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BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte TOBIAS BRUNNER, THOMAS HAGLER,
SYLVAIN BASTIAN, and KLAUS SZOUCSEK

Appeal 2014-006506
Application 12/792,331
Technology Center 3700

Before JENNIFER D. BAHR, STEFAN STAICOVICI, and
ERIC C. JESCHKE, *Administrative Patent Judges*.

BAHR, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Tobias Brunner et al. (Appellants) appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 1–4. We have jurisdiction under 35 U.S.C. § 6(b). An oral hearing in accordance with 37 C.F.R. § 41.47 was held on November 15, 2016.

We REVERSE.

THE CLAIMED SUBJECT MATTER

Claim 1, reproduced below, is the only independent claim pending in the application and is illustrative of the claimed subject matter.

> 1. A method of operating a cryo-compressed tank, in which cryogenic hydrogen for supplying a consumer is storable at a supercritical pressure of 13 bar or more, the method comprising the acts of:
>
> conveying removed hydrogen that has been heated in an external heat exchanger to an in-tank heat exchanger provided in the cryo-compressed tank, through a tank pressure regulating valve and a branch line from the tank pressure regulating valve which branches off of a supply line leading to the consumer in order to compensate for pressure loss resulting from hydrogen removal from the cryo-compressed tank;
>
> introducing the removed hydrogen that has passed through the in-tank heat exchanger into the supply line downstream of the branch line; and
>
> either (a) guiding the removed amount of hydrogen that has passed through the external heat exchanger without limitation into the in-tank heat exchanger while the tank pressure regulating valve is completely open, or (b) having no return of the hydrogen that has passed through the external heat exchanger into the in-tank heat exchanger occur at all while the hydrogen passes through the external heat exchanger and then the tank pressure regulating valve to continue downstream in the supply line, wherein the tank pressure regulating valve is completely closed when a pressure in the cryo-compressed tank is above a higher tank pressure threshold value for opening the tank pressure regulating valve and is completely open when the pressure in the cryo-compressed tank is between the higher tank pressure threshold value and a lower tank pressure threshold value corresponding to a minimum desired pressure required by a hydrogen consumer for operation without functional limitation,
>
> wherein in the supply line downstream of the return of the removed hydrogen from the in-tank heat exchanger to the supply line, the supply line has a pressure regulating unit configured to supply hydrogen to the consumer at the desired pressure

> irrespective of changes in pressure in the supply line upstream of the pressure regulating unit caused by switching the tank pressure regulating valve.

REJECTIONS

I. Claims 1 and 2 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Moen (US 3,827,246, iss. Aug. 6, 1974) and Andonian (US 5,357,758, iss. Oct. 25, 1994).

II. Claims 3 and 4 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Moen, Andonian, and Immel (US 2005/0183425 A1, pub. Aug. 25, 2005).

DISCUSSION

Each of the Examiner's rejections is predicated in pertinent part on the determination that it would have been obvious "to have provided Moen with the operational setting of Andonian which has only a complete open and complete close[d] setting for the pressure regulating valve in order to reduce the duration of fluid travel through additional heat exchangers which result in a pressure loss of the fluid." Final Act. 4–5. According to the Examiner, "the operation of the valve only when the pressure within the tank crosses a threshold value increases the efficiency of the system." *Id.* at 5.

Appellants argue that "[m]odification of Moen to incorporate a binary open-or-closed valve" would result in "highly undesirable 'step' changes in downstream pressure . . . as the 'on/off' valve switches between its completely open and completely closed positions" and "therefore would eliminate Moen's ability to regulate pressure in a manner that maintains the desired constant pressure supply to consumers." Appeal Br. 12. Thus,

Appellants contend that "one of ordinary skill would not have sought to combine the teachings of Moen and Andonian because incorporation of an 'on/off' valve in the Moen pressure regulator 60 would have rendered Moen unsatisfactory for its intended purpose." *Id.*

An object of Moen's invention is to provide "a system wherein the heat imparted to the vessel contents [to maintain the desired operating pressure of the vessel] be controlled by effectively proportioning the flow or quantity of delivery fluid circulated through the heat exchanger means for that purpose." Moen, col. 2, ll. 33–38. Moen seeks to operate a pair of regulators (i.e., regulators 30 and 32 in the embodiment of Figure 1 or nozzles 80 and 82 of control regulator device 60 in the embodiment of Figure 2) "cooperatively such that the delivery of fluid is *constantly* proportioned between [heat exchanger coil 40 in the embodiment of Figure 1 or heat exchanger 40a in the embodiment of Figure 2] and the by-pass to maintain the desired operating pressure." *Id.*, col. 3, ll. 47–51; col. 6, ll. 3–37. In the embodiment of Figure 2 of Moen, control regulator device 60 is provided to proportion fluid flow between heat exchanger coil 40 within chamber 18a and bypass line 67. *Id.*, col. 5, ll. 29–40; *see also* Final Act. 3 (reading the claimed "tank pressure regulating valve" on Moen's regulator device 60). When the pressure within chamber 18a is below a predetermined value, seat 74 of control regulator device 60 is closed, and all fluid flows past open seat 76 through nozzle opening 82 and through heat exchanger 40a, thereby heating the contents of chamber 18a and increasing the chamber pressure. *Id.*, col. 6, ll. 3–14. Once the chamber pressure rises to a level sufficient to overcome the bias of spring 88, valve element 72 will be unseated from nozzle 80, thus permitting some of the fluid to flow

through bypass line 67 directly to discharge valve 36, while simultaneously moving toward nozzle 82 to reduce flow to coil 40a. *Id.*, col. 6, ll. 18–25. As the chamber pressure continues to rise, valve element 72 will move further toward nozzle 82, which will close completely when the chamber pressure reaches a predetermined upper limit. *Id.*, col. 6, ll. 26–30.

Thus, Moen's chamber pressure control regulator continuously proportions the flow of fluid from the chamber between the bypass line and the line leading to the heat exchanger coil within the chamber to maintain the chamber pressure continuously at the appropriate level. As Moen explains, valve element 72

> will continue to be adjusted between the opposite positions against the nozzle openings 80 and 82 so that fluid entering the inlet 62 is proportioned between outlets 64 and 66 of the regulator, *causing only that amount of fluid to pass through the coil 40a necessary to maintain the desired operating pressure.*

Id., col. 6, ll. 31–37 (boldface omitted, emphasis added).

Replacing Moen's continuously adjustable control regulator device 60 with an on/off valve having only a completely open position and a completely closed position, as proposed by the Examiner, would destroy the capability of the regulator to constantly proportion the flow of the fluid between the heat exchanger coil within the chamber and the bypass line to maintain the desired operating pressure, which, as noted above, is an object of Moen's invention. Thus, we agree with Appellants that a person of ordinary skill in the art would not have been prompted to make such a modification.

The Examiner asserts that passing fluid through the long conduit leading to the tank heat exchanger in Moen causes a pressure loss and that "[a]llowing a greater amount of fluid to use the bypass conduit will result in

avoiding this pressure loss." Ans. 10. However, the Examiner does not provide any evidence or technical reasoning explaining why modifying Moen to provide a binary on/off tank pressure regulating valve having only a completely open position and a completely closed position would allow a greater amount of fluid to use the bypass conduit. As already noted above, Moen discloses that operation of its continuously adjustable regulator 60 causes "only that amount of fluid to pass through the coil 40a necessary to maintain the desired operating pressure." Moen, col. 6, ll. 31–37 (boldface omitted, emphasis added). The Examiner's articulated reason for making the modification — "to reduce the duration of fluid travel through additional heat exchangers which result in a pressure loss of the fluid" and thereby increase the efficiency of the system by operating the valve only when the tank pressure crosses a threshold value (Final Act. 4–5; Ans. 5) — lacks rational underpinnings, for the reasons set forth by Appellants on page 8 of the Reply Brief.

For the above reasons, the Examiner fails to establish that the subject matter of claims 1–4 would have been obvious. Accordingly, we do not sustain the rejection of claims 1 and 2 under 35 U.S.C. § 103(a) as unpatentable over Moen and Andonian or the rejection of claims 3 and 4 under 35 U.S.C. § 103(a) as unpatentable over Moen, Andonian, and Immel.

DECISION

The Examiner's decision rejecting claims 1–4 is reversed.

REVERSED