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R. LESSING

TREATMENT OF COAL

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Fig. 1,

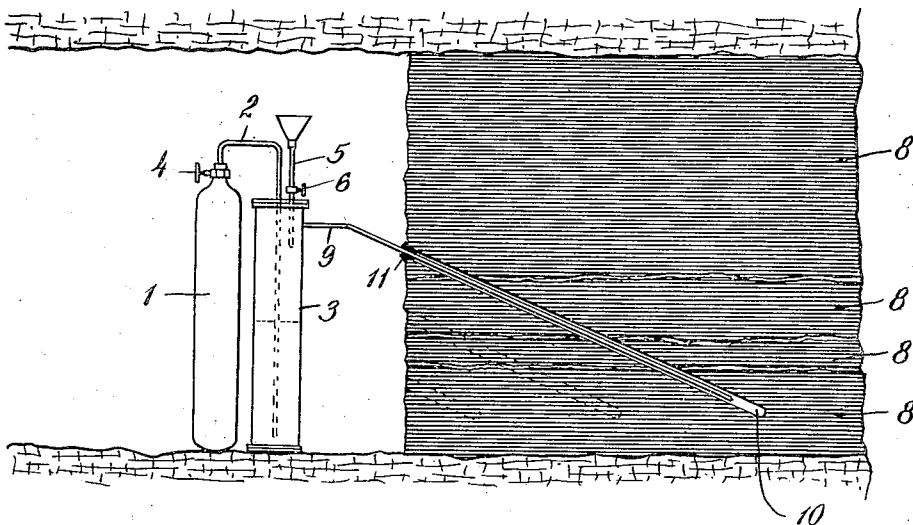
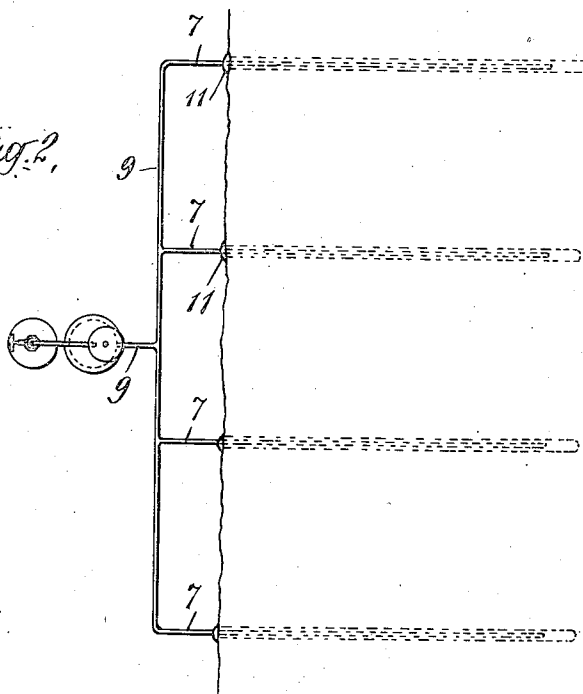


Fig. 2,



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TREATMENT OF COAL.

Application filed September 12, 1921. Serial No. 500,180.

To all whom it may concern:

Be it known that I, RUDOLF LESSING, residing at London, England, have invented certain new and useful Improvements in Treatment of Coal; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

10 This invention relates to the treatment of coal for the purpose of breaking up the coal or facilitating the breaking up or crushing of the coal.

Coal, as is well known, is composed of several constituents, including well defined varieties of coal, such as bright coal (vitrian and clarian) dull coal (durain), coking coal, steaming coal, etc., as well as the ash-forming constituents and foreign matter. The term "ash-forming constituents" is intended to include certain coal constituents of somewhat indefinitely defined character but which nevertheless may be properly classed as coal material, and which yield relatively high percentages of ash when burned.

It shall also be borne in mind that the purest coal particles, after all attached mineral matter has been removed, contain a certain amount of inherent ash, which I believe to be the ash derived from the original plant substances. This amounts to something of the order of 1.5 to 2 per cent in the case of bright coal (vitrian and clarain) and rather more, say 4 to 6 per cent with dull coal (durain). In the latter case, however, it is possible that some of this ash is merely intermingled earthy matter which got trapped in the plant debris during coal formation. This would be distinct from the mineral matter introduced after coal formation was practically completed.

The foreign matter proper is mainly the debris of rock from the roof, sides, and bed of the coal, which partly penetrates the coal seam even in situ, and partly is loosened and mixed up with the coal during mining operations.

The more clearly defined coal constituents (vitrian, clarain, durain) are differentiated by differences in composition, especially as respects the amount and nature of the products obtained by destructive distillation. They also differ in their physical properties, such as density, etc., in their inherent ash content and have different structural characteristics arising in part at least from differ-

ences in the ash content and morphological form of the organic material from which the coal deposit was originally formed.

Taking bituminous coal as an example of a coal deposit, I find that it comprises portions of bright coal of marked coking properties, dull coal of a harder character and the very soft, friable portion, of the character of charcoal, which generally yields a high percentage of ash as compared with the other carbonaceous constituents. In addition there is always present more or less foreign matter of mineral character attached to the carbonaceous constituents.

Now, I have found, for instance, that by subjecting such coal to the action of an agent, preferably an acid, the union between these several constituents of the coal is weakened so that mechanical separation of the constituents or aggregates of these is facilitated. It follows that by preliminary treatment with an agent of this character the separation of the constituents of the coal by washing or other concentration process is improved.

Furthermore, I have found that the mining of coal may be facilitated by the action of such an agent (as for example an acid) on the coal in situ. In this case also the agent acts to loosen the union between masses of coal, the first attack being at the comparatively extensive interface between the layers which occur in the seam or deposit, as the attack proceeds the agent permeates the coal to a greater extent.

In treating mined coal it is generally convenient to pass acid gases, for instance furnace gases, more particularly such as contain sulphur dioxide, over or through the moist coal. For example, the coal is charged into a tower or hopper up which acid gases are passed while water is allowed to trickle down the coal.

An aqueous solution of acid may also be used either by trickling it over or through the coal or by immersing the coal in it. Or where practicable, acid may be added to the water used for washing the coal.

The quantity of acid required per ton of coal depends on the nature of the coal as a whole and must be determined experimentally, such as by continuing the treatment on a sample until it can be more easily crushed, by hand pressure for instance, than an untreated sample.

As an example of the quantity of acid required it may be said that with a bituminous coal quantities of acid agent of the order of 0.1 per cent of sulphur dioxide or its equivalent will so far alter the coal that it is more readily separated into its constituents.

When the acid agent is used in aqueous solution the latter should be sufficiently dilute to avoid degradation of true coal substance, since the desired result is attained when the bond of union (as for example a cementing substance) between constituents of the coal has been attacked and further action is undesirable.

When the coal is in situ an acid agent applied in the form of gas is generally more conveniently used. For example, the face of the coal may be bored to a suitable depth in a direction in which the bore will intersect the layers, where layer formation exists, and the mouth of the bore may be connected in substantially gas-tight manner with a source of sulphur dioxide under pressure sufficient to ensure entry of the gas, which should preferably be moist, into the bore. After a few hours the coal will be so far loosened that it can be more readily removed than by ordinary working.

Suitable apparatus and the manner of applying the same when treating coal in situ is diagrammatically illustrated in the accompanying drawing; in which Figure 1 is an elevation of the apparatus in its operating position in respect to the body of coal; and Fig. 2 is a plan thereof.

A container 1, such as is commonly employed for the transportation and storage of a liquefied gas or a gas under pressure, is connected by a pipe 2 for the passage of gas into a receptacle 3 adapted to contain either a liquid or a gas under pressure, or both. The quantity and pressure of gas passing into the receptacle 3 is controlled by a valve 4. A funnelled pipe 5 having a control valve 6 passes into the receptacle 3. A distributing apparatus, here shown with its plurality of working tubes 7 in operating position in preconstructed openings 10 traversing the interface of coal seams 8, is connected to the receptacle 3 by a T-shaped pipe 9. The space between the working tubes and the walls of the preconstructed openings are closed in any manner, such as by packing 11 for preventing the escape of gases from the openings.

Water or a solution of an agent suitable for effecting the purpose of the invention is passed into the receptacle 3 through the funnelled pipe 5. The control valve 4 of pipe 2 is then opened and gas bubbles through the liquid in the receptacle 3 collecting under pressure above the liquid and in the pre-constructed openings 10. The interfaces of the coal seams and bonds of

union of the various constituents of the coal are thereby subjected to the action of a moist gaseous agent capable of separating or promoting the separation of the various coal constituents.

A similar arrangement of apparatus may be employed where a liquid agent is pumped or otherwise forced into the pre-constructed openings in the coal bed.

This remarkable action of the acid in loosening the bond of union between the coal constituents I believe to be due, in many instances, to a chemical decomposition of certain cementing substances which hold the constituents together, either directly or indirectly, but in other instances the acid I believe acts at least in part by causing expansion or swelling up of a mineral infiltration deposit in the boundary region between the coal constituents, thus mechanically forcing these constituents apart.

Instead of using acid I may, in certain instances, use other agents, such as basic substances of which pyridine, aniline, and quinoline will serve as examples, where the bond of union is of such nature that it will be weakened thereby, without departing from the scope of my invention.

In using the acid or other agent, means which facilitate the entrance of the agent at the interface between the masses, layers or constituents of coal, such as change of temperature or alternation of increase and decrease pressure, are useful in hastening the action desired. Thus, the control valve 4 may be used to alternately decrease and increase the pressure of the agent (whether gaseous or liquid) within the openings or bores 10, and the resulting expansion and contraction of the agent within the openings or bores may be employed to effect an advantageous change in temperature.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. The method of treating massive mineral coal which comprises subjecting the coal at a temperature below the decomposition temperature of the organic coal constituents to the action of an agent capable of weakening the bond of union between the organic constituents of the coal by chemical action, and thereafter separating the said constituents thus weakened to the desired extent by the action of such agent.

2. The method of treating massive mineral coal which comprises subjecting the coal at a temperature below the decomposition temperature of the organic coal constituents to the action of an acid, thereby weakening the bond of union between the organic constituents of the coal, and thereafter separating said constituents.

3. The method of treating massive mineral

eral coal which comprises subjecting the coal at a temperature below the decomposition temperature of the organic coal constituents to the action of a fluid agent capable of
5 weakening the bond of union between the organic constituents of the coal by chemical action and applying means to facilitate the entrance of the fluid agent into the boundary region between the constituents of the coal, and thereafter separating the said constituents thus weakened to the desired extent by the action of such agent.

4. The method of treating mineral coal which comprises subjecting the coal to the
15 action of an acid and simultaneously subjecting the coal and the acid to change of temperature and to alternate increase and decrease of pneumatic pressure to weaken the bond of union between the coal constituents, and separating the said constituents thus weakened to the desired extent by the
20 action of such agent.

5. The method of treating massive mineral coal which comprises subjecting the
25 coal at a temperature below the decomposition temperature of the organic coal constituents to the action of acidic gaseous combustion products, thereby weakening the bond of union between the organic constituents of the coal, and thereafter separating said constituents.

6. The method of treating massive mineral coal which comprises subjecting the coal to the action of sulphurous acid and
35 separating the constituents of the coal by physical means.

7. The method of treating massive mineral coal which comprises subjecting the coal at a temperature below the decomposition temperature of the organic coal constituents to the action of acidic gaseous combustion products and water, thereby
40 weakening the bond of union between the organic constituents of the coal, and thereafter separating said constituents.

8. A method of facilitating the mining of

coal which consists in treating the coal in situ with an acid agent which is capable of weakening the bond between the constituents of the coal by chemical action. 50

9. A method of facilitating the separation of constituents of coal by washing or concentration, which consists in treating the coal at a temperature below the decomposition temperature of the organic coal constituents and without previous pulveriza-
55 tion with an acid agent capable of weakening the bond of union between the organic constituents of the coal by chemical action.

10. A process of mining coal consisting in introducing into a bore of suitable depth in the face of the coal an acid agent and after this has had time to loosen the union between the masses of coal, removing the coal by mining operations. 60

11. In the process of mining coal in the manner referred to in claim 10, introducing sulphur dioxide into the bore. 65

12. A method of facilitating the mining of coal which consists in treating the coal in situ with gaseous sulphur dioxide. 70

13. The method of treating massive mineral coal which comprises subjecting the coal at a temperature below the decomposition temperature of the organic coal constituents to the action of an agent capable of weakening the bond of union between the organic constituents of the coal, and thereafter separating the constituents of the coal by subsequent mechanical treatment. 75

14. The method of treating massive mineral coal which comprises subjecting the coal at a temperature below the decomposition temperature of the organic coal constituents to the action of an acid capable
85 of weakening the bond of union between the organic constituents of the coal and subsequently mechanically separating the constituents of the coal.

In testimony whereof I affix my signature. 90

RUDOLF LESSING.