

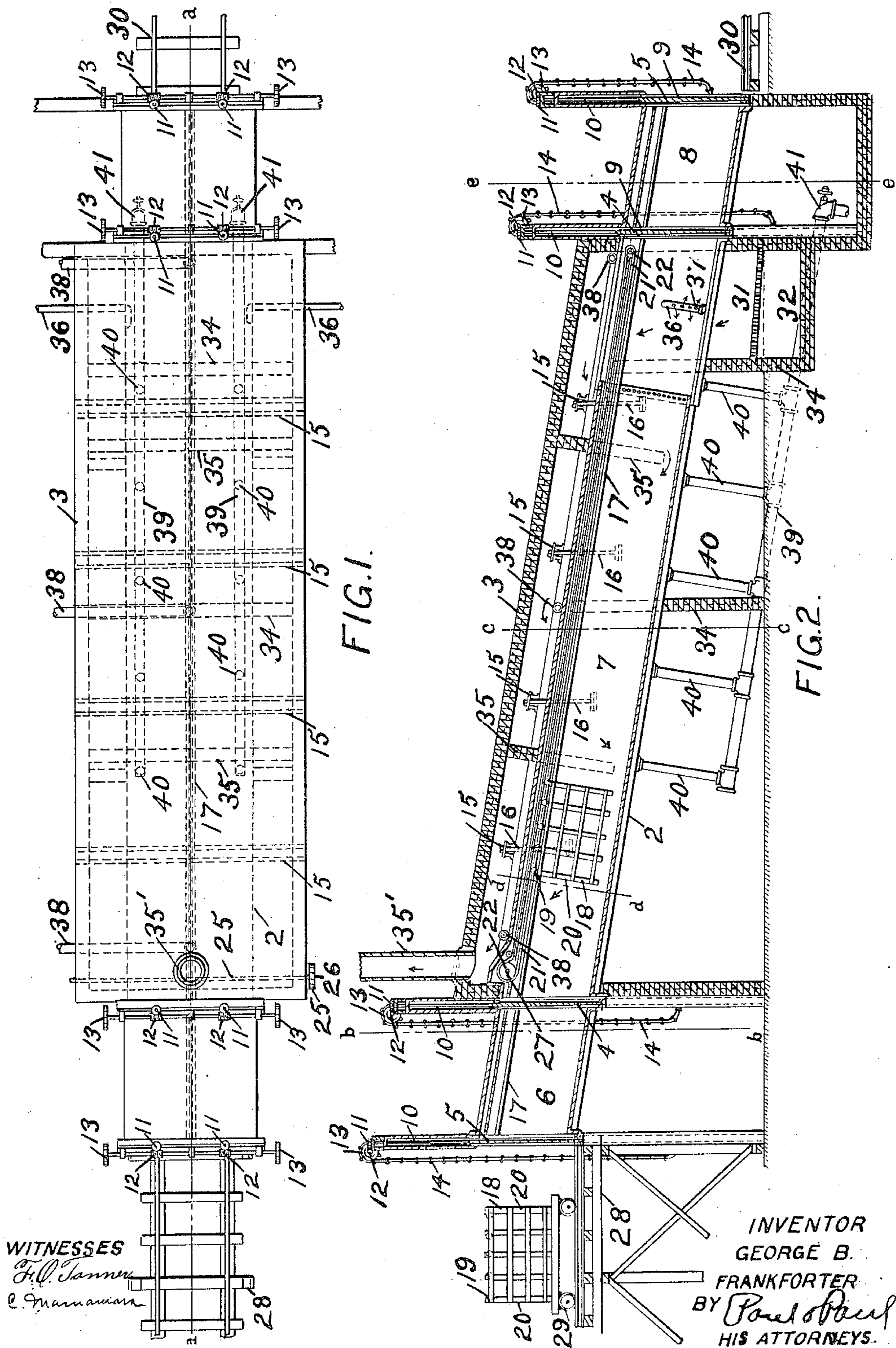
No. 875,342.

PATENTED DEC. 31, 1907.

G. B. FRANKFORDER.  
APPARATUS FOR WOOD DISTILLATION.

APPLICATION FILED MAR. 20, 1905.

4 SHEETS—SHEET 1.



No. 875,342.

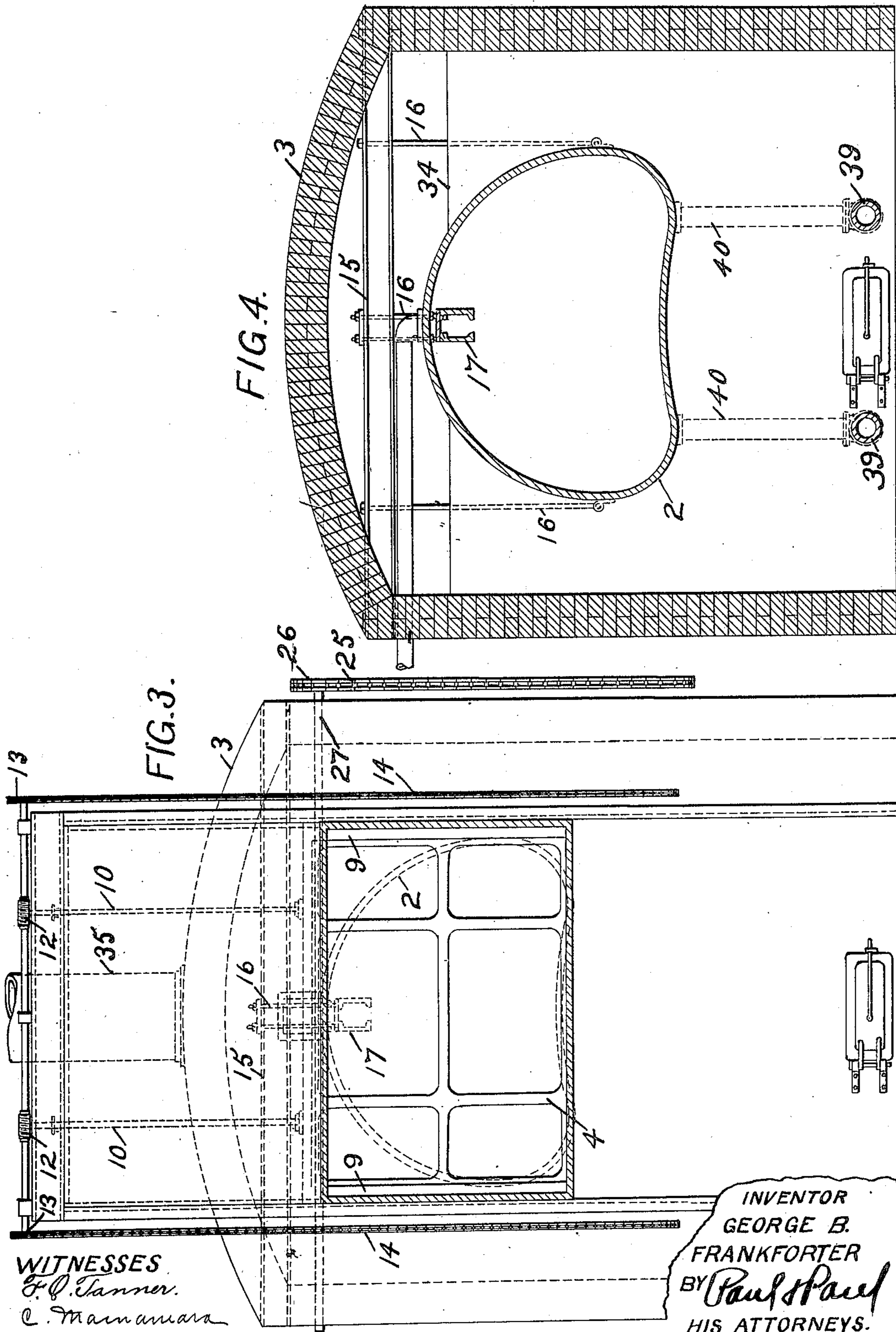
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4 SHEETS—SHEET 3.

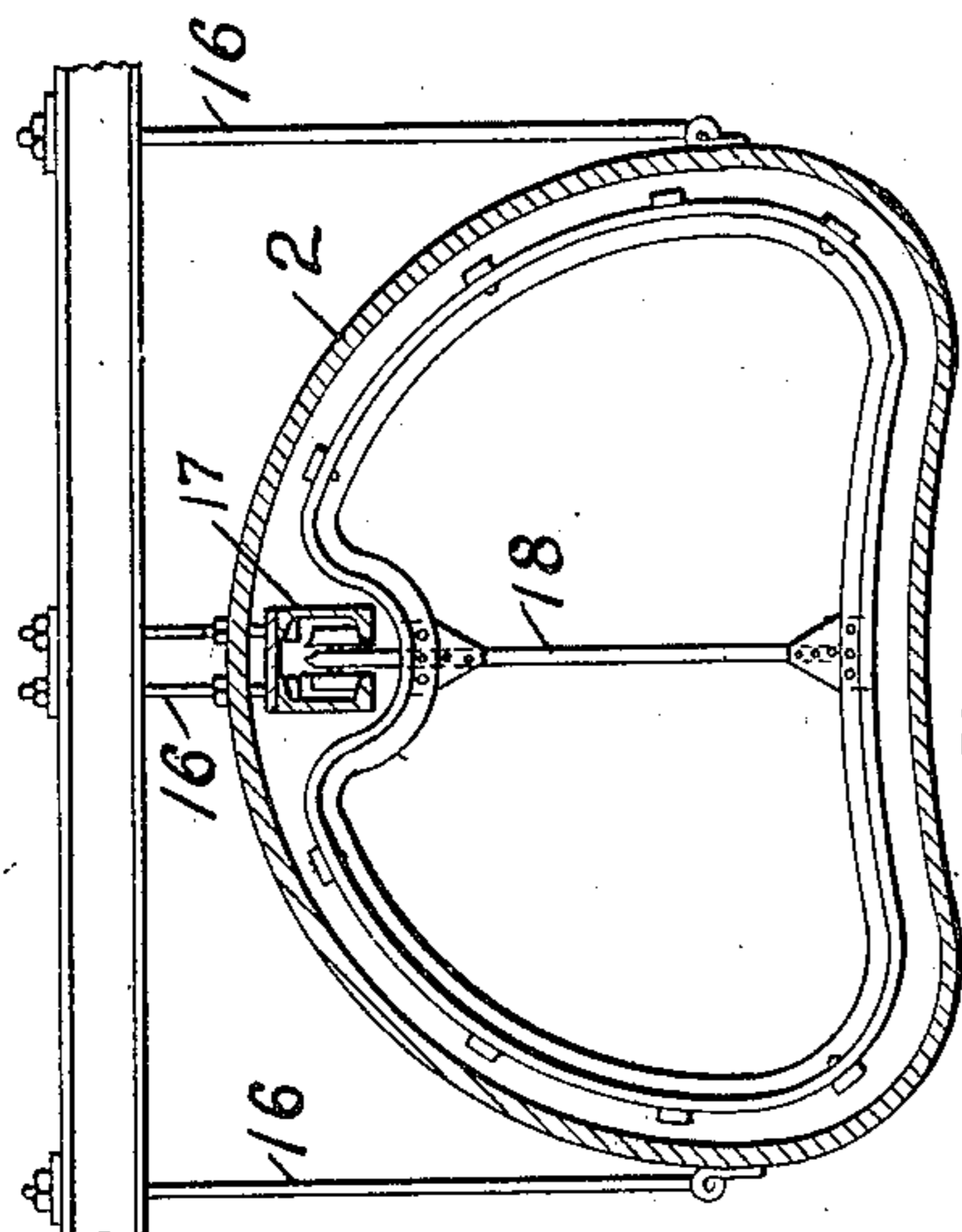


FIG. 5.

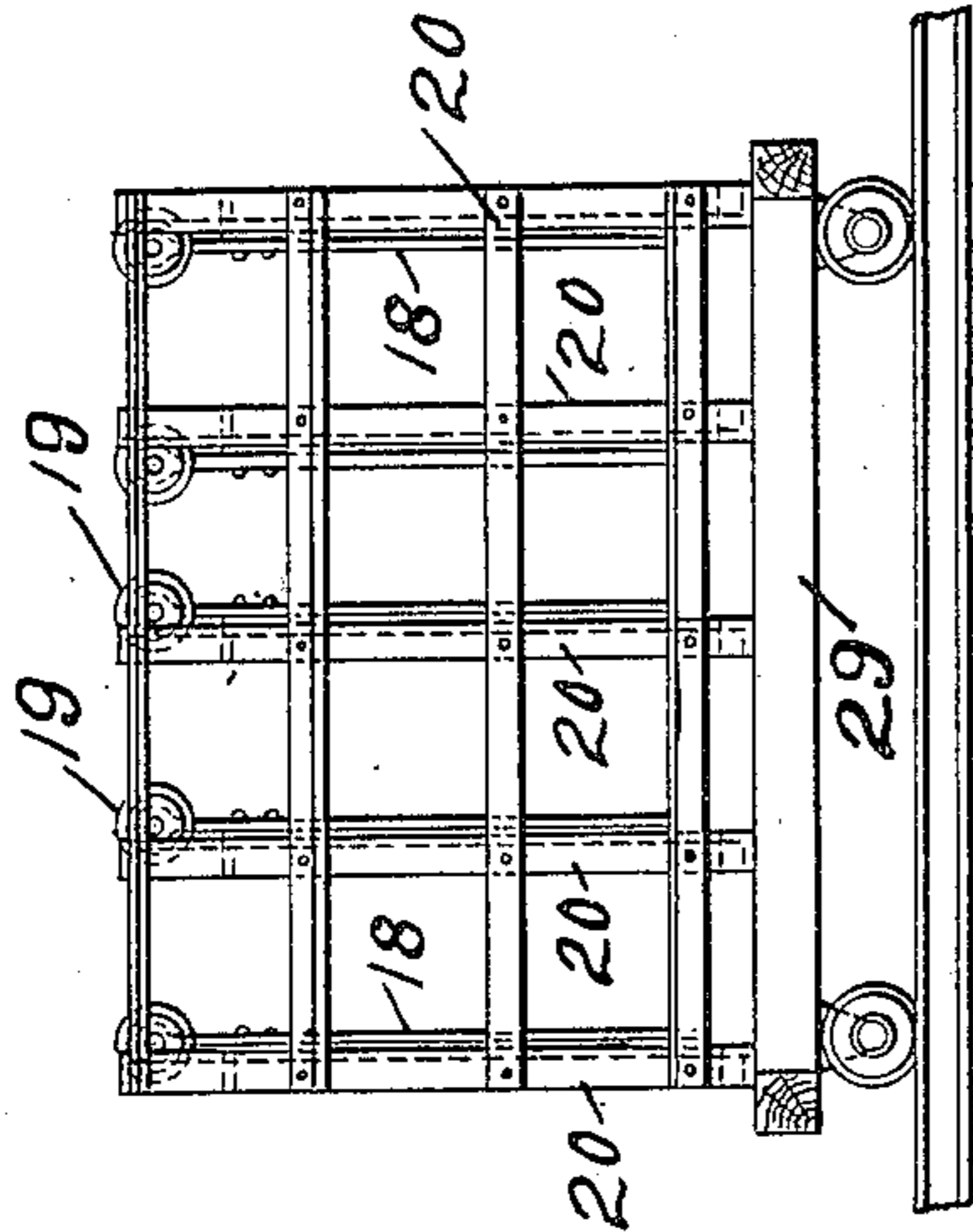


FIG. 6.

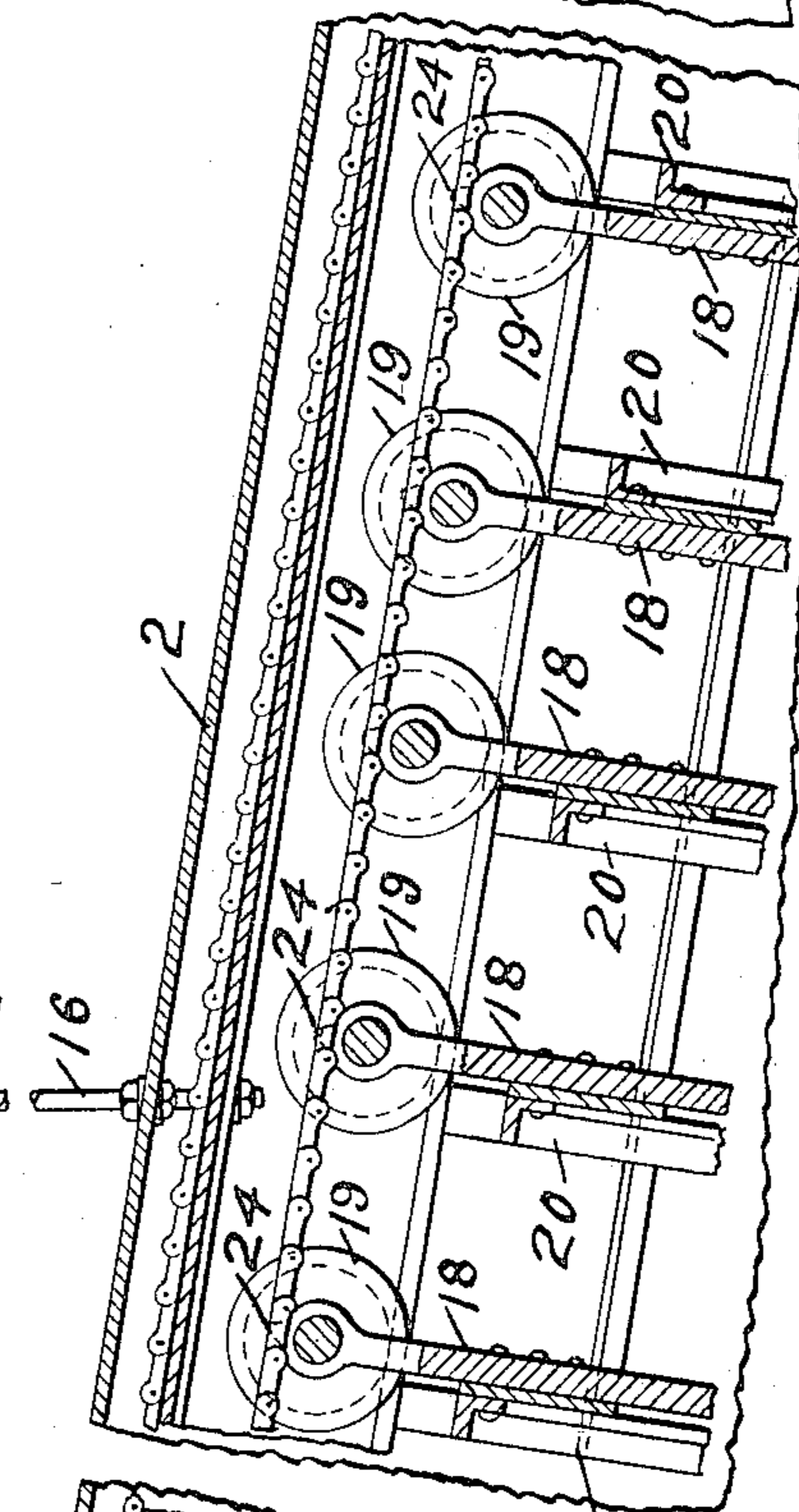
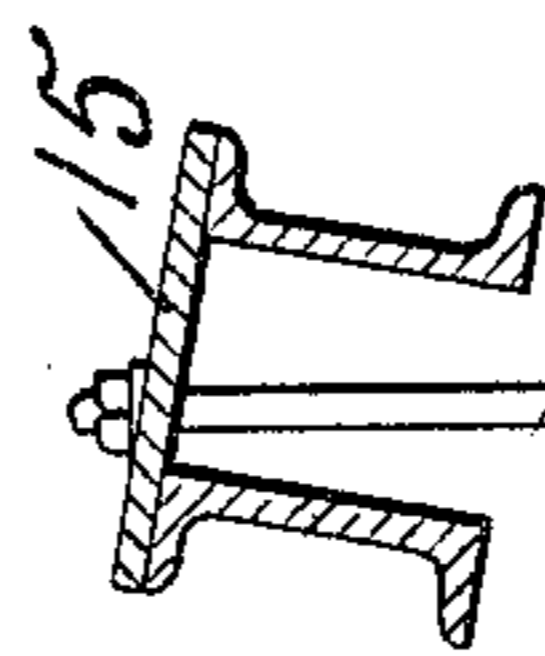


FIG. 7.

WITNESSES  
F. C. Tanner.  
C. Marnamark.

INVENTOR  
GEORGE B. FRANKFORTER  
BY *Paul Paul*  
HIS ATTORNEYS.

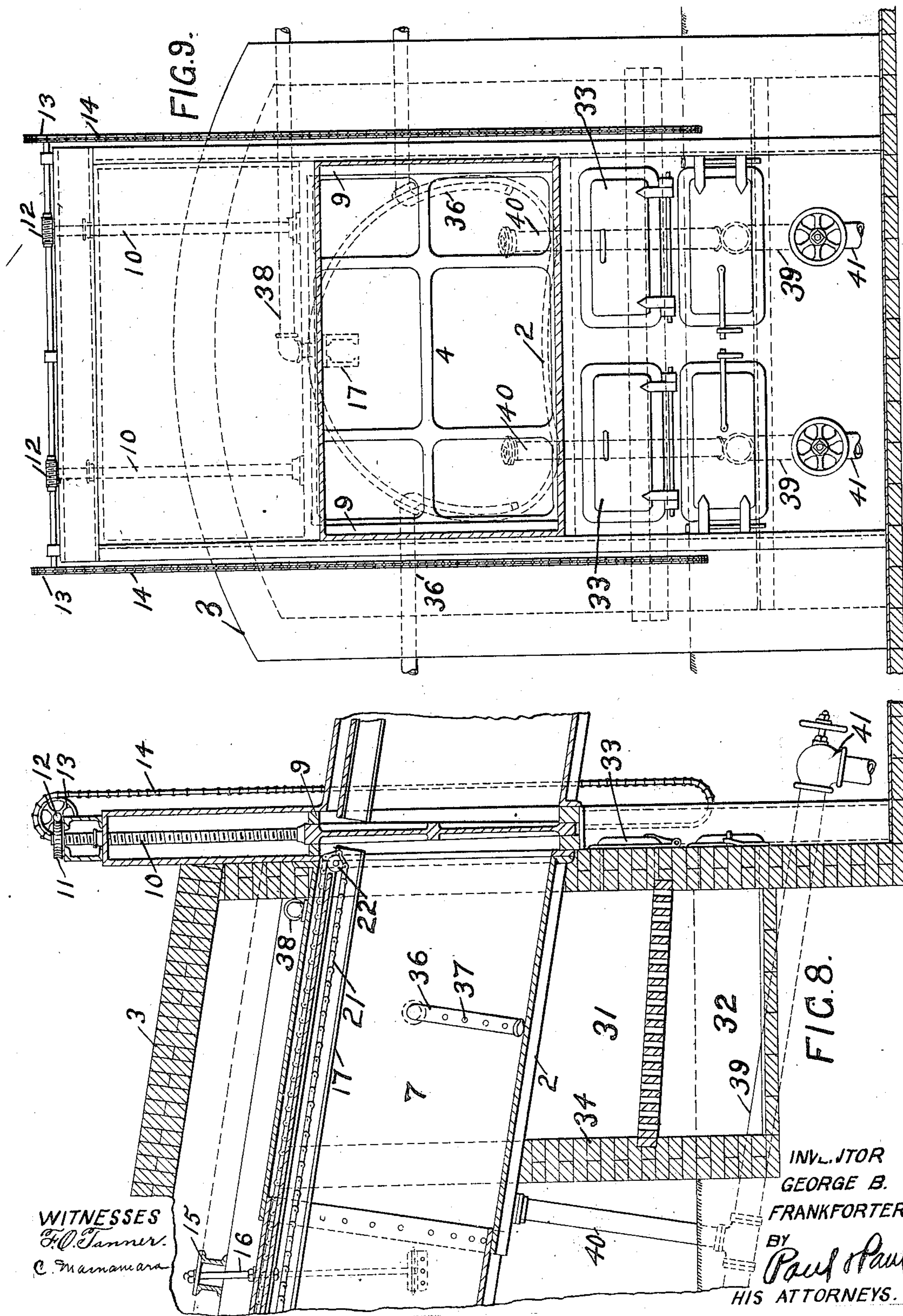
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4 SHEETS—SHEET 4.



WITNESSES  
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# UNITED STATES PATENT OFFICE.

GEORGE BELL FRANKFORDER, OF MINNEAPOLIS, MINNESOTA.

## APPARATUS FOR WOOD DISTILLATION.

No. 875,342.

Specification of Letters Patent.

Patented Dec. 31, 1907.

Application filed March 20, 1905. Serial No. 250,915.

*To all whom it may concern:*

Be it known that I, GEORGE BELL FRANKFORDER, of Minneapolis, Hennepin county, Minnesota, have invented certain new and useful Improvements in Apparatus for Wood Distillation, of which the following is a specification.

My invention relates to the dry or destructive distillation of wood, and the object of the invention is to provide an apparatus in which the process of distillation can be carried out with great economy and efficiency.

A further object is to provide an apparatus that will be simple in construction and operation and have a very large capacity.

Other objects of the invention will appear from the following detailed description.

The invention consists generally in providing a retort arranged at an incline and having a furnace at one end and feeding the wood slowly through said retort toward said furnace, and thereby subjecting the wood to a gradually increasing temperature.

Further, the invention consists in improved means for receiving and discharging the products of distillation from the retort.

Further, the invention consists in an improved construction of retort, and further, the invention consists in various constructions and combinations, all as hereinafter described and particularly pointed out in the claims.

In the accompanying drawings forming part of this specification, Figure 1 is a plan view of the retort with the crates in which the wood is placed omitted. Fig. 2 is a longitudinal vertical section on the line *a—*a** of Fig. 1. Fig. 3 is a transverse vertical section on the line *b—*b** of Fig. 2. Fig. 4 is a transverse vertical section on the line *c—*c** of Fig. 2. Fig. 5 is a detailed cross sectional view of the retort on the lines *d—*d** of Fig. 2, the position of the crate in the retort being shown in full lines. Fig. 6 is a side elevation of one of the crates upon its supporting truck. Fig. 7 is a detailed sectional view illustrating the sprocket mechanism in the upper part of the retort for controlling the movement of the wood crates. Fig. 8 illustrates a sectional elevation at the lower end of the retort. Fig. 9 is a transverse vertical section on the line *e—*e** of Fig. 2.

In the drawing, 2 represents a steel retort, preferably in the form of a cordate-shaped

shell and built upon inclined ground or within suitable masonry 3 and varying in diameter according to the capacity desired. The retort is divided by gates 4 and 5 Fig. 2 into chambers 6, 7 and 8. These gates are all wedge-shaped, as shown clearly in Fig. 8, and are vertically movable in guides 9 by means of threaded rods 10 on the top of said gates carrying worm wheels 11 that engage worms 12 operated by sprocket wheels 13 and chains 14. The gates 4 separate the chambers 6 and 8 from the intermediate chamber 7, and the gates 5 separate the other or outer ends of the chambers 6 and 8 from the atmosphere.

The charge of wood is first introduced to the chamber 6 and the gate 5 closed behind it. Then the gate 4 is raised and the wood admitted to the interior or distilling chamber of the retort. The retort is braced and supported in any suitable way, as by a series of cross bars 15 and hangers 16 suspended therefrom.

In the top of the retort I provide a guideway composed of channel bars 17 Fig. 3 arranged parallel with one another with their flanges contiguous and spaced at the bottom sufficiently to allow straps 18 Fig. 7 supported at their upper ends upon trucks 19 Fig. 6 to slide between them. The trucks roll upon the lower flanges of the channel bars and carry the steel crates or baskets 20 that are bolted to the lower ends of the straps 18, and are adapted to contain the charge of wood that is being subjected to the process of distillation.

The crates are of any suitable size and conform in cross section to the shape of the retort, as indicated in Fig. 5, and there are a sufficient number of trucks and straps connecting them with the crate to insure a substantial support for the charge of wood as it is moved through the retort. To protect the crates and the exposed parts of the retort from the air, I prefer to paint them with a thin paste of water-glass and kaolin or clay. The channel bars and trucks are located preferably in the top of the retort where they will be least affected by the extreme temperature.

The crates, owing to the inclined position of the retort, will move down by gravity therein, and in order to keep them under perfect control I provide an endless sprocket chain 21 arranged to operate over sprockets

22 and 23 between the channel bars 17, and lugs 24 are provided on the upper ends of the straps 18 to engage the links of the sprocket chain and thereby retard the downward movement of the basket or crate. The sprocket chain inclines upwardly near each extremity of the chain so that the middle portion of the lower run of the chain is below the level of the end portions. The straps 18 are so arranged that they will engage the middle or lower portion of the chain and clear the end portions and consequently the crate will be retarded during the time the straps 18 are in engagement with the chain and will be held back thereby until the crate passes out of the chamber 7. The chain 21 is within the control of the operator through a chain 25 and a sprocket 26 secured on the shaft 27.

20 A suitable approach 28 Fig. 2 is provided at the in-take end of the retort supporting a truck 29 that is adapted to deliver the crates to the retort.

It is my purpose to provide a sufficient number of crates to keep the retort chamber filled to its full capacity, each crate being charged with a supply of wood suitable for distillation purposes.

At the discharge end of the retort a support 30 is provided upon which trucks may be arranged to receive the crates as they are delivered from the cooling chamber 8.

The filling of the retort will be timed in such a manner that as soon as one crate enters the chamber 8 to allow the crate and charcoal to be cooled before exposure to the air the next preceding crate will have passed out of said chamber and the next succeeding one will be either directly above the furnace and undergoing the carbonizing process or will be approaching that stage in the retort. As soon as one crate has been cooled and the charcoal discharged it is ready to be filled and sent through the retort again. In this way the crates are kept in rotation; the process is made as nearly continuous as possible and the retort is operated at the highest degree of economy and efficiency.

The furnace which I prefer to employ in connection with this apparatus is represented at 31 and may be of any suitable style, but its location is important being at the extreme lower end of the distillation chamber for the purpose of causing a gradual increase in the temperature from the upper toward the lower end of said chamber. This furnace is provided with the usual ash pit 32 and is filled from the front, as shown in Fig. 9, through the doors 33 or from the side if preferred. A wall 34, of fire brick, is arranged in front of the fire box to deflect the heat upward, and another wall 35, also of fire brick, serves to deflect the heat downward. There may be a series of these walls 34 and 35, the number depending upon the length of the re-

tort, to compel the heat to follow a tortuous passage to the stack 35'. In the opposite sides of the retort and preferably just above the furnace, I provide pipes 36 entering the chamber 7 (see Figs. 8 and 9) and having a series of perforations 37 through which steam or other suitable gas is introduced into the distillation chamber for the purpose of sweeping or driving out all vapors, such as turpentine, as fast as they are liberated from the wood.

When it is desired to employ steam I prefer to allow water to flow slowly through the pipes 36, which will be vaporized immediately upon entering the distillation chamber. Distillation will begin as soon as the wood enters the chamber 7, wherein the temperature is so regulated that it will range between 100° and 250° C. at the upper end of the retort; that is, near the chamber 6, and all volatile liquids, such as water and turpentine, will be driven off. As the crate moves slowly downward toward the furnace and the temperature increases pyroligneous acid (wood vinegar), and other products, are driven off. These distillates may escape from the retort by two independent outlets: first, by real distillation through pipes 38 which connect the top of the retort (see Fig. 1) by the shortest possible course with an ordinary condenser (not shown), a number of these outlets being provided throughout the length of the distillation chamber to provide escapes at the different steps in the travel of the crates, as will be well understood. A second escape for the distillates is by a system of drainage through the pipes 39 having a series of branch pipes 40 leading into the bottom of the distillation chamber through the lower lobes of the retort at intervals therein, and adapted to receive the liquids of a high boiling point, such as tar, and conduct them into the pipes 39, from whence they are drawn off through the valves at 41. By means of this main and the system of branch pipes I am able to remove the colophonium through the upper and cooler of these branch pipes in an almost undecomposed state.

The shape of the retort with the lobes on each side of the bottom below the middle portion enables me to provide two sets of drainage pipes to conduct away the liquids of high boiling point, whereas in a retort circular in form it would be impracticable to use more than one set.

During the process of carbonizing the wood large quantities of combustible gases will escape through the pipes leading to the condenser. These gases may be collected in holders or conducted directly to the furnace for use as fuel. By the time the crate with its charge of wood has reached the lower end of the retort the temperature will be sufficiently high to completely carbonize the

wood. The crate will then be allowed to pass into the chamber 8 where it is cooled before exposure to the open air.

To use the apparatus described in the foregoing specification, a crate is placed upon the truck and charged with wood and then rolled down to the receiving end of the retort. The gate 5 at the outer end of the receiving chamber 6 is then raised and the crate moved forward until its trucks pass onto the channel bars and enters the said chamber. The gate 5 is then closed. The gate 4, at the receiving end of the distillation chamber 7, is raised and the crate allowed to enter the said chamber 7 and engage the sprocket chain. The operator can then control its speed of travel toward the furnace. The temperature in the retort will be variable according to the distance from the furnace, and at the receiving end of the distillation chamber will be sufficiently high to drive off the volatile liquids, as heretofore explained. Then, as the crate travels downward, the liquids of a high boiling point will drain off through the pipes 40 into the mains 39; the gases will pass off through the pipes 38, and whenever desired a sufficient amount of steam can be introduced into the distillation chamber to assist in carrying away the distillates present therein in the form of vapor. By the time the crate reaches the lower end of the distillation chamber the wood will be completely carbonized, whereupon the gate 4 will be raised and the crate allowed to pass out of engagement with the sprocket chain and into the cooling chamber 8, where the crate and charcoal are allowed to cool before being exposed to the air through the opening of the gate 5.

By this apparatus I am able to separate and preserve valuable distillates, taking advantage of the different degrees of temperature required to drive them from the wood, and produce an apparatus that will not only have a very large capacity and be very simple in operation and construction, but will also possess a very high degree of efficiency for the purpose designed.

I claim as my invention:

1. The combination, with an elongated retort having a bottom provided with a convex middle portion extending lengthwise thereof and longitudinal gutters upon each side of said convex portion, drain pipes 39 provided beneath said retort and provided with branch pipes 40 communicating with said gutters through the bottom of said retort, and a basket adapted to contain a supply of wood and arranged to travel slowly through said retort.

2. The combination, with an elongated retort arranged at an incline and having a bottom provided with a convex middle portion and longitudinal depressions on each

side forming gutters, of a furnace located beneath and near the discharge end of said retort whereby the heat in the retort will gradually increase from its receiving to its discharge end, drain pipes 39 located beneath said retort and parallel therewith, and branch pipes extending vertically from said drain pipes through the bottom of said retort and communicating with said gutters at intervals between said furnace and the receiving end of said retort, substantially as described.

3. The combination, with an elongated retort having a bottom provided with a convex middle portion and longitudinal depressions on each side forming channels or gutters, and drain pipes connected with said channels at intervals, of a crate or basket adapted to contain a supply of wood and having a bottom provided with a convex central portion and depressions on each side and suspended within said retort, substantially as described.

4. The combination, with a retort having receiving and discharge openings and closing means therefor, of a heating means, a wood receptacle arranged to travel by gravity in said retort, a sprocket chain and lugs or teeth provided on said receptacle and adapted to engage the links of said chain, for the purpose specified.

5. The combination, with an elongated retort arranged at an incline and having a distillation chamber and receiving and cooling chambers, and gates separating said receiving and cooling chambers from said distillation chamber and also from the open air, a receptacle adapted to contain a supply of wood arranged to enter said distillation chamber through said receiving chamber and travel slowly toward said cooling chamber, means in the path of said receptacle to be automatically engaged by and disengaged from said receptacle for regulating the speed of travel of the same, and a furnace located beneath the discharge end of said distillation chamber and arranged to produce an intense heat at said discharge end gradually decreasing in intensity toward the receiving end of said chamber.

6. The combination, with an elongated retort having a bottom provided with a convex middle portion and depressions on each side forming gutters, of a receptacle adapted to contain a supply of wood also having a bottom provided with a convex middle portion and depressions on each side to conform substantially to the shape of the retort, the top of said receptacle having a longitudinal depression and a series of wheels supported therein, and channel bars arranged in the top of said retort and wherein said wheels are supported and adapted to travel, substantially as described.

7. The combination, with a retort having receiving and discharge openings and closing means therefore, of a heating means, a wood receptacle arranged to travel by gravity in said retort, and means arranged in the path of said receptacle and traveling therewith to regulate the travel of said receptacle, and said regulating means being automatically

engaged by and disengaged from said receptacle, substantially as described. 10

In witness whereof, I have hereunto set my hand this 15th day of March 1905.

GEORGE BELL FRANKFORDER.

Witnesses:

RICHARD PAUL,  
C. MACNAMARA.