

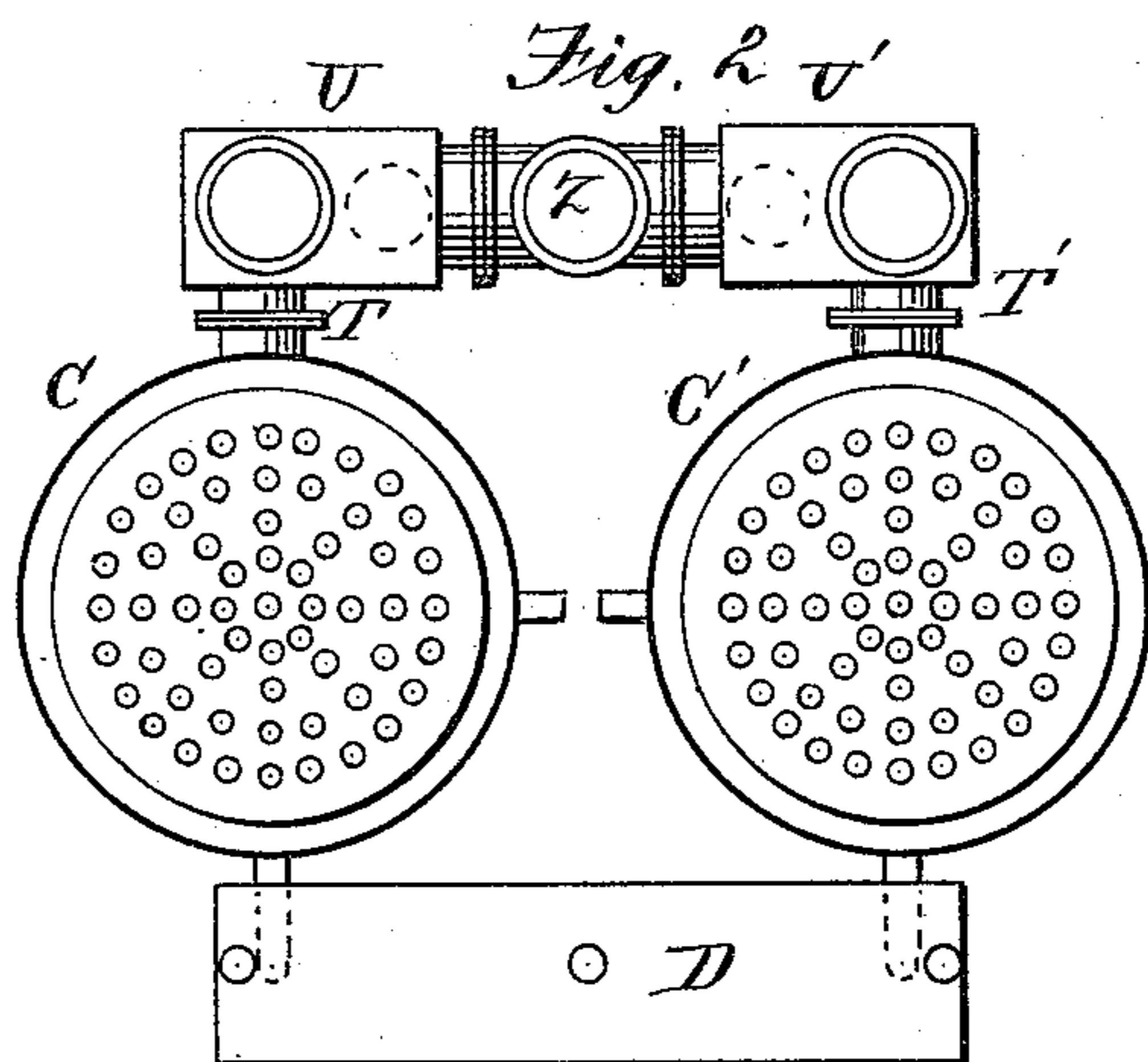
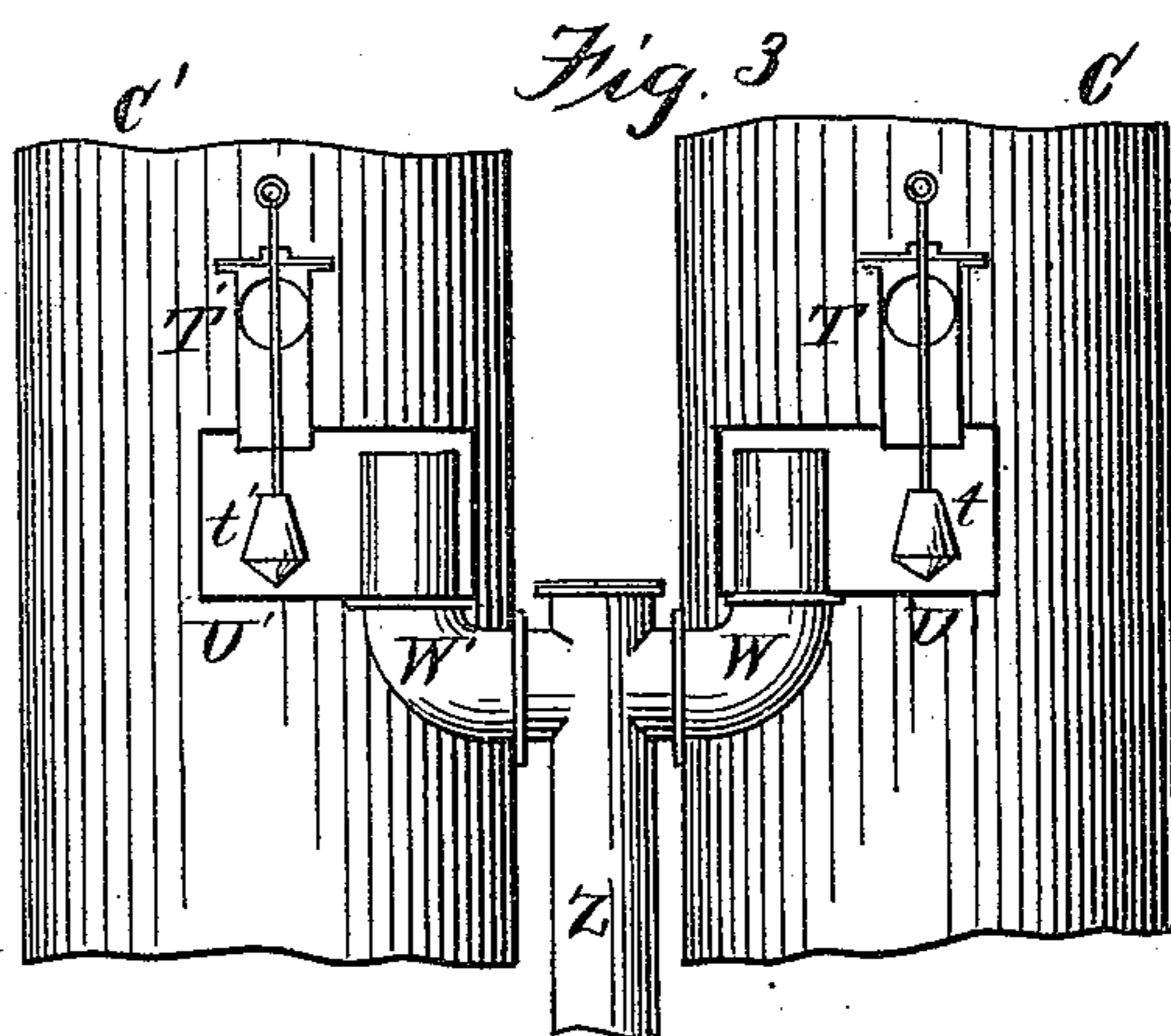
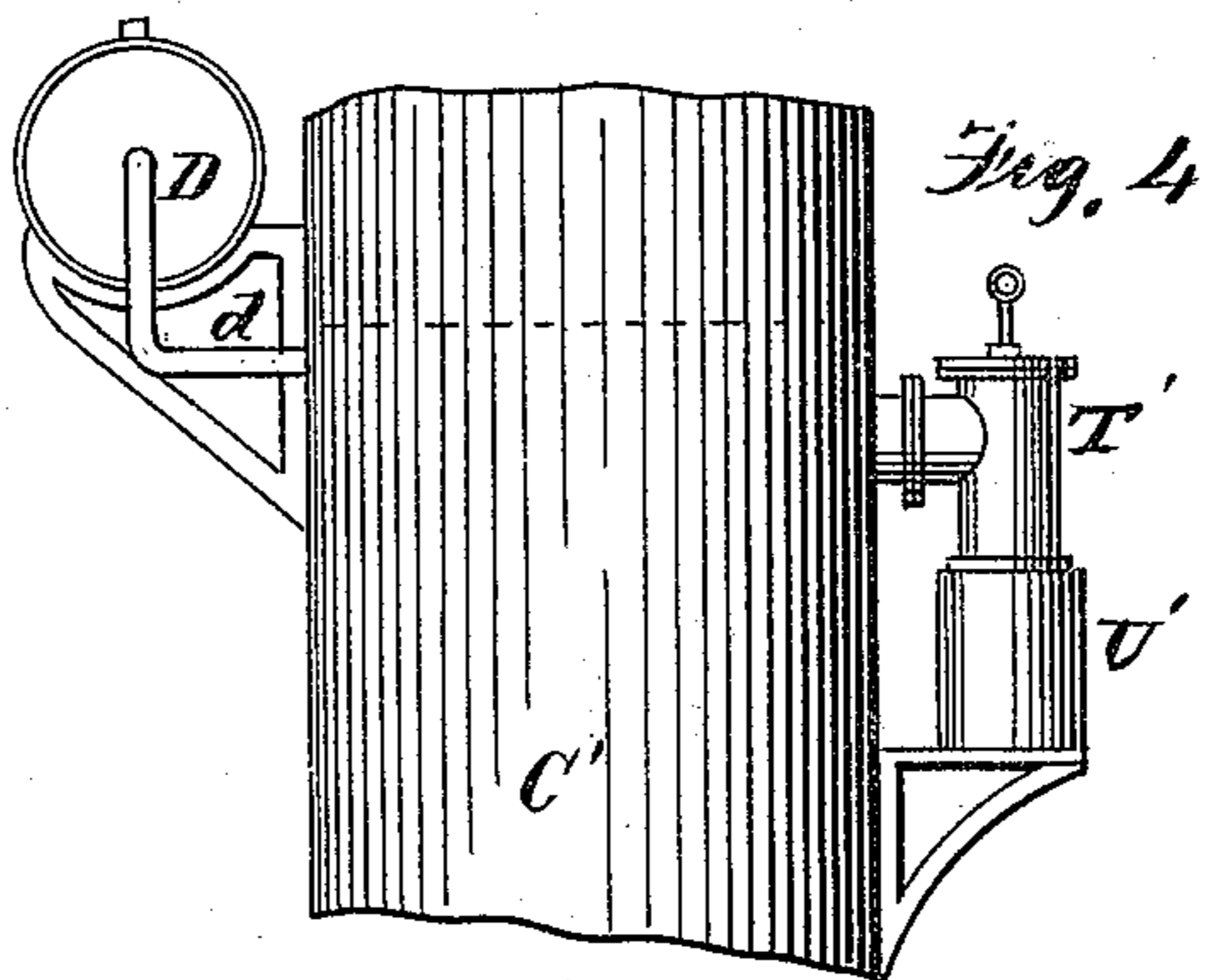
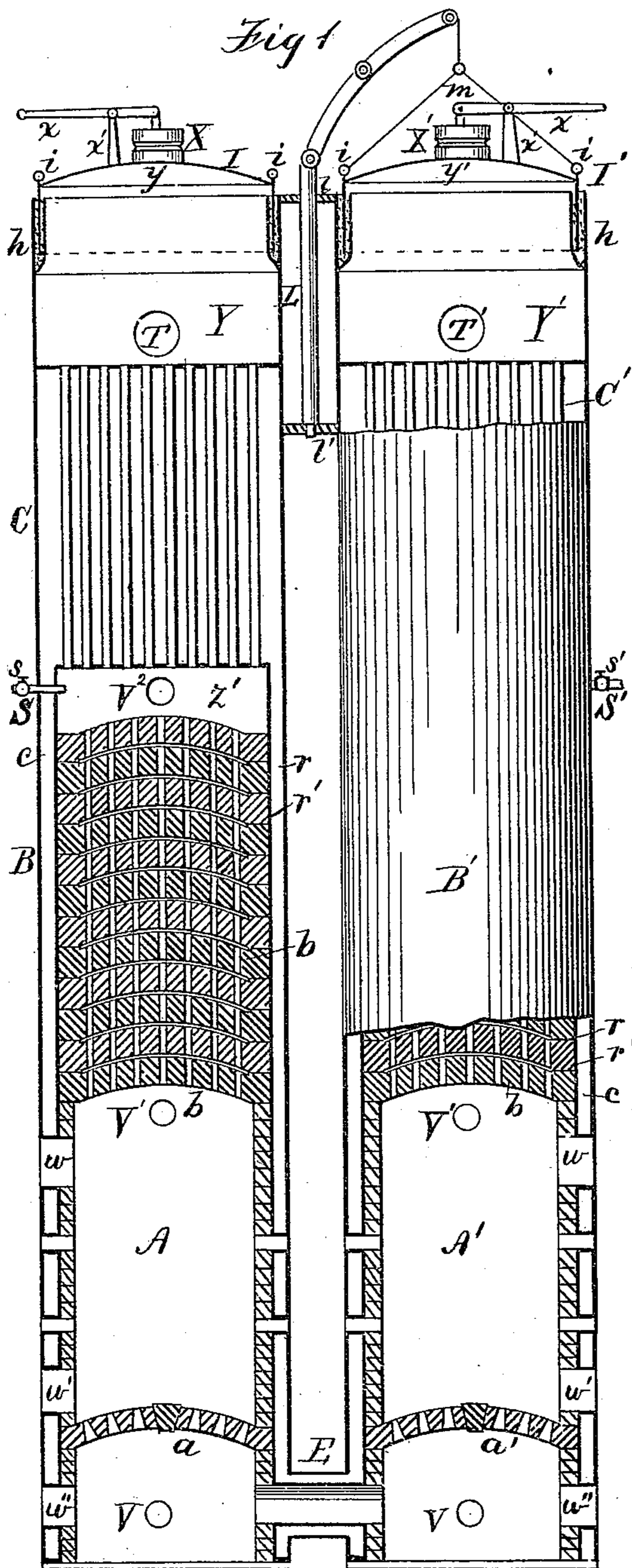
(No Model.)

3 Sheets—Sheet 1.

J. L. STEWART.  
APPARATUS FOR MANUFACTURING GAS.

No. 447,916.

Patented Mar. 10, 1891.



Witnesses  
*Chas. M. ...*  
*Fred. Schur*

Inventor  
*John L. Stewart*

(No Model.)

3 Sheets—Sheet 2.

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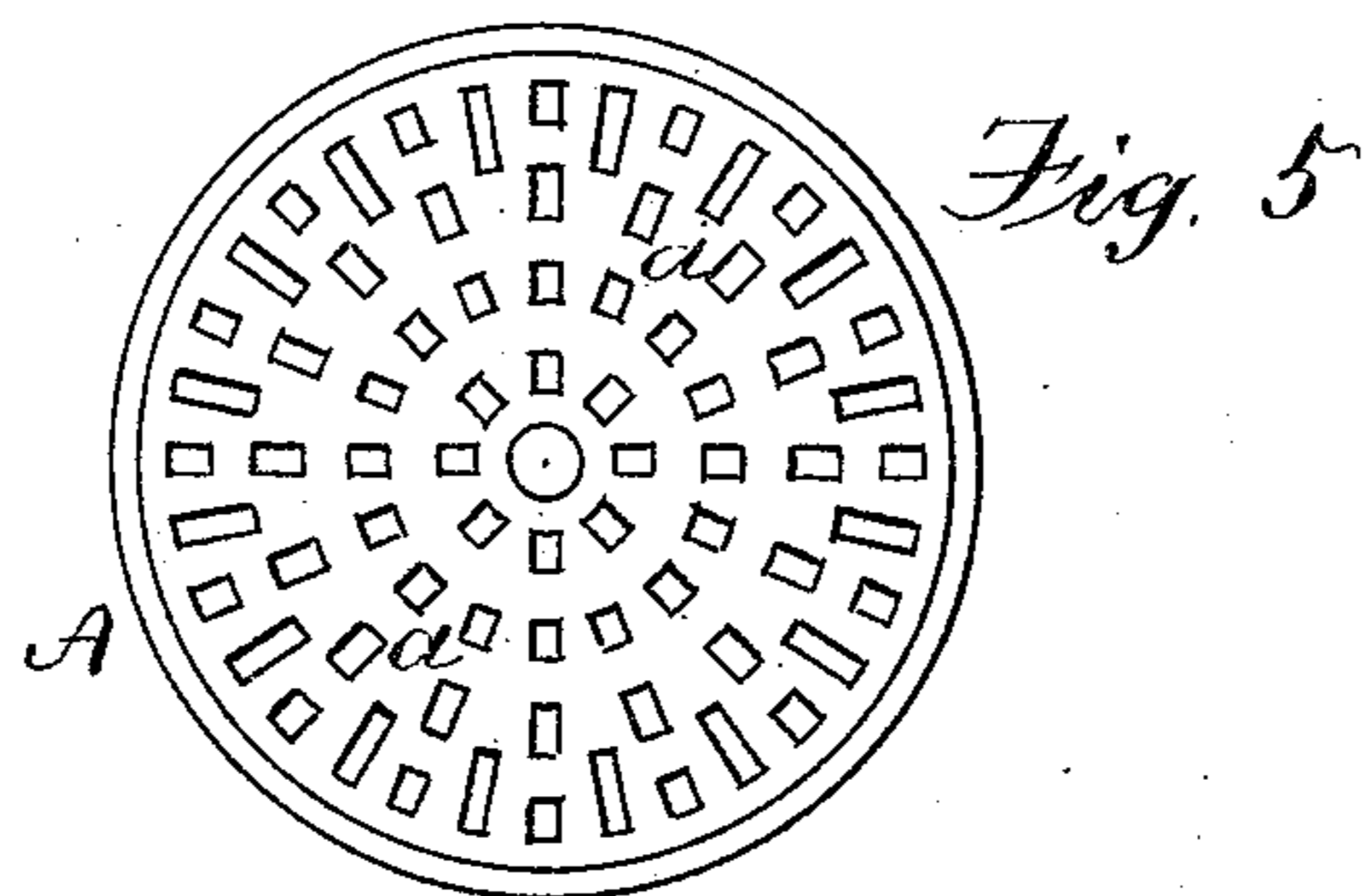


Fig. 5

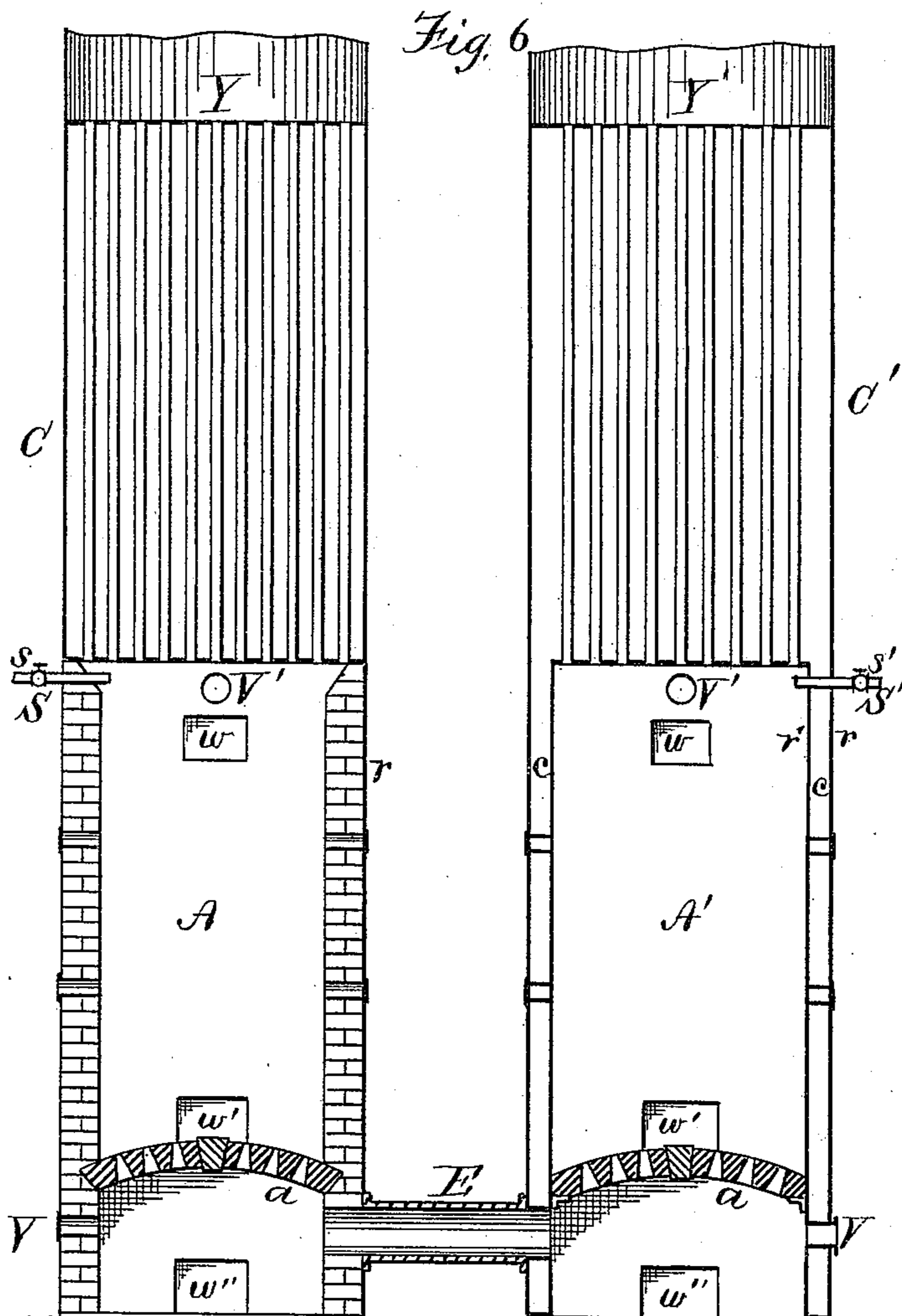


Fig. 6

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Inventor  
*John L. Stewart*

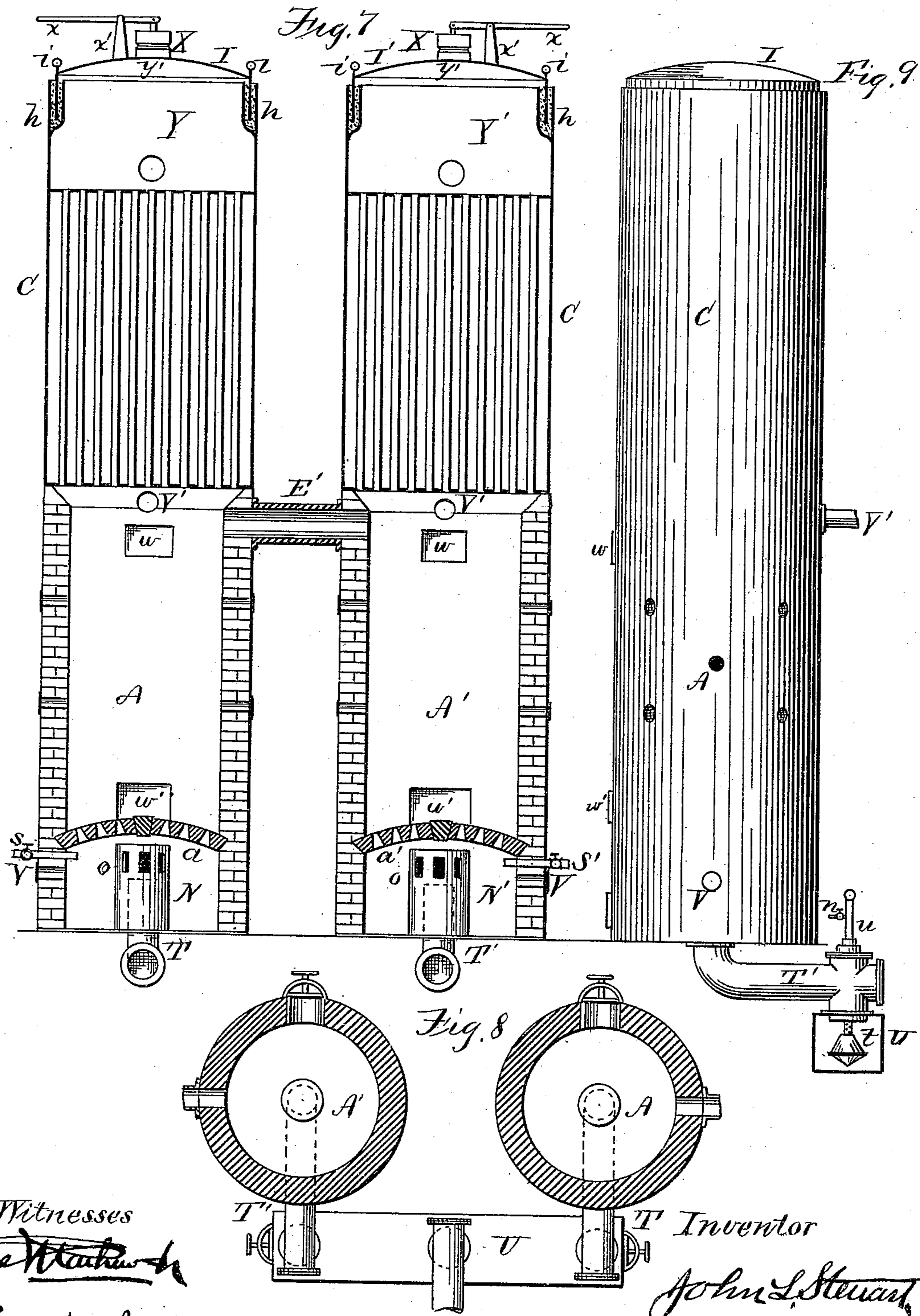
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# UNITED STATES PATENT OFFICE.

JOHN L. STEWART, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE UNITED STATES LIGHT AND FUEL COMPANY, OF SAME PLACE.

## APPARATUS FOR MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 447,916, dated March 10, 1891.

Application filed March 25, 1886. Serial No. 196,515. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN L. STEWART, a citizen of the United States, and a resident of the city of Philadelphia and county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Manufacturing Gas, of which the following is a specification.

This invention embraces improvements on the apparatus described in Letters Patent granted to me, No. 329,967, November 10, 1885, Nos. 333,691, 333,692, and 333,693, January 5, 1886; and the invention consists in the construction and combination of parts in a gas-manufacturing apparatus, as hereinafter described, and pointed out in the claims.

Figure 1 represents a vertical section of the apparatus, with parts in elevation, showing two cupolas connected at the base. Fig. 2 represents a horizontal section thereof above the boiler-tubes. Figs. 3 and 4 are detail views in elevation showing the gas-outlet pipes. Fig. 5 represents a plan view of the grate. Fig. 6 represents a vertical section of the apparatus of modified form, without the fixing-chambers. Fig. 7 represents a vertical section of the apparatus in modified form. Fig. 8 is a horizontal section, and Fig. 9 is a side elevation thereof.

In this apparatus two cupola generators, each of the general form and arrangement shown in my Patent No. 333,691, are connected together below or above the grate, whereby double the decomposing and generating surface of incandescent or highly-heated fuel is secured for producing complete decomposition of steam and conversion into pure hydrogen and carbonic oxide, and whereby longer runs may be made between the intervals of blasting with air, and a largely increased product obtained.

The cupolas are provided with fuel-chambers A A', superheating and fixing chambers B B', and in Fig. 1 with boilers C C', and they are connected at the ash-pits by short flue E, which may be formed by extensions of the outer and inner iron jackets r r', as in Fig. 1, or of a separate pipe, as in Fig. 6. The purifying or fixing chambers B are filled with arches of brick-work b, constructed as described in my Patent No. 333,691.

The shell of chambers A B and A' B', Fig. 1, are formed of two iron casings r r', stayed together with stay-bolts, the outer one r being of a diameter sufficiently larger than the inner one to form a water space or jacket c between them, which space opens at the top freely into the steam-boiler, and, in fact, forming part of it. The fuel-chamber may also be lined with brick, as shown in Fig. 1, or the iron casing may be left bare, as in chamber A', Fig. 6. The inner casing r' is riveted to the lower tube-sheet of the boiler, and the outer casing extends from the base of the cupola to the top of the smoke or gas box Y Y', above the boiler.

Important features of improvement are the removable top I over the whole area of the boiler and the annular seal-cup h around the upper rim of the box Y, in which such cover is sealed by its downwardly-extending flange. Rings i in the periphery of the cover serve for the attachment of chains m, connecting with the swinging crane L, supported by the cross-bars and guides l l'. The covers are provided with smoke and vent passages y y', closed by caps X X', and such caps are operated by levers x, pivoted to fulcrums x'. The seal-boxes are to be filled with sand, which may be dry or wet, or with water for making a tight joint.

When it is desired to clean the boiler tubes or flues in the brick-work of chamber B, the cover is raised out of the seal-box and swung to one side, exposing all the tubes of the boiler for the convenient insertion of a tube-cleaner, and after the tubes and flues have been cleaned the cover is readily replaced and secured in the seal-cup. In case water is used as the sealing-fluid a continuous stream is caused to flow into and out of the cup by means of suitable supply and discharge pipes.

The water-cooled grates described in my patent above mentioned are replaced by perforated grates a, made of refractory heat-resisting material in the form of an arch with a central key-block. These grates made in the form of an arch are very durable and economical.

A steam-drum D, mounted on a bracket, is connected by pipe d with the top of the boilers. The gas take-off pipes T T' connect with

the valve-boxes U U', and their downwardly-projecting ends are controlled by conical valves  $t$   $t'$ , provided with rods projecting through packing-boxes at the tops of the pipes, as shown in Figs. 3 and 4. A single long box might be substituted for the two boxes U U' shown. Branch pipes W W' lead from the boxes to the discharge-pipe Z, which connects with the water-heater or scrubber. (Not shown.)

The fuel-chambers are provided with fuel-supply openings  $w$ , clinker-openings  $w'$ , just above the grates, and ash-pit openings  $w''$ , which in practice are provided with tight-fitting doors. Air-blast pipes V connect with the ash-pits, pipes V' with the tops of the fuel-chambers, and pipes V'' with chamber Z', just below the boiler. A steam-supply pipe S and S', having a valve  $s$  and  $s'$ , connects with chamber Z' above the brick-work of each chamber B B'.

Referring to Fig. 6, it is seen that the apparatus is slightly modified in construction, the chambers B B' are omitted, and the walls of chamber A are constructed of brick, having the boiler mounted on top, while the walls of chamber A' are formed simply of the two iron casings  $r$   $r'$ , with the inclosed water-space communicating with the boiler above. The connecting-flue E is made of iron and lined with brick or fire-clay. The tops of the boilers and the gas take-off pipes (not shown in Fig. 6) are to be formed like those above described with reference to Fig. 1.

Referring to Figs. 7, 8, and 9, it is seen that the modifications consist in connecting the fuel-chambers at the top by pipe E' and in connecting the gas take-off pipes T T' with the ash-pits. Protecting caps or hoods N N', having circumferential openings  $o$ , are placed over the open ends of pipes T T' in the ash-pits to prevent dust and ashes from falling into the pipes. Since the gas flows directly from the fuel-chambers, in a highly-heated state, into the box U, it is desirable to cool valve-stem  $u$  and valve  $t$ . Therefore such valve-stem is made hollow and perforated, and has connected with it, near the top, a steam or water supply pipe  $n$ . The conical valve  $t$  may also be hollow and perforated, for the distribution of steam or water, to keep the valve seat and box sufficiently cool, as described and claimed in my patent, No. 332,569. The steam-supply pipes S S' connect with the ash-pits.

The operation of the apparatus represented in Fig. 1 is as follows: A fire is kindled in each chamber A A', caps X X' being open, and fuel is supplied while air-blasts are admitted to the ash-pits by pipes V V, so as to form deep beds of incandescent fuel. As soon as combustible gases are given off from the fuel they are ignited and burned by the admission of air-blasts by pipes V' V', and chambers B B' are thereby heated, and the boilers are also heated by hot products of combustion passing up through the flues. Should com-

bustible products pass up through chambers B B', additional air-blasts are admitted at V'' in chamber Z' for completing the combustion. The brick-work in chambers B B' serves a very useful purpose aside from the well-known function of superheating steam and fixing gas, and this is in causing more perfect combustion of the waste combustible gases while blowing up the fire in the fuel-chamber—that is, by reason of the brick-work being highly heated the combustion of gas passing through it is much more perfect than it would be while passing through the boiler-flues, the smoke being kept hot, and thus all consumed, resulting in increased heat. The apparatus having been properly heated the air-blasts are shut off and the caps X X' closed. Then steam is admitted to one of the chambers Z', as by pipe S above chamber B, and is highly superheated by passage down through the heated flues in the brick-work, and is then decomposed by passage through the incandescent fuel, resulting in hydrogen, carbonic oxide, and carbonic acid, and in case bituminous coal is used in the generator some tarry or oily vapors may accompany the gases. The mixed gases pass into the second body of fuel, where the small percent. of carbonic acid present is converted into carbonic oxide and the oily or tarry vapors are converted into a fixed gas. The perfected and purified gas finally passes off through the boiler, imparting its heat to the water and generating steam. The direction of the current of steam and gas through the apparatus may be reversed whenever desired. By forcing the steam down through chambers B B' the dust and ashes are blown out of the flues in the brick-work, thus keeping them clean and securing better results. The refractory grates are advantageous in resisting the intense heat of the gases passed down through them, and by their use I avoid the objectionable cooling of the gases that would result from the use of water-circulation grate-bars. The process above described produces a superior heating-gas, well adapted for cooking and warming, for running gas-engines, and for illuminating in connection with incandescent burners.

When it is desired to manufacture illuminating-gas for use with ordinary burners, hydrocarbon vapor is preferably admitted under pressure from a hydrocarbon evaporating still or boiler, as described in my patents numbered 333,691 and 333,692.

The vaporization of oil is effected by either passing steam through a coil in the still or by a banked fire under the still, or by both combined, and the pressure in the still may be regulated by a pressure-valve, by which the steam may be turned on or off, or by a damper automatically opened or closed.

The hydrocarbon vapor should be admitted into the second cupola between the grate and fixing-chamber, so as to mix with the gases passed from the first one.

The apparatus shown in Fig. 6 is operated substantially like that shown in Fig. 1, except that, as chambers B B' are omitted, the steam is not superheated except in the upper  
 5 part of the fuel and the gas is not fixed except in the second bed of fuel; but these operations may be well effected in this form of apparatus, and it is simpler and can be more economically constructed and operated and  
 10 is well adapted for making heating or fuel gas.

In the apparatus shown in Fig. 7 the products of combustion only are passed through the boiler-flues, and the gas to be stored is passed off by pipes connecting below the  
 15 grates. The connecting-pipe E' being located at the top of the fuel-chambers, the steam-pipes are connected with the ash-pits, and steam is passed up through the first fuel-chamber, and the resulting gases are passed  
 20 down through the second body of fuel and conducted away by the gas-take-off pipe leading from the ash-pit. It will be understood that the valve in the gas-take-off pipe leading from the chamber into which steam is  
 25 being admitted is always closed, so that little or no steam can escape in that direction, while the valve in the take-off pipe leading from the other chamber is always opened for the escape of gas.

30 Hydrocarbon oil or vapor may be admitted into the fuel-chambers between the grates and boilers in the apparatus shown in Figs. 6 and 7, the oil or vapor preferably going into the second fuel-chamber, or that one into which  
 35 the gas is being passed from the primary steam-decomposing chamber.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an apparatus for manufacturing gas, 40 the combination of two cupola gas-generating furnaces, each having a fuel-chamber at the base and a tubular boiler at the top, a steam-supply pipe connected with each furnace above the fuel, a gas-flue connecting the fuel-cham- 45 bers at the base, the gas-take-off pipes, the annular seal-cups above the boilers, and the removable covers having vents closed by caps, substantially as shown and described.

2. In an apparatus for manufacturing gas, 50 the combination of two connected gas-generating furnaces having tubular boilers at the top, the annular seal-cups secured to the extended shells of the boilers, the removable flanged covers set in said seal-cups and hav- 55 ing vents, caps for closing said vents, levers for raising said caps, and a crane supported between the boilers for lifting either cover, substantially as described.

3. In an apparatus for manufacturing gas, 60 the combination, with two water-jacketed furnaces, of a connecting-flue formed by extensions of the two casings *r r'* of the water-jackets, substantially as shown and described.

4. In combination with a gas-generating fur- 65 nace, the gas-take-off pipe leading from the ash-pit, and the perforated protecting-hood covering the open end of such pipe.

In testimony that I claim the foregoing as my invention I have signed my name, in pres- 70 ence of two witnesses, this 24th day of March, 1886.

JOHN L. STEWART.

Witnesses:

CHA. MATHEWS, Jr.,  
 FRED. SCHUR,