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F. WHITE.

PROCESS OF FORMING PEAT INTO BLOCKS FOR FUEL.

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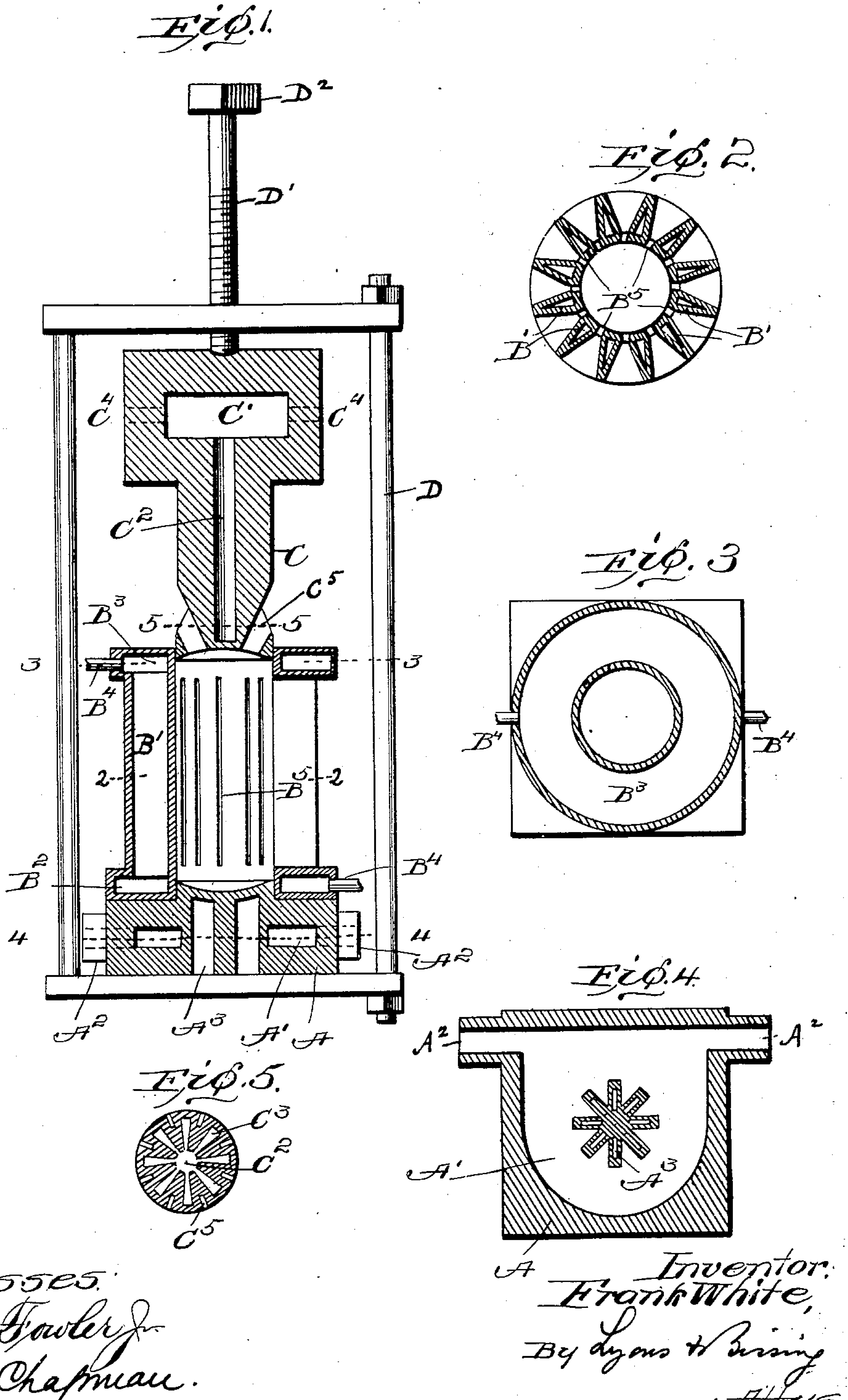
NO MODEL



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No. 738,135. Patented September 1, 1903.

UNITED STATES PATENT OFFICE.

FRANK WHITE, OF TORONTO, CANADA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO HIMSELF, AND GEORGE ALEXANDER GRIFFIN, OF GUELPH, CANADA.

PROCESS OF FORMING PEAT INTO BLOCKS FOR FUEL.

SPECIFICATION forming part of Letters Patent No. 738,135, dated September 1, 1903.

Application filed June 28, 1902. Renewed June 13, 1903. Serial No. 161,388. (No specimens.)

To all whom it may concern:

Be it known that I, FRANK WHITE, a citizen of the Dominion of Canada, residing at Toronto, Ontario, Canada, have invented a new and useful Process of Forming Peat into Blocks for Fuel, of which the following is a specification.

Peat as it comes from the bog contains a very large percentage of moisture, varying in quantity from seventy to ninety per cent. of the total mass. The art of condensing such peat into blocks for fuel is very old, and many plans have been suggested having this end in view. Thus it has been proposed to express this moisture from the peat as it comes from the bog or after it has been somewhat drained by natural methods by the simple application of pressure in perforated molds at ordinary temperatures. While many processes and apparatuses for carrying out this idea have been patented, none of them have come into commercial use, since it has been found that pressure taken by itself is not adapted to expel any large percentage of moisture from the peat. Among other objections to such process I may state that it has been found that in pressing the moist peat in perforated or drained molds at ordinary temperatures large quantities of peat particles are expressed with such of the moisture as comes through the drains, and mechanical screens placed over the drainage-apertures in addition to being troublesome are inefficient in preventing this escape of peat. The plan thus generally outlined has further been modified by crushing and breaking up the peat fibers and reducing them to a more or less homogeneous moist mass before applying the pressure; but the inherent difficulties of the process have not thus been overcome, and it remains true that the process of applying pressure to moist peat in drained molds has, in so far as it has been used at all, been a process of expressing a comparatively small percentage of the excess moisture from the peat and not of compressing the peat into hard and dry blocks usable for fuel. It has also been proposed to compress thoroughly-dried peat which has been more or less disintegrated both in inclosed molds and in bottomless molds. I mean by a "bottomless" mold that type of mold in which each charge of peat in the mold serves as a bottom for the newly-introduced charge, a number of charges thus being forced through and toward the open bottom of the mold, where they are discharged by the action of a plunger at the feed end. Here the difficulties seem partly due to the air occluded by the peat and partly to the high pressure necessary to cause the fibers of dried peat to cohere into a solid block. This great pressure when dried peat is under treatment is especially needed when bottomless molds are employed, in which case some rapidity of operation is necessary to insure an output on a commercial scale. This already great pressure must be still further increased when the dry peat is disintegrated or in flakes. It is quite common to employ pressures of seventy tons to the square inch, and despite the manifest objection to such tremendous pressures and the difficulties of construction and operation occasioned thereby and the trouble and expense of obtaining and treating dried and disintegrated peat it is found that the process of compressing dried and disintegrated peat in bottomless molds is the only one in commercial use to-day for forming peat into blocks usable for fuel. No mention need here be made of the manifestly illusory plan of compressing wet peat in heated but undrained molds, since in such methods the moisture of the peat cannot escape, and reference to the plan of compressing wet peat in bottomless heated molds can more readily be made at the end of the specification after my process has been described.

To carry out the process of my invention, I use a drained but otherwise completely inclosed mold—that is to say, a mold which is sharply differentiated from the bottomless type, since the material of the mold completely surrounds the charge. Furthermore, I prefer to use a single mold for each finished block, and I gain capacity or size of output by the facility which my process affords of simultaneously subjecting the peat charges contained in a large number of molds to the action of my process.

Briefly outlining my process, I may say that I take a charge of moist peat, preferably in an undisintegrated form about as it comes from the bog and place it in such an inclosed and drained mold and keep it therein under a low initial pressure for a short period of time, varying from half a minute to, say, five minutes. During this time heat is applied to the surface of the inclosed charge of peat by having the mold heated. In this time occupied by the first step of my process I have discovered that a matte composed of peat fibers is formed by contact with the heated mold-walls, which matte extends across the drainage-apertures and serves a most important function in the further conduct of the process. These peat fibers, in so far as they lie against the apertures, have had their water-cells ruptured by the heat of the mold-walls and the contained water set free, so that they are in condition to form an efficient screen or matte. Putting this in a few words, I in accordance with the first step of my process inclosed the surface of a charge of moist peat, except at drainage-points, and apply heat to the inclosed surface and preferably a low or slight pressure to the charge to form a matte over the drainage-points.

The matte having been formed, I now gradually increase the applied pressure, this increase of pressure keeping pace with the drying out of the wet-peat charge. This second step of the process may take from twenty to fifty minutes, though the process may be conducted to take a less or a greater time, and during this time the moisture in the peat charge is escaping—first in the form of water and thereafter in the form of steam—through the matte over the drainage-apertures and through these apertures to the exterior air. The matte which has been formed permits a free escape of moisture, whether in the form of water or steam, but does not permit any appreciable quantity of the peat particles of the charge to escape. By the end of the second step of the operation the pressure may have been increased to some two hundred or three hundred pounds per square inch, though the process may be conducted so as to employ greater pressures or less pressures. Putting this in a few words, the second step of my process consists in having the surface of a charge of moist peat inclosed except at drainage-points and applying heat and pressure to the inclosed charge, which pressure increases as the moisture of the charge decreases. This pressure reaches a maximum when the charge has been dried and compressed into a block for fuel. At this point I have found that a jacket has been formed over what has now become the peat block. This jacket, for want of a better name, I designate as a "tarry" jacket. The third step of my process consists in gradually permitting the applied pressure to run down when once the tarry jacket has been completely formed. This third step of my process may take some three or four minutes.

The product of the process is a firm dense hard block containing what is called a "commercial" percentage of moisture and which is usable for fuel without further treatment or which may, if desired, be further air-dried. Among other good features of this block I may mention that my process enables me to treat undisintegrated peat about as it comes from the bog so that the resulting block preserves the fiber of the peat unimpaired. The block thus formed is inclosed by the sharp and clean tarry jacket above referred to, the surface of the jacket being, however, broken by well-defined permeable sections corresponding to those portions of the surface of the block which were over the drainage-apertures of the mold. Now during the entire second step of my process the moisture has a tendency to escape toward the drainage-apertures along well-defined lines, which when once established in any given block remain the same during the drying step of the process. These interior vent-channels thus formed in the body of the block of course communicate with the more permeable portions of the jacket above referred to. It follows that any subsequent drying of the block which may take place after it has left the mold will proceed along channels already established and will not, therefore, tend to disintegrate or crumble the block. It thus results that the block formed by my process remains hard and firm and does not disintegrate in the air as readily as would otherwise be the case.

While my process may be executed with any type of inclosed mold which can be thoroughly drained and to which heat can be applied, I have shown, to fix ideas, a simple type of such mold in the drawings, in which—

Figure 1 is a vertical cross-section of the mold and press. Fig. 2 is a horizontal cross-section on the line 2 2; Fig. 3, a horizontal cross-section on the line 3 3; Fig. 4, a horizontal cross-section on the line 4 4, and Fig. 5 a horizontal cross-section on the line 5 5.

The mold which I have shown consists of a base A, a body portion B, and a plunger C. The base A is provided with ports A^2 for the admission and exit of steam or hot air. These ports communicate with a steam-space A', by which the base of the mold is thoroughly heated. Drainage-slots A^3 communicate with the interior of the mold. The body of the mold is heated by steam or hot air fed through the ports B^4. The steam which is used to heat the body of the mold passes around the steam-spaces B^2 B^3 at the top and bottom of the mold-body, these steam-spaces being connected by the longitudinal steam-spaces B'. Longitudinal slots B^5 are formed in the mold-body and permit the moisture of the charge therein to escape to the outer air.

With the type of mold shown it is preferable to employ a longitudinal slot or port as a drainage-point in my process instead of a series of separate orifices or instead of a transverse slot or port. Such longitudinal slot or port will not tend in the second step of my process to rupture the matte which has been formed in the first step. I have found that the slots should not be wider at their point of entrance into the mold than three sixty-fourths of an inch. While I refer to those portions of the surface of the peat charge through which water or steam is permitted to drain as "drainage-points," it will of course be understood that in a strictly mathematical sense they constitute drainage areas.

The mold may conveniently be made some three inches in diameter and may form a block from two to two and a half inches high. Of course I can use radically different constructions of mold from the one I have shown; but in each case it will be well not to make the blocks much larger than is here indicated and to choose a shape which will permit moisture from any interior part of the block to escape through the surface without being obliged to travel too great a distance in the block.

The plunger C is fed with steam or hot air through the ports C^4, which communicate with the steam-spaces C' C^2 C^3 for the purpose of thoroughly heating the plunger and more especially that portion of it which is in contact with the charge. The face of the plunger is provided with drainage-slots C^5.

The mold is surrounded with a press-frame D, and pressure may be supplied by a screw D' by means of a handle applied to the squared head D^2; but this is merely one of a number of apparatus which may be used to produce the compression.

Coming now to a somewhat more detailed description of my process, I note that I have already called attention to the fact that I consider one of its great advantages to lie in the fact that it can treat undisintegrated peat about as it comes from the bog, thus not disturbing the fibers of the peat in the resulting product. At the same time when carrying out my process on a large scale, in which case a number of charges of peat will be under treatment simultaneously by the same master or controlling apparatus, it is necessary to insure that there shall be a certain degree of uniformity between the density of the charges in the several molds under treatment in order that some blocks may not be unduly compressed and others not be compressed sufficiently. In order to accomplish this, I may intermix peats of different degrees of density or peats which vary in their fibrous character, so as to produce a practical uniformity of density and of fibrous character for the number of charges which are under simultaneous treatment by the same master apparatus. Such intermixture need not cause any breaking up of the peat fiber. I have also indicated above that prior to my treatment I drain from the peat such water as will naturally flow off. It is one of the objects of my process to get rid of that amount of moisture which will not naturally flow off and to reduce the percentage of moisture in the peat from somewhere between fifty and eighty per cent. to twenty-five per cent. or less—preferably, say, to twelve per cent. In making these statements it is yet evident that my process can still be employed even though the peat has been previously disintegrated or has been previously deprived of more moisture than will naturally flow from the same; but such disintegration is not a desirable or even a useful step in my process. The prior deprivation of excess moisture which will not naturally flow off may, however, at times be useful.

The mold prior to placing the charge of peat therein should be heated to 300° or 350° Fahrenheit and may be maintained at or about this temperature by the constant application of heat throughout the operation. This is a good temperature. At the same time nothing will prevent the employment of much higher temperatures. At the beginning of the second step of the process such higher temperature would result in somewhat hastening the operation of drying, and toward the end of the second step the higher temperature would cause a carbonization of the peat, which is desirable for some of its uses. So, too, although I have described steam, either superheated or otherwise, as the means to be used for heating the mold, it is yet evident that hot air or any other heating means might be employed to the same end. The mold having been heated, a charge of wet peat is placed therein and the cover put on. I thus cause heat to be applied to the inclosed surface of the peat charge by means of the heat in the mold-walls. I thereupon preferably apply what I may term a "slight" pressure—say a pressure of ten pounds to the square inch. This slight pressure is maintained for a period of time which may vary from half a minute to four or five minutes, or even longer. During this time which is consumed by the first step of my process the matte of peat fiber is being formed over the drainage-apertures. Although the matte will be formed by the mere contact of the wet peat with the heated mold-walls and without pressure, the formation of the matte is facilitated by employing a slight pressure, since this more effectively drives the peat into contact with the mold. I have before explained that this matte exercises a most important function in the subsequent conduct of my process. Without this matte peat and moisture together will escape through the drainage-apertures under a pressure as small as five pounds to the square inch. With the matte the moisture alone, practically speaking, escapes. When this matte is five minutes old, it will generally stand a pressure of from seventy-five to one hundred pounds to the square inch. It follows from this that the pressure applied by me in the first step of the process could rise above ten pounds or even considerably above twenty pounds to the square inch so long as it is not high enough to rupture the matte. It is also clear that the matte over the drainage-points is formed by the action of the hot mold-wall immediately adjacent to the drainage-apertures. It will therefore be understood that whenever I speak of a "heated and drained" mold in connection with forming the matte I mean that those portions, at least, of the mold which are adjacent to the drainage-apertures are heated. I may also mention that it is better to introduce cold wet peat, meaning peat which has not been previously heated to any substantial extent, into the heated mold instead of using a charge of peat which has been previously heated. I have found that heat, say, at 212° Fahrenheit applied to a charge of wet peat tends to break up the peat-cells and to liberate water contained therein. When, then, hot moist peat is introduced into a heated and drained mold, there is so much free water as to somewhat interfere with a formation of the matte over the drainage-apertures. When a charge of cold wet peat is put into such a mold, it is only the moisture of the outer layer of the peat which is set free. This, however, quickly evaporates and escapes through the drainage-apertures, the matte thus being formed. The peat on the inside of the mass not yet having had an opportunity to be heated keeps its water absorbed and prevents it from getting to the drainage-apertures, where it would tend, by its excessive quantity, to break up the matte as quickly as it was formed. It will also now be readily understood why in the type of mold shown longitudinal slots in the side walls of the mold are better for my purpose than a series of separate apertures or transverse slots. The edges of such apertures would manifestly have the effect, to some extent, at least, of shearing off the matte and destroying it during the operation of compression in the second step of my process.

I come now to a more detailed description of the second step of my process. It is plain from what has been said before that the pressure during this second step of the process is gradually increased until toward the end of the operation, such increase of pressure keeping step with the increasing dryness of the block. In fact, these two things—the pressure at any instant of time in the second step of the process and the dryness of the block at the same instant of time—are correlated. They go together and should be adapted each to the other. If, for instance, the heat outstrips the pressure, vacant spaces will be formed in the interstices of the peat which would otherwise have been closed up upon the exit of the moisture therefrom. If, on the other hand, the pressure is in excess of that adequate for working in proper combination with the heat, the mass of peat is too much compressed to permit of the proper escape of the moisture. Of course it is evident that peat which is not very wet requires more pressure than peat containing a greater percentage of moisture. It is equally evident that the exact temperatures and pressures in this second step of my process are to some extent dependent upon the character of the peat and are within limits variable by the operator; but I may say that I have obtained excellent results by increasing the pressure from, say, ten or twenty pounds at the beginning of the second step of the process up to two hundred or three hundred pounds at the end of the second step of the process. During this second step of the process heat was applied at temperatures which were taken at from 300° to 350° Fahrenheit. With such temperatures and pressures I have obtained good results when the second step of the process has lasted for about thirty minutes. During all this time the moisture is escaping, first in the shape of water and then in the shape of steam, and the block is becoming drier. At the same time the block is being more and more compressed and the interaction of pressure and drying prevents any air from entering the block and taking the place of the expelled moisture. It is of course possible to gradually and uniformly increase the pressure in the second step of the process from its minimum at the beginning to its maximum at the end and to thus keep at each instant of time what may be called a "following" pressure upon the charge. I have found, however, by experiment that the block dries more rapidly and a better product is obtained if the pressure during this second step of the operation is increased stepwise or in jumps. Thus, for instance, I may at the proper stage of the operation raise the pressure from, say, one hundred and seventy-five to two hundred pounds to the square inch and then not touch my compressing mechanism for half a minute. During this period the block is drying out and shrinking away from the plunger, so that the pressure actually acting upon the charge at the end of half a minute may, and actually does, sink back to, say, one hundred and seventy-five pounds to the square inch. Further pressure is now applied, as by giving a turn to the screw of the press, and the pressure on the block may thus be brought back to two hundred pounds to the square inch, or such pressure can be increased to, say, two hundred and twenty-five pounds to the square inch. When the pressure is increased stepwise or in jumps, the intervals during which the pressure is allowed to run down apparently give the moisture of the charge a better opportunity to establish for itself definite lines of travel toward the drainage-apertures, so that the drying of the block is much facilitated. It will be understood, therefore, that while I intend to cover the gradually-increasing application of pressure in the second step of my process as within my invention I prefer the stepwise application of this pressure, since it results, other things being equal, in a drier and more compact block. At the end of this second stage of the operation the block will be found to have what is generally spoken of as a "commercial" percentage of moisture. The number expressing this in percentages may vary considerably; but, generally speaking, it will not be far from fifteen per cent. It is at this time at which the tarry jacket, above referred to, has about assumed its final form. The tarry jacket apparently has its birth in the matte which is formed over the mold in the first step of the process. As the combined drying and compression takes place it grows gradually thicker, at no time, however, reaching a very great depth. This tarry jacket seems to consist of superdesiccated peat fiber, probably mixed with some peat which is not fiber, the whole being permeated with tar and oil forced out of the peat by the gradual softening of the tarry substance of the peat through the action of heat and pressure. I need only add that this jacket is somewhat brittle.

The third step of my process, as I have before indicated, consists in gradually reducing the pressure to avoid fracture of the tarry jacket. Should the pressure be much increased after this tarry jacket has been formed and more especially should it be suddenly increased, the tarry jacket will be ruptured. On the other hand, if the pressure is taken off too quickly before the block becomes set it seems that the sudden expansion of the peat which naturally follows results in fracturing the inclosing tarry jacket. I have therefore found that after the maximum pressure has been applied at the end of the second stage of my process it is advisable to apply no further pressure. This naturally has the effect of permitting the pressure to run down of its own accord by the shrinking of the block. I may give as an example a case in which I had applied a maximum pressure of three hundred pounds to the square inch at the end of the second step of the process. I added no further applied pressure during four minutes, and the pressure upon the block thereupon ran down gradually to one hundred and fifty pounds to the square inch, whereupon I released the applied pressure still further and finally took the completed block from the mold. Generally speaking, I let the pressure run down to from one hundred and fifty to seventy pounds to the square inch before releasing the applied pressure and taking the block from the mold. It will now be clear why a bottomless mold is not adapted to execute my process and why it would not be naturally so used. The rationale of operation of a bottomless mold is to introduce a charge therein and to displace this charge along the mold in a series of steps, the treatment of the charge in each position of the mold being adapted to the charge at that period of its history and the successive treatments which the charge receives in its successive positions in the mold constituting a single gradually-varying cycle of operations, which begins with the entry of the charge into the mold and which ends with the discharge of the finished block therefrom. Let us assume that we attempt to execute my process in a bottomless mold containing ten blocks at a time. The first block or charge must in accordance with my process be subjected to slight pressures—say of twenty pounds to the square inch. The eighth and ninth blocks near the exit end, which are about completely formed, must be under a pressure approximating, say, two hundred pounds to the square inch. But such difference of pressure at different points of the mold at the same instant of time is impracticable of attainment and certainly impossible of proper regulation in the normal operations of bottomless molds. Again, with ten blocks in a mold and thirty minutes, say, as the time in which a given block remains in the mold it will be necessary to displace the block initially introduced after it has been in the mold but three minutes. At this time the matte will not have been sufficiently formed to be certainly able to stand the friction against the side walls without rupture. Finally, the blocks which have been in the bottomless molds for some time and are about to leave it have shrunk away somewhat from the side walls of the mold. These blocks are therefore receiving the minimum pressure at a time when my process requires that they should receive the maximum pressure.

What I claim is—

1. The process which consists in inclosing the surface of a charge of moist peat, except at drainage-points, and applying heat to the inclosed surface to form a matte over the drainage-points, substantially as described.

2. The process which consists in inclosing the surface of a charge of cold moist peat, except at drainage-points, and applying heat to the inclosed surface to form a matte over the drainage-points, substantially as described.

3. The process which consists in inclosing the surface of a charge of undisintegrated, moist peat, except at drainage-points, and applying heat to the inclosed surface to form a matte over the drainage-points, substantially as described.

4. The process which consists in inclosing the surface of a charge of moist peat, except at drainage-points, and applying a slight pressure to the charge and heat to the inclosed surface to form a matte over the drainage-points, substantially as described.

5. The process which consists in inclosing the surface of a charge of cold, moist peat, except at drainage-points, and applying a slight pressure to the charge and heat to the inclosed surface to form a matte over the drainage-points, substantially as described.

6. The process which consists in inclosing the surface of a charge of undisintegrated, moist peat, except at drainage-points and applying a slight pressure to the charge and heat to the inclosed surface, to form a matte over the drainage-points, substantially as described.

7. The process which consists in inclosing the surface of a charge of moist peat, except at drainage-points, and applying heat and pressure to the inclosed charge, which pressure increases as the moisture of the charge decreases, substantially as described.

8. The process which consists in inclosing the surface of a charge of moist peat, except at drainage-points, and applying heat and pressure to the inclosed charge, which pressure increases as the moisture of the charge decreases and reaches a maximum when the charge has been dried and compressed into a block for fuel, substantially as described.

9. The process which consists in inclosing the surface of a charge of moist peat, except at drainage-points, and applying to the charge heat and a pressure which increases stepwise, to dry and compress the peat into a block for fuel, substantially as described.

10. The process which consists in inclosing the surface of a charge of moist peat, except at longitudinal drainage-ports having a given direction, and applying heat and a pressure in the same direction as the ports, to dry and compress the peat into a block for fuel, substantially as described.

11. The process which consists in inclosing the surface of a charge of moist peat, except at drainage-points, and applying heat and a correlated increasing pressure to the charge, to uniformly dry and compress the peat into a block for fuel, substantially as described.

12. The process which consists in inclosing the surface of a charge of moist peat, except at drainage-points, and applying heat to the inclosed surface and increasing pressure to the charge until a tarry jacket is formed upon the peat block, substantially as described.

13. The process which consists in inclosing the surface of a charge of moist peat, except at drainage-points, applying heat to the inclosed surface and an increasing pressure to the charge until a tarry jacket is formed upon the peat block, and then causing or permitting the pressure to decrease gradually to avoid rupture of the jacket, substantially as described.

14. The process which consists in inclosing the surface of a charge of moist peat, except at drainage-points, applying heat to the inclosed surface to form a matte over the drainage-points, and then treating the charge to the combined action of heat and increasing pressure to dry and compress the peat into a block for fuel, substantially as described.

15. The process which consists in inclosing a charge of moist peat, except at drainage-points, applying heat to the inclosed surface to form a matte over the drains, thereupon continuing the heat and applying an increasing pressure to the charge to expel the moisture from the peat and reduce its bulk and to form a tarry jacket upon the peat block, and finally permitting or causing the pressure to decrease gradually to avoid rupture of the jacket, substantially as described.

16. The process of manufacturing peat into blocks which consists in inclosing a charge of moist peat, except at drainage-points; applying heat to the inclosed surface and a light pressure to the charge to produce a matte at the surface of the peat which will permit of the escape of water or steam, while preventing the passage of the moister peat of the interior; and continuing the application of heat to the inclosed surface and increasing the pressure on the charge as the peat becomes heated so as to force out water and steam as rapidly as formed without permitting air to take their place to ultimately form a tarry jacket upon the surface of the peat, substantially as described.

17. The process of manufacturing peat into blocks which consists in inclosing the surface of a charge of moist peat, except at drainage-points; applying a light pressure to the charge and heat at the inclosed surface to produce a matte at the surface of the peat which will permit the escape of water or of steam while preventing the passage of the moister peat of the interior; continuing the application of heat to the inclosed surface and increasing the pressure on the charge as the peat becomes heated so as to force out water and steam as rapidly as formed without permitting air to take their place and to ultimately form a tarry jacket upon the surface of the peat; and finally allowing the pressure to run down gradually to avoid rupture of the jacket, substantially as described.

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

FRANK WHITE.

Witnesses:

EDWIN S. CLARKSON,

F. T. CHAPMAN.