A. G. BETTS.

METHOD OF UTILIZING BURIED COAL.

APPLICATION FILED DEC. 27, 1906.

947,608. Patented Jan. 25, 1910.

2 SHEETS—SHEET 1.

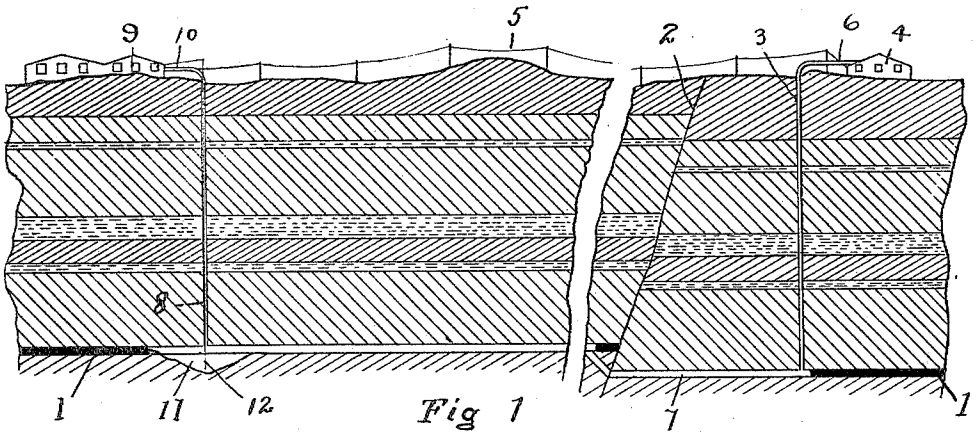


Fig 1

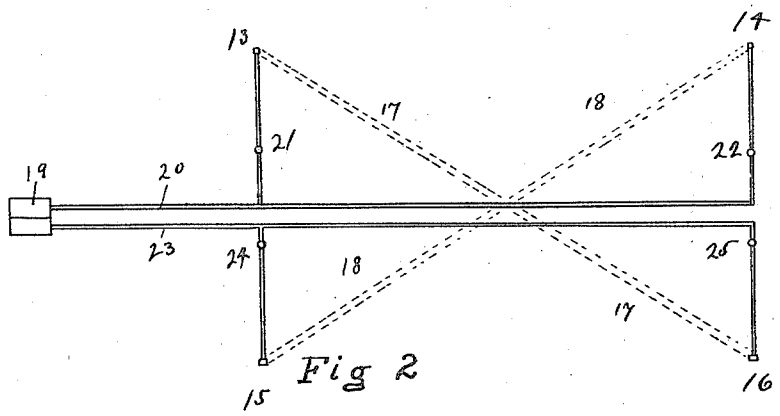


Fig 2


Fig 3

WITNESSES

Ralph N. Sherry.

Benj. Starbuck

INVENTOR

Anson Gardner Betts

A. G. BETTS.

METHOD OF UTILIZING BURIED COAL.

APPLICATION FILED DEC. 27, 1906.

947,608. Patented Jan. 25, 1910.

2 SHEETS—SHEET 2.

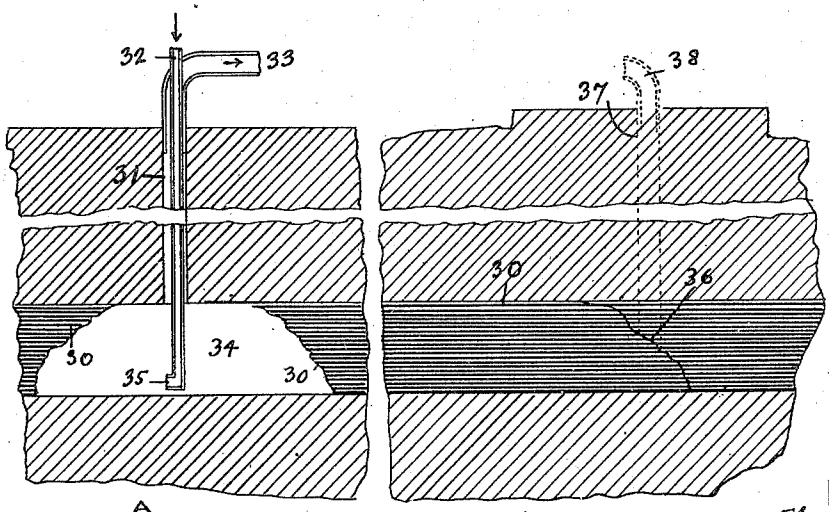


Fig 4

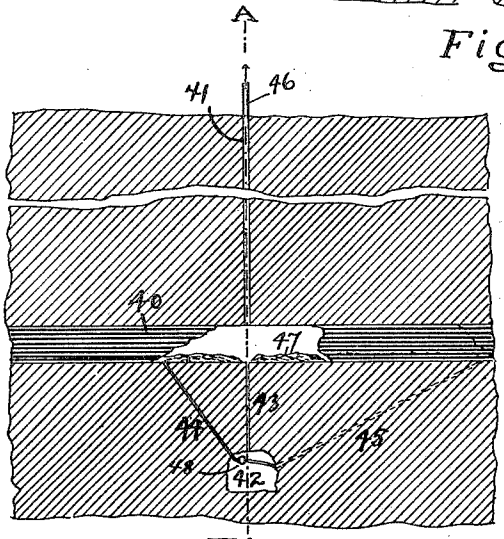


Fig 5

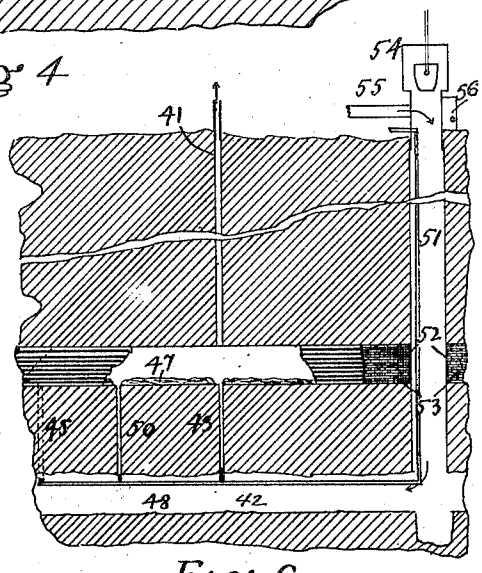


Fig 6

WITNESSES

Ralph W. Sherry

Benj. Starbuck

INVENTOR

Anson Gardner Betts

# UNITED STATES PATENT OFFICE.

ANSON G. BETTS, OF TROY, NEW YORK.

## METHOD OF UTILIZING BURIED COAL.

947,608. Specification of Letters Patent. Patented Jan. 25, 1910.

Application filed December 27, 1906. Serial No. 349,606.

*To all whom it may concern:*

Be it known that I, ANSON GARDNER BETTS, a citizen of the United States, residing at Troy, in the county of Rensselaer and State of New York, have invented a certain new and useful Method of Utilizing Buried Coal, of which the following is a specification.

This invention relates to a method of utilizing the coal measures and coal remaining in worked-out mines.

Hitherto coal has been dug and brought to the surface for utilization at the expense of much sweat and loss of life.

The object of my invention is to obviate these sacrifices and also to provide for the utilization of coal seams too thin or too poor for commercial use by present methods.

Other objects will appear in the following description of my method.

Figure 1 is a vertical cross section of an arrangement and location of plant in carrying out my invention. Fig. 2 is a plan view of a similar arrangement. Fig. 3 is a plan view of an arrangement for utilizing the coal in a worked-out mine. Fig. 4 is a view in vertical cross section of an arrangement of plant I may use in carrying out my invention. Figs. 5 and 6 are views in vertical cross section of still another arrangement of plant, Fig. 6 being a section on the line A in Fig. 5.

It is well known that coal may be "gasified", that is, converted into combustible gases by combustion with insufficient air for complete combustion, and if the right proportion of steam or water be used with the air, the coal can be gasified without causing an excessively high temperature in the coal or in the escaping gases, and the gas may be made so that it contains as much as 80% of the total heat of the coal, all that it is then necessary to do being to mix it with the proper amount of air for complete combustion. Such gases are a more valuable and convenient fuel than the coal from which they are produced, and are especially suitable for running gas engines. The great advantage of gas over coal lies in its easy transportation to where it is used, and it produces no ashes, besides all which an even heat can be maintained without attention. Hitherto these gases have been produced by mining coal and gasifying it in a producer. According to my invention, I gasify the coal where it lies underground, and I will now describe methods for carrying out my invention.

Two shafts, or a shaft and bore hole, may be provided to the coal seam, and an air passage through the seam provided, either by driving from one shaft to the other or the bore hole is sunk to the workings, if such does not already exist. A fire is started at the bottom of one shaft and a supply of air pumped down and water or steam also supplied, when gas analogous to producer gas comes out of the other shaft, and can be used for running gas engines, smelting works, glass works, firing boilers, etc.

The tar and ammonia produced can be collected in any suitable way.

My invention contemplates the use of several different drifts in the coal with separate air supplies, so that the combustion rate may be regulated by the use of just the right number of fires to give the best results, as well as the use of crooked fire passages, both of which will aid in completely burning out a given area.

The advantage of several holes to the surface through which the gases may be drawn out, is apparent. If air cracks allow air to come in near a gas outlet and too much free oxygen comes out in the gas, by operating another gas outlet at a greater distance from the air inflow, obviously a greater degree of combustion may be obtained.

As the removal of coal from an area may cause subsidence and open cracks through which the valuable gases may escape to the surface of the ground and be lost, my invention contemplates when desirable the use of suction at the gas outlet at least, in order rather to draw air in through such cracks instead of forcing gas out through them. The subsidence is useful however in that it tends to fill the space left vacant where the coal has been burned out, except near the face of the coal, which circumstance causes a large part of the air to pass near the face of the coal.

Other methods of carrying out the invention may be used, in which it is required only to use one bore-hole to the coal. After the bore-hole is completed, a pipe is let down to the coal through the bore-hole for a supply of air, the coal ignited and thereafter a current of air forced in, and gas taken out. After so large an area is burned out that the

action is not satisfactory, another bore-hole may be let down to near the edge of the burned area, through which air is supplied thereafter instead of through the air pipe, until that too ceases to work well, when other holes may be put down.

Another method consists in sinking a shaft nearly down to the coal or beyond, and drifting from the shaft either above the coal or better below it, and boring air holes to the coal from the drift, where they are required. The gas produced in this method to be drawn or forced preferably to the surface through a bore-hole or another shaft. It is obvious that if air without water or steam is used to gasify the coal, intensely high temperatures may be obtained, sufficient to fuse some rocks, and in this way I contemplate being able to melt rock down to fill up burned-out spaces, and form pillars to support the ground so that the subsidence or caving that occurs with the removal of the coal, need not extend to a sufficient height above the workings to make open cracks to the surface for the escape of gas, or at least to prevent it to a large extent.

For the greatest economy of fuel in making gas water should be brought to the burning coal as well as air. If sufficient water is not supplied by natural agencies, it may be passed in the gaseous state with the air supply.

The chemical reactions are as follows: The first action of the air on carbon is to form $CO_2$ with considerable evolution of heat. The $CO_2$ reacts with hot carbon further on to form CO with absorption of heat, about $\frac{1}{3}$ of the total heat obtainable appearing as a result of these two reactions, and the other two-thirds being capable of utilization at any desired point, by simply burning the gas. When water is supplied with the air, it is decomposed by hot carbon with the formation of combustible gases, increasing yet considerably the proportion of the heat still remaining in the gas for use in the furnace or engine, etc. Such gases are very valuable for many purposes, although not as rich as natural gas. I may produce gases having higher heating values more like natural gas, in the following way: The hot gases from the gasification of the coal on passing through or near a good deal more coal, will heat this coal, and tend to coke it, producing large quantities of a rich gas, mixed with the heating gas. After this coal gets well baked, it will not be possible to get these rich gases in quantity any more from that particular coal, but by operating a number of subterranean fires in different stages of completion, various qualities of gas may be obtained and applied to various uses for which each may be especially economical.

Having reference to the accompanying drawings, in Fig. 1, I have shown a coal seam 1, vaulted at 2. Air is forced down the shaft 3, by pumps not shown, in the pumping plant 4, operated electrically by a current carried over the electric conductor 5. The air goes through the pipe 6 then through the shaft 3, and passage 7, cut in the coal to the shaft 8, whence the resulting gas passes to the power plant 9, being connected with the shaft by the pipe 10. The power plant 9 may contain gas cleaning apparatus, gas engine and dynamo, and transmit beside cleaned gas, the larger part of the electric power produced to a desirable point of consumption, and a small part to the air pump in the pumping plant. The well 11, collects tar, which may be pumped out through a pipe 12, let down the shaft.

In Fig. 2, I have shown four shafts 13, 14, 15 and 16, driven to the coal seam, and drifts 17 and 18, connecting the bottom of shafts 13 and 16, and 14 and 15 respectively. The plant 19 may contain electric generating machinery driven by gas engines, and consume the gas produced in generating useful electric energy or the gas may be cleaned and pumped to distant points for consumption. The plant 19 also supplies air through the air pipe 20 to shafts 13, and 14, the valves 21 and 22 being used for cutting the air supply from either one at choice. The gas generated under ground is delivered to the electric plant by the pipe 23. The valves 24 and 25 serve the purpose of regulating the direction of the air and gaseous current underground either toward shaft 15 or 16 as desired.

In Fig. 3, I have indicated in dotted lines a partially worked-out coal mine and two shafts 26 and 27, one for the supply of air, and the other to carry out the gas produced.

In Fig. 4, I have shown a coal seam 30, reached by the bore-hole 31, down which has been passed an air and steam pipe 32, while the top of the bore-hole is provided with a delivery pipe 33 for gas. The opening 34 is due to the gasification of coal by the air and steam, and widens continually as the coal is gasified, a side air jet 35, being provided to blow the air toward the coal, while the air jet may be turned in any horizontal direction by simply turning the air-pipe. After the opening gets too large for successful action, and reaches the line 36, another bore-hole 37 shown by dotted lines may be drilled and thereafter air and steam passed down one and gas taken out of the other if desired. An air or gas pipe 38 to be provided at the top of bore-hole 37.

In Fig. 5, I have shown a coal seam 40, reached from the surface by the bore-hole 41, and from the lower drift 42, by several bore-holes, 43, 44 and 45, driven at different periods, according to the position of the face of the coal at the time. Air and steam for

gasification are supplied through the working 42, through any one or ones of the bore-holes 43, 44 and 45 according to circumstances, the gasification of the coal taking place in the seam as usual while the useful gases go to the surface by the hole 41, with a delivery pipe 46, at the top, for gas. 47 is the ash of the coal. Steam is supplied by the pipe 48.

Fig. 6 is a section on the line A, of Fig. 5, and shows in addition to the drift 42, the bore-hole 41, the ash 47, the air and steam supply holes 43 and 45 and steam pipe 48, another hole 50, also for air and steam or water supply. The drift 42, is reached by the shaft 51, protected by iron 52, and brick 53, where it passes the coal. The top of the shaft is inclosed with a building 54, with air supply pipe 55. On closing the door 56, air passes down the shaft, and is delivered to the coal through the bore-holes 43, 45, 50, etc.

The term coal as used by me in the claims includes the various varieties of mineral fuel.

I use the term "unmined coal" in the claims in the sense that the coal has not been removed from its original position. If passages are driven through the coal for example, the coal remaining after removing the passages is then to be regarded for the present purpose as still unmined, though exposed.

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

1. The process of utilizing unmined coal which consists in supplying oxidizing gas thereto, gasifying the coal, and utilizing the gas produced.

2. The process of working unmined coal which consists in providing an open passage from the surface to the coal, through the coal and back to the surface, supplying to the coal a current of oxidizing gas to gasify the coal, and conducting off the gas thus produced.

3. The process of utilizing coal seams, which consists in forming a passage to the coal in the seam, supplying oxidizing gas to the coal through such passage and causing the gas to pass through a plurality of passages in the coal, whereby the coal is gasified, and withdrawing the gas produced thereby.

4. The process of utilizing unmined coal which consists in mining out part, and gasifying remaining coal by conducting air or equivalent gas thereto, which gasifies the coal, and collecting the combustible gases resulting therefrom.

5. The process of working unmined coal which consists in supplying oxidizing gas thereto, gasifying the coal and removing the gas at a less pressure than atmospheric pressure at the level of the gas outlet from the coal.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

ANSON G. BETTS.

Witnesses:

RALPH H. SHERRY,

FREDERICK CLARK.