UNITED STATES PATENT OFFICE.

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PROCESS OF PREPARING FUEL.


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To all whom it may concern:

Be it known that I, CHARLES H. URQUHART, a citizen of the United States, residing in the city of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in the Processes of Preparing Fuel, of which the following is a specification.

The present invention relates to a process of preparing fuel.

Certain substances herein called low grade coals comprising particularly lignite and also such substances as peat and the like are unsatisfactory for use as fuels in the condition in which they come from the deposits. The high volatile content is productive of smoke and the presence of the light volatile matter and water causes rapid disintegration, both when the lignite (which is hereinafter used as illustrative of all low grade coals) is stored and during combustion. This tendency to disintegrate causes the lignite to crumble so rapidly in the firebox that a large percentage of it falls unburned through the fire grates and is thereby lost and wasted.

It has been proposed heretofore to treat such low grade coals as lignite and the like, so as to prevent them from disintegrating both in storage and combustion. To this end, lignite has been briquetted, but it has been found that unless the volatile substances have been removed before briquetting, the disintegrating characteristics still remain to a large extent. Moreover, where the lignite is retorted or carbonized and the disintegrated or crumbled substance obtained therefrom is briquetted by means of a binder and a hard fuel is thereby obtained, much difficulty has been experienced in providing binders which will be constant in analysis so as to produce boulets and briquets consistent in weathering qualities. Consequently, the making of briquetted fuel from substances such as lignite and other low grade coals, is not at present a commercial proposition of any great moment. By the present process, all low grade coals, such as lignite, peat and the like, are converted into a fuel having the appearance, qualities and burning characteristics of hard coal. This prepared fuel is produced without converting the lignite or other low grade coals into boulets or briquets. The crude lump lignite is treated in the condition in which it comes from the mine and during the treatment the lignite is preserved whole in its lumpy condition, so that the product produced by the practice of the process is a hard fuel in lump form. The fuel produced by this process will not disintegrate either in storage or in the fire box and can be handled like ordinary hard coal without crumbling. The whole process can be practiced in one retort or container with no further handling than is necessary to charge it into the retort and to discharge it therefrom upon the completion of the process. The apparatus used for practising the process is therefore simple and inexpensive, and the practice of the process itself may be carried on at small cost comparatively to the value of the product produced.

The process of the present invention by which the lignite or other low grade coal or similar substance is converted into a hard, smokeless, slow burning fuel, consists in first depriving the lignite of a portion of its lighter volatile substances and a portion of its water, and continuing this step until cracks open in the lignite but without allowing the lignite to disintegrate or go to pieces. The cracks in the lignite as thus treated are then filled with a suitable binder such as melted pitch or the like and the lignite treated with the binder is permitted to stand until the binder is sufficiently viscous or hardened to prevent disintegration. The lignite is then subjected to a temperature sufficient to drive off the remaining lighter volatile substances and the remaining water. When this step has been accomplished the lignite is subjected to a temperature sufficient to cause a carbonization of the lignite and its binder. The fuel produced by this process is anthracite-like in its characteristics, that is to say, it is hard, smokeless, slow burning and non-friable with ordinary handling and usage.

A form of apparatus by which the present process may be practised is shown in the accompanying drawing which is a diagrammatic representation of one type of plant adapted for the practice of the process. The lignite is conveyed to the plant by a
charging car 1 from which the lignite is charged into a retort or container 2 through a door 3 in its upper part. This retort is of such construction that the inert gases driven from the lignite can be drawn from the retort by a pump or other suitable means, passed through a condenser and a super-heater and returned to the retort so as to maintain a proper circulation through the apparatus and for the purpose of practising the process. When the retort has been charged with sufficient quantity of the lignite, its temperature is raised sufficiently to drive off much of the water and light volatiles from the lignite. The primary supply of gas for this purpose may be contained in a gasometer 4 which is primarily designed to take care of surplus gas and regulate gas pressure, from which it passes through the pipes 20 to the usual gas burner surrounding the inner jacket of the retort 2. The water in its vaporized state and the lighter volatile substances driven from the lignite by raising its temperature are drawn from the retort by a gas fan 10, whence they are passed into a gas scrubber 11 which acts to clean the gases by removing foreign substances. In their passage from the retort to the gas fan, the gases and the water vapor pass through a tar trap 12 and a condenser 13. A portion of the gases pass from the gas scrubber 11 through a pipe 6 to a superheater 7, whence they pass through the pipe 8 to the valve 9 back into the retort and thereby maintain a circulation through the retort and at the same time assist in the practice of the process. The surplus gases pass through the pipe 5 to the gasometer 4, whence they may be drawn through the pipe 21.

Care must be exercised in this first step of the process that the temperature be not raised too high or that the step be practised too long. It has been found that it is usually desirable to keep the temperature about 250° F. and undesirable to raise it above 400° and to continue this preliminary heating step much longer than two hours. This treatment of the lump lignite causes cracks to open up in it but the lumps will not disintegrate or go to pieces if the heat is not too high or the lignite is not subjected to it for too long a period. The length of time necessary to cause the lignite to attain its cracked condition without disintegration varies to a certain extent with the individual characteristics of the raw material. But generally the desired result can be obtained within approximately three hours. The lignite is now in condition to be subjected to the next step of the process which consists in filling the cracks with a binding material such as melted pitch or the like. Either before or after the cracks have been filled with the binder, and preferably before, a vacuum pump 14 is used to draw the gases from the interstices in the lignite so that the melted pitch may penetrate into the spaces formerly occupied by the gases. This pitch when cooled acts to weld or bind together the particles of the lignite so as to produce a compact and difficulty friable mass. It is desirable that the binder should have a melting point above 250° F. The melted pitch may be filled into the cracks in a number of ways. A convenient way to inject the binder into the cracks in the lignite is to spray it into the retort in atomized form or it may be run in the retort in a mass. When the pitch is otherwise introduced into the retort a caldron or pitch melter 15 is employed under which there is a source of heat 16. Compressed air is conducted to the caldron through a pipe 17 and acts to force the melted pitch into the retort through a pipe 18. Such surplus pitch as remains after all the cracks in the lignite are completely filled will be drained back into the original pitch caldron. During the step of filling the cracks with pitch it will be understood that the circulation of the gases through the retort is temporarily stopped.

When the lignite has become thoroughly impregnated with the binder, that is to say, when all the cracks in the lignite have filled up with the binder, the temperature of the retort is allowed to decrease to a point at which the binder becomes more or less viscous and solidified. The solidifying of the binder at this point in the treatment of the lignite effects the temporary binding or holding together of the particles of the lignite so that it will withstand the further dehydrating treatment without crumbling. When the binder has become sufficiently solidified so as to hold the particles of the lignite together in a compact mass, the temperature of the retort is again raised to a point sufficient to expel all the remaining water from the lignite and such of the lighter volatile substances as can be driven off. The temperature, however, is not permitted to rise to that point at which the binder will become fluid so as to lose its binding qualities.

When all the remaining water has been thoroughly removed from the lignite by this secondary heating step and such of the lighter volatile substances have been driven off as can be without raising the temperature to the melting point of the binder, the lignite has undergone such chemical changes that it will not now further disintegrate even when the temperature is subsequently raised to a point where the binder carbonizes. The lignite is now, therefore, in condition for the practice of the final step of the process, which consists in rapidly raising the temperature of the retort from 700° to 1200° F. depending upon the individual characteristics of
the lignite being treated. At this temperature fusing takes place. The lumps of lignite and the binder are carbonized, the gases, the tars and the oils are retorted off by means of the appropriate devices connected with the retort. The fuel produced by the fusing or welding step of the process is anthracite-like in condition, appearance and characteristics. It may be handled without liability of crumbling. During the process of combustion, it burns without smoke and does not disintegrate in the fire place, so that there is no loss or waste by reason of unburned particles falling through the grate. It is thus seen that soft, low grade coals easily friable and therefore of great wastage and burning with much smoke, are by the foregoing process converted into a fuel which is hard and difficultly friable and which burns without smoke. It is sometimes found desirable to repeat the steps of injecting the binder and carbonizing the lignite two or three or even more times.

The present process possesses additional advantages beyond converting low grade coals into fuel having characteristics of high grade coals. During the process of conversion many valuable by-products are recovered, for example, gas, light and heavy oils, tars and ammonia. It is thus seen that by the present process a substance which in its crude or native state is of small value as a fuel, and which cannot be shipped or stored or burned without crumbling, is converted into a valuable high grade fuel and at the same time the valuable by-products of the material which are wasted in the combustion of the material in its crude state are saved. The cost of operating the retort is low, because the great proportion of the gas necessary to heat the retort is derived from the heat of the coal. The pitch or other material used as a binder is relatively inexpensive, in fact, at the present time the cost of such substances is relatively very low. But little machinery is required to effect the practice of the process, and the handling of the material is reduced to a minimum, inasmuch as it is only necessary to charge the retort, and when the process is complete to discharge the finished product therefrom. Those skilled in the art, will recognize that the present process can be carried out at far less cost than the processes of briquetting lignite and other low grade coals.

The fuel produced by the present process is a low grade coal such as lignite, peat and the like, which has been devolatilized, carbonized, fused and welded together into a condition in which it is difficultly friable and burns slowly and without smoke. It will therefore be recognized that the steps of the process may be varied without departing from the scope of the invention.

The phrase "low grade coal" used in the claims is a term of description and not of limitation, and is intended to designate all relatively soft carbonaceous material ranging from bituminous coal down through lignite and peat, which may be treated by this process for the purpose of converting it into a hard anthracite-like fuel.

Having thus described the invention, what I claim is new, is:—

1. The process of preparing fuel from low grade coal which comprises partially drying the coal until cracks open up in it, filling the cracks with melted pitch, cooling the coal until the pitch hardens, removing the remainder of the water content from the coal and such light volatile substances as can be driven off at a temperature lower than the melting point of the pitch, and then heating the coal until it fuses with the pitch.

2. The process of preparing fuel from low grade coal which comprises subjecting the coal to a temperature sufficient to remove a portion of the water content and some of the lighter volatile substances from the coal, and continuing this step until cracks open up in the coal, filling the cracks with melted pitch, expelling the remainder of the water content and more of the lighter volatile substances from the coal at a temperature under the melting point of the pitch, and then rapidly increasing the temperature of the coal until it carbonizes.

3. The process of preparing fuel from low grade coal which comprises removing a portion of the water content from the coal by heating until cracks open up in it, filling the cracks with a suitable binder, removing the remainder of the water content and some of the lighter volatile substances from the coal without melting the binder, and then heating the coal until it fuses with the binder.

4. The process of preparing fuel from low grade coal which comprises inclosing lumps of the coal in a suitable retort, raising the temperature of the retort sufficiently to remove a portion of the water content and some of the lighter volatile substances from the coal, maintaining the retort at this temperature until cracks appear in the coal, introducing melted pitch into the retort to fill the cracks, reducing the temperature of the retort until the pitch has a binding effect, increasing the temperature of the retort but keeping it under the melting point of the pitch until the remainder of the water content and some of the lighter volatile substances are removed from the coal, and then increasing the temperature of the retort until the coal carbonizes.

5. The process of preparing fuel from low grade coal which comprises inclosing lumps of the coal in a retort, heating the retort to
remove from the coal a portion of its water content, maintaining the retort at this temperature until cracks appear in the coal, introducing a suitable binder into the retort to fill the cracks in the coal, keeping the retort at a temperature below the melting point of the binder until all the water content of the coal is removed, and then rapidly raising the temperature of the retort until the coal fuses with the binder.

6. The process of preparing fuel from low grade coal which comprises opening up cracks in the coal by heating, introducing a suitable binder into the cracks, and fusing the coal and binder.

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