

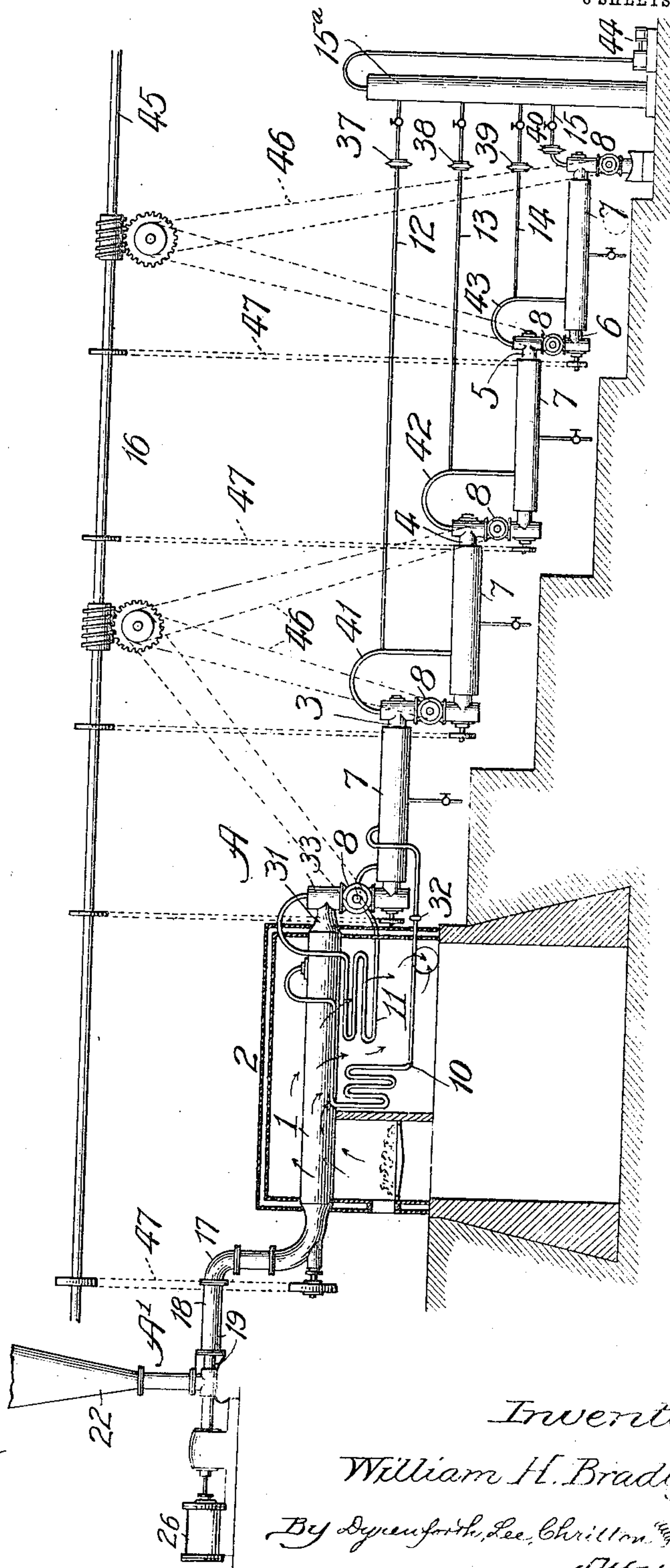
962,118.

W. H. BRADLEY.  
 DRYING APPARATUS.  
 APPLICATION FILED SEPT. 14, 1908.

Patented June 21, 1910.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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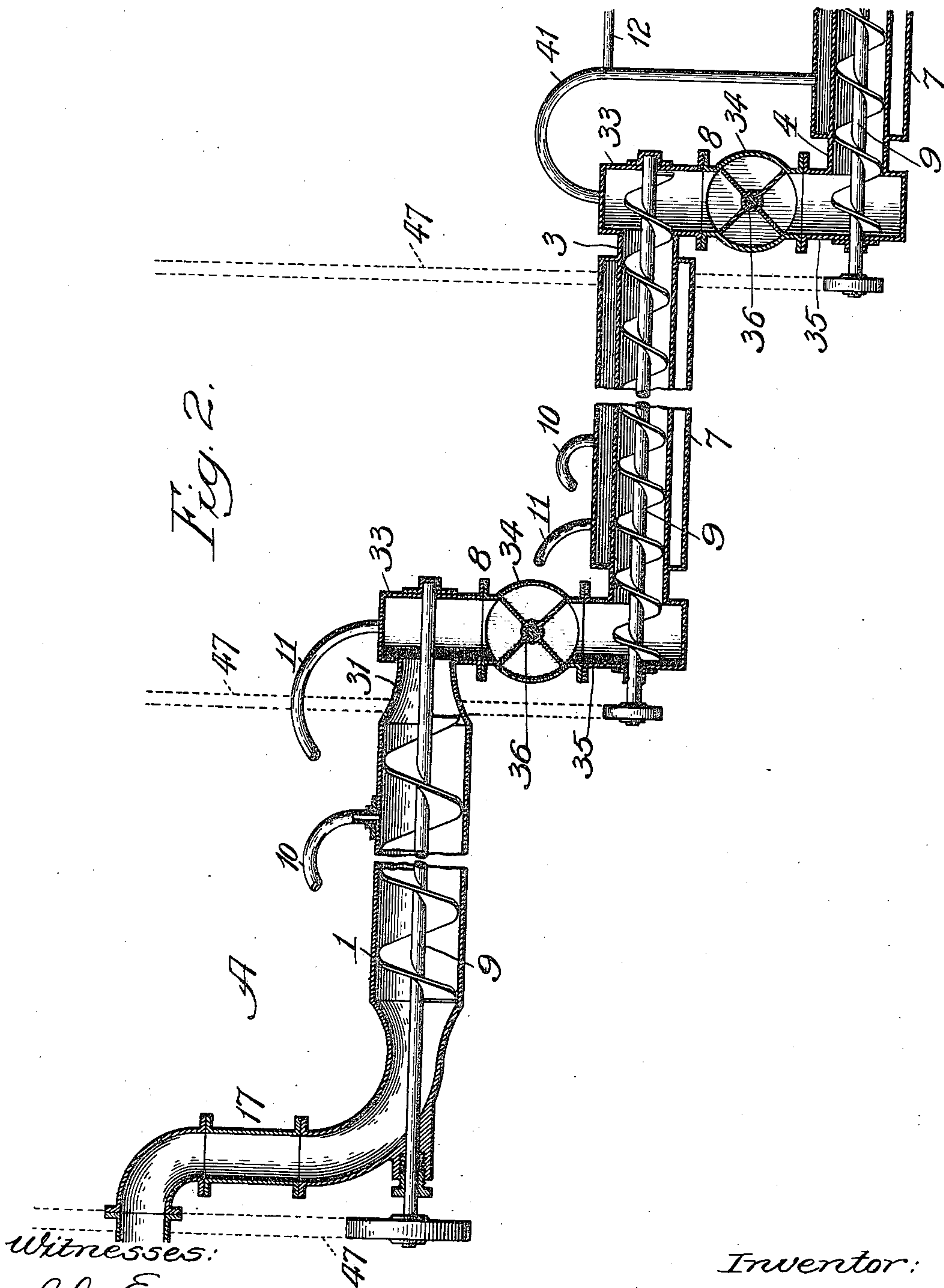
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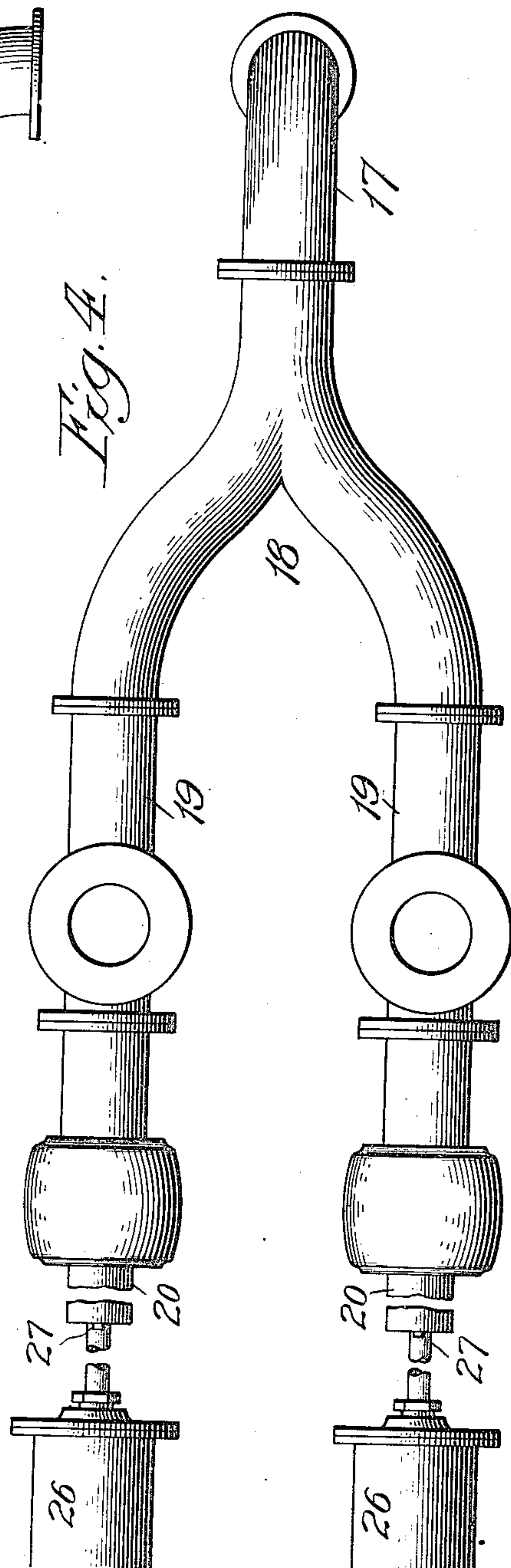
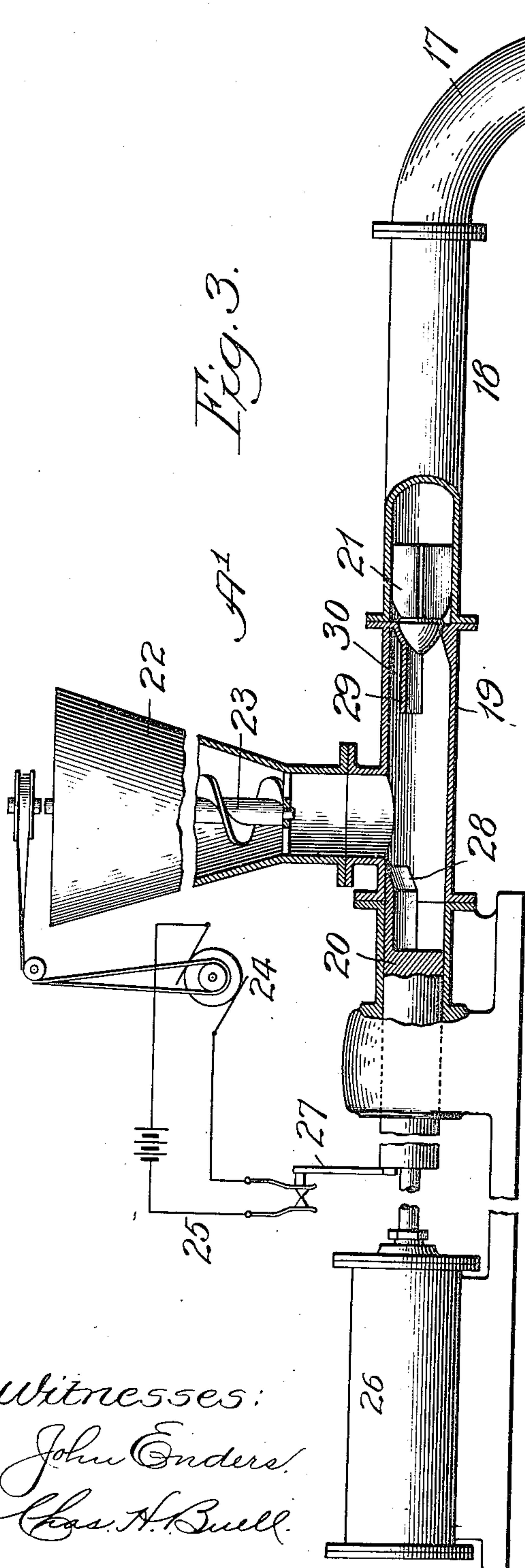
Witnesses:  
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 3 SHEETS—SHEET 3.



Witnesses:  
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# UNITED STATES PATENT OFFICE.

WILLIAM H. BRADLEY, OF CHICAGO, ILLINOIS.

## DRYING APPARATUS.

962,118.

Specification of Letters Patent. Patented June 21, 1910.

Application filed September 14, 1908. Serial No. 452,965.

*To all whom it may concern:*

Be it known that I, WILLIAM H. BRADLEY, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Drying Apparatus, of which the following is a specification.

My invention relates particularly to a process and apparatus for use in drying wet peat; and my primary object is to provide a process capable of producing an improved peat product and simple and efficient apparatus which can be economically operated in the practice of said process.

My invention is particularly adapted to the purpose, among other purposes, of removing the water of absorption from wet peat mass after the peat mass has been preparatorily treated, if necessary, to remove foreign substances and to remove water of suspension, where the preparatory treatment involves the use of an excess amount of water. For instance, the wet peat mass may be taken from a centrifugal machine, in which the water of suspension is separated from the peat, and the wet peat mass may be advantageously and economically treated in the apparatus herein shown for the purpose of removing water of absorption, that is, drying the peat to any desired degree.

The invention is illustrated in its preferred embodiment in the accompanying drawings, in which—

Figure 1 represents a broken elevational view of drying apparatus constructed in accordance with my invention; Fig. 2, an enlarged broken sectional view, showing details of construction of the boilers, or chambers, in which the moisture is separated from the peat, together with the means for transferring the material through the chambers and from chamber to chamber; Fig. 3, a broken sectional view, on an enlarged scale, of the mechanism employed for feeding the wet material to the drying apparatus; and Fig. 4, a plan view of a portion of the mechanism shown in Fig. 3.

It may be stated here that I employ a series of cylinders, or boilers, through which the material to be dried is moved by means of conveyers, maintaining successively reduced pressures in said cylinders, transfer the material from cylinder to cylinder, out of atmospheric contact, and employ the steam from one cylinder to heat another,

and so on through the series. I preferably provide means for superheating the steam taken from the first cylinder and employ the superheated steam to heat the second cylinder, and then successively employ the latent heat of the steam from one cylinder to heat the next cylinder throughout the series.

In the illustration given, A represents my improved drying apparatus; and A<sup>1</sup>, means for feeding the wet material to the drying apparatus.

The apparatus A preferably comprises a cylinder, or boiler, 1, located in a furnace 2; a series of cylinders, or boilers, 3, 4, 5 and 6, through which the material is fed in succession after leaving the boiler 1; steam-jackets 7 for the boilers 3 to 6 inclusive; connecting and transferring devices 8 serving to transfer the material from cylinder to cylinder; screw-conveyers 9 extending longitudinally of the cylindrical boilers; a superheating coil 10 having one end connected with the boiler 1 and the other end connected with the first steam-jacket 7; a superheating coil 11 having one end connected with the dome of the first device 8 and the other end connected with the first steam-jacket 7; series of exhaust pipes 12, 13, 14 and 15 connected with the boilers 3 to 6 inclusive; a condenser 15<sup>a</sup> connected with said pipes; and gear-mechanism 16 serving to actuate the screw-conveyers mentioned and the rotary members of the transferring devices 8.

The mechanism A<sup>1</sup>, which serves to feed the wet material into the drying apparatus, comprises a pipe 17 which connects at one end with the front end of the cylinder 1 and terminates at the other end in branches forming a Y 18, as shown in Fig. 4; cylinders 19 connected with the branches of the Y 18; plungers 20 working in said cylinders; automatically opening and closing valves 21 guarding the outlet ends of the cylinders 19; hoppers 22 surmounting the cylinders 19; screw-conveyers 23 in said hoppers operated by motors 24 (one shown) controlled by electric circuits 25; and steam-cylinders 26 equipped with pistons which serve to operate the plungers 20. Each plunger 20 is equipped with a circuit-closer 27 adapted to close the circuit 25 and set the motor 24 in operation when the plunger 20 is retracted. Each plunger 20 is equipped with a semi-cylindrical valve 28, constituting a forward projection, which



serves to close the outlet to the hopper when the plunger moves forward, so that the material contained in the cylinder 19 will be forced into the pipe 17. The rear end of the cylinder 19 is provided with a semi-cylindrical sleeve 29 which projects into the cylinder adjacent to the valve 21, and above the member 29 is afforded a space or clearance 30 for the projection 28. As the plunger 20 moves forward, it forces the material in the cylinder 19 past the valve 21, the valve opening automatically under the pressure exerted by the plunger. Upon the return stroke of the plunger, the valve closes automatically under the pressure behind it. The plungers 20 work in alternation, thereby insuring a certain uniformity of feed.

From the foregoing explanation it will be understood that the wet material is forced through the pipe 17 into the cylinder 1 under suitable pressure, the passage through the pipe 17 being sealed by the material against back-pressure from steam generated in the cylinder 1. The cylinder 1 extends through the furnace 2 and has a reduced rear end 31 at the point of connection with the first transferring device 8. The superheating coil 10 connects with the cylinder 1 in advance of the contracted portion 31 and is provided at some distance in front of its connection with the steam-jacket 7 with a pressure-valve 32. The steam coil 11 connects with the dome of the first transferring device 8. Each transferring device 8 comprises a chamber, or dome, 33 in communication with the cylinder in advance of it; a casing 34 whose open upper end is surmounted by the chamber 33 and whose open lower end connects with an upturned pipe 35 at the front end of the next succeeding cylinder, or boiler; and a rotary member 36 contained in the casing 34, by means of which the material is transferred without appreciably affecting the difference in the pressures maintained in the successive boilers. The casing 34 has curved sides adapted to permit rotation of the member 36; and the member 36 has wings or vanes crossing each other at its axis, so that as the member rotates the pressure will not be permitted to pass from one cylinder to the other. The pipes 12, 13, 14 and 15 are provided, respectively, with pressure-valves, or reducing valves, 37, 38, 39 and 40. The front end of the pipe 12 is connected, by a pipe 41, with the dome of the second transferring device 8 and with the steam-jacket 7 of the cylinder 4. Similarly, the pipe 13 is connected, by a pipe 42, with the dome of the third transferring device 8 and with the steam-jacket 7 of the cylinder 5. The pipe 14 is connected, by a pipe 43, with the dome of the next transferring device and with the jacket of the cylinder 6. The pipe 15 is connected with the dome of the last transferring

device 8, and it may be stated here that the last transferring device 8 is adapted to deliver the material into the atmosphere, the material being allowed to drop upon any suitable conveyer or into any suitable place of storage (not shown).

The condenser 15 is equipped with an exhaust-pump 44, as shown in Fig. 1.

The gear-mechanism 16 may comprise any suitable construction and arrangement. As shown, it comprises a shaft 45 serving to operate belts, or chains, 46, connected with the rotary members 36 of the transferring devices 8, and serving also to operate belts, or chains, 47, connected with the screw-conveyers 9.

The operation will be understood from the foregoing detailed description. The wet peat, or other wet solid, usually in a plastic state, is fed into the hoppers 22 in any suitable manner and thence into the cylinders 19. The plungers 20 operate alternately to force the material through the pipe 17 into the boiler 1. By means of the furnace, the boiler 1 is heated and the material therein raised to a comparatively high temperature, say a temperature of 300°, more or less, and steam generated in the cylinder 1 is superheated to any desired degree and passed into the first steam-jacket 7. The material, issuing from the cylinder, or boiler, 1, is transferred by the first transferring device 8 to the cylinder or boiler 3, through which it is transferred, by the screw-conveyer operating therein. Successively lower pressures are maintained in the cylinders or boilers of the multiple-effect drying apparatus, and the latent heat of the steam from one cylinder may thus be employed to boil the material in the next cylinder. By preference, the drying operation is finished at about atmospheric pressure, or a little above atmospheric pressure, and the compacted and dried peat thus issues into the atmosphere in a state enabling it to be freely handled without danger of crumbling. As the material is passed through the conveyers, it is subjected to endless tumbling while the drying proceeds, and forms in pellets, or balls, so that it issues in convenient form for use.

It will be understood from the foregoing description that the material is dried out of atmospheric contact, and as stated, the drying operation is preferably completed at or near atmospheric pressure. It is to be noted, also, that during the drying process the central portions of the peat-masses, balls, or pellets, are at higher temperature than the exterior portions, so that there results a constant expulsion of the moisture from the center outward. The drying continues under such conditions as to obviate the premature formation of an exterior crust, so that cracking of the pellets is avoided; and, moreover, the drying is effected under pres-



sure, which is lowered by gradations, so that a uniform compacting upon or condensing about the center of each pellet is effected, the result being an exceedingly hard, uniformly compacted product practically impervious to water and free from danger of crumbling.

The foregoing detailed description has been given for clearness of understanding only, and no undue limitation should be understood therefrom.

What I regard as new, and desire to secure by Letters Patent, is—

1. In apparatus for the purpose set forth, the combination of a series of boilers, means for maintaining different pressures in said boilers, and means for transferring solid material from one boiler to another.

2. In apparatus of the character set forth, the combination of a furnace, a boiler contained therein, a series of boilers adapted to receive the material in succession after it passes from the first boiler, means for transferring solid material from one boiler to the next boiler throughout the series, said means adapted to prevent the flow of pressure from boiler to boiler, means for heating each boiler succeeding the first boiler, said means receiving, as a heating fluid, the steam generated in the preceding boiler, and means for maintaining different pressures in the several boilers.

3. In apparatus of the character set forth, the combination of a series of boilers, means for mechanically moving material through said boilers and transferring the same, out of atmospheric contact, from boiler to boiler, means for feeding a wet solid under pressure into the first boiler, means for employing the steam generated in one boiler to heat the succeeding boiler throughout the series, and means for maintaining successively reduced pressures in said boilers.

4. In apparatus of the character set forth, the combination of a series of boilers, screw-conveyers operating to feed the material therethrough, connecting devices joining the boilers in series and equipped with rotary transferring devices adapted to prevent the flow of pressure from boiler to boiler, means for maintaining different pressures in said boilers, and means for heating the several boilers.

5. In apparatus of the character set forth, the combination of a boiler, means for heating said boiler, a succeeding boiler equipped with a steam-jacket, means for transferring material from the first boiler to the second boiler, a steam-jacket for the second boiler, and a superheater receiving its steam supply from the first boiler and discharging it into the jacket of the second boiler.

6. In apparatus of the character set forth, the combination of a furnace, a boiler heated thereby, means for feeding a wet solid under

pressure into said boiler, a superheater in said furnace receiving its steam supply from said boiler, a series of boilers equipped with steam-jackets, transferring devices connecting said boilers in series, a connection between said superheater and the first steam-jacket, and means for conducting steam from the second boiler to the jacket of the third boiler, and so on throughout the series.

7. In apparatus of the character set forth, the combination of a furnace, a boiler heated thereby, means for feeding a wet solid under pressure into said boiler, a superheater in said furnace receiving its steam supply from said boiler, a series of boilers equipped with steam-jackets, transferring devices connecting said boilers in series, a connection between said superheater and the first steam-jacket, means for conducting steam from the second boiler to the jacket of the third boiler, and so on throughout the series, and exhaust-devices connected with the several boilers and equipped with means for maintaining different pressures therein.

8. In apparatus of the character set forth, the combination of a series of boilers, transferring devices connecting the boilers in series and adapted to convey wet solids from boiler to boiler, means for maintaining successively reduced pressures in said boilers, a heating device for each boiler receiving, as a heating fluid, steam from a preceding boiler, and means for forcing a wet solid into the first boiler, comprising a cylinder and plunger.

9. In means of the character set forth, the combination of a plurality of boilers arranged in series, transferring devices connecting the boilers in series and adapted to transfer solid materials from boiler to boiler, screw-conveyers in said boilers, means for maintaining different pressures in said boilers, means for heating said boilers, and means for feeding a wet solid into the first boiler, comprising a plunger and a conduit equipped with an automatically opening and closing valve.

10. In apparatus of the character set forth, the combination of a series of boilers equipped with jackets, transferring devices connecting said boilers in series, conduits through which steam may pass from the several boilers to the jackets of the succeeding boilers, and conduits through which steam may escape from the several boilers, said last-named conduits equipped with pressure-valves adapted to maintain successively reduced pressures in the several boilers.

11. In apparatus of the character set forth, the combination of a furnace, a series of boilers, one of which is located in said furnace, transferring devices connecting the boilers in series and adapted to transfer solid material from boiler to boiler, an ex-



haust device, conduits connecting said exhaust device with said boilers, pressure devices connected with said conduits serving to maintain different pressures in said boilers, and means for conducting steam from each boiler and applying the same to heat the next succeeding boiler.

12. In the treatment of peat, the process of removing water of absorption which consists in mechanically moving the wet peat mass and subjecting it, while in motion, to successive heat-effects out of atmospheric contact, under successively reduced pressures.

13. In the treatment of peat, the process of removing water of absorption which consists in moving the wet peat mass through a chamber and subjecting it therein to a given heat and pressure, transferring the material mechanically, out of atmospheric contact, to another chamber in which a lower pressure is maintained, and subjecting the material to a heat-effect in the second-named chamber.

14. In the treatment of peat, the process of removing water of absorption, which consists in heating the wet mass of peat to a high temperature in a chamber, collecting and superheating the steam taken from the mass, passing the mass into a second chamber, and employing the superheated steam to heat the second receptacle.

15. In the treatment of peat, the process of removing water of absorption, which consists in passing the wet peat mass through a series of chambers, applying heat to the mass at one chamber, maintaining successively reduced pressures in said chambers, and employing the latent heat of steam from one chamber to boil the mass in the next chamber.

16. In the treatment of peat, the process of removing water of absorption, which consists in passing the wet peat through a series of chambers, applying heat to the mass at one chamber, collecting and superheating steam from the first chamber and employing it to heat the second chamber, maintaining successively reduced pressures in the several chambers, and employing the steam from

the second chamber to heat the third chamber, and so on through the series.

17. In the treatment of peat, the process of removing water of absorption, which consists in heating the wet peat mass and subjecting it to successive heat-effects at successively reduced pressures and out of atmospheric contact, and employing the latent heat of steam taken from one chamber to boil the material in the next chamber.

18. In the treatment of peat, the process of removing water of absorption, which consists in heating the wet peat mass and subjecting it to successive heat-effects under successively reduced pressures.

19. In the treatment of peat, the process of removing water of absorption which consists in heating the wet peat mass out of atmospheric contact to a high temperature and under a pressure above atmospheric pressure, and subjecting the heated mass to successive heat-effects out of atmospheric contact and under successively reduced pressures.

20. In the treatment of peat, the process of removing water of absorption which consists in heating the wet peat mass out of atmospheric contact to a high temperature and under a pressure above atmospheric pressure, subjecting the heated mass to successive heat-effects out of atmospheric contact and under successively reduced pressures, and ending the treatment under a pressure near atmospheric pressure.

21. In the treatment of peat, the process of removing water of absorption, which consists in heating the wet peat mass out of atmospheric contact to a high temperature and under a pressure above atmospheric pressure, subjecting the heated mass to successive heat-effects out of atmospheric contact and under successively reduced pressures, and subjecting the mass also to a tumbling operation during the successive heat treatments.

WILLIAM H. BRADLEY.

In presence of—

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