No. 774,705. PATENTED NOV. 8, 1904.

J. J. SHEDLOCK.

MANUFACTURE OF ARTIFICIAL FUEL.

APPLICATION FILED FEB. 23, 1904.

NO MODEL.

Fig. 1.

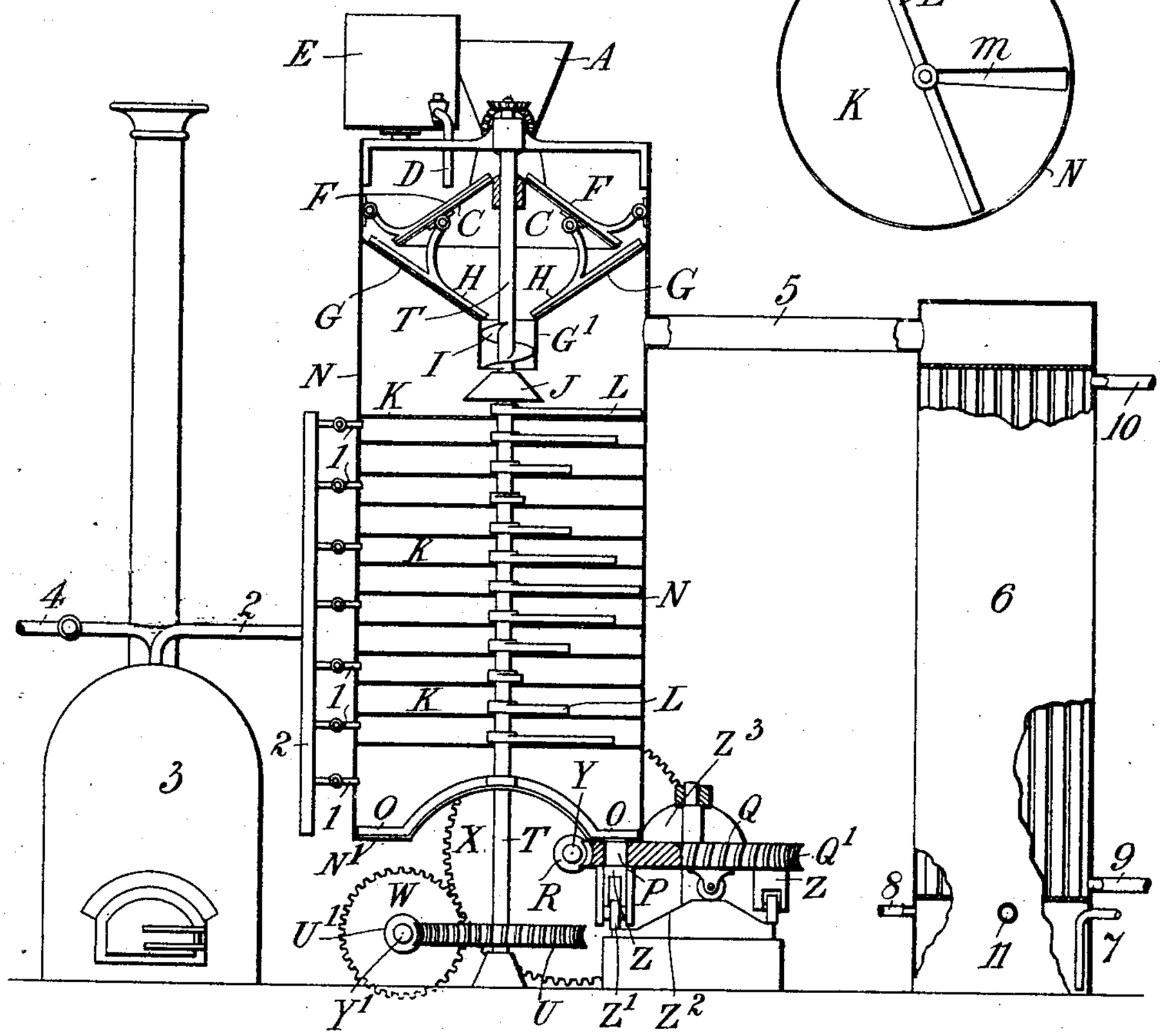
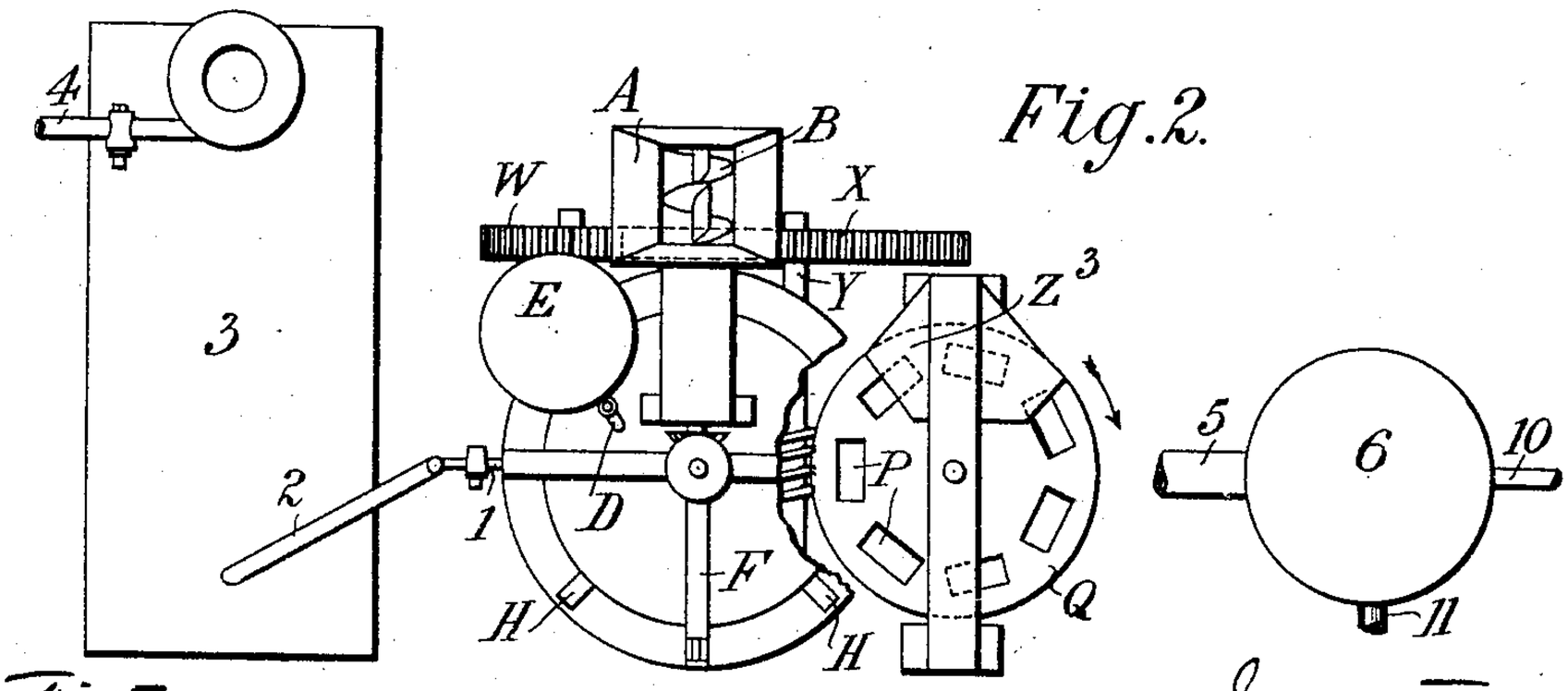


Fig. 3.

Fig. 2.



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No. 774,705. Patented November 8, 1904.

UNITED STATES PATENT OFFICE.

JAMES JOHN SHEDLOCK, OF LITTLE BENTLEY, ENGLAND.

MANUFACTURE OF ARTIFICIAL FUEL.

SPECIFICATION forming part of Letters Patent No. 774,705, dated November 8, 1904.

Application filed February 23, 1904. Serial No. 194,803. (No specimens.)

To all whom it may concern:

Be it known that I, JAMES JOHN SHEDLOCK, consulting engineer, a subject of the King of Great Britain, residing at Little Bentley, near Colchester, in the county of Essex, England, have invented certain new and useful Improvements in or Relating to the Manufacture of Artificial Fuel, of which the following is a specification.

This invention relates to the manufacture of solid artificial fuel or so-called "patent" fuel (either with or without added agglutinants) from carbonaceous substances—as, for example, coal of any description, such as small or refuse coal or crushed coal, (bituminous, semibituminous, or anthracite,) coke, charcoal, peat, sawdust, &c.—or mixtures thereof, all of which carbonaceous materials, for the sake of brevity, I will hereinafter refer to simply as "coal;" and this invention has for its objects (*inter alia*) to thoroughly coat the particles of coal in the process of manufacture with the added agglutinant or agglutinants, to produce a fuel-block which is very homogeneous and thoroughly even and compact throughout, to reduce the amount of agglutinant or agglutinants which are added to the coal, (and with some characters of coal to even dispense entirely or as far as possible with the addition of any such agglutinant,) and thereby to effect very considerable economy in the total cost of the components employed in manufacturing artificial fuel, and whereby I am enabled to produce artificial fuel with many advantages; and my present invention primarily consists in subjecting the coal in detail in a subdivided state to the action of highly-heated inert aeriform fluid or fluids, such as superheated steam or highly-heated inert gases, (or, if desired, both may be used,) under pressure in a gas-tight vessel or chamber, whereby any agglutinant originally present in the coal, together with any agglutinant which has been added to the coal, (in which latter event the added agglutinant, such as tar, is previously mixed with the coal,) is heated while adhering to the particles of the coal—*i. e.*, in the presence of the coal—and the volatile constituents (or such of them as it may be desired to remove, as hereinafter explained) of such agglutinants are vaporized and carried off by and with such aeriform fluid, (superheated steam or inert gases,) leaving a pitchy coating or pitch-like deposit on the solid particles of the coal, so that the particles of the latter are rendered adhesive, and the resulting fuel mixture emerging from the said vessel or chamber will possess all the necessary qualities for producing a solid homogeneous body or briquet on being subjected while heated to the necessary pressure in any suitable press, while the volatiles carried off by the aforesaid aeriform fluid or fluids (steam or gases) are conducted by and with the latter into an adjoining chamber or vessel and condensed, and thus recovered; and my present invention comprises other improvements and details, all of which will be fully described hereinafter and the novel features finally pointed out in the claims.

Referring to the accompanying drawings, Figure 1 is an elevation, partly in section, (on a greatly-reduced scale,) of a complete plant or installation for carrying out the present process. Fig. 2 is a plan, also partly in section. Fig. 3 is a plan of one of the trays or divisions of the gas-tight heating chamber or vessel.

For the sake of example I will describe the process for making fuel-blocks from a mixture of either of the following materials, the proportions given in each example being by weight, viz: First. Tar, such as ordinary gas-tar, eight to ten per cent.; coal, such as semibituminous coal, ninety-two to ninety per cent.; or, (B) tar, such as ordinary gas-tar, ten to twelve per cent.; anthracite coal, ninety to eighty-eight per cent.; or, (C) tar, such as ordinary gas-tar, nine to eleven per cent.; anthracite, forty-five per cent.; bituminous or semibituminous coal, forty-six to forty-four per cent.

Any of the aforesaid mixtures of materials for the manufacture of fuel according to the present process are fed into the apparatus as follows: The coal in a finely-divided state is fed into the hopper A, thence it is conveyed by the carrier-worm B, and thereby delivered in regulated quantity onto the cone C, which latter is revolved, (as hereinafter described,)

and thereby carries the coal thereon under the pipe D, from which issues the regulated amount of tar in the desired proportion, as above set forth, such tar being supplied to the pipe D from the reservoir E, which latter, if desired, may be heated—as, for example, by a steam-pipe therein. (Not shown.) The coal may be supplied to the hopper A and the tar to the reservoir E in any suitable manner. The cone C as it revolves carries the fuel mixture round with it until same is brought under the influence and action of the fixed scrapers F F, which cause the mixed materials to fall off the cone C onto the interior surface of the lower cone G, which at its outer edge is in gas-tight connection all round with the inside of the wall of the gas-tight chamber or vessel N, while the central part of the lower cone G has an opening through which the fuel mixture can descend as and when same is acted on by the revolving arms or scrapers H H, which latter are carried on the under side of the revolving upper cone C. This central opening in the fixed lower cone G is provided with a depending tube or mouth G′, in which revolves the feed-worm I, which latter delivers the fuel mixture in regulated quantities onto the distributing-cone J, off which latter the fuel material falls onto the uppermost tray or division of the series of spaced-apart and superposed trays or divisions K K K, fixed in the gas-tight chamber or vessel N, over each of which trays, respectively, a revolving arm (or arms) L travels, so as to sweep the fuel material before same over the aperture M, through which latter the fuel material falls onto a solid part of the next tray K beneath, off which in turn it is swept by its arm or arms L through the aperture M onto the next tray below, and so on throughout the series of trays until the fuel material finally arrives at the bottom of the chamber N. Thus it will be seen that a thorough admixture of the fuel materials is accomplished as same pass from the top to the bottom of the apparatus, and, furthermore, while said fuel material is passed over and descends through the series of superposed trays or divisions K the same is very efficiently heated and acted on in detail by the superheated steam or heated inert gas as follows: Each of the trays K is provided with an opening M, as aforesaid, (or with more than one such opening therein,) and these trays are arranged with the opening (or openings) disposed relatively to one another in such wise as to afford the maximum amount of travel or a considerable travel of the fuel mixture over the surface of each of the trays in turn, while the revolving arms L, respectively arranged to travel over said trays, are advantageously arranged in spiral order vertically round the central vertical shaft T, by which latter they are revolved, such arms L being advantageously mounted on said shaft T by forming the latter of square section throughout the part thereof where said arms L are mounted thereon, each of the said arms being provided with a square opening adapted to fit over said square shaft T, so that each respective arm L is simply passed over the shaft T and rests by its own weight on the surface of its tray K, the weight of said arm as it is revolved serving to scrape the surface of said tray. The highly-heated inert aeriform fluid or fluids, hereinafter referred to as "superheated steam" or "heated inert gas," are admitted in between the series of trays advantageously by introducing a separate supply of such steam or inert gas in between each pair of trays, or, as illustrated, in between each alternate pair, by means of a series of branch pipes 1 (leading from the main pipe 2) in between said superposed series of trays K, this main pipe 2 leading from a "superheater" 3 of any well-known or suitable construction, which latter is supplied with steam or inert gas from the supply-pipe 4, leading in the case of steam from the steam-generator (not shown) and in the case of inert gas—such, for example, as nitrogen or carbon dioxid—from a gas generator or reservoir (not shown) or from the condensing-chamber, as when said inert gas is used over and over again then same will be led from the condensing-chamber to said supply-pipe 4. It will be seen that the aforesaid shaft T revolves not only the arms L, but also revolves the cone C, scrapers H, feed-screw or worm I, and distributing-cone J, which feed screw or worm I serves the double purpose of collecting a mass of fuel material in the tube or mouth G′ to thereby form a seal (by means of said fuel material) to prevent escape of gases or steam from the upper part of the gas-tight chamber or vessel N through said tube or mouth G′, while at same time this worm I serves to regulate the feed of the fuel mixture into the closed part of said chamber N, where it is heated and acted on by the superheated steam or gases, as aforesaid. As the fuel mixture drops from the last of the trays K upon the bottom N′ of the chamber N it is swept round by the feed-scraper arm O, which is also revolved by the shaft T and may be similarly mounted to the arms L, whereby said fuel mixture is caused to fall through an aperture in the bottom N′ of the chamber N into one or other of the molds P in a rotary horizontal mold-table Q, located immediately below said aperture and in more or less gas-tight connection therewith—*i. e.*, so that the bottom end N′ of the chamber N is practically maintained in a gas-tight condition by means of the close fit of the molding apparatus in conjunction with the fuel-seal formed by the accumulated mass of fuel lying over the aforesaid aperture in the bottom N′ of the chamber N. The mold-table Q is constantly revolved, and each mold-chamber P in turn as it passes under the aperture in

the bottom N′ of the chamber N is filled with the fuel mixture, which latter is then compressed in such mold-chamber P by the movable bottom die or plunger Z, the lower part of which latter carries the roller Z′, which travels over an inclined track Z^2, concentric with the mold-table Q, whereby as the table Q revolves each die Z in succession is forced upward into the mold-chamber P and compresses the fuel therein against a fixed plate or block Z^3, so that the maximum pressure is applied before the mold-chamber emerges from under said plate or block Z^3, and thereafter further upward movement is imparted (by a further incline) to each die Z, and thereby pushes upward the now fully-pressed fuel-block or briquet entirely out of the mold-chamber P, and said fuel-block is then removed in any suitable manner—for instance, by an arm, (not shown,) which is arranged to sweep over the top of the mold-table Q at this point, and thereby remove the briquet. The briquets or fuel-blocks as they are moved from the mold-table may be disposed of in any suitable way—*e. g.*, the same may, if desired, be passed onto an endless traveling band and carried through water to rapidly cool and harden same, or the briquets may be sprinkled with water or otherwise cooled, if necessary, in any suitable manner.

The mold-table Q is advantageously operated by means of worm-teeth cut in its periphery Q′, with which gears a worm R on the shaft Y, which latter is rotated by the gear-wheels X and W, the latter in turn revolving the shaft Y′, on which is a worm U′, geared into the worm-wheel U, fixed on the shaft T, by which the latter is rotated, power being supplied (from any suitable source) to either shaft Y or shaft Y′.

Having thus described suitable means for pressing the fuel mixture into briquets, I wish it to be clearly understood that I do not confine myself to the particular form of press as shown, as any other suitable means for compressing the fuel mixture (while heated) into the solid blocks or briquets may be employed as desired in carrying my present invention into practice.

I will now describe the part of the process relating more particularly to the heating of the fuel mixture and to the withdrawal and recovery of the volatiles by condensation.

The superheated steam or inert gas sent into the chamber N acts on the fuel mixture both while same is lying on the trays K and as the fuel material falls through the apertures M from tray to tray, and as the said steam or gas passes upward through the said slots or openings M while the fuel material is falling through said apertures to the trays below consequently the fuel material is thus subjected while falling in a subdivided state to the action of said superheated steam or gas and is thus thoroughly and rapidly heated in detail, and at same time the volatile constituents of such fuel mixture which are thereby volatilized are carried off by and pass upward with the said steam or gas to the escape outlet-pipe 5. In the case where superheated steam is employed the latter, together with the volatiles, will pass out of the chamber N through the pipe 5 into the condensing-chamber 6 (which may advantageously be of the type of an ordinary surface condenser) where the condensed steam (water of condensation) and condensed volatiles will collect in the bottom of said chamber, and such water of condensation will escape therefrom through the pipe 7 and the distillates pass out through the pipe 8. Water for condensation purposes enters from the pipe 9 and passes out by the pipe 10. When heated inert gas is used, the outlet 7 is dispensed with and the inert gas after passing through the condensing-chamber 6 and being freed from the distillates therein is withdrawn from said chamber through the pipe 11 and by any suitable means (such as a fan) is forced again into the pipe 4 and the superheater 3 and thence back again into the chamber N, and so on, any loss of gas through leakage or otherwise being made good from any suitable source of supply, the superheater 3, the chamber N, the condenser 6, the fan, (not shown,) and the connections between same being all joined up in a gas-tight manner, and in order to maintain the desired pressure in the entire circuit or system including the gas-tight vessel N—say, for instance, from two to ten pounds, according to the speed at which the process is being carried on—I may advantageously employ any suitable form of weighted gas-holder or gasometer or a flexible reservoir in connection with such circuit or system for the aforesaid purposes.

Instead of the aforesaid mixtures of fuel materials I may employ other mixtures in proportion, as, for example, when using peat or the like same would require a much larger proportion of tar—say eighteen to twenty per cent.—while, on the other hand, when using a highly-bituminous coal I can use a very small quantity of tar or even dispense with the use of any added agglutinant where the coal itself originally contains sufficient agglutinant, as in the latter event by the use of highly-heated inert gases according to this invention I can apply enough heat to sufficiently soften such highly-bituminous coal to cause the latter to become adhesive and enable same to be pressed into solid fuel blocks without the possibility of the coal igniting while being thus highly heated and sufficiently softened to enable same to form a solid compact fuel block or briquet upon being subjected to pressure in any suitable mold or press, as in the ordinary fuel-making process.

In describing my present invention as aforesaid as carried into practice with tar as the

added agglutinant I wish it to be clearly understood that I do not in any way limit myself to the use of tar only, for, on the contrary, I may employ in place of tar any other suitable material which will render the fuel particles sufficiently adhesive to form solid fuel blocks when subjected under heat to pressure in the ordinary or any suitable way, such materials for use in place of tar being, for example, the refuse or residue produced in refining oils or fats, or I may use crude petroleum, asphaltum, astatki, or the like, or, if desired, I may use any such material or materials in combination with tar.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The herein-described process for the manufacture of artificial fuel from a mixture of coal and tar in or about the proportions hereinbefore specified, which consists in subjecting said mixture in detail to the action of highly-heated inert aeriform fluid or fluids in a gas-tight vessel and recovering by distillation the volatile constituents which are vaporized by said heat, substantially as and for the purposes set forth.

2. The herein-described process for the manufacture of artificial fuel from a mixture of carbonaceous and hydrocarbonaceous materials which consists in subjecting said mixture in detail to the action of highly-heated inert aeriform fluid or fluids in a gas-tight vessel, vaporizing the volatile constituents of said mixture and carrying off such vapors with the aeriform fluid or fluids and thereby forming a pitch-like coating or pitchy deposit on the solid particles of said mixture which latter on subsequent compression while heated will produce solid fuel blocks, substantially as and for the purposes set forth.

3. The herein-described process for the manufacture of artificial fuel from a mixture of carbonaceous and hydrocarbonaceous materials which consists in subjecting said mixture in detail to the action of highly-heated inert aeriform fluid or fluids in a gas-tight vessel, vaporizing the volatile constituents of said mixture and carrying off such vapors with the aeriform fluid or fluids and thereby forming a pitch-like coating or pitchy deposit on the solid particles of said mixture which latter on subsequent compression while heated will produce solid fuel blocks and recovering such volatiles, substantially as and for the purposes set forth.

4. The herein-described process for the manufacture of artificial fuel from a mixture of coal and tar which consists in subjecting said mixture in detail to the action of highly-heated inert aeriform fluid or fluids in a gas-tight vessel, vaporizing the volatile constituents of said fuel mixture and carrying off such vapors with the aeriform fluid or fluids and thereby forming a pitch-like coating or pitchy deposit on the solid particles of such fuel mixture which latter on subsequent compression while heated will produce solid fuel blocks, substantially as and for the purposes set forth.

5. The herein-described process for the manufacture of artificial fuel from a mixture of coal and tar which consists in subjecting said mixture in detail to the action of highly-heated inert aeriform fluid or fluids in a gas-tight vessel, vaporizing the volatile constituents of said fuel mixture and carrying off such vapors with the aeriform fluid or fluids and thereby forming a pitch-like coating or pitchy deposit on the solid particles of such fuel mixture which latter on subsequent compression while heated will produce solid fuel blocks, and recovering such volatiles, substantially as and for the purposes set forth.

6. The herein-described process for the manufacture of artificial fuel from a mixture of coal and tar in or about the proportions hereinbefore specified, which consists in subjecting said mixture in detail to the action of highly-heated inert aeriform fluid or fluids in a gas-tight vessel, vaporizing the volatile constituents of said fuel mixture and carrying off such vapors with the aeriform fluid or fluids and thereby forming a pitch-like coating or pitchy deposit on the solid particles of such fuel mixture which latter on subsequent compression, while heated, will produce solid fuel blocks, substantially as and for the purposes set forth.

7. The herein-described process for the manufacture of artificial fuel from a mixture of coal and tar in or about the proportions hereinbefore specified, which consists in subjecting said mixture in detail to the action of highly-heated inert aeriform fluid or fluids in a gas-tight vessel, vaporizing the volatile constituents of said fuel mixture and carrying off such vapors with the aeriform fluid or fluids and thereby forming a pitch-like coating or pitchy deposit on the solid particles of such fuel mixture which latter on subsequent compression while heated will produce solid fuel blocks, and recovering such volatiles, substantially as and for the purposes hereinbefore set forth.

8. In the manufacture of artificial fuel from a mixture of carbonaceous and hydrocarbonaceous materials in a gas-tight vessel, the formation on the fuel particles of a pitch-like coating or pitchy deposit by the step of removing by heat the volatile constituents in the presence of the said particles to thereby cause such particles to become adhesive and form a solid block of fuel, when subsequently compressed while heated, substantially as and for the purposes set forth.

9. In the manufacture of artificial fuel from a mixture of carbonaceous and hydrocarbonaceous materials in a gas-tight vessel, the formation on the fuel particles of a pitch-like coating or pitchy deposit by the step of removing by heat the volatile constituents in the presence of the said particles to thereby cause

such particles to become adhesive and form a solid block of fuel when subsequently compressed while heated, and recovering said volatiles, substantially as and for the purposes set forth.

10. In the manufacture of artificial fuel from a mixture of carbonaceous and hydrocarbonaceous materials in a gas-tight vessel, removing and recovering by distillation the lighter volatile constituents of such mixture and thereby forming a pitch-like coating or pitchy deposit on the solid particles of the fuel mixture and thereafter compressing said fuel mixture while heated into solid fuel blocks, substantially as and for the purposes set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

JAMES JOHN SHEDLOCK.

Witnesses:
E. GANDER,
A. NUTTING.