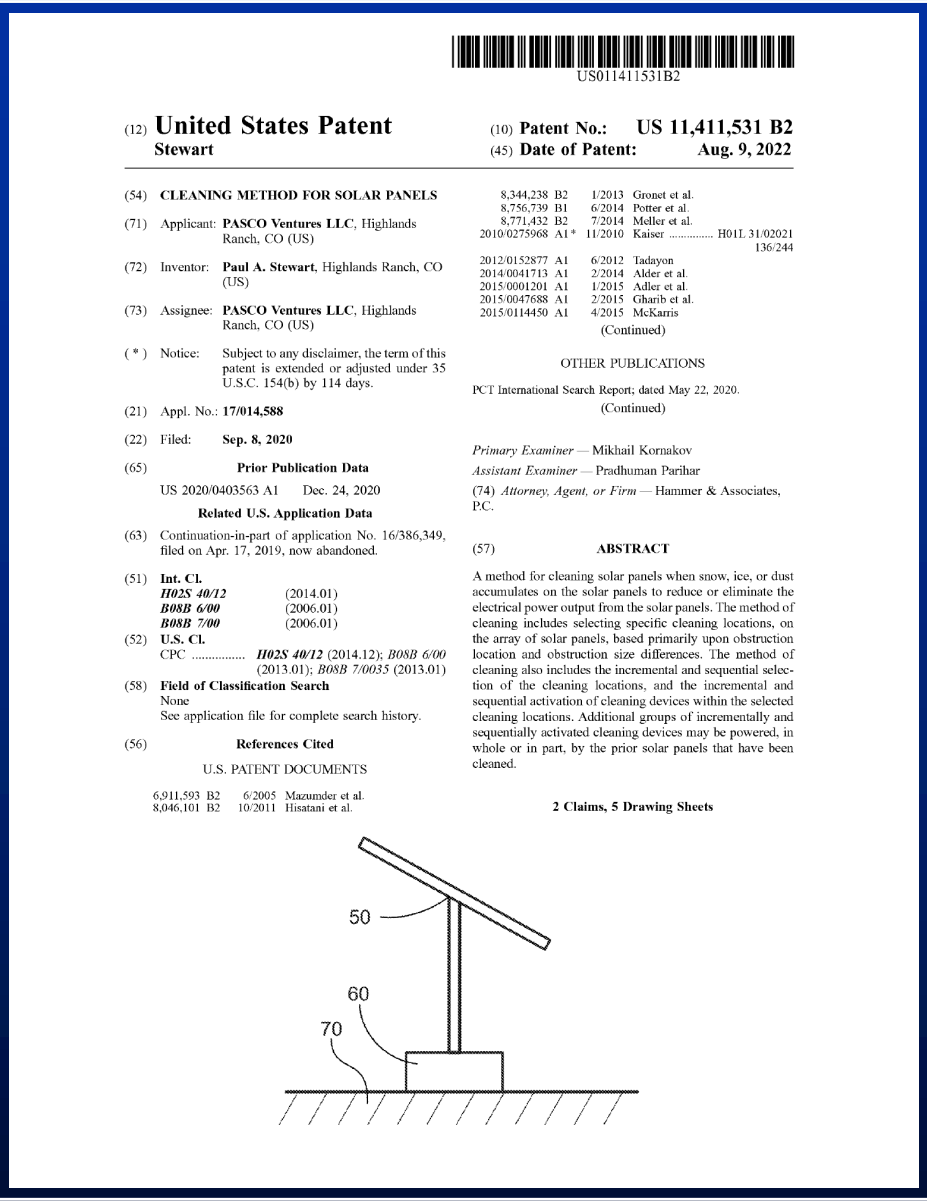
US Patent 11,411,531
(titled *Cleaning Method for Solar Panels*)

*Also referred to as the Solar Panel Cleaning Invention … or "**SPCI**".*



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Stewart

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(54) **CLEANING METHOD FOR SOLAR PANELS**

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(22) Filed: **Sep. 8, 2020**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 16/386,349, filed on Apr. 17, 2019, now abandoned.

(51) **Int. Cl.**
H02S 40/12 (2014.01)
B08B 6/00 (2006.01)
B08B 7/00 (2006.01)

(52) **U.S. Cl.**
CPC ***H02S 40/12*** (2014.12); *B08B 6/00* (2013.01); *B08B 7/0035* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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(57) **ABSTRACT**

A method for cleaning solar panels when snow, ice, or dust accumulates on the solar panels to reduce or eliminate the electrical power output from the solar panels. The method of cleaning includes selecting specific cleaning locations, on the array of solar panels, based primarily upon obstruction location and obstruction size differences. The method of cleaning also includes the incremental and sequential selection of the cleaning locations, and the incremental and sequential activation of cleaning devices within the selected cleaning locations. Additional groups of incrementally and sequentially activated cleaning devices may be powered, in whole or in part, by the prior solar panels that have been cleaned.

2 Claims, 5 Drawing Sheets

*A total of **46 countries** now **have SPCI patent coverage** issued or filed, with patent coverage in those countries which together account for an estimated 80-90% of projected future global solar panel installations.*

Meet Paul A. Stewart, SPCI inventor, skiing with his wife at Telluride …

"I was often frustrated after we had heavy frost or snowfall in our Denver-area neighborhood because our Tesla solar panels would remain covered for 1-5 days afterwards, rendering our 50-panel solar power system incapable of generating electricity. Those 50 solar panels on the roof of my home were covered for 31 days in 2022, 30 days in 2023, 31 days in 2024, and 30 days in 2025 – that's a ***month*** of lost power each year!

The irony was that snowstorms often gave way to clear-sky 'bluebird' days with intense sunlight that were perfect for solar energy generation, yet our solar panels couldn't harness that energy because they were still covered with snow!

While ascending on a ski lift with my wife at Telluride, I had an epiphany while looking down at all the snow-covered roofs below us. You ***don't*** have to clean your ***entire*** solar array of all the snow, frost, sand or dust that has accumulated – you just need to ***selectively*** clean just ***one or two*** panels, then use the power generated from the newly-cleaned panels to ***incrementally*** and ***sequentially*** clean obstructions from the ***remaining covered*** solar panels!"

Today: ***Wasted*** *Sunlight …*

It would be nice to flip a switch and heat your entire solar power array to melt all of the frost or snow that has accumulated on your solar panels. The problem is, doing it that way is inefficient because you usually end up consuming ***more*** electricity melting than you generate.

snow on solar panels

frost & snow

frost & snow

*But … if you **selectively** melt that frost & snow … starting with **just one or two panels** … and then use the power generated by the **newly-cleaned** panels to **incrementally** and **sequentially** clean those obstructions from the **remaining covered** solar panels, you can harness sunlight that goes wasted today!*

*Tomorrow: **Increase** Net Value of Annual Solar Power Generation by up to 7.3%*

In regions that experience seasonal snowfall, ***the value of annual total solar electricity generated – as measured in kilowatt-hours (kWh) – could experience a net increase of up to 7.3% when employing SPCI.*** (This 7.3% figure accounts for the energy consumed during the cleaning process and reflects a comparison with 'legacy' solar panels without SPCI.) The benefit is ***Billions of Dollars*** worth of incremental value of solar electricity generated for our world.

Illustration of the ‘old’ method in action

Before cleaning. Most of the solar panels on a roof are covered with snow.

Illustration of the ‘old’ method in action

In the ‘old’ cleaning method, heating elements heat the ***entire system*** of solar panels in the array, but the problem with heating the ***entire system*** like this is that it uses more energy melting the snow than you get back after melting the snow.

Legend:
Red = heater is melting frost, snow or other obstruction

Illustration of new SPCI ***incremental*** and ***sequential*** method in action

Step 1. *Incrementally* and *sequentially* select panels that are currently generating power to power selected panels for heating/cleaning; if no panels are currently generating power, then select one or more obstructed panels for initial heating.

Note: this illustrative example is just one permutation of many potential ways of implementing SPCI.

Illustration of new SPCI ***incremental*** and ***sequential*** method in action

Step 1. *Incrementally* and *sequentially* select panels that are currently generating power to power selected panels for heating/cleaning; if no panels are currently generating power, then select one or more obstructed panels for initial heating.

Legend:
Green = panel(s) generating power and NOT using any power to heat that(those) panel(s)

Note: this illustrative example is just one permutation of many potential ways of implementing SPCI.

Illustration of new SPCI ***incremental*** and ***sequential*** method in action

Step 1. *Incrementally* and *sequentially* select panels that are currently generating power to power selected panels for heating/cleaning; if no panels are currently generating power, then select one or more obstructed panels for initial heating.

Legend:
Green = panel(s) generating power and NOT using any power to heat that(those) panel(s)
Red = NO power being generated; heater is melting frost, snow or other obstruction

Note: this illustrative example is just one permutation of many potential ways of implementing SPCI.

Illustration of new SPCI ***incremental*** and ***sequential*** method in action

Step 2. Once the obstructed panels are clear, deactivate those heaters. These panels all now switch to power generation mode.

Legend:
Green = panel(s) generating power and NOT using any power to heat that(those) panel(s)

Note: this illustrative example is just one permutation of many potential ways of implementing SPCI.

Illustration of new SPCI ***incremental*** and ***sequential*** method in action

Step 3. Utilize the electricity produced by the now-active panels to ***incrementally*** and ***sequentially*** power the heaters on more obstructed solar panels, aiming to clear all of the snow-covered panels of their obstructions.

Legend:
Green = panel(s) generating power and NOT using any power to heat that(those) panel(s)
Red = NO power being generated; heater is melting frost, snow or other obstruction

Note: this illustrative example is just one permutation of many potential ways of implementing SPCI.

Illustration of new SPCI ***incremental*** and ***sequential*** method in action

Step 4. Continue this process, using the combined power from the previously cleared panels to clear subsequent panels. Repeat this cycle until all panels are obstruction-free and fully operational for power generation.

Legend:
Green = panel(s) generating power and NOT using any power to heat that(those) panel(s)

Note: this illustrative example is just one permutation of many potential ways of implementing SPCI.

Illustration of new SPCI ***incremental*** and ***sequential*** method in action

Step 5. Continue this process, using the combined power from the previously cleared panels to clear subsequent panels. Repeat this cycle until all panels are obstruction-free and fully operational for power generation.

Legend:
Green = panel(s) generating power and NOT using any power to heat that(those) panel(s)
Red = NO power being generated; heater is melting frost, snow or other obstruction

Note: this illustrative example is just one permutation of many potential ways of implementing SPCI.

Illustration of new SPCI ***incremental*** and ***sequential*** method in action

Step 6. Continue this process, using the combined power from the previously cleared panels to clear subsequent panels. Repeat this cycle until all panels are obstruction-free and fully operational for power generation.

Legend:
Green = panel(s) generating power and NOT using any power to heat that(those) panel(s)
Red = NO power being generated; heater is melting frost, snow or other obstruction

Note: this illustrative example is just one permutation of many potential ways of implementing SPCI.

Illustration of new SPCI ***incremental*** and ***sequential*** method in action

Step 7. Continue this process, using the combined power from the previously cleared panels to clear subsequent ones. Repeat this cycle until all panels are obstruction-free and fully operational for power generation.

Legend:
Green = panel(s) generating power and NOT using any power to heat that(those) panel(s)

Note: this illustrative example is just one permutation of many potential ways of implementing SPCI.

Cleaning Large Solar Farms …

Let's extrapolate from that one example house to large solar farms with ***thousands*** of panels. Snow and frost aren't the only culprits that reduce efficiency of solar panels; ***dust and sand can also cause significant fouling***. The same incremental and sequential concept applies by using different cleaning mechanisms (*e.g.*, electrostatic repulsion or mechanical cleaning instead of heaters). Implementation of SPCI could mitigate this fouling and result in significant power increases.

← Large solar farm

Dust & sand reduce efficiency of solar panels →

Two excerpts from MIT News Office article* by David L Chandler: *"How to clean solar panels without water"*

March 11, 2022

"… a 1 percent reduction in power, for a [single] 150-megawatt solar installation … could result in a $200,000 loss in annual revenue. The [MIT] researchers say that ***globally, a 3 to 4 percent reduction in power output from solar plants would amount to [an annual revenue] loss of between $3.3 billion and $5.5 billion***."

"… ***cleaning solar panels currently is estimated to use about 10 billion gallons of water per year*** — enough to supply drinking water for up to 2 million people."

* Full article available at https://news.mit.edu/2022/solar-panels-dust-magnets-0311

Solar Power in Space …

SPCI may also reduce the payload weight required for solar panels and batteries on future Moon, Mars, and other Space missions. This weight reduction would free up payload capacity, thus ***lowering the launch cost per usable kilogram.*** This could ***allow for other desired payload items*** that might otherwise be excluded from the same mission.

Mars faces similar challenges removing dust & sand from solar panels

This Patent Can Still Be Beneficial in Extremely-Snowy Areas

Some places in the world have too much snowfall to make it possible for SPCI to generate ***incrementally***-more electricity.

Nevertheless, homeowners, commercial building owners, and ski resort owners in areas with heavy snowfall might still choose to invest in and install SPCI. This is not only due to the convenience it offers but also because it promotes safety, eliminating the need for workers to physically shovel or rake snow off those roofs.

Identifying Future SPCI Infringers Will Be Straightforward

The SPCI inventor comments:

"I believe that SPCI will become a preferred embodiment in everything from residential solar installations … to giant solar farms around the world … and beyond to the Moon and Mars.

On the Earth, high-resolution overhead digital comparative imaging (*e.g.*, via aircraft, drones, and satellites) is now common, so identifying any future SPCI infringers down to the *per-panel* level will be relatively straightforward. Since my patent is a broad method patent, whether snow, ice, frost, dust, pollen, sand or something else causes the obstruction, whatever device or mechanism uses my *incremental* and *sequential* cleaning method will all be covered by my SPCI patent."

If your firm is interested in licensing or acquiring SPCI, please contact ...

Paul A. Stewart at PASCO Ventures LLC, Denver, CO

pas@pascoventures.com

To prioritize our response to you, please put the following words in the subject line of your email:

"*SPCI / Solar Panel Cleaning Invention*"

Albert Szent-Györgyi (1893-1986):

"*Discovery is seeing*
what everybody else has seen, and
thinking what nobody else has thought."