

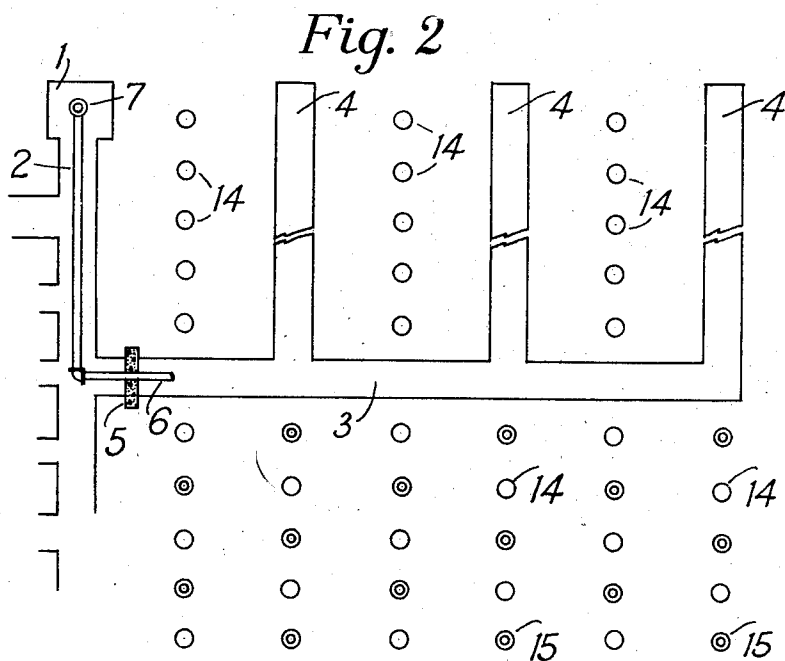
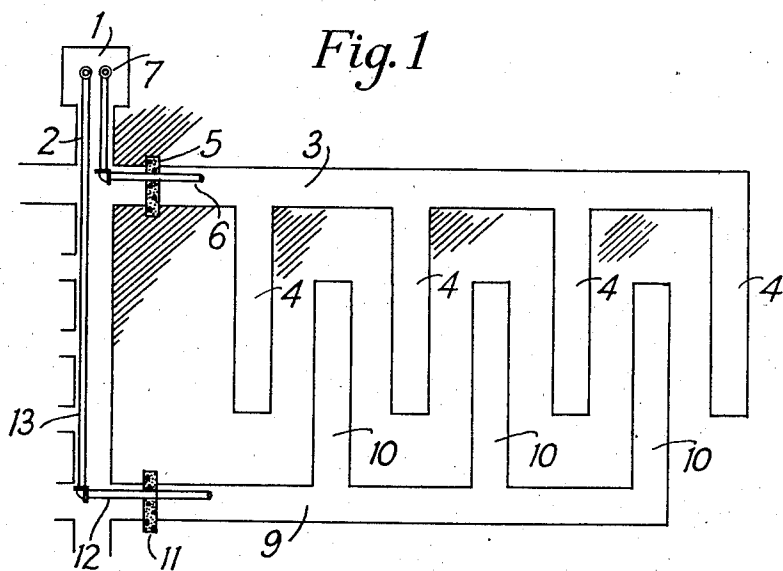
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PROCESS OF DEGASIFYING COAL AND OTHER CARBONACEOUS MATERIAL IN SITU

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PROCESS OF DEGASIFYING COAL AND
OTHER CARBONACEOUS MATERIAL IN
SITULeo Ranney, New York, N. Y., assignor of one-
tenth to James H. Hayes, Greens Farms, Conn.Application September 2, 1932, Serial No. 631,578
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9 Claims. (Cl. 262—1)

This invention relates to improvements in the process of degasifying coal and other carbonaceous material in situ, and is an improvement in the process disclosed and claimed in my Letters Patent No. 1,867,758 issued July 19, 1932.

The primary object of this invention is to provide a method of accelerating the exudation and recovery of gas from coal seams when practising the method of degasification disclosed in my previous application, or similar methods.

A considerable part of the gas exuded by coal when pressure is released and it is exposed to the air, exists in the coal as free gas, whether laid down as such with the coal or later absorbed by it from outside sources or formed within the coal by chemical processes. Before pressure is released, part of this free gas lies in the fissures extending through the coal, but a much greater part is absorbed within the coal itself in pores, often of molecular size, under pressures sometimes as high as several thousand pounds per square inch. These minute pores are connected with each other, and the system so connected is in a way a network of small capillaries.

This network of capillaries connecting with the gas filled pores is cut in innumerable places by the small fissures or fractures extending through the coal. When pressure is released on the coal body, the absorbed or occluded gas slowly passes out of the capillary system into the fissures and through the fissures toward the point at which pressure is partially released, and eventually into the open air. This exudation of gas is normally relatively slow.

In some coals a quantity of gas is formed by chemical changes after a part of the rock pressure on the coal has been released. This formed gas, as well as the originally occluded or absorbed gas, in order to escape from the coal, must also pass out through the capillary system to and through the fissures in the coal.

I have found that the exudation of gas from the pores and capillaries of coal is greatly hastened by slightly raising the temperature of the coal, likewise an increase in temperature hastens any gas forming chemical action that may be taking place within the coal. Thus, when it is desired to secure a supply of gas from standing coal, an increase in temperature has a doubly beneficial effect. The gas held within the pores and in the capillary system tends to expand and drive itself out of the pores even with a slight increase in temperature. In some cases an increase of ten degrees may be expected to almost double the rate of gas exudation. The applica-

tion of heat also reduces the viscosity of the gas.

My improved method of stimulating and accelerating the formation and exudation of gas by coal, and the recovery of gas from coal, consists of raising the temperature of the coal and applying pressure to the gas together with means for bringing about the temperature elevation and means for applying pressure.

With the foregoing objects outlined, and with other objects in view which will appear as the description proceeds, the invention consists of the novel features hereinafter described in detail, illustrated in the accompanying drawing, and more particularly pointed out in the appended claims.

In the drawing:

Fig. 1 is a plan view of a degasification system located adjacent to the workings of a coal mine.

Fig. 2 is a plan view of a modified form of the invention illustrating the substitution of wells for one or both of the tunnel systems illustrated in Fig. 1.

Referring to the drawing, 1 represents a shaft leading to the workings 2 of a coal mine. From the workings 2, I drive a tunnel 3 of any desired length and cross section, into or adjacent to the coal seam comprising the area to be degasified, and from this tunnel 3 I extend into the coal area to be degasified the spaced tunnels 4.

Having completed the tunnel 3 and the connecting tunnels 4, I then construct a seal 5 in the open end of tunnel 3 nearest the old or new workings of the mine. A pipe 6 is extended either from the shaft or from the workings through the seal 5 into the tunnel 3 and is connected through a suitable pipe 7 to exhausting pumps and gas reservoirs, not illustrated, located on the surface of the ground.

Having completed the gas recovery system above described, I construct a second tunnel system consisting of tunnel 9, connecting tunnels 10, which are located substantially parallel to and between tunnels 4 of the gas recovery system, the seal 11, and the pipes 12 and 13. Pipe 13 is connected with a source of heated gas and means for placing the heated gas under pressure. This second tunnel system may be designated as a warm gas pressure system.

Having completed the gas recovery system, and the warm gas pressure system above described, I proceed as follows:

Heated natural or manufactured gas is pumped, under pressure, through pipes 13 and 12 into the tunnel 9 and the connecting tunnels 10. This gas is thus driven into the fissures exposed at the

coal face, and passes along these fissures through the coal toward the parallel gas recovery tunnels 4, heating the coal in the area between and adjacent to the tunnels 4 and 10 to any desired degree, depending upon the initial temperature and pressure of the gas introduced.

When the temperature of the coal composing the walls of the pressure tunnels 10 has been increased ten degrees or more and this increased temperature has extended well back into the coal face or tunnel wall, the temperature of the injected gas may be reduced to allow such injected gas to take up the heat of the coal near the walls of the pressure tunnels 10 and carry this heat into the coal nearer the gas recovery tunnels 4.

While the above operations are being carried on, the gas recovery system may, if gas is not being produced therein at pressures sufficient to deliver it to storage reservoirs on the surface of the ground, be placed under partial vacuum, and the gas exhausted through pipes 6 and 7.

In cases where the gas is delivered from the recovery system at relatively high temperatures, it may be desirable to use a part thereof for re-injection into the warm gas pressure system. This may be accomplished by passing a part of the gas through a compressor, (saving the heat of compression), then through a heating chamber or coil to further raise the temperature, and into the warm gas pressure system through pipes 12 and 13.

The exudation and recovery of gas is controlled by the temperature and pressure of the gas injected, the higher the temperature and pressure, the more rapid the extraction.

When the body of coal under treatment has been sufficiently heated, and a sufficient percentage of occluded gas affected, the injection of heated gas may be discontinued, and if desirable, the pressure tunnels 9 and 10 may be converted into gas recovery tunnels, while the coal is still warm, the gas being exhausted through pipes 12 and 13, either by pressure or the application of suction. In this way gas may be withdrawn simultaneously from all sides of the coal body under treatment.

In some cases where the coal is quite porous, I may substitute wells 14 and 15, Fig. 2, drilled from the surface of the ground, for one or both of the tunnel systems, sealing the wells from the infiltration of atmospheric air, and from each other, the same as when tunnel systems are used. In this modification of my process I inject the warm gas through wells 14 and recover gas either through the tunnel system composed of tunnels 3 and 4 or through wells 15.

When wells for gas extraction or for warm gas injection are used I prefer to drill same from the surface to and through the coal seam, and to explode explosive charges in the wells opposite the exposed coal face therein, to fracture the coal and facilitate the extraction or injection of gas, as the case may be.

In the operation of either system, it is desirable to recover the gas from the coal before the coal has time to cool off, as coal absorbs some gas, particularly when it is cold. If the coal is heated and allowed to cool again without any gas being removed in the meanwhile, the coal when cool will contain its original gas, but if while the coal is warm, substantially all recoverable gas is extracted from it, then when the coal cools again, it will be substantially non-gaseous in subsequent mining operations.

From the above description, taken in connec-

tion with the drawing, it is believed that those skilled in the art will clearly understand the present invention; and it is manifest that changes may be made in the details disclosed without departing from the spirit of the invention as expressed in the claims.

What I claim and desire to secure by Letters Patent is:

1. The process of extracting gas from coal deposits in situ, which process comprises gaining access to the coal deposit through a tunnel system, sealing said tunnel system against the infiltration of atmospheric air, applying heat to the coal deposit adjacent to the tunnel system sufficient only to expand and thereby accelerate the removal of gas already existing in the coal deposit, while leaving the coal in the deposit intact and removing the gas escaping into the tunnel system from said coal deposit.

2. The process of extracting gas from coal deposits in situ, which process comprises gaining access to the coal deposit through a tunnel system, sealing said tunnel system against the infiltration of atmospheric air, applying heat to the coal deposit adjacent to the tunnel system sufficient only to expand and thereby accelerate the removal of gas already existing in the coal deposit, while leaving the coal in the deposit intact, placing the tunnel system under partial vacuum and removing the gas from the coal deposit.

3. The process of extracting gas from coal deposits in situ, which process comprises gaining access to the coal deposit through wells driven from the surface of the ground, sealing said wells against the infiltration of atmospheric air, applying heat to the coal deposit adjacent to the wells sufficient only to expand and thereby accelerate the removal of gas already existing in the coal deposit, while leaving the coal in the deposit intact and removing the gas escaping into the wells from said coal deposit.

4. The process of extracting gas from coal deposits in situ, which process comprises gaining access to the coal deposit through wells driven from the surface of the ground, sealing said wells against the infiltration of atmospheric air, applying heat to the coal deposit adjacent to the wells sufficient only to expand and thereby accelerate the removal of gas already existing in the coal deposit, while leaving the coal in the deposit intact, placing the wells under partial vacuum and removing the gas from the coal deposit.

5. The process of extracting gas from coal deposits in situ, which process comprises constructing independent tunnel systems consisting of one or more tunnels each, in the area of the coal deposit to be degasified, sealing said tunnel systems against the infiltration of atmospheric air, injecting under pressure into one tunnel system gas heated to a degree sufficient only to expand and thereby accelerate the removal of gas already existing in the coal deposit adjacent to said tunnel system, while leaving the coal in the deposit intact, and removing the gas escaping into the other tunnel system from said coal deposit.

6. The process of extracting gas from coal deposits in situ, which process comprises constructing independent tunnel systems consisting of one or more tunnels each, in the area of the coal deposit to be degasified, sealing said tunnel systems against the infiltration of atmospheric air, injecting under pressure into one tunnel system gas heated to a degree sufficient only to expand and thereby accelerate the removal of gas

already existing in the coal deposit adjacent to said tunnel system, while leaving the coal in the deposit intact, placing the other tunnel system under partial vacuum and removing the gas from the coal deposit.

5 7. The process of extracting gas from coal deposits in situ, which process comprises constructing independent systems of wells from the surface of the ground to and through the area of the coal deposit to be degasified, sealing said independent systems of wells against the infiltration of atmospheric air, injecting under pressure into one well system gas heated to a degree sufficient only to expand and thereby accelerate the removal of gas already existing in the coal deposit adjacent to said well system, while leaving the coal in the deposit intact, and removing the gas escaping into the other well system from the coal deposit.

10 8. The process of extracting gas from coal deposits in situ, which process comprises constructing a tunnel system composed of one or more tunnels in the area of the coal deposit to be degasified, sealing the tunnel system against the infiltration of atmospheric air, driving the wells from the surface of the ground into the coal deposit adjacent to the tunnel system, injecting under pressure into said wells gas heated to a degree sufficient only to expand and thereby accelerate the removal of gas already existing in the coal deposit, while leaving the coal in the deposit intact, placing the tunnel system under partial vacuum and removing the gas from the coal deposit.

wells from the surface of the ground into the coal deposit adjacent to the tunnel system, injecting under pressure into said wells gas heated to a degree sufficient only to expand and thereby accelerate the removal of gas already existing in the coal deposit, while leaving the coal in the deposit intact, and removing the gas escaping into the tunnel system from the coal deposit.

5 9. The process of extracting gas from coal deposits in situ, which process comprises constructing a tunnel system composed of one or more tunnels in the area of the coal deposit to be degasified, sealing the tunnel system against the infiltration of atmospheric air, driving the wells from the surface of the ground into the coal deposit adjacent to the tunnel system, injecting under pressure into said wells gas heated to a degree sufficient only to expand and thereby accelerate the removal of gas already existing in the coal deposit, while leaving the coal in the deposit intact, placing the tunnel system under partial vacuum and removing the gas from the coal deposit.

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