APPLICATION FOR A (b) STANDARD/PETTY PATENT

ATLANTIC RICHFIELD COMPANY

515 South Flower Street
Los Angeles, California,
United States of America.

hereby apply for the grant of a (c) Standard/Petty Patent for an invention entitled

(i) REDUCING THE TENDENCY OF DRIED COAL TO SPONTANEOUSLY IGNITE

which is described in the accompanying (d) COMPLETE specification.

(Note: The following applies only to Convention applications)

Details of basic application(s)

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<th>Application No.</th>
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This application is a further application made by the virtue of sub-section (1) of Section 51 of the Patents Act 1952 from the following original application:

No. of original application: 15646/83
Filed in name of: ATLANTIC RICHFIELD COMPANY
Address for Service: PHILLIPS ORMONDE AND FITZPATRICK Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia 3000


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AUSTRALIA

Patents Act

DECLARATION FOR A PATENT APPLICATION

In support of the (a) application made by
(b) ATLANTIC RICHFIELD COMPANY

(hereinafter called "applicant(s) for a patent (c)

REDDUCING THE TENDENCY OF DRIED COAL TO
SPONTANEOUSLY IGNITE

I/We (e)

Mike R. Bowlin, Senior Vice President, of Atlantic
Richfield Company, of 515 South Flower Street,
Los Angeles, California, United States of America,
do solemnly and sincerely declare as follows:

1. I am/We are the applicant(s).

2. I am/We are the actual inventor(s) of the invention.

3. I am/We are the assignee of the said invention
from the said actual inventors.

(Note: Paragraphs 3 and 4 apply only to Convention applications)

3. The basic application(s) for patent or similar protection on which the application is based
are identified by country, filing date, and basic applicant(s) as follows:

4. The basic application(s) referred to in paragraph 3 hereof was/were the first application(s)
made in a Convention country in respect of the invention the subject of the application.

Declared at (k) Denver, Colorado
Dated (l) February 24, 1987

Mike R. Bowlin
Senior Vice President

To: The Commissioner of Patents

Atlantic Richfield Company

PHILLIPS ORMONDE & FITZPATRICK
Patent and Trade Mark Attorneys
367 Collins Street
Melbourne, Australia
7258 Gore Range Road, Littleton, Colorado, 80127; and
Donald K. Wunderlich, 1233 Cherokee Drive, Richardson,
Texas, 75080, all of the United States of America.
1. A method for producing a dried particulate coal fuel having a reduced tendency to spontaneously ignite wherein crushed mined coal is heated in a drying zone with a hot gas to vaporize water from the coal and dry the coal to a moisture content of less than about 20 percent by weight of water and wherein the dried coal is removed from said drying zone, comprising contacting and intimately mixing said removed dried coal particles with a water-base dispersion comprised of water and latex paint type solids whereby an elastic film is formed on said dried coal particles.
COMPLETE SPECIFICATION
(ORIGINAL)

Application Number: 67830/87.

Complete Specification Lodged:
Accepted:
Published:

Priority

Related Art:

This document contains the amendments made under Section 49 and is correct for printing.

APPLICANT'S REF.: DIV. OF DP 50-6-544

Name(s) of Applicant(s): ATLANTIC RICHFIELD COMPANY

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Actual Inventor(s): MR. LI.
J.D. MATTHEWS.
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B.F. BONNECAZE.
D.K. WUNDERLICH.

Address for Service is:

Complete Specification for the invention entitled:

"REDUCING THE TENDENCY OF DRIED COAL TO SPONTANEOUSLY IGNITE".

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):
This application is divided from Australian Patent Application No. 15646/83 in which is described and claimed a method for producing a dried coal fuel having a reduced tendency to spontaneously ignite from a low rank coal. The present invention is directed to an improved method for producing a dried particulate coal fuel having a reduced tendency to spontaneously ignite. The subject matter of Australian Patent Application is herein incorporated.

In many instances, coal as mined contains undesirably high quantities of water for transportation and use as a fuel. This problem is common to all coals, although in higher grade coals, such as anthracite and bituminous coals, the problem is less severe because the water content of the coal is normally lower and the heating value of such coals is higher. The situation is different with respect to lower grade coals such as sub-bituminous, lignite and brown coals. Such coals, as produced, typically contain from about 25 to about 65 weight percent water. While many such coals are desirable as fuels because of their relatively low mining cost and since many such coals have a relatively low sulfur content, the use of such lower grade coals as fuel has been greatly inhibited by the fact that as produced, they typically contain a relatively high percentage of water. Attempts to dry crushed mined coals for use as a fuel have been inhibited by the tendency of such coals after drying to undergo spontaneous ignition and combustion in storage, transit or the like.

As a result, a continuing effort has been directed to the development of improved methods whereby such lower grade coals can be dried and thereafter safely transported, stored and used as fuels.

Dried crushed mined coal particles are sprayed with a water-base dispersion or emulsion of a small amount of latex paint type solids, hereinafter defined.

The latex paint type solids form an elastic film on the dried coal particles and thereby reduce its tendency to spontaneously ignite. The dispersion or emulsion is easy to apply at ordinary temperatures, and is relatively nonflammable and nontoxic, and has very little unpleasant odor. The OK
dispersion is readily formed on site from dry or concentrated chemicals, thereby reducing shipping, storing and handling costs.

According to the present invention there is provided a method for producing a dried particulate coal fuel having a reduced tendency to spontaneously ignite wherein crushed mined coal is heated in a drying zone with a hot gas to vaporize water from the coal and dry the coal to a moisture content of less than about 20 percent by weight of water and wherein the dried coal is removed from said drying zone, comprising contacting and intimately mixing said removed dried coal particles with a water-base dispersion comprised of water and latex paint type solids whereby an elastic film is formed on said dried coal particles.

Figure 1 is a schematic diagram of a coal drying process to which the method of this invention may be applied; Figure 2 is a schematic diagram of an apparatus for use in contacting particulate coal with the special deactivating dispersion of this invention; and, Figure 3 is a schematic diagram of a further embodiment of an apparatus for use in contacting particulate coal with the special deactivating dispersion.

This invention is an improved method of reducing the tendency of dried coal to spontaneously ignite. Coals may be dried to remove surface water or deep dried to remove interstitial water and thereby increase the heating (BTU) value of the coal. In this description, dried coal is coal that has been dried to remove some of the interstitial water and the moisture content of a dried coal is measured in accordance with the procedures set forth in ASTM D3173-73, entitled "Standard Test Method for Moisture in the Analysis Sample of Coal and Coke" published in the 1978 Annual Book of ASTM Standards, Part 26. The method of this invention is applicable to all forms of dried coal, especially deep fried coals, but is especially useful for dried low grade coals, such as sub-bituminous, lignite and brown coals.

In the description of the Figures, the same numbers will be used to refer to the same or similar components throughout.
Further, it should be noted that in the description of the Figures, reference will be made to lines generally rather than attempting to distinguish between lines as
conduits, conveyors or the like as required for the handling of particulate solid materials.

In Figure 1, a run of mine coal stream is charged through a line 12 to a coal cleaning or preparation plant 10 from which a coal stream is recovered through a line 14 with a waste stream comprising gangues and the like being recovered and passed to discharge through a line 11. In some instances, it may not be necessary to pass the run of mine coal to a coal cleaning or processing plant prior to charging it to the process of the present invention, although in many instances, such may be desirable. The coal stream recovered from preparation plant 10 through line 14 is passed to a crusher 16 where it is crushed to a suitable size and passed through a line 18 to a hopper.

While a size consist less than about two inches, i.e. two inches by zero may be suitable in some instances, typically a size consist of about one inch by zero or about three-quarters inch by zero will be found more suitable. The particulate coal in hopper 20 is fed through a line 22 into a dryer 24. In dryer 24, the coal moves across dryer 24 above a grate 26 at a rate determined by the desired residence time in dryer 24. A hot gas is passed upwardly through the coal moving across grate 26 to dry the coal. The hot gas is produced in Figure 1 by injecting air through a line 30 to combust a stream of coal fines injected through a line 34. The combustion of the coal fines generates hot gas at a temperature suitable for drying the coal. As will be obvious to those skilled in the art, the temperature can be varied by diluting the air or the hot gas with a non-combustible gas such as the exhaust gas from the dryer, by the use of alternate fuels, by the use of oxygen enriched streams or the like. Clearly, alternate fuels, i.e. liquid or gaseous fuels could be used instead of or in addition to the finely divided coal, although it is contemplated that in most instances, a stream of finely divided coal will be found most suitable for use as a fuel to produce the heated gas. Ash is recovered from dryer 24 through a line 36. In Figure 1, a combustion zone 28 is provided beneath grate 26 to permit the production of the
hot gas in dryer 24, although it will be readily understood that the hot gas could be produced outside dryer 24 or the like. The exhaust gas from dryer 24 is passed to a cyclone 40 where finely divided solids, typically larger than about 100 Tyler mesh, are separated from the exhaust gas and recovered through a line 44. The exhaust gas, which may still contain solids smaller than about 100 Tyler mesh, is passed through a line 42 to a fine solids recovery section 46 where finely divided solids, which will typically consist primarily of finely divided coal are recovered through line 34 with all or a portion of the finely divided coal being recycled back to combustion zone 28. The purified exhaust gas from fine solids recovery section 46 is passed through a line 48 to a gas cleanup section 50 where sulfur compounds, light hydrocarbon compounds, and the like are removed from the exhaust gas in line 48, as necessary to produce a flue gas which can be discharged to the atmosphere. The purified gas is discharged via a line 51 with the contaminants recovered from the exhaust gas being recovered through a line 76 and optionally passed to a flare, a wet scrubber or the like. The handling of the process gas discharge is not considered to constitute a part of the present invention, and the cleanup of this gaseous stream will not be discussed further. The fine coal stream recovered through line 34 may in some instances constitute more coal fines than are usable in combustion zone 28. In such instances, a fine coal product can be recovered through a line 54. In other instances, the amount of coal fines recovered may not be sufficient to provide the desired temperature in the hot gas used in dryer 24. In such instances, additional coal fines may be added through a line 52.

The dried coal product recovered from dryer 24 is recovered via a line 38 and combined with the solids recovered from cyclone 40 through line 44 and passed to a hopper 116 from which dried coal is fed via a line 78 to a cooler 80. In cooler 80, the dried coal moves across cooler 80 above a grate 82. A cool gas is introduced through a line 86 into a distribution chamber 84 beneath grate 82 and
passed upwardly through the dried coal to cool the dried coal. The exhaust gas from cooler 80 is passed to a cyclone 90 where solids generally larger than about 100 Tyler mesh are separated and recovered through a line 94 with the exhaust gas being passed through a line 92 to fine solids recovery section 46. Optionally, the gas recovered through line 92 could be passed to combustion chamber 28 for use in producing the hot gas required in dryer 24. The cooled dried coal is recovered through a line 96 and combined with the solids recovered from cyclone 90 to produce a dried coal product. The tendency of such dried low rank coals to spontaneously ignite is inhibited greatly by cooling such coals after drying. In some instances, no further treatment may be necessary to produce a dried coal product which does not have an undue tendency to spontaneously ignite upon transportation and storage. In other instances, it will be necessary to treat the dried coal product further. In such instances, the dried coal product may be coated with a suitable deactivating fluid in a mixing zone 100. The deactivating fluid is introduced through a line 102 and intimately mixed with the cooled dried coal in mixing zone 100 to produce a coal product, recovered through a line 104, which has a reduced tendency to spontaneously ignite under normal storage and transportation conditions. While the dried coal is mixed with deactivating fluid after cooling in Figure 1, it should be understood that the dried coal can be mixed with the deactivating fluid at higher temperatures before cooling although it is believed that normally the mixing is preferably at temperature no higher than about 200°F (93°C).

While cool gas alone may be used in cooler 80, an improvement is accomplished by the use of water injection in cooler 80. The water is added through a line 106 and a spray system 108 immediately prior to passing the dried coal into cooler 80 or through a spray system 110 which adds the water to the dried coal immediately after injecting the coal into cooler 80. Either or both types of systems may be used. In any event, it is highly desirable that the water be sprayed uniformly over the coal surface. An important limitation, however, is that the amount of water
added is only that amount required to achieve the desired cooling of the dried coal by evaporation. The water is very finely sprayed onto the coal, and is controlled to an amount such that the added water is substantially completely evaporated from the coal prior to discharge of the cooled dried coal via line 96. In many areas of the country, relatively dry air is available for use in such cooling applications. For instance, in Wyoming, a typical summer air condition is about 90°F. (32°C.) dry bulb and about 65°F. (18°C.) wet bulb temperature. Such air is very suitable for use in the cooler as described. While substantially any cooling gas could be used, the gas used will normally be air. Air is injected in an amount sufficient to fluidize or semi-fluidize the dried coal moving along grate 82 and in an amount sufficient to prevent the leaking of water through grate 82. The flow is further controlled to a level such that the velocity above the coal on grate 82 is insufficient to entrain any liquid water in the exhaust stream flowing to cyclone 90. Desirably, the air flow is at a rate such that the air leaving the cooler is no more than about 85 percent saturated with water. A preferred range is from about 50 to about 85 percent saturation. Such determinations are readily within the skill of those in the art and need not be discussed in detail since the flow rates will vary depending upon the amount of cooling required.

In a further variation, the water may, in some instances, be introduced as a fine mist beneath grate 82 via a spray system 109 and carried into the coal moving along grate 82 with the cooling gas or sprayed directly into the coal via a spray system 111. In such instances, similar considerations apply, and only that amount of water is added which is required to accomplish the desired temperature reduction in the coal on grate 82. When relatively dry air is available, it may be desirable in some instances to use evaporative cooling outside cooler 80 to produce a cooled air stream for use in cooling the dried coal in cooler 80. When relatively dry air is available, it may be desirable in some instances to use evaporative cooling outside cooler 80 to produce a cooled air stream for use in cooling the
dried coal in cooler 80.

In the operation of dryer 24, the discharge temperature of the dried coal is typically from about 130 to about 250°F. (54 to 121°C.) and is preferably from about 190 to about 220°F. (88 to 104°C.). The hot gas is passed upwardly through the coal on grate 26 at a suitable rate to maintain the coal in a fluidized or semi-fluidized condition above grate 26. The residence time is chosen to accomplish the desired amount of drying and is readily determined experimentally by those skilled in the art based upon the particular type of coal used and the like. For instance, when drying sub-bituminous coal, an initial water content of about 30 weight percent is common. Desirably, such coals are dried to a water content of less than about 15 weight percent and preferably from about 5 to about 10 weight percent. Lignite coals often contain in the vicinity of about 40 weight percent water and are desirably dried to less than about 20 weight percent water with a range from about 5 to about 20 weight percent water being preferred. Brown coals may contain as much as, or in some instances even more than about 65 weight percent water. In many instances it may be necessary to treat such brown coals by other physical separation processes to remove portions of the water before drying is attempted. In any event, these coals are desirably dried to a water content of less than about 30 weight percent and preferably to about 5 to about 20 weight percent. The determination of the residence time for such coals in dryer 24 may be determined experimentally by those skilled in the art for each particular coal. The determination of a suitable residence time is dependent upon many variables and will not be discussed in detail.

The discharge temperature of the dried coal from dryer 24 is readily controlled by varying the amount of coal fines and air injected into dryer 24 so that the resulting hot gaseous mixture after combustion is at the desired temperature. Temperatures beneath grate 26 should be controlled to avoid initiating spontaneous combustion of the coal on grate 26. Suitable temperatures for many coals are from about 250 to about 950°F. (104 to 570°C.).

In the operation of cooler 80 as discussed above, the
temperature of the dried coal charged to cooler 80 in the process shown in Figure 1 is typically that of the dried coal discharged from dryer 24 less process heat losses. The temperature of the dried coal is desirably reduced in cooler 80 to a temperature below about 100°F. (38°C.) and preferably below about 80°F. (27°C.). The cool gas is passed upwardly through the coal on grate 82 at a suitable rate to maintain the coal in a fluidized or semi-fluidized condition above grate 82. The residence time, amount of cooling air, cooling water and the like may be determined experimentally by those skilled in the art. Such determinations are dependent upon the amount of cooling required and the like. As well known to those skilled in the art, after drying, lower rank coals are very susceptible to spontaneous ignition and combustion upon storage, in transit or the like. While such is the case, it is highly desirable that such coals be available for use more widely than is possible at the present. The high moisture content of these fuels results in excessive shipping costs, due at least in large measure to the excessive amount of water which is subject to freight charges and similarly results in lower heating values for the coals since a substantial portion of the coal is water rather than combustible carbonaceous material. The lower heating value results in a limited use for the coals since many furnaces are not adapted to burn such lower heating value coals. By contrast, when the water content is reduced, the heating value is raised since a much larger portion of the coal then comprises combustible carbonaceous material. As a result, it is highly desirable that such coals be dried prior to shipment.

After the dried coal particles are removed from dryer 24, the coal particles are contacted with the deactivating fluid. The deactivating fluid may be sprayed on the particles before, during or after the hot coal solids are cooled. This deactivating fluid is an elastic film forming water-base dispersion comprised of finely divide or milled latex paint type solids dispersed or emulsified with water. This includes emulsion polymerization. Surfactants, protective colloids and similar paint additives may be added to help spread and stabilize the solids and to increase the adherence of the
solids. It appears that dispersions with concentrations as low as 0.25% by weight of latex paint type solids will be successful. The maximum concentration will depend on costs; but it is believed that the maximum concentration will not exceed 60% by weight of latex paint type solids. The dispersion may be used in any suitable quantity; but tests indicate that quantities between 0.5 to 2.0 gallons of dispersion per 2000 pounds of dried coal will usually be adequate. Suitable solids are vinyl acetate, polyvinyl chloride, vinyl acetate/acrylic copolymers, styrene-butadiene, acrylic latex or resins, natural gums or resins, tall oil, neoprene, rubber and polyesters. If the quantity of solids in relation to the coal is significant, halogen containing solids will not be used; but for the most part, the amount of solids is practically negligible in comparison to the weight of the dried coal.

The intimate mixing of the dried coal and deactivating fluid is readily accomplished in a vessel such as shown in Figure 2. In Figure 2, the dried coal product or oxidized dried coal is charged to a contacting vessel 140 through a line 146 with the contacted coal being recovered through a line or discharge 148. In contact vessel 140, the deactivating fluid is maintained as a finely divided mist by spraying the deactivating fluid into vessel 140 through spray mist injection means 150 which, as shown in Figure 4, are nozzles 152. Clearly, vessel 140 can be of a variety of configurations, and any reasonable number of mist nozzles 152 can be used. It is, however, necessary that the residence time between the upper end 142 of contacting vessel 140 and the lower end 144 of vessel 140 be sufficient that the coal is intimately contacted with the deactivating fluid as it passes through vessel 140. Deactivating fluid is injected into vessel 140 through lines 158 which supply nozzles 152. Optionally a diverter 143 may be positioned to disrupt the flow of the coal to facilitate contact with the deactivating fluid.

A further embodiment of a suitable contacting vessel is shown in Figure 3. The contacting vessel shown in Figure 5 is positioned on a storage hopper 162 and includes on its inner walls a plurality of projections 154, which serve to...
break up the smooth fall of particulate coal solids through vessel 140 thereby facilitating intimate contact of the particulate solids with the deactivating fluid mist present in vessel 140. Projections 154 may be of substantially any effective shape or size. Mist injection means 150 as shown in Figure 5 comprise tubes 156 positioned beneath projections 154. Tubes 156 include a plurality of mist injection nozzles 152. Mist injection nozzles 152 could also be positioned in the walls of vessel 140. Further, a deflector 160 is provided near lower end 144 of vessel 140 to further deflect the stream of particulate coal solids as they are discharged from vessel 140. A tube 156 including mist nozzles 152 is positioned beneath deflector 160.

In the operation of the vessels shown in Figures 2 and 3, a particulate coal stream is introduced into the upper portion of the vessels 140 and passes downwardly through vessel 140 by gravity flow in continuous contact with a finely divided mist of a suitable deactivating fluid. The residence time is highly variable depending upon the size of the stream passed through vessel 140 the presence or absence of projections in vessel 140 and the like. The contact time and amount of mist are adjusted to obtain a desired quantity of deactivating fluid in intimate mixture with the coal.

Accordingly, in the use of the special oil, sometime after the dried coal particles are removed from dryer 24, the coal particles are contacted with the special deactivating oil composition previously described. The special oil composition may be used in any suitable quantity; but between 0.5 to 4.0 gallons of special oil per 2000 pounds of dried coal will usually be adequate. Additional quantities of the special oil may be used if required for dust control.

The intimate mixing of the dried coal and deactivating oil is readily accomplished in a vessel such as shown in Figures 2 and 3.

Other suitable materials for use as deactivating fluids are water-base dispersions or emulsions of latex paint type solids.
fluid is readily accomplished in vessels such as shown in Figures 2 and 3.

In the practice of the method of the present invention as shown in Figures 1 and 2, it may be desirable in some instances that an oxidation step be used, whereas with other coal feed stocks, such a step may not be necessary. In general, it is believed that it will be necessary to cool all low rank coals to produce a desirable dried coal fuel which is not undesirably susceptible to spontaneous ignition. In many instances, it may be necessary to do no more than dry the coal and cool the resulting dried coal to produce
a stable fuel. In other instances, it may be necessary to use a deactivating fluid with the dried coal. In still other instances with more reactive coal, it may be necessary to use drying in combination with oxidation, cooling and/or a deactivating fluid. The selection of the particular process will be dependent to a large extent upon the particular coal feed stock used. Another variable which may affect the choice of the process for a particular low rank coal is the risk involved upon spontaneous ignition. For instance, it may be desirable to over-treat dried coal products which are to be shipped by sea or the like in view of the substantially greater risk of damage upon spontaneous ignition than would be the case for coals which are to be stacked near a coal-consuming facility. A magnitude of considerations will affect the particular process chosen; however, it is believed that the particular combination of steps set forth will be found effective in the treatment of substantially any low rank coal to produce a dried fuel product which has a reduced tendency toward spontaneous ignition.

Having thus described the present invention by reference to certain of its preferred embodiments, it is respectfully pointed out that the embodiments discussed are illustrative rather than limiting in nature, and that many variations and modifications are possible within the scope of the present invention. Many such variations and modifications may be considered obvious and desirable based upon a review of the foregoing description of preferred embodiments.
The claims defining the invention are as follows:

1. A method for producing a dried particulate coal fuel having a reduced tendency to spontaneously ignite wherein crushed mined coal is heated in a drying zone with a hot gas to vaporize water from the coal and dry the coal to a moisture content of less than 20 percent by weight of water and wherein the dried coal is removed from said drying zone, comprising contacting and intimately mixing said removed dried coal particles with a water-base dispersion comprised of water and latex paint type solids whereby an elastic film is formed on said dried coal particles.

2. A method according to claim 1 wherein said crushed mined coal is selected from the group consisting of sub-bituminous, lignite, brown coals and combinations thereof.

3. A method according to claim 1 or claim 2 wherein said crushed mined coal is heated to a temperature from 54 to 121°C. in said coal drying zone.

4. A method according to any one of claims 1 to 3 wherein said removed dried coal is contacted with 0.5 gallon to 2 gallons of said dispersion per short U.S. ton of coal and said dispersion contains at least 0.25% by wt. of said latex paint type solids.

5. A method according to any one of the preceding claims wherein said removed dried coal is cooled to a temperature below 38°C. before said removed dried coal is contacted with said dispersion.

6. A method according to any one of the preceding claims wherein the coal is dried to a moisture content of between 5 and 20 percent by weight of water.

7. A method substantially as hereinbefore described with reference to any one of the Examples.


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