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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte BROCK ALAN FORREST,
JEREMY ERON FETVEDT, and
PETER MICHAEL McGRODDY

Appeal 2024-002039
Application 17/832,247
Technology Center 3700

Before JAMES P. CALVE, BRADLEY B. BAYAT, and
SHEILA F. McSHANE, *Administrative Patent Judges*.

CALVE, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the decision of the Examiner to reject claims 27–33 and 35, which are all of the pending claims on appeal.[2] *See* Appeal Br. 1; Final Act. 2. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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[1] "Appellant" refers to "applicant" as defined in 37 C.F.R. § 1.42(a). Appellant identifies 8 Rivers Capital, LLC as the real party in interest in this appeal. Appeal Br. 1.

[2] Claims 1–26 are cancelled. *See* Appeal Br. 20 (Claims App.). Claims 34 and 36–38 are withdrawn from consideration. *See* Final Act. 2.

CLAIMED SUBJECT MATTER

Claim 27, the sole independent claim, is reproduced below.

> 27. A method for heating a stream, the method comprising:
> compressing a stream comprising CO_2 to form a compressed stream comprising CO_2;
> firstly, heating the compressed stream comprising CO_2 in a recuperator heat exchanger with heat withdrawn from a stream of combustion products arising from combustion of a first fuel source; and
> secondly, heating the compressed stream comprising CO_2 with heat obtained by oxidizing, without substantial combustion, a second fuel source that is a dilute stream of one or more gaseous hydrocarbons, said oxidizing being carried out separate from the combustion of the first fuel source.

Appeal Br. 20 (Claims App.).

REJECTIONS

Claims 27–33 and 35 are rejected under 35 U.S.C. § 112(a) as lacking a written description of the claimed subject matter.

Claims 27–33 and 35 are rejected under 35 U.S.C. § 112(b) as being indefinite for failing to particularly point out and distinctly claim the subject matter of the invention.

Claims 27, 30, and 31 are rejected under 35 U.S.C. § 103 as being unpatentable over Allam (US 2013/0205746 A1, pub. Aug. 15, 2013) and Gerhold (US 2003/0217555 A1, pub. Nov. 27, 2003).

Claim 28 is rejected under 35 U.S.C. § 103 as being unpatentable over Allam, Gerhold, and White (US 7,640,739 B2, iss. Jan. 5, 2010).

Claim 29 is rejected under 35 U.S.C. § 103 as being unpatentable over Allam, Gerhold, and Maslov (US 2013/0236371 A1, pub. Sept. 12, 2013).

Claims 32 and 35 are rejected under 35 U.S.C. § 103 as being unpatentable over Allam, Gerhold, and Kesseli (US 6,895,760 B2, iss. May 24, 2005).

Claim 33 is rejected under 35 U.S.C. § 103 as being unpatentable over Allam, Gerhold, Kesseli, and Maslov.

Claims 27–33 and 35 are rejected on the ground of nonstatutory double patenting over claims 1–6 and 8 of Forrest (US 11,359,541 B2, June 14, 2022) in view of Gerhold.

ANALYSIS

Written Description Rejection of Claims 27–33 and 35

The Examiner determines that "heat obtained by oxidizing, without substantial combustion, a second fuel source" is not described sufficiently in the Specification. Final Act. 8. The Examiner finds that the Specification describes "thermal oxidation takes place without substantial combustion in that the conditions do not allow for formation of a sustained flame." *Id.* (quoting Spec. 14:14–15). The Examiner finds that "there is no disclosure of the steps applied to achieve thermal oxidation without formation of a sustained flame . . . the specification does not provide enough detail to conclude that the [inventors] had possession of the claimed invention." *Id.*

We agree with Appellant that the Specification describes this subject matter. Appeal Br. 6–7. A recycle CO_2 stream is combined with a dilute hydrocarbon stream 171, and the mixture is sent through heat exchanger 120 where it is heated by turbine exhaust to the point that hydrocarbons in dilute hydrocarbon stream 170 undergo thermal oxidation, without substantial combustion, which the Specification describes as less than 5% by volume of the hydrocarbon compounds may combust. Spec. 13:28–14:22.

The Specification further describes the thermal oxidation process as occurring without substantial combustion because conditions for combustion are not met. The mixture of recycle CO_2 stream and dilute hydrocarbon stream is controlled so the total hydrocarbon content of the mixture is below the lower explosive level ("LEL"). Spec. 15:4–13. Thus, combustion does not occur when the mixture is heated in heat exchanger 120, and the process oxidizes the dilute hydrocarbons to CO_2 and water and produces sensible heat for the recycle CO_2 so the heat produced by the turbine exhaust can be preserved and used downstream in the heat exchanger. *Id*. at 15:14–26.

The Examiner further finds that it is "not clear that applicants possessed the invention of oxidizing a hydrocarbon without substantial combustion, because once the reaction is started – it will proceed to completion in presence of a sufficient amount of oxygen." Final Act. 8–9.

We agree with Appellant that the Specification describes a stream of dilute hydrocarbons that is maintained at a concentration of hydrocarbons that is below the LEL after the stream is mixed with a recycle CO_2 stream and sent through the heat exchanger with an entrained amount of residual O_2 at a very small concentration. Spec. 7:29–8:5, 14:26–15:26; Appeal Br. 3.

The thermal oxidation reactions are enabled by operating power cycle combustor 100 with an excess of O_2 that results in residual O_2 in the recycle CO_2 stream at very small concentrations of about 0.01% by volume to about 10% by volume, about 0.1% by volume to about 8% by volume, or about 0.2% by volume to about 5% by volume. This residual O_2 causes the hydrocarbons in the dilute hydrocarbon stream that is entrained with the recycle CO_2 stream to begin to oxidize in the channels of the power cycle heat exchangers as the hydrocarbons are heated. Spec. 14:26–15:3.

Accordingly, we do not sustain the rejection of claims 27–33 and 35 for lack of written description.

Indefiniteness Rejection of Claims 27–33 and 35

The Examiner determines that claim 27 is indefinite because "heat obtained by oxidizing, without substantial combustion, a second fuel source" is not understood to what degree "without substantial combustion" occurs, and the Specification does not define "substantial" but only gives examples of percentages of hydrocarbon compounds that may combust. Final Act. 9.

We agree with Appellant that the Specification describes oxidation of hydrocarbon compounds in a dilute hydrocarbon stream being *without substantial combustion* to mean at least 95% of the hydrocarbon compounds by volume undergo thermal oxidation while less than 5% by volume of the hydrocarbon compounds may combust. Appeal Br. 7; Spec. 14:12–20. This description and the ranges provide objective boundaries and guidance for a skilled artisan to understand what is meant by oxidation of the hydrocarbon compounds in the dilute hydrocarbon stream "without substantial oxidation." *See* MPEP § 2173.05(b)(I); *see also Niazi Licensing Corp. v. St. Jude Med. S.C., Inc.*, 30 F.4th 1339, 1347–49 (Fed. Cir. 2022) (explaining that terms of degree do not have to be defined with mathematical precision where they provide enough certainty in the context of the invention). Accordingly, we do not sustain the rejection of claims 27–33 and 35 for indefiniteness.

Obviousness of Claims 27, 30, and 31 Over Allam and Gerhold

The Examiner takes the position that Allam teaches partial oxidation reactor 4 heats a compressed stream of CO_2 with heat obtained by oxidizing, without substantial combustion, second fuel source 26 that is a dilute stream of hydrocarbons. Final Act. 11 (citing Allam ¶ 88, Fig. 1).

We agree with Appellant that Allam's partial oxidation ("POX") reactor 4 performs a partial oxidation that *combusts* part of the fuel in the reactor to produce a stream of partial oxidation products. Appeal Br. 8–10 (citing Allam ¶¶ 6, 109). Paragraph 109 of Allam indicates POX reactor 4 is a reactor that can *combust* a carbonaceous fuel. Thus, partial oxidation of a fuel in Allam is understood to mean that part of the fuel in POX reactor 4 is combusted and the rest of the fuel is not combusted. The Examiner has not shown that POX reactor 4 oxidizes a fuel without substantial combustion so less than 5% of the fuel is combusted in POX reactor 4.

Accordingly, we do not sustain the rejection of claims 27, 30, and 31.

Rejections of Dependent Claims 28, 29, 32, 33, and 35

The Examiner's reliance on White to teach the limitations of claim 28, Maslov to teach the limitations of claim 29, Kesseli to teach the limitations of claims 32 and 35, and Maslov to teach the limitations of claim 33 does not cure the above-noted deficiencies in the rejection of independent claim 27 from which these claims all depend. Accordingly, we do not sustain the rejection of claims 28, 29, 32, 33, and 35.

Double Patenting over Forrest and Gerhold

We agree with the Examiner that claim 1 of Forest recites a method that performs the claimed steps of compressing a stream comprising CO_2 to form a compressed stream of CO_2, heating the compressed stream of CO_2 in a recuperator heat exchanger with heat withdrawn from a stream of products of combustion from a first fuel source, and heating the stream of compressed CO_2 with heat from a second fuel source of a dilute stream of hydrocarbons that is oxidized without substantial combustion, as recited in claim 27. Final Act. 5; Ans. 3.

The fact that claim 1 of Forrest recites a power production method does not alter the fact that it recites the steps of claim 27 of compressing a stream of CO_2 and heating the compressed stream in a recuperator heat exchanger with the heat of combustion products and by oxidizing a dilute hydrocarbon stream without substantial combustion. Ans. 3 (the patented claims may be used to anticipate the present claims); *Abbvie Inc. v. The Mathilda and Terence Kennedy Institute of Rheumatology Trust*, 764 F.3d 1366, 1374(Fed. Cir. 2014) (a later claim that is not patentably distinct from or anticipated by an earlier claim is invalid for obviousness-type double patenting) (citations omitted). The Examiner also reasonably determines that using the method of claim 1 of Forrest to heat a stream would have been obvious to a skilled artisan who would know that heating a stream is a step required for power production, so the method of claim 1 of Forrest would have been obvious to use to perform the method of claim 27. Final Act. 6.

Accordingly, we sustain the rejection of claim 27, which we select as representative of the claims rejected on this ground, where Appellant argues the rejected claims as a group. Appeal Br. 4–5; 37 C.F.R. § 41.37(c)(1)(iv) (2023). Claims 28–33 and 35 fall with claim 27.

CONCLUSION

We reverse the rejection of claims 27–33 and 35 under 35 U.S.C. § 112(a) as lacking a written description of the claimed subject matter.

We reverse the rejection of claims 27–33 and 35 under 35 U.S.C. § 112(b) as being indefinite for failing to particularly point out and distinctly claim the subject matter of the invention.

We reverse the rejection of claims 27, 30, and 31 under 35 U.S.C. § 103 as being unpatentable over Allam and Gerhold.

We reverse the rejection of claim 28 under 35 U.S.C. § 103 as being unpatentable over Allam, Gerhold, and White.

We reverse the rejection of claim 29 under 35 U.S.C. § 103 as being unpatentable over Allam, Gerhold, and Maslov.

We reverse the rejection of claims 32 and 35 under 35 U.S.C. § 103 as being unpatentable over Allam, Gerhold, and Kesseli.

We reverse the rejection of claim 33 under 35 U.S.C. § 103 as being unpatentable over Allam, Gerhold, Kesseli, and Maslov.

We affirm the rejection of claims 27–33 and 35 on the ground of nonstatutory double patenting over claims 1–6 and 8 of Forrest in view of Gerhold.

DECISION SUMMARY

Claim(s) Rejected	**35 U.S.C. §**	**Reference(s)/ Basis**	**Affirmed**	**Reversed**
27–33, 35	112	Written Description		27–33, 35
27–33, 35	112	Indefiniteness		27–33, 35
27, 30, 31	103	Allam, Gerhold		27, 30, 31
28	103	Allam, Gerhold, White		28
29	103	Allam, Gerhold, Maslov		29
32, 35	103	Allam, Gerhold, Kesseli		32, 35
33	103	Allam, Gerhold, Kesseli, Maslov		33
27–33, 35		Nonstatutory Double patenting US 11,359,541 B2, Forrest	27–33, 35	
Overall Outcome			27–33, 35	

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED