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UNDERGROUND GASIFICATION OF COAL

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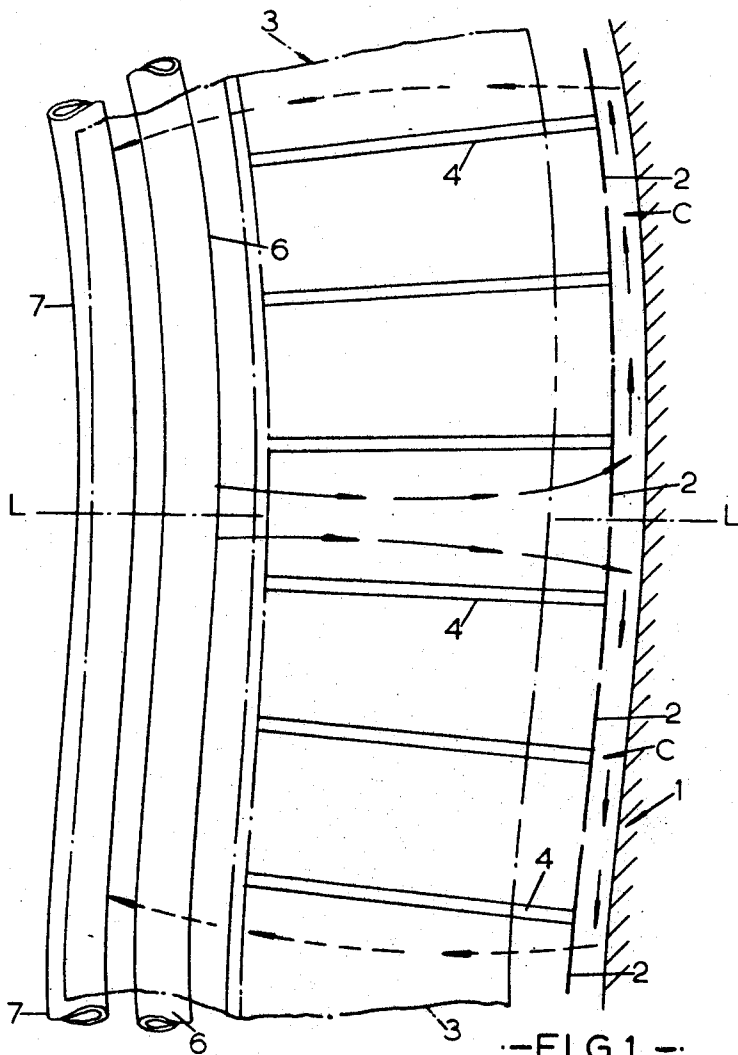
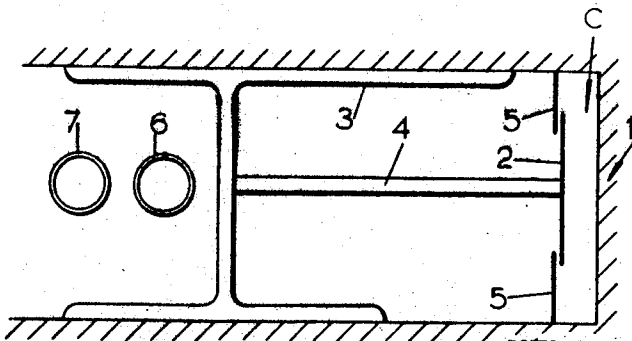


FIG. 1.

FIG. 2.



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1

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ABSTRACT OF THE DISCLOSURE

Gasification of coal underground using a movable furnace wall structure spaced from and substantially parallel to the coal face so as to form an enclosed furnace space to which oxidant is supplied, preferably via a multiplicity of openings through the wall, to promote gasification of the coal along this face, the hot products of combustion being extracted continuously from the furnace space and the wall structure being advanced as the coal face is consumed, preferably by connection with remotely controlled self-advancing roof supports.

This invention relates to the gasification of coal underground to enable it to be used for power production or other commercial purposes without mining the coal and bringing it above ground.

Generally speaking proposals for doing this have up to now entailed combustion of the coal seam within cavities produced by boring or by other means, the gases from the combustion of the coal being piped to the surface where they are converted into heat or other form of usable power. The progress of the underground combustion follows largely natural laws and is governed largely by the direction and size of the coal seam and by the nature of the surrounding ground. Much heat from the combustion is lost by heating the surrounding ground, roof falls or wall collapses may block or divert progress of the combustion, and in many ways the process is very arbitrary and uncontrollable.

The chief object of this invention is to provide a method of and means for gasifying the coal underground in a much more controlled manner which will achieve greater efficiency in the extraction of power or other useful properties from the coal.

To this end the method proposes to expose a face of the coal seam, such as a longwall face, to locate a movable furnace wall structure spaced from and substantially parallel to such face so as to form an enclosed furnace space, to supply one or more streams of an appropriate oxidant to the said furnace space and extract the hot products of combustion, and to advance the furnace wall structure as the coal face is consumed. These products may be converted into power below or above ground or partly in each sphere, and they may consist of gases which can be burnt to provide heat or which can be used to transmit their heat to water or some other medium from which the available power can be obtained. Alternatively to power production, or in conjunction with the same, the products may be used as a starting material or feed stock for chemical processes to produce other materials.

To enable this method to be used means will be provided (a) for advancing the furnace wall structure as the coal face is consumed, (b) for supporting the roof at least over a sufficient region near the furnace space, (c) for protecting said structure from the effects of the heat and chemical corrosion, and (d) for the maximum practicable conservation of the heat produced.

These provisions may vary but, for example, items (a) and (b) might be fulfilled by use of a system of self-advancing roof supports linked with the furnace wall

2

structure so as to advance the latter also. The system would be provided, where necessary, with means for negotiating small roof falls and/or obstructions from non-combustible strata. The furnace wall structure may be made flexible as necessary by constructing it from a series of interlinked sections or otherwise making it articulated so that it can flex in a vertical, horizontal or other plane as required under various conditions. These self-advancing operations could be controlled from above ground or otherwise remotely and all aspects of the whole operation could be monitored by suitable instruments and apparatus. Automatic control of the advancing movement might be achieved by use of sensing devices associated with the furnace wall and arranged to sense the distance ahead of the coal face and to control the self-advancing operations.

Item (c) might be fulfilled by causing all or a part of the oxidant supply to cool the furnace wall and/or to form a barrier between the inner face of the wall and the combustion products, or part of these gaseous products (cooled if necessary) might likewise be used in a recirculated flow to form such a barrier. This cooling flow of oxidant or combustion products may be directed through the wall via a multiplicity of channels or other openings in the wall, the exits being arranged to direct the cooling flow and produce the barrier to the best effect. The wall may thus be constructed wholly or partly of metal, refractory material or other suitable substance.

Item (d) might be fulfilled by the use of the well-known heat recuperator principle and/or of insulated product gas conduits in order to conserve much of the heat which would otherwise escape from the system. Such insulation may be by lagging or like covering of all conduits, or by the use of vacuum-jacketed conduits where the vacuum might be maintained by constant pumping. The recuperator principle, if used, might employ two or more concentric or similarly arranged conduits with an inert gas or gases or other transfer medium passing in contact with the wall of the product gas conduit, the heat being afterwards (either above or below ground) recovered from such medium. Also this medium may be brought into contact with the product conduit wall in successive stages along the length of the conduit in order to make greater use of the heat differentials and thereby increase the efficiency of the heat transfer.

In order that the invention may be fully and clearly comprehended, the same will now be described, with reference to the accompanying drawings which are intended merely to illustrate diagrammatically the general features of the method according to the invention and some features of an apparatus which might be used for carrying out the method. In these drawings:

FIGURE 1 represents a broken plan view of an apparatus in its working position opposite to the coal face, and

FIGURE 2 represents an end view corresponding mainly with FIGURE 1.

In these drawings, part of a longwall face is indicated at 1, and at a suitable distance from it is located the furnace wall structure 2. This is composed of a series of vertical sections articulated together so as to span the coal face from end to end and to extend from floor to roof. Each section is mounted on or connected to one or more self-advancing roof supports 3 by arms 4 and the whole line of supports can be arranged to advance progressively as the coal face is consumed. As indicated in FIGURE 2, the top and bottom edges of the furnace wall 2 may carry self-adjusting sealing members 5 of asbestos or other suitable material which are spring-pressed to maintain sealing contact with the floor and roof in spite of unevenness therein or minor obstructions. Al-

3

ternatively, these self-adjusting sealing members might be flexible and secured to the wall.

There is thus formed between the coal face and the furnace wall a furnace space C where combustion takes place. This may be a single long space as indicated in FIGURE 1, or it might be compartmented by partitions carried on and extending forwardly from the furnace wall so as to approach close to or actually contact the floor, roof and face.

Carried on the rear of the roof supports 3 are an oxidant conduit 6 and a product gas conduit 7. These extend the length of the furnace wall and communicate respectively at one or both ends with a supply of oxidant and with a delivery pipe for the product gases, these communicating means allowing the conduits to follow the advancing furnace wall. Any suitable oxidant may be used, for example, air, oxygen, steam, carbon dioxide or a combination of two or more of these, and the combustion in the space C will be initiated by any suitable means.

The oxidant is led from conduit 6 to a multiplicity of channels or passages passing through the wall 2 so that the oxidant sweeps across the inner face of the wall and is suitably distributed. The product gas is led through suitable outlets in the wall 2 to the conduit 7. In FIGURE 1 the path of the oxidant is indicated by full-line arrows and that of the product gas by broken-line arrows, these paths being repeated at intervals along the coal face. This arrangement of inlets and outlets through the wall 2 will be arranged to promote uniform and complete gasification of the coal. As indicated in FIGURE 1 the oxidant may be directed respectively to the left and to the right on the left hand side and the right-hand side of a centre line L. If desired, some compartmentation of the furnace space C may be achieved by suitable control of the flow of the oxidant and the product gas therein. Thus it will be seen that the gasification process can be continuous, the furnace wall being advanced gradually as the coal face is consumed.

The successful operation of the method according to the invention may require the following features of control of the combustion conditions in order to attain an optimum output of heat and of gas calorific value from the combustion:

- (1) control of the proportion of the components of the oxidant flow;
- (2) control of the points of entry to the hot region of different parts of the total oxidant flow;
- (3) control of the points of exit from the furnace space of the furnace gases;
- (4) control of the rate of all these flows;
- (5) control of the distance of the furnace wall or various parts thereof from the coal face;
- (6) control of the possible compartmentation of the furnace space.

Whilst the hereinbefore described embodiments of the invention have been mentioned merely by way of example, it is to be understood that other suitable embodiments may be evolved for carrying out the invention and that protection is hereby claimed for all such embodiments within the scope of the appended claims.

I claim:

1. A method of gasification of coal underground which consists in exposing a face of the coal seam, providing a movable furnace wall structure underground which is spaced from and substantially parallel to said face of said coal seam and thereby defines an enclosed furnace space, supplying one or more streams of an oxidant to said furnace space to promote at least partial combustion and gasification of the coal along said face, extracting the hot products of combustion from the furnace space to a point of use or storage, and thereafter advancing the movable

4

furnace wall structure and its associated oxidant feeding means to keep pace with the consumption of the coal face.

2. The method according to claim 1, wherein said oxidant is directed past the inner face of the furnace wall to protect the latter.

3. The method according to claim 1, wherein part of the product gases are cooled and are recirculated over the inner face of the furnace wall to protect the latter.

4. The method according to claim 1, wherein heat losses during extractions of the combustion-products to said point of use or storage are reduced by interposing a fluid heat transfer medium from which heat is recovered.

5. Apparatus for gasification of coal underground comprising a furnace wall structure supported so that it can be advanced towards the coal face and arranged to form with the coal face, floor and roof a furnace space, means to supply oxidant to said furnace space to promote combustion and gasification of the coal, means for extracting the hot products of combustion from said space and for conveying them to a point of use or storage and power-operated means for advancing the furnace wall structure and its associated oxidant feeding means towards the coal face as the latter is consumed.

6. Apparatus according to claim 5, wherein said furnace wall structure consists of a series of interlinked sections articulated along its length to flex in several directions to accommodate itself to the varying contours of the adjacent terrain.

7. Apparatus according to claim 5, including self-adjusting sealing members extending along the top and bottom edges of the furnace wall to maintain sealing contact with the floor and roof.

8. Apparatus according to claim 5, wherein the furnace wall is connected to a series of self-advancing roof supports, wherein power means are provided for said supports, and wherein remote control means are provided for controlling the operation of said supports from a remote control point.

9. Apparatus according to claim 8, wherein an oxidant supply conduit and a product gas delivery conduit are carried on said roof supports and extend substantially the full length of the furnace wall, said oxidant supply conduit conveying the oxidant to said furnace space via a multiplicity of openings through said wall.

10. Apparatus according to claim 9, wherein at least some of said openings are fitted with deflector devices to direct the oxidant over the inner face of the furnace wall.

11. Apparatus according to claim 9, including additional openings through the furnace wall for supplying a re-circulated portion of the product gases so that they are directed over the inner face of the furnace wall.

12. Apparatus according to claim 5, wherein said furnace space is provided with compartments which are formed within the space as a result of the control of the flow of combustion gases.

13. Apparatus according to claim 12, wherein said compartments are formed by partitions.

14. Apparatus according to claim 12, wherein said compartments are defined by controlled jets of gas.

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