IN THE CANADIAN PATENT OFFICE

DECISION OF THE COMMISSIONER OF PATENTS

Patent application 497,554 having been rejected under Rule 47(2) of the Patent Regulations, the Applicant asked that the Final Action of the Examiner be reviewed. The rejection has consequently been considered by the Patent Appeal Board and by the Commissioner of Patents. The findings of the Board and the ruling of the Commissioner are as follows:

Agent for Applicant

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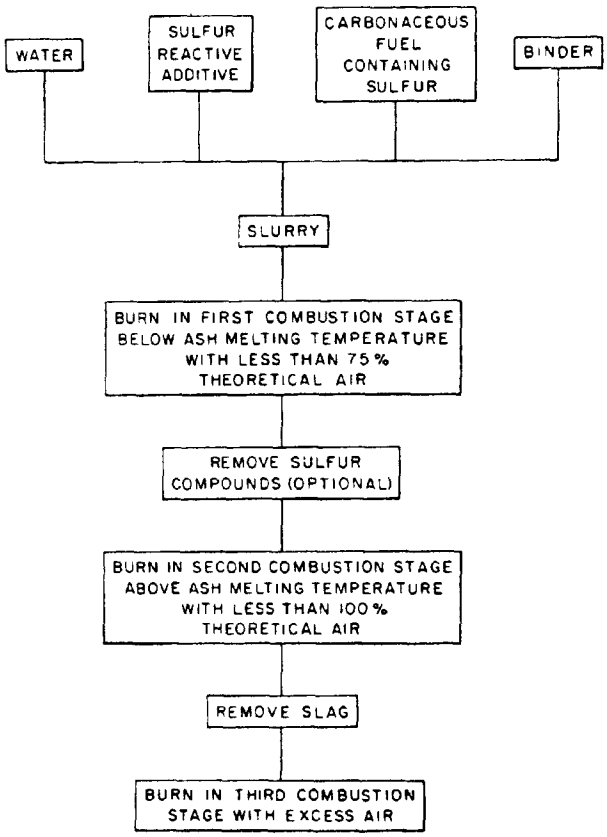
This decision deals with the Applicant's request that the Commissioner of Patents review the Examiner's Final Action on application 497,554 (Class 44-4), filed December 13, 1985 entitled "Three-stage Process for Burning Fuel Containing Sulfur to Reduce Emission of Particulates and Sulfur-containing Gases". The inventors, Melvin H. Brown and David H. DeYoung, have assigned the application to the Aluminum Company of America. The Examiner in charge issued a Final Action on February 26, 1990 refusing to allow the application. No request for an oral hearing was made.

The application relates to a combustion process that reduces the emission of particulates and sulfur compounds in combustion gases by burning the fuel in a three-stage combustion process. In particular, the invention relates to a process wherein the removal of both sulfur and particulates is optimized to therefore reduce the emission of both materials.

Figure 1 of the invention, reproduced below, is a flow diagram that illustrates the process of the invention.



Claim 1 of the application reads:

> 1. A three-stage combustion process for burning a fuel containing sulfur characterized by low sulfur emission and good ash removal comprising:
>
> (a) mixing the sulfur containing fuel with an additive capable of reacting with sulfur:
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> (b) burning the mixture in a first combustion stage with less than 75% theoretical air and at a temperature below the melting point of the ash but sufficiently high to cause reaction between said additive and any sulfur in said fuel to facilitate removal of the sulfur compounds formed:
>
> (c) passing combustible fuel gases from said first stage to a second combustion stage:
>
> (d) burning said gases in said second stage with less than 100% theoretical air, based on theoretical air for products from the first stage, at a temperature above the melting point of the ash to form a liquid slag which is removable from said second stage: and
>
> (e) burning combustible gases from said second stage in a third stage with an excess of air to ensure complete combustion of said fuel.

Steps b), d) and e) define the actual three stages of the process, with the other steps being preparatory or transitory.

In the Final Action, the following art was cited by the examiner:

Australian Patent:		
548,115	September 28, 1982	Moriarty
United States Patent:		
4,232,615	November 11, 1980	Brown

Claims 1 and 5 of the Moriarty patent read as follows:

> 1. A method for the entrained-flow combustion of a carbon-nitrogen- and sulfur-containing fuel for substantially reducing emission of gaseous sulfur compounds and nitrogenous compounds formed during the combustion of fuel with a substoichiometric amount of oxygen comprising:

introducing said fuel, an inorganic alkaline absorbent and an oxygen-containing gas into a first combustion sulfur capture zone of an entrained-flow combustor to form a fluent mixture therein of fuel and absorbent entrained in said gas,

the oxygen being present in said zone in an amount to provide from about 25%-40% of the total stoichiometric amount required for the complete combustion of the fuel,

the inorganic alkaline absorbent being present in an amount to provide a molar ratio of alkaline absorbent to sulfur compounds of from about 1.0:1 to 3.0:1, said ratio including any alkaline absorbents contained in the fuel;

reacting said fuel and absorbent entrained in said oxygen-containing gas by maintaining them in said zone at a temperature from about 1000°-1800°K. for a time sufficient

(a) to gasify at least about 75% of the carbon content of the fuel and substantially all of the sulfur in a fuel,

(b) to combust the gasified fuel and oxygen to produce a fuel-rich stoichiometry in the gas-phase, and

(c) to react in excess of about 70% of the fuel sulfur with the inorganic alkaline absorbent to form a solid alkaline sulfide compound,

introducing the resultant combustion mixture into a second combustion zone;

maintaining said mixture at a temperature in the range of 1800°K.-2500°K. in said second combustion zone while introducing additional air in an amount to provide about 45%-75% of the total stoichiometric amount of air required for complete combustion of the fuel;

maintaining said mixture including said alkaline sulfide compound, at said temperature for a time sufficient to reduce said nitrogenous compound content to a desired level; and

discharging said mixture having a substantially reduced gaseous sulfur compound and nitrogenous compound content.

5. The method of claim 1 further including introducing the combustion products from said second combustion zone into at least a third combustion zone and maintaining said products at a temperature of from about 1600° to 2000°K. while completing the combustion by the introduction of additional air in an amount to provide from about 100% to about 120% of the total stoichiometric requirements for complete combustion of the fuel.

Claim 1 of the Brown patent reads as follows:

> A method for burning a pulverized carbonaceous material containing sulfur and ash, comprising forming a slurry containing the carbonaceous material, water and a reagent adapted to react with the sulfur, burning the slurry in a first stage with less than 100% theoretical air, removing the combustible gases from the first stage to a second stage, and burning the gases in the second stage with additional air.

In refusing the claims the Examiner, in her Final Action, said, in part:

> Moriarty describes as does the applicant a three stage combustion process wherein in each subsequent stage, the air/fuel stoichiometry is increased. The first stage in the instant invention and references cited is directed to form readily removable solid sulfur compounds using an additive. Both references show in said first stage to use a temperature sufficiently high to cause reaction between the additive and the sulfur and lower or around the melting point of ash, and less than 75% theoretical air. Brown utilizes less than 100% theoretical air preferably 50% theoretical air and Moriarty specifically 25-40% theoretical air. Brown teaches the conditions set out in the second stage of the instant invention with regard to form a liquid slag which is removable, said conditions consist to maintain a temperature above the melting point of ash with less than 100% theoretical air. Moriarty shows the third stage of the instant invention to burn the combustible gases coming from the second stage with an excess of air.
>
> Brown also teaches the options described in the instant invention of preparing a water-slurry with the fuel and the additive, maintaining in the first stage a temperature below 1100°C (1373°K) and removing the sulfur compounds in the first stage.
>
> The applicant has argued that neither the Moriarty or the Brown reference are applicable for the following reasons:
>
> in the first reference,
>
> - it is unconcerned with the problem of removing ash,
> - the solid sulfur compounds formed in the first stage are not stable enough to be passed to second stage and be removed with the slag, and

- the temperature in the first stage of the process can be above the melting point of ash.

In the second reference,

- it does not expressly describe the temperature in the first stage to be below the melting point of ash.

The applicant's argument is mistaken with respect to both references. It is true that Moriarty is unconcerned with the problem of removing ash because it is directed to fuels having a low ash content. Consequently, the temperature in second stage of the Moriarty's method was not set to take into account ash removal. Moriarty is concerned with method of reducing the amount of gaseous sulfur compounds and nitrogen compounds. It forms in fact in the first stage a very stable solid sulfur compound using as mentioned previously specific conditions. Said sulfur compound can be retained in a solid form in the second combustion stage under a temperature of 1800°K-2500°K with 45%-75% theoretical air.

Brown is directly concerned with the removal of ash. Brown teaches that the melting point of ash varies depending upon the particulate binding absorbent used. It shows the alternative of removing the ash in a solid or liquid form with less than 100% theoretical air. The temperature of 1100°C (1373°K) is preferred as explained by Brown because of the thermal instability of sulfides above said temperature.

Given the foregoing, it is expected skill to modify the three stage combustion process of Moriarity in the manner proposed by the applicant. Claims 1 to 19 are obvious in view of Moriarity when considered in conjunction with the general knowledge that is shown by Brown.

The Applicant's arguments in the submission responding to the Final Action are as follows, in part:

> It is believed that the Examiner has not correctly assessed the disclosure of the references, and has not given sufficient consideration to the comments previously made by applicant in regard to the cited art. For these reasons, it is believed that at the least, the Examiner was incorrect in making the action final.
>
> On page 3 of the Action, paragraph 4, the Examiner indicates in the first sentence that applicant's argument is mistaken, although in the next sentence the Examiner admits one aspect of the argument, that Moriarty (Australian Patent 548,115) is not concerned with the problem of removing ASH.
>
> Besides this, applicant had argued that Moriarty does not require temperature in the first stage to be below the melting point of the ash while this is a requirement in the present application. The Examiner casually dismissed this point by saying that since Moriarty was only concerned with fuels having a low ash content, consequently the temperature in second stage of Moriarty's method was not set to take into account ash removal. This appears to be circular reasoning --- since Moriarty has got nothing to do with the problem addressed by applicant, Moriarty is unconcerned with applicant's essential steps. These, according to the Examiner can simply be supplied by combining the disclosure of Brown.
>
> However, nothing is said by the Examiner as to any possible reason for such combining, and applicant's view is that only hindsight from reading applicant's specification leads to the combination.
>
> The Examiner states that Moriarty forms a stable sulfur compound in the first stage. However, applicant pointed out previously that the temperature range specified in the first stage by Moriarty is (1000° to 1800°K).
>
> Since the temperature range of Moriarty includes temperatures above the ash melting point, Moriarty discloses removal of sulfur under conditions when the ash removal is made difficult. This goes to the very essence of applicant's invention. Applicant previously argued:
>
> > In the discussion of the prior art in the present specification, it is pointed out that it was known in the art to remove sulfur as solids, and also to

remove ash. However, the known methods improved ease of removal of sulfur but at the expense of making ash removal harder, or when the method was directed to easier removal of ash, problems with removal of sulfur were created. By the particular essential requirements of the present invention as specified in claim 1 parts (b) and (d), the highly advantageous result was achieved whereby optimum ease of removal of both sulfur and ash was obtained.

Clearly, there is no reason for combining Moriarty with Brown. The present claims therefore are believed to be allowable.

The issue before the Board is whether or not the claims are patentable in view of the cited prior art. More specifically, it must determine if, as the examiner states in the Final Action, it is but expected skill to modify the three stage combustion process of Moriarity in the manner proposed by the applicant, and whether the claims are obvious in view of Moriarity, when considered in conjunction with the general knowledge shown by Brown.

Upon analyzing the references, the Board finds that major differences occur between the cited patents and the invention described and claimed in the application in three main areas as follows:

- The first difference is in the temperature used in the first combustion stage. The upper half of the temperature range specified by Moriarty, if used in the invention, would render inoperable the process claimed in the instant application, because the ash would be melted in the first stage and the sulfur compounds would not be passed on to the second stage, and some of the less stable sulfur compounds would be broken down prior to their removal.

- The second difference occurs with respect to the second stage of the instant process. The first stage of the Brown reference teaches a temperature of less than 1100°C, whereas the second stage temperature in the instant application is greater than 1100°C. The use of the lower temperature in the second stage of the application would favour the removal of the ash in solid form in this stage or its transmission to a further stage, both being contrary to the invention. Furthermore, if as taught in Brown, the second stage of the instant process were operated below 1100°C, and additives were introduced in order to lower the melting point of the ash, it would likely be melted in the first stage, which

event the applicant seeks to avoid. Use of the higher temperature by the applicant, melts the ash and permits smaller ash particles to be impinged on the thus resulting molten, slag-coated walls.

- The third difference occurs in the last combustion stage. The Moriarty reference teaches that a preferred embodiment resulting from use of the process is that:

> the solid sulfur compounds generated in the first sulfur-capture combustion zone, are retained in the combustion gases and, therefore, must pass through this third combustion zone (24) (see column 9, line 68).

In Moriarity, the solid sulfur compounds are intended to be removed from the combustion mixture by conventional filtration techniques (column 4, lines 3 to 6). The process of the instant application specifies the removal of all sulfur products either in the first or second stage and is designed not to pass any of the sulfur compounds on to the third stage.

In order to determine whether or not the invention is obvious in view of the prior art, the Board is guided by the following Court decisions:

In Leithiser v Pengo Hydra Pull, 17 C.P.R. (2d), 110 at 115, Jackett C.J. said:

> there is a further requirement that the thing claimed as an invention must be the result of inventive ingenuity and not mere "workshop" improvement or development. See Commissioner of Patents v Farbwerke Hoescht Aktiengesellschaft vormals Meister Lucius & Bruning...[1964] S.C.R. 49...per Judson, J. (delivering the judgment of the Supreme Court of Canada) at pp. 56-7.

Furthermore, the following guideline is set down in Niagara Wire Weaving v Johnson Wire Works Ltd. (1939) Ex. C.R. 259 at page 273,

> Small variations from, or slight modifications of, the current standards of construction, in an old art, rarely are indicative of invention; they are usually obvious improvements resulting from experience, and the changing requirements of users.

and at page 276,

> No step is disclosed there which could be described as invention. There is not, in my opinion, that distinction between what was known before, and that disclosed...that called for that degree of ingenuity requested to support a patent.

The consideration before the Board is, therefore, whether the invention is directed towards a mere "workshop" improvement or development, or whether it is the result of a small variation from, or a slight modification of the current standards...in an old art.

The Board is of the view that the invention described and claimed in the application is more than an obvious improvement resulting from experience and the changing requirements of users. The distinctions between the invention claimed in the application and the prior art references are more than slight and, in our opinion, it would not be obvious for a person skilled in the art to modify the three-stage combustion process of Moriarity to arrive at the instant invention and to further incorporate the ash melting step disclosed in the Brown reference into the process.

The Board recommends, therefore, that the rejection of Claims 1 to 19, on the grounds of obviousness in view of the prior art, be withdrawn.

F.H. Adams	V. Duy	A. J. Legris
Chairman	Member	Member
Patent Appeal Board	Patent Appeal Board	Patent Appeal Board

I concur with the findings and recommendations of the Patent Appeal Board. Accordingly, I remand this application to the examiner for prosecution consistent with the recommendation.

M. Leesti
Commissioner of Patents

dated at Hull, Quebec
this 19th day of November 1992

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