

**No. 683,269.**

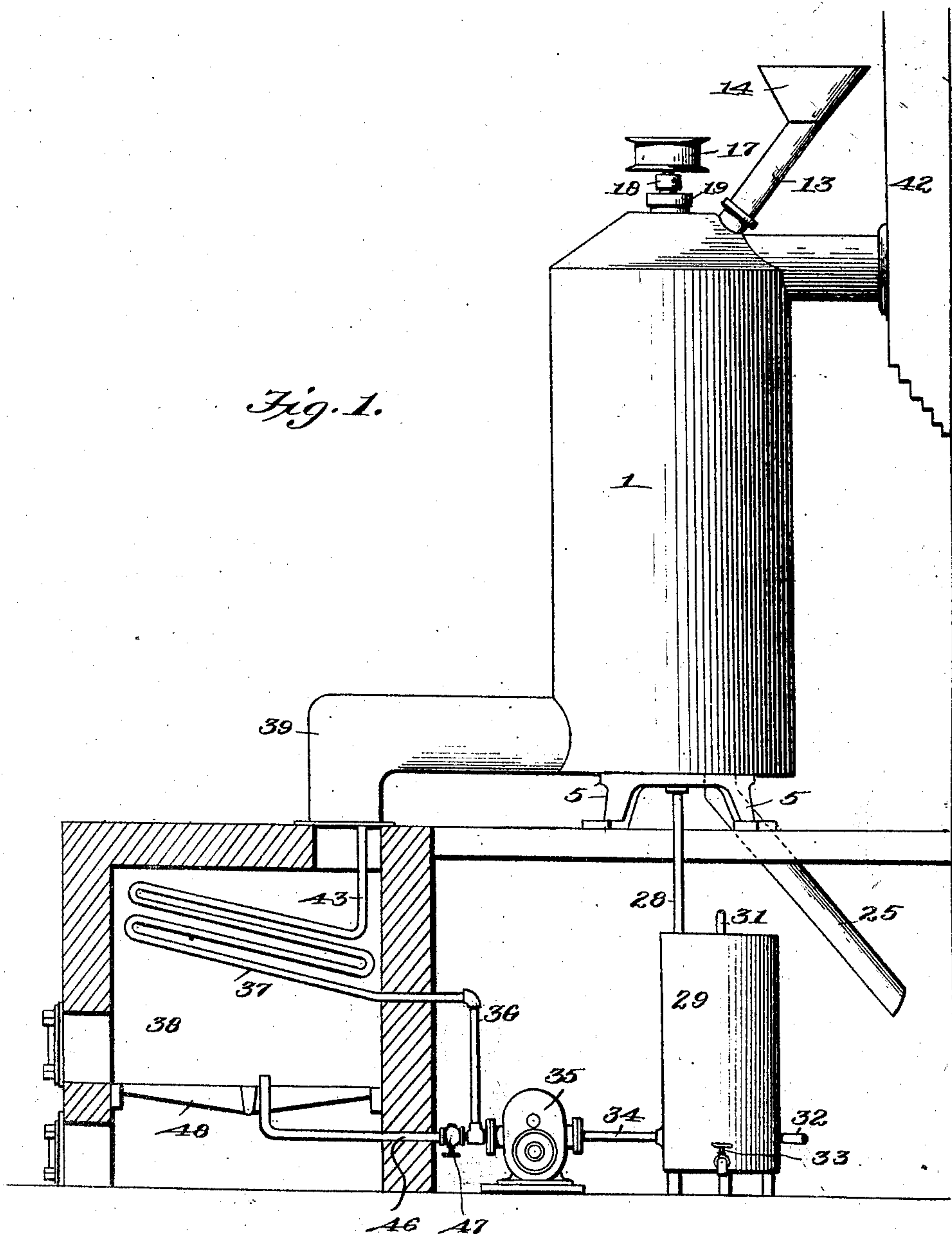
**Patented Sept. 24, 1901.**

**J. G. GARDNER.**  
**DRYING APPARATUS.**

(Application filed May 23, 1900. Renewed Mar. 2, 1901.)

(No Model.)

**2 Sheets—Sheet 1.**



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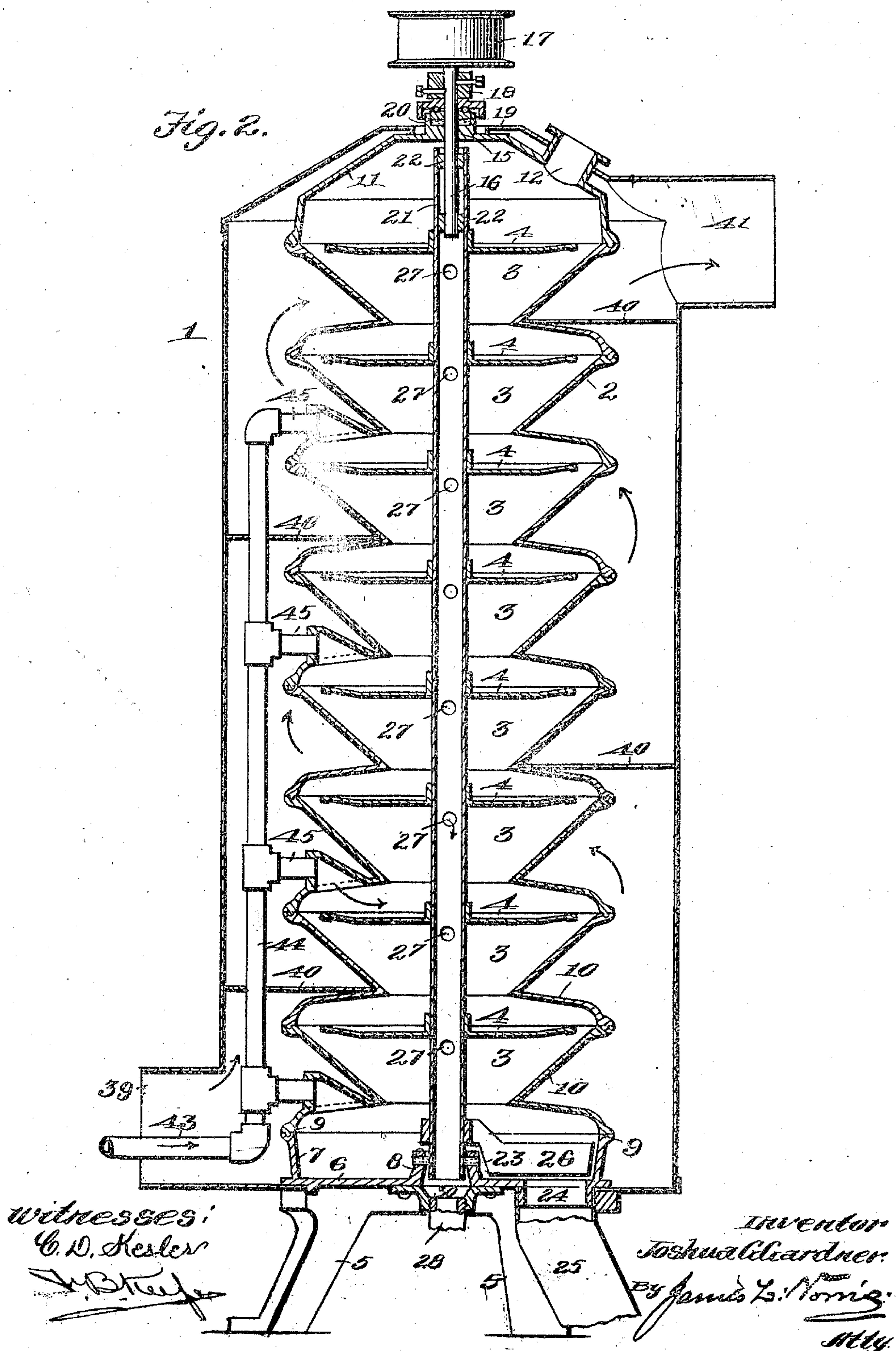
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# UNITED STATES PATENT OFFICE.

JOSHUA G. GARDNER, OF BALTIMORE, MARYLAND, ASSIGNOR OF ONE-HALF  
TO JOHN MITCHELL, JR., OF WASHINGTON, DISTRICT OF COLUMBIA.

## DRYING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 683,269, dated September 24, 1901.

Application filed May 23, 1900. Renewed March 2, 1901. Serial No. 49,645. (No model.)

*To all whom it may concern:*

Be it known that I, JOSHUA G. GARDNER, a citizen of the United States, residing at Baltimore city, in the State of Maryland, have invented new and useful Improvements in Centrifugal Apparatus, of which the following is a specification.

This invention relates to centrifugal apparatus for drying, separating, and to some extent carbonizing various granular materials—such, for instance, as sawdust, grains, and other substances—in such manner as to eliminate moisture and gases from the materials treated and utilize said gases when reheated for continuing the drying and carbonizing operation.

The invention consists in an apparatus comprising a casing or jacket inclosing a retort having a number of communicating chambers, centrifugal disks mounted in said retort-chambers, a rotary tubular shaft by which the centrifugal disks are carried, said shaft being provided with perforations to afford exit for the gases and vapors eliminated from the material under treatment, a condenser in communication with one end of said tubular shaft and in which condenser the condensible gases and vapors are collected, a blower for removing the non-condensable gases from the condenser, a furnace having therein a heating-coil to receive the gases from said blower, pipe connections leading from said heating-coil to the centrifugal retort, a flue connecting the furnace with the jacket or casing of the retort, and another flue connecting said jacket or casing with a chimney.

My invention further consists in features of construction and in combinations of parts in a centrifugal retort or drying and carbonizing apparatus as hereinafter set forth.

In the annexed drawings, Figure 1 is a part sectional elevation of one form of my improved centrifugal drying and carbonizing apparatus. Fig. 2 is an enlarged sectional elevation of the centrifugal retort and its jacket or casing.

The reference-numeral 1 in Figs. 1 and 2 designates a heating jacket or casing in which is inclosed a retort 2; preferably comprising a series of vertically-arranged and communi-

cating retort-chambers 3 and a series of centrifugal disks 4, respectively mounted in the several retort-chambers. The retort casing or jacket 1 may be supported in any suitable manner—as, for instance, by means of pedestals 5—as shown. In its bottom portion the jacket or casing 1 is provided with a horizontally-arranged base-plate 6, Fig. 2, having two vertical and concentrically-arranged annular flanges 7 and 8, one of which is located at or near the periphery of said base-plate and the other at its center. The rim or top edge of the outermost annular flange 7 is preferably grooved or channeled to receive an interlocking rib 9 on the lower edge of a casting or section 10, that constitutes the lower half of the lowermost retort-chamber. A series of similar castings or sections 10 are superposed one on another to constitute the walls of the vertical series of retort-chambers 3 comprised in the retort. These several sections or castings 10 are preferably so shaped that the retort-chambers will each have approximately the form of a truncated cone with the lower portion of each retort-chamber inclined downward and inward and in communication with the chamber below. The uppermost retort-chamber 3 is constructed with a hood 11, Fig. 2, having in one side a flanged feed-opening 12 to connect with the spout 13, Fig. 1, of a hopper 14, through which the material to be treated is fed to the retort. The upper central portion of the retort-hood 11 may be in proximity to the top of the retort-casing 1 and is provided with a central opening 15 for passage of a depending spindle 16, having a driving-pulley 17 on its upper and outer end. On the outer portion of the spindle 16 there is a collar 18, through which the said pulley-spindle is suspended on ball-bearings 19, of any suitable construction, above the top of the retort. A suitable asbestos or other non-conducting packing 20 may surround the spindle 16 in or adjacent to its ball-bearings to prevent the escape of heat at that point. The lower end of the depending pulley-spindle 16 enters the upper end of a tubular vertically-arranged shaft 21, by which the centrifugal-disks 4 are carried. The spindle 16 and the tubular shaft 21 may be securely connected by means of



keys or annular plugs 22, so that said spindle and shaft will rotate together for actuating the centrifugal disks. At its lower end the vertical tubular shaft 21 is received in the annular flange or nipple 8 on the base-plate 6 before mentioned. A suitable packing 23, of asbestos or other non-conducting material, is secured on the nipple 8 and closely surrounds the lower portion of the vertical tubular shaft.

In one side of the base-plate 6 there is an exit-opening 24, communicating with a chute 25 for discharge of the material that has been treated in the retort or drier. The sweep 26 is carried by a lower portion of the vertical tubular shaft 21 to rotate therewith and thereby feed the treated material to the said discharge-chute.

The vertical tubular rotary shaft 21 is provided in each retort-chamber 3 and below a centrifugal disk 4 with an aperture 27 for exit of the gases and moist vapors that are eliminated from the material under treatment. These gases and vapors are drawn downward through the tubular shaft 21 into a pipe 28, Figs. 1 and 2, that connects with a condenser 29, Fig. 1, of any suitable construction. The upper end of the pipe 28 is suitably connected with an opening 30 in the base-plate 6, immediately below the lower open end of the rotary tubular shaft 21, to provide communication between said pipe and tubular shaft.

As shown in Fig. 1, the condenser 29 is provided with suitable pipe connections 31 and 32 for the circulation of a cooling medium, and it also has a tap 33 for drawing off condensed gases and vapors. The non-condensable gases are drawn off through a pipe 34 by means of a blower 35 and are passed thence through a pipe 36 to a heating-coil 37 in a furnace 38 of any suitable construction. This furnace 38 is provided with a flue 39, Figs. 1 and 2, connecting with the lower portion of the retort jacket or casing 1 for the passage of heated products of combustion into and through said casing or jacket and around the retort 2 therein. For the purpose of causing these heated products of combustion to circulate around the retort 2 there are provided in the casing or jacket 1 a series of suitably-arranged baffle-plates 40, Fig. 2, so that the heating medium will be compelled to take a tortuous course from the flue 39 and through the jacket or casing 1 to an upper flue 41, communicating with a chimney 42, as shown in Fig. 1. The products of combustion from the furnace 38 are thus utilized in applying heat to the exterior of the several communicating retort-chambers that are inclosed by the heating jacket or casing. The non-condensable gases drawn from the condenser 29 by the blower 35, and which are passed thence through the pipe 36 to the heating-coil 37, will leave said heating-coil through a pipe 43, that passes through the furnace-flue 39 and connects with a vertically-arranged pipe 44, Fig. 2, having lateral branches 45, which communicate at suitable intervals with sev-

eral of the series of communicating retort-chambers 3, and thus the reheated gases eliminated from the material under treatment are utilized for the heating and drying of continuously-supplied quantities of the same material. If desired, a pipe 46, Fig. 1, may be arranged to conduct from the blower 35 and into the lower part of the furnace 38 a portion of the non-condensable gases which are drawn from the condenser, and thus these gases may be partly utilized by burning the same in said furnace for heating the coil 37 instead of employing other fuel. The pipe 46 will be provided with a hand-valve 47 for controlling the supply of such gases to the furnace. The furnace may be also provided with a grate 48 for solid fuel.

In operating this apparatus the material to be treated—such as grain, sawdust, or other granular material—will be fed through the hopper 14 and chute 13 into the upper part of the sectional centrifugal retort, and the centrifugal disks 4 will be rotated through power applied to the pulley 17 on the rotary tubular shaft 21, by which said centrifugal disks are carried. A fire having been previously started in the furnace 38, the heated products of combustion therefrom will pass through the flue 39 into the casing or jacket 1 of the centrifugal retort 2 and after circulating around the same, as directed by the baffles 40, will pass out from the upper part of the casing or jacket and through the upper flue 41 to the chimney. The several superposed retort-chambers are thus thoroughly heated from the outside. The sawdust or the granular material that enters the retort through the feed-opening 12 will fall upon the uppermost centrifugal disk 4 and by the rotation of said disk will be thrown outward against the walls of the retort-chamber and will fall thence onto the next lower centrifugal disk and be again thrown outward against the walls of the retort-chamber in which this disk is located. This operation is repeated continuously throughout the retort from above downward. By reference to Fig. 2 it will be observed that the peripheral portion of each centrifugal disk is inclined slightly upward, so that the material is thrown from each disk in an upwardly-inclined direction to strike against the upper portion of each retort-chamber. Under the centrifugal action to which the material is thus subjected and also by the impact of the material against the walls of the retort the particles of said material are separated from each other, and thus exposed on all sides of each particle to the action of the heating medium contained in the retort. At the beginning of the operation this heating medium will be furnished by the air that is contained in the retort; but as the operation proceeds the gases or vapors that are eliminated from the material under treatment and which are gradually increased in temperature will in turn act upon the material to dry the same. As the sawdust or



other material passes down through the retort its particles are kept separated from each other and are continuously surrounded by the hot gases contained in the retort. These hot gases extract from the material all light oil-vapors, pyroligenous acid, and other by-products. The gases and vapors eliminated from the material under treatment will enter the tubular rotary shaft 21 through the openings 27 therein and will be drawn off from this shaft and into the pipe 28 and condenser 29 by the action of the blower 35, which communicates with said condenser. The openings 27 are so located in the tubular shaft 21, preferably at points adjacent to the under side of each centrifugal disk 4, that there is no liability of any of the sawdust or other solid material entering the tubular shaft, the said solid material being thrown away from said openings by the action of the centrifugal disks, while only the gases will enter the tubular shaft. By the action of the centrifugal disks the particles of sawdust or other granular material are thoroughly separated from each other, so as not to remain in a compact or agglomerated condition, and thus the hot gases are given free access to every particle of material to thoroughly dry the same. When the sawdust is treated in this manner, the fibers are not disintegrated nor in any way injured, but the sawdust is merely dried out and, it may be, slightly carbonized or browned. The sawdust is not subjected to such a high degree of heat as to eliminate its heavy oil constituents, and thus the browned sawdust is left in a condition to be readily briqueted in any desired shape or form suitable for making shingles, roofing material, chair-bottoms, table-tops, or other articles. When the sawdust is thus browned, it is completely seasoned and it has been relieved of the acids and other chemicals that are objectionable in articles of furniture. The fiber of the sawdust is not injured, and it can therefore be pressed into any desired shape without necessity of a binder. The sawdust will be properly browned in this apparatus for the construction of articles, as above named, when it has passed through a temperature of from about 120° centigrade to 220° centigrade. If it is desired to employ the sawdust for fuel, it can be briqueted into suitable shapes and the briquets may be passed into another retort, (not shown,) where they can be reduced to charcoal. By reason of the peculiar construction of the centrifugal retort sawdust or other granular material can be fed into and passed continuously through such retort without choking the same, and at the same time every grain or particle of the material under treatment will be so completely separated from the others as to have each grain or particle wholly surrounded by hot gases. The drying or carbonizing takes place in the retort while the particles of material acted upon are thus separated and suspended and while they are falling

through the hot gases. It will be noted that the centrifugal operations and the heating or drying of the material are repeated in each retort-chamber and as many times as may be necessary, and for this purpose the retort may be constructed with any suitable number of communicating retort-chambers each inclosing a centrifugal disk. The instant that the dust is heated sufficiently the products to be eliminated will burst out in the form of vapor, or hot gas, which in turn will react on the material to continue the elimination of the by-products. When the sawdust reaches the bottom of the retort, it is conducted by the sweep 26 to the discharge-chute 25 and may be collected therefrom for briqueting or any other purpose. The non-condensable gases that are drawn from the condenser 29 are forced by the blower 35 into and through the coil 37 and are there reheated and passed through the pipes 43 and 44 and lateral branches 45 into the retort, to be there utilized for drying and carbonizing the sawdust or other material.

The furnace 38 may be heated by means of solid fuel or by gas supplied through the pipe 46, as preferred.

What I claim as my invention is—

1. In a centrifugal apparatus for drying, seasoning or carbonizing granular material, a retort comprising a series of communicating retort-chambers, a plurality of centrifugal disks mounted respectively in the several retort-chambers, a rotary hollow shaft connected to said disks, means for externally heating said retort, means for feeding material into the uppermost retort-chamber and for discharging treated material from the lowermost retort-chamber, a condenser suitably connected to said shaft and adapted to receive from the retort-chambers the gases or vapors evolved from the material treated in the retort, means for drawing off the non-condensable vapors or gases from said condenser, means for reheating said non-condensable gases or vapors, and means connected thereto for returning said reheated gases or vapors to said retort-chambers.

2. In centrifugal apparatus for drying, seasoning or carbonizing granular materials, the combination of a retort comprising a number of communicating retort-chambers, a heating jacket or casing for said retort, a tubular rotary shaft extended through the retort-chambers, centrifugal disks located in the several retort-chambers and mounted on said tubular rotary shaft, the said tubular rotary shaft being provided with apertures for the exit from the several retort-chambers of gases or vapors evolved from the material treated therein, means for feeding material into the uppermost retort-chamber, discharge devices at the bottom of the retort for removing the treated material, a furnace for heating the retort casing or jacket, and pipes for conducting hot gases into the retort, substantially as described.



3. In centrifugal apparatus for drying, seasoning or carbonizing granular materials, the combination of a retort comprising a number of superposed and communicating retort-chambers and having a feed-inlet in the uppermost chamber and a discharge leading from the lower chamber, a heating jacket or casing for said retort, a vertically-arranged tubular rotary shaft suspended through the communicating retort-chambers, said tubular rotary shaft being provided with apertures for the passage of gas or vapor from the retort-chambers and into said shaft, a number of centrifugal disks mounted on said tubular rotary shaft and respectively arranged in the several retort-chambers, means for heating the retort from the exterior, and pipes for conducting hot gas to the interior of the retort, substantially as described.

4. In centrifugal apparatus for drying, seasoning or carbonizing granular materials, the combination of a retort comprising a number of communicating retort-chambers and having a base-plate provided with a centrally-located upwardly-projecting annular flange or nipple, a rotary tubular shaft suspended through the several communicating retort-chambers and having its lower end received in said nipple, non-conducting packing surrounding the lower end of said tubular shaft and secured to said nipple, the said rotary tubular shaft being provided with apertures for exit of gas from the retort-chambers into said tubular shaft, a number of centrifugal disks mounted on the rotary tubular shaft and arranged respectively in the several chambers, a rotary spindle through which said shaft is suspended at its upper end, said spindle being provided with a driving-pulley and with ball-bearings and non-conducting packing, a heating jacket or casing surrounding the retort, a condenser having an inlet-pipe communicating with the lower end of the tubular rotary shaft, for passage of gas from the retort to said condenser, and means for discharging treated material from the retort, substantially as described.

5. In centrifugal apparatus for drying, seasoning or carbonizing granular materials, the combination of a retort comprising a number of communicating retort-chambers, each approximately in the form of a truncated cone, a tubular rotary shaft extended through the

retort-chambers and provided with apertures for exit of gas from said chambers and into said shaft, a number of centrifugal disks mounted on said shaft and arranged respectively in the several retort-chambers, the uppermost retort-chamber being provided with a feed-inlet arranged to discharge material upon the uppermost centrifugal disk, a discharge-chute leading from the bottom of the retort, a rotary sweep carried by the lower end of said rotary tubular shaft, a heating jacket or casing surrounding the retort, pipes for conducting hot gases into the retort, and a pipe for conducting gas away from the lower end of the tubular rotary shaft, substantially as described.

6. In centrifugal apparatus for drying, seasoning or carbonizing granular materials, the combination of a retort comprising a number of communicating retort-chambers constructed in sections superposed one on another, a rotary tubular shaft extended through the retorts and provided with passages for the exit of gas, centrifugal disks mounted on and actuated through said shaft, said disks being severally arranged in the retort-chambers, means for feeding material into the uppermost retort-chamber to be received therein on the uppermost centrifugal disk, and devices for discharging treated material from the lower part of the retort, substantially as described.

7. In centrifugal apparatus for drying, seasoning or carbonizing granular materials, the combination of a retort, a rotary tubular shaft extended vertically through the retort, a number of centrifugal disks mounted on and actuated by said shaft, a heating jacket or casing surrounding the retort and provided at its lower end with an inlet-flue and at its upper end with an outlet-flue, baffles arranged in said jacket or casing to cause the heating medium to circulate around the retort, and pipes for conducting hot gases to the interior of the retort, substantially as described.

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

JOSHUA G. GARDNER.

Witnesses:

JAMES L. NORRIS,  
GEO. W. REA.