

EXHIBIT 3

**UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
ALEXANDRIA DIVISION**

RAI STRATEGIC HOLDINGS, INC. and)
R.J. REYNOLDS VAPOR COMPANY,)
Plaintiffs and Counterclaim Defendants,)
v.)
ALTRIA CLIENT SERVICES LLC; PHILIP)
MORRIS USA, INC.; and PHILIP MORRIS)
PRODUCTS S.A.,)
Defendants and Counterclaim Plaintiffs.)
_____)

Civil No. 1:20-cv-00393-LO-TCB

**EXPERT REPORT OF DR. THOMAS F. FULLER
REGARDING U.S. PATENT NO. 6,803,545**

Dated February 24, 2021 Thomas F. Fuller

Dr. Thomas F. Fuller

not be discharged at a current greater than 1000 milliamps (mA) or 1 amp. This is because discharging the battery at rates greater than 1 C could cause the battery to become hot, catch fire, or explode.” (’545 patent, col. 9, lines 18-28)

56. The ’545 patent specification further states that “[t]he electrical resistance heaters of the present invention draw peak discharge currents in the range of 15 to 30 C. This is well above industry norms of discharge rates of between 2 to 3 C for consumer products that are considered to require high discharge rates. Although lithium ion batteries are not intended to deliver the discharge rates required for electrical smoking systems, the electrically heated smoking device of the present invention provides an arrangement wherein lithium ion batteries can be used safely and effectively.” (’545 patent, col. 9, lines 28-37)

57. I disagree with the statement that lithium ion batteries were not necessarily intended to deliver the discharge rates required for electrical smoking systems at the time of the filing of the ’545 patent. This statement seems to be based on a incorrect or incomplete understanding of the lithium-ion batteries that were available at the time of the filing of the ’545 patent. As already discussed, at that time lithium-ion batteries were being used in high current medical device applications, and even Philip Morris had patents recognizing the use of lithium-ion batteries (e.g., Counts ’962 Patent).

58. Moreover, battery manufacturers generally do not provide a single value for the maximum discharge rate (C-rate) for batteries. Larger batteries typically are able to sustain larger currents. The rate at which current is drawn from the cell is normalized in terms of the capacity (size) of the cell in A-h. The reason for this is that the same discharge current may represent a very high rate of discharge for a small battery and a low rate of discharge for a large-capacity

battery. The normalized rate of charge or discharge is expressed as a C-rate, which is a multiple of the rated capacity. A rate of “1C” draws a current that is equal to the capacity expressed in Ah.

59. It is not accurate now, nor was it at the time of the '545 patent, to state without qualification that “manufacturers of lithium ion batteries recommend that the battery not be discharge at greater than 1C . . .” The more relevant question is whether the current draw is continuous or short term. For example, the same battery that can provide continuous discharge at 1C may be capable of 5C for short periods of time. The temperature of the cell can also be a factor in limiting the rate capability of the cell.

60. In addition to the cell chemistry (lithium-ion, lead-acid, NiCd, etc.), the design of the cell has a tremendous influence on the rate capability of the battery. Changing the thickness of electrodes and the separator can result in the same cell materials being able to discharge safely at much higher rates. See e.g., Fuller and Harb, *Electrochemical Engineering*, Wiley 2018, Ch. 8.. As an example, the battery used in the Honda Accord hybrid is capable of discharging at 60 C, https://www.gs-yuasa.com/en/newsrelease/article.php?ucode=gs160711142215_271. With the similar chemistry, another design (18650) is only rated for 3C for pulse discharges. <https://www.antbatt.com/wp-content/uploads/2019/09/18650-3.6V-2600mAh-Datasheet.pdf>.

61. The '545 patent claims to “prevent damage to the lithium ion power source” through the use of pulsed controller. ('545 patent, 11:35) Based on description in the specification, and its use in connection a “controller to control the flow of modulated pules of electrical power,” I understand the claim to be talking about preventing damage to the lithium-ion battery cells in the “electrical sense” –not physical protection, like a housing or case. Similarly, I would not expect this claim language to be directed to the preventing the normal wear and tear on a lithium-ion

battery based on use and aging. It is well-known that lithium-ion batteries lose capacity and power capability over time.

62. Damage, loss of capacity or complete failure, can be the result of negligence, carelessness or misuse; i.e., using the battery under conditions outside of the intended design parameters and conditions. It is well known that a lithium-ion battery can be designed to operate at rates of 15 to 30C for short periods of time, and that such techniques were known at the time of the filing of the '545 patent, *see e.g.*, the Takeuchi '953 patent discussed previously. My understanding from reading the '545 patent, however, is that the inventors are claiming to have invented a system using a pwm controller to prevent damage to a lithium-ion power source, where the battery is used well outside of its intended design envelope.

63. The '545 patent specification suggests to a POSA that the electrical smoking system claimed in the '545 patent are those systems having a peak current discharge rate in the range of 15 C to 30 C. Specifically, the '545 patent specification suggests that the problem purportedly solved by the '545 patent is “an arrangement wherein lithium ion batteries can be used safely and effectively” in an electrical smoking device having resistance heaters that require high peak discharge current values. ('545 patent, col. 9, lines 28-37)

64. But based on my review of the '545 patent specification, I did not identify a description of “a controller to control a flow of modulated pulses of electrical power from the lithium-ion power source to the at least one electrical resistance heating element to prevent damage to the lithium ion power source” as required by the last limitation of claim 1 of the '545 patent.

65. Instead, the '545 patent specification simply provides that for the electrical smoking system disclosed “the required current is drawn from the lithium ion battery for a short period of time on the order of approximately one to two seconds, preferably 1.6 seconds, which is too short

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