

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 25

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MARK A. PAISLEY

Appeal No. 96-1165
Application 08/060,422¹

ON BRIEF

Before WEIFFENBACH, ELLIS and OWENS, *Administrative Patent Judges*.

WEIFFENBACH, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134 from the examiner's final rejection of claims 1-35, which are all of the claims in the application. We affirm-in-part.

¹ Application for patent filed May 11, 1993.

The Claimed Subject Matter

The claims on appeal are directed to a process for recovering sulfur from metal sulfates and recycling by-products of the process to reduce process fuel and energy requirements. Claims 1 and 30 are representative of the claimed subject matter and read as follows:

1. A process for sulfur recovery from sulfate comprising:
 - a) reducing a metal sulfate with a reducing agent comprising recycle carbon monoxide to form sulfur dioxide;
 - b) contacting said sulfur dioxide with carbonaceous matter to produce elemental sulfur and said recycle carbon monoxide, said recycle carbon monoxide being produced in sufficient quantity and purity for use in said metal sulfate reducing step; and
 - c) recycling said recycle carbon monoxide for use as a portion of said reducing agent in said step of reducing said metal sulfate to form said sulfur dioxide.

30. An apparatus for the conversion of metal sulfates to sulfur and carbon monoxide with recycle of said carbon monoxide comprising:
 - a) a first reactor for reducing a metal sulfate to a corresponding sulfide;
 - b) means for feeding said sulfate and a reducing agent to said first reactor;
 - c) means for contacting said sulfate and said reducing agent at a temperature and for a period of time, [sic] sufficient to effect reduction of said sulfate to the corresponding sulfide thereby producing a product stream containing said sulfide and waste by-products;
 - d) means for removing said product stream from said first reactor;
 - e) means for separating said sulfide from said waste by-products;
 - f) a second reactor for oxidizing said sulfide to a corresponding oxide;
 - g) means for feeding said sulfide and an oxidizing agent to said second reactor;
 - h) means for contacting said sulfide and said oxidizing agent at a temperature and for a period of time sufficient to effect oxidation of said sulfide to said corresponding oxide and sulfur dioxide thereby producing a product stream containing said oxide and sulfur dioxide;
 - i) means for removing said oxide and said sulfur dioxide from said second reactor;
 - j) means for separating said oxide from said sulfur dioxide;
 - k) a third reactor for reducing said sulfur dioxide to sulfur and carbon monoxide;

- l) means for feeding said sulfur dioxide and a carbonaceous material to said third reactor;
- m) means for contacting said sulfur dioxide and said reducing agent at a temperature and for a period of time sufficient to effect the production of a gaseous mixture of carbon monoxide and sulfur;
- n) means for removing said gaseous mixture from said third reactor;
- o) means for separating said sulfur from said carbon monoxide; and
- p) means for feeding said carbon monoxide to said first reactor.

References of Record

The following references of record are relied upon by the examiner as evidence of obviousness:

Gorin	3,729,551	Apr. 24, 1973
Kertamus et al. (Kertamus)	3,904,387	Sep. 9, 1975
Wheelock	4,102,989	Jul. 25, 1978

The Rejection

Claims 1-35 stand rejected under 35 U.S.C. § 103 as being unpatentable over Gorin in view of Kertamus and Wheelock.

Opinion

We have carefully considered the respective positions advanced by appellant and the examiner. For the reasons set forth below, we will affirm-in-part the examiner's rejection.

At the outset, we note that on page 9 of the brief, appellant states that the claims do not stand or fall together. The examiner, however, stated that the claims are presumed to stand or fall together because appellant failed "to present reasons in support thereof not [sic, nor] does the brief provide for different

groupings of the claims" (answer: p. 2, ¶ 5). We find that appellant has presented reasons for the separate patentability of claims 8, 10, 12, 15 and 32 on pages 31-35 of the brief. Accordingly, claims 2-7, 9, 11, 13, 14, 16-31 and 33-35 will stand or fall with claim 1 and claims 8, 10, 12, 15 and 32 will each be considered to the extent that separate patentability has been argued. *See In re Nielson*, 816 F.2d 1567, 1570, 2 USPQ2d 1525, 1526 (Fed. Cir. 1987); *In re Burckel*, 592 F.2d 1175, 1178-79, 201 USPQ 67, 70 (CCPA 1979) .

The process set forth in claim 1 is directed to the recovery of sulfur from a metal sulfate. The process comprises (a) reducing the metal sulfate with a reducing agent comprising carbon monoxide to form sulfur dioxide, (b) reducing sulfur dioxide with carbonaceous matter such as char or coke to produce elemental sulfur and carbon monoxide, and (c) recycling the carbon monoxide to step (a). According to appellant's specification, step (a) involves first reducing the metal sulfate to the metal sulfide in a first reactor using BTU fuel gas² and then feeding the metal sulfide to a second reactor to oxidize the metal sulfide with air to form a metal oxide and sulfur dioxide (see appellant's Figure; specification: p. 8, line 35 to p. 10, line 23).

Appellant argues that (i) the examiner "has imposed too high a level of skill to the person of ordinary skill in making the determination of obviousness" (brief: p. 10-11); (ii) the examiner has erroneously rejected claims 2-11, 13-17, 22, 23, 27-29, 31 and 32 on the basis of claim 1, step (a), over

² According to appellant, BTU fuel gas comprises a mixture of ethane, methane, hydrogen and carbon monoxide (specification: p. 12-13).

Gorin and erroneously rejected claims 4, 18-21 and 24-26 on the basis of claim 1, step (b), over Kertamus., i.e., the examiner has not considered the claims and references as a whole in determining obviousness and has therefore engaged in hindsight reconstruction of the claimed subject matter; (iii) Gorin, Kertamus and Wheelock taken alone or in combination fail to teach or suggest the claimed subject matter because none of the references suggest using recycled carbon monoxide in the reduction of the metal sulfate, neither Gorin nor Wheelock disclose reducing sulfur dioxide to form sulfur and carbon monoxide, and Kertamus does not mention sulfate processing to obtain sulfur dioxide; and (iv) since “Gorin, Kertamus, and Wheelock are directed to separate, distinct and complete invention [sic, inventions] with quite different objectives, it would not be obvious to add, modify, subtract or substitute portions of apparatus or change reactions schemes from any one reference to give the claimed invention” (brief: p. 26). We do not find any of these arguments persuasive.

Gorin discloses a process of reducing calcium sulfate in reactor **42** to calcium sulfide with a reducing agent which includes carbon monoxide, feeding the calcium sulfide to reactor **44** to oxidize the sulfide to calcium oxide and sulfur dioxide, feeding the sulfur dioxide into reactor **56** and reducing the sulfur dioxide to sulfur by subjecting the sulfur dioxide to a reducing gas and then to a Claus reaction (Fig. 2; col. 2, line 26-59; col. 4, lines 30-64). Gorin further teaches recovering gas from the conversion of sulfur dioxide to sulfur and recycling the gas in the initial stages of the process for producing sulfur dioxide. Reducing calcium sulfate with a reducing agent containing carbon monoxide is further taught by Wheelock (col. 1, lines 44-52). Wheelock further teaches that the rate of the reaction is directly proportional to the

concentration of the reducing gas (col. 1, lines 57-62). According to Wheelock, the reducing gas can be carbon monoxide or hydrogen or preferably a mixture thereof (col. 5, lines 44-51).

It is known in the art, as evidenced by Kertamus, that sulfur dioxide in the presence of char or coke can be converted to sulfur and carbon monoxide (col. 1, line 67 to col. 2, line 2; col. 2, lines 58-64). While Kertamus ultimately burns the elemental sulfur so produced, Kertamus discloses and suggests a simple one step chemical means for converting sulfur dioxide to elemental sulfur. Gorin's process is more complex in that it involves two steps. The sulfur dioxide produced from the oxidation of calcium sulfide is divided into two parts; one part is treated in a first vessel with carbon monoxide and hydrogen and the product of this reaction is combined with the remaining sulfur dioxide and subjected to a Claus reaction in a second vessel. We find that the simpler chemistry of Kertamus would have motivated a person having ordinary skill in the art to replace the more complicated chemical process disclosed by Gorin for converting sulfur dioxide to elemental sulfur.

As for the carbon monoxide by-product of the conversion process, it is well known in the chemical arts that an effluent containing by-products from a process can be recycled back through the process. *See Ex parte Brown*, 65 USPQ 531 (Bd. App. 1945). This is evidenced by the teachings of Gorin. Moreover, the motivation for recycling by-products can be based on both economic as well as environmental factors, and need not be expressly suggested or taught by the prior art. *See In re Thompson*, 545 F.2d 1290, 1294, 192 USPQ 275, 277 (CCPA 1976); *In re Clinton*, 527 F.2d 1226, 1229, 188 USPQ 365, 367 (CCPA 1976). Accordingly, we find that recycling of carbon monoxide to

the first step of the Gorin process would be both economical and environmentally desirable by a person skilled in the chemical arts in order to provide a ready source of carbon monoxide and thereby reduce the amount of hydrocarbonaceous solids required for the source of the carbon monoxide reducing agent and to prevent toxic carbon monoxide from polluting the atmosphere.

Appellant argues that Kertamus is non-analogous art. We do not agree. The test of whether a reference is from a non-analogous art is first, whether it is within the field of the inventor's endeavor, and second, if it is not, whether it is reasonably pertinent to the particular problem with which the inventor was involved. *In re Wood*, 599 F.2d 1032, 1036, 202 USPQ 171, 174 (CCPA 1979). A reference is reasonably pertinent if, even though it may be in a different field of endeavor, it is one which because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem. *In re Clay*, 966 F.2d 656, 659, 23 USPQ2d 1058, 1061 (Fed. Cir. 1992).

As evidence that Kertamus is in a different field of endeavor, appellant points to the different PTO classifications of the Kertamus patent and appellant's application. We do not find this, in and of itself, particularly relevant since patents and applications are classified based on claimed subject matter, and not with respect to what is disclosed in the patent or application. Appellant argues that Kertamus is not particularly relevant to the second part of the test as set forth, *supra*, since the reference is not reasonably relevant to the "problem of producing elemental sulfur from metal sulfates while reducing the amount of capital equipment and fuel requirements by the conventional Claus sulfur production process" and the problem of "improving the efficiencies of the sulfate processing and sulfur production process" (brief: p.

20). Both Kertamus and Gorin disclose chemical reactions for producing elemental sulfur. The Gorin process is more complex than the Kertamus process (Gorin: col. 4, lines 38-64; Kertamus: col. 2, lines 58-64). Since the Kertamus reaction is simpler for reasons already give, *supra*, it would appear to be obvious that the amount of capital equipment and fuel requirements would be reduced. Moreover, the efficiency of the process would be improved since the by-product of the Kertamus reaction, carbon monoxide, can be reused, i.e., it can be recycled to reduce calcium sulfate, thus reducing the amount of non-recycled carbon monoxide required from other sources. Accordingly, we find that Kertamus is analogous art within the test set forth above. In addition, we find that the teachings of Kertamus logically would have commended itself to an inventor*s attention in considering his problem since the chemical reaction to produce elemental sulfur is a one step as opposed to the two step process for converting sulfur dioxide to sulfur as disclosed by Gorin. *See In re GPAC, Inc.*, 57 F.3d 1573, 1577-78, 35 USPQ2d 1116, 1120 (Fed. Cir. 1995).

Appellant argues that claims 10 and 15 are separately patentable. Appellant points to the following definition of circulating fluidized bed on page 12, lines 14-20 of his specification:

A circulating fluidized bed reactor is defined as one in which the reactor bed is pneumatically conveyed through the reactor by a gas stream. Gas velocities in the circulating fluidized bed reactor must be above the particle terminal velocities. Solids are continuously removed from the top of the reactor and circulated on to the next stage of the system.

Appellant contends the “fluidized bed reaction such as used by Gorin or Wheelock is defined as a reactor system in which gas passes upwardly through a bed of fine particles causing the bed to expand and behave

as a fluid” (brief: p. 31). The examiner relies on the teachings of Wheelock which discloses at col. 4, lines 42-49 that

[b]ecause of the continuous circulation of materials within the fluidized bed reactor, the occurrence of exothermic reactions in another portion of the bed, [sic] does not lead to undue fluctuations in the bed temperature. On the contrary, the temperature throughout the fluidized bed can be controlled to relatively stable temperature, which favors the desired reactions and avoids sintering.

The examiner urges that “there is nothing in appealed claims 10 or 15 which set forth a patentable distinction between the circulating fluidized bed of the appealed claims ... and that of the Wheelock patent in a fashion that would impart patentable merit to the appealed claims” (answer: p. 12). We are in agreement with the examiner.

Claim 10 requires feeding the metal sulfate and reducing agent including carbon monoxide into a first reactor which is a circulating fluidized bed reactor and contacting the sulfate with the reducing agent at a temperature and for a period of time to effect reduction of the sulfate to a metal sulfide, removing the product from the first reactor and separating the sulfide from the waste by-products of the reducing reaction. Claim 15 requires feeding the sulfide and an oxidizing agent into a second reactor which is a circulating fluidized bed reactor, contacting the sulfide and oxidizing agent at a temperature and for a period of time to effect oxidation of the sulfide to a metal oxide and sulfur dioxide, and then removing and separating sulfur dioxide from the metal oxide.³ The claims do not set forth a patentable distinction between the appellant’s circulating fluidized bed and that disclosed by Wheelock.

³ We note that in claim 11, the term “sulfur” in the third line of step (c) is in error and should be --sulfide--.

Both appellant and Wheelock seek to continuously move solids in the reactor from one portion of the bed to another to eventually removing the solids from the reactor. See pipe or conduit **28** in Wheelock wherein calcium oxide is removed from the fluidized bed. In addition, Gorin discloses that the solids in reactors **42** and **44**, which reactors appear to be similar to appellant's first and second reactors, are maintained in a fluidized state (col. 3, lines 64-66; col. 4, lines 10-14). We see no structural difference between what is illustrated in appellant's figure for reactors **16** and **28** and Gorin's reactors **42** and **44** illustrated in Fig. 2 of Gorin. For the foregoing reasons, we do not find any merit in appellant's argument.

Appellant argues that claims 8 and 32 are separately patentable because the prior art does not teach or suggest the steps or means required by claims 8 and 32, respectively. Claim 8 is a process claim and requires incinerating the waste by-products from the reduction of the sulfate in the first reactor and using the heat produced thereby to heat the sulfate feed to the first reactor. Claim 32 is an apparatus claim and requires a means for incinerating the waste by-products produced in the first reactor and heating the sulfate feed to the first reactor. The examiner maintains on pages 13 and 14 of the answer that

[t]he Gorin patent clearly renders obvious the need to heat his metal sulfate reducing zone to a temperature effective for the reduction of the metal sulfates into metal sulfides and accomplishes this by the combustion of hydrocarbonaceous [sic, hydrocarbonaceous] fuel to provide the necessary heat, which is not seen to patentably distinguish from incinerating the waste by-products from the reduction step to provide the necessary heat for the sulfate reduction as set forth in appealed claim 8 in as much as [sic, inasmuch as] there is nothing in appealed claim 8 to exclude the "hydrocarbonaceous [sic, hydrocarbonaceous] solids" of the Gorin patent ... from the "waste by-products" of appealed claim 8 or the "combustion" of said hydrocarbonaceous [sic, hydrocarbonaceous] solids as set forth in col. 2, lines 34-42 of Gorin from the "incineration" set forth in appealed claim 8 nor is there anything in appealed claim 8 which sets forth that the incineration is conducted in a vessel that is

distinct from and apart from the sulfate reduction reactor of Gorin [reactor **42**] in a manner that would impart a patentable distinction from appealed claim 8 and the Gorin patent.

Whether or not the heat values within the “waste by-products” are worth utilizing in the process is purely a matter of the comparative cost of recovering it and re-using it - an analysis that is submitted to be well within the skill level of the ordinary engineer acquainted with this art. Nor has the appellant set forth any surprising or unexpected advantages to recycling the “waste by-products” back into the sulfate reduction step in order [sic, in order] to utilize the residual heat values therein to help provide the necessary heat for the reduction. Therefore, while it is granted that the Gorin patent does not “anticipate” this recycle of the waste gas stream as argued by appellant, it is submitted that this step is obvious to one of ordinary skill in this art even if it is not expressly taught by Gorin.

Appellant urges that the examiner used hindsight to arrive at his conclusion of obviousness since Gorin fails to disclose incinerating the waste by-products of the reducing step.

We find ourselves in agreement with appellant. The claims require the incineration of waste by-product gases and using the heat from the incineration step to heat the sulfate feed. Appellant discloses that the waste by-products are separated from the metal sulfide in cyclone **24** (specification: p. 9, lines 28-36) which is similar to Gorin’s cyclone **64**. The by-product of the reduction step disclosed by Gorin is reducing gas (col. 4, lines 1-9) which is designated in Fig. 2 as being surplus fuel gas. While Gorin does not disclose incinerating this gas, the nature of the gas would have suggested to a person having ordinary skill in the art that the gas can be incinerated and that heat would be produced therefrom. However, we find no basis from the teachings of Gorin which would have led a person having ordinary skill in the art to use heat produced from the incineration of fuel gas to heat the sulfate feed since the feed from boiler **40** to reactor **42** is already heated. Nor do we find any teaching in Kertamus or Wheelock to make up for the deficiency

of Gorin. We do not find that the examiner has established a *prima facie* case of obviousness because we cannot conclude that Gorin's hydrocarbonaceous solids referred to by the examiner is a "waste by-product" to be incinerated as called for in appellant's claims. Accordingly, we reverse the rejection of claims 8 and 32.

Appellant argues that claim 12 is separately patentable because it would not have been obvious from the teachings of Gorin, Kertamus and Wheelock to avoid water and hydrogen sulfide in the sulfide feed to prevent contamination of the carbon monoxide which is produced in the formation of elemental sulfur. Claim 12 requires that the sulfide and oxidizing agent fed into the second reactor is "substantially free of water and hydrogen sulfide." The examiner maintains that claim 12 does not patentably distinguish over Gorin "in as much as [sic, inasmuch as] Gorin does not set forth the presense [sic, presence] of either water or H₂S in either the sulfide or oxidizing agent sent to the reactor (please note col. 3, line 64 to col. 4 [sic, missing comma] line 28 of Gorin)" (answer: p. 14). We are in agreement with the examiner. We further note that Wheelock also does not indicate the presence of water and H₂S in the sulfur dioxide "off-gas" produced from the oxidation of calcium sulfide. Wheelock discloses that the "off-gas" is "substantially free of S, H₂S, etc." (col. 6, lines 50-55).

Conclusion

For the foregoing reasons, we reverse the examiner's rejection of claims 8 and 32 over the combined teachings of Gorin, Kertamus and Wheelock and affirm the rejection of claims 1-7, 9-31 and 33-35 under 35 U.S.C. § 103 as being obvious over the same references. We conclude that the combined teachings of Gorin, Kertamus and Wheelock establish a *prima facie* case of obviousness of the claimed subject matter set forth in claims 1-7, 9-31 and 33-35 and that appellant has not presented any objective evidence or sufficient arguments to rebut the *prima facie* case. *In re Rijckaert*, 9 F.3d 1531, 1532, 28 USPQ2d 1955, 1956 (Fed. Cir. 1993); *In re Piasecki*, 745 F.2d 1468, 1471-73, 223 USPQ 785, 787-88 (Fed. Cir. 1984); *In re Rinehart*, 531 F.2d 1048, 1051, 189 USPQ 143, 147 (CCPA 1976). Accordingly, the decision of the examiner is affirmed-in-part.

Appeal No. 96-1165
Application 08/060,422

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

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