W. F. BROWNE.

4 Sheets--Sheet 1.

Apparatus for the Manufacture of Water Gas.

No. 151,833.

Patented June 9, 1874.

Fig. 5.

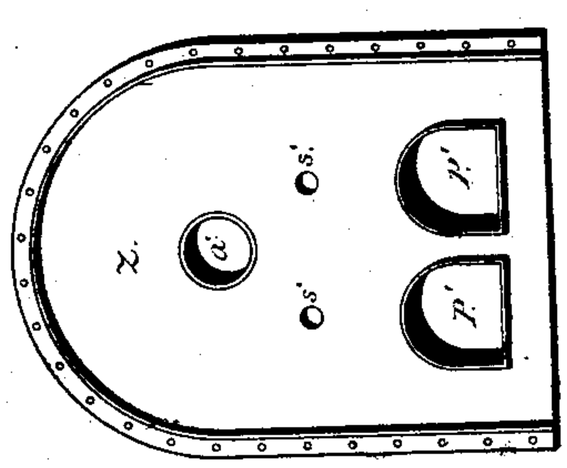


Fig. 6.

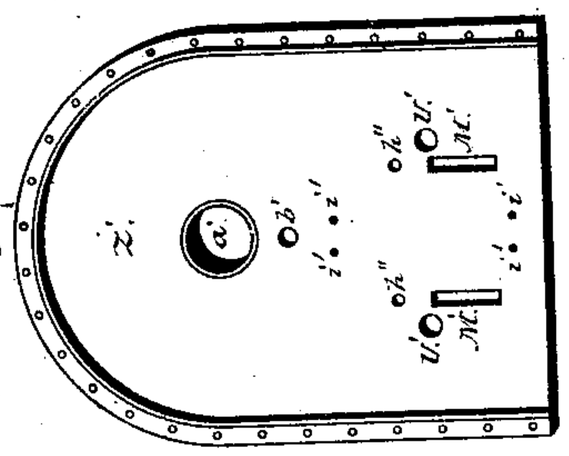


Fig. 1.

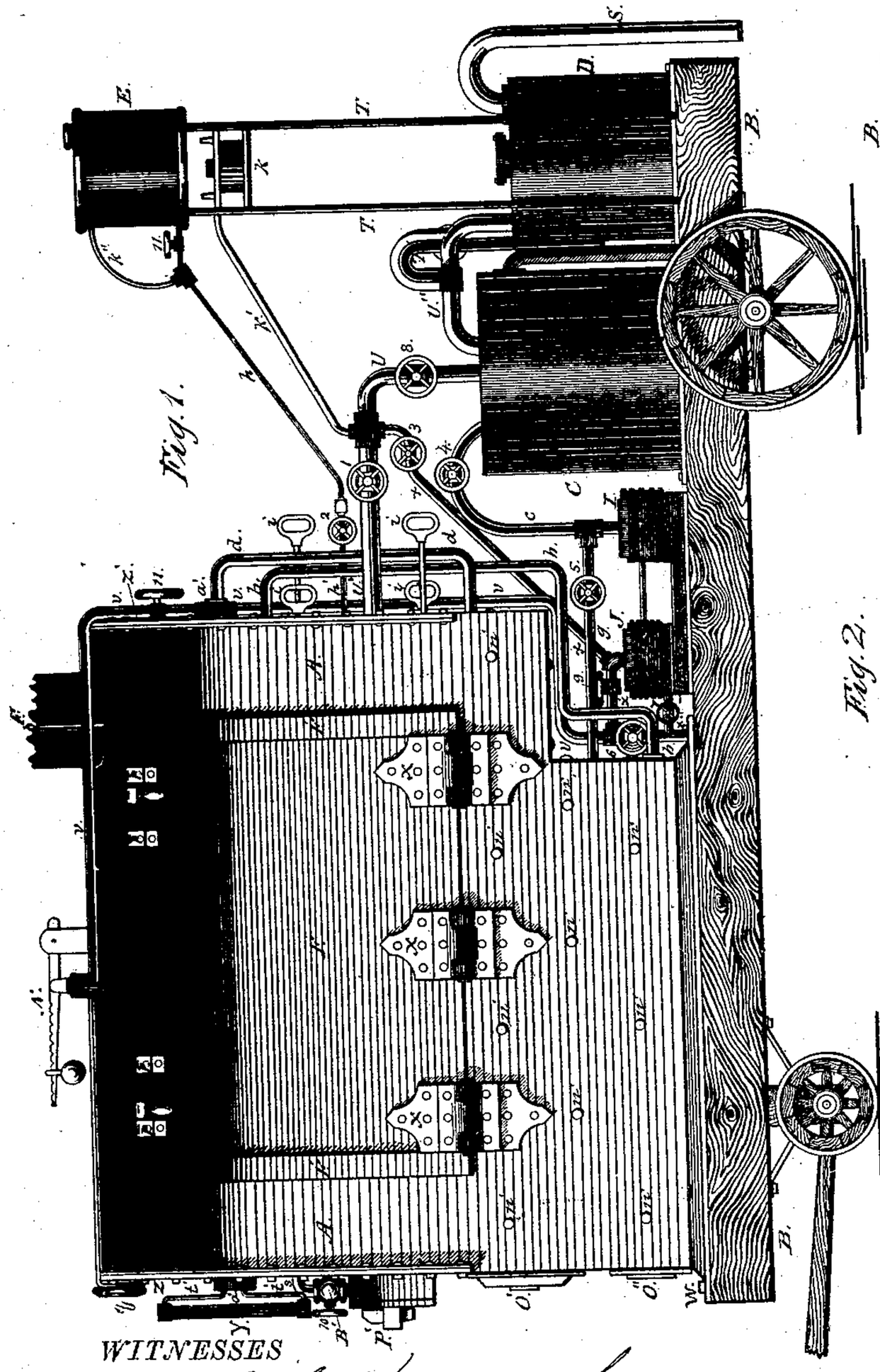
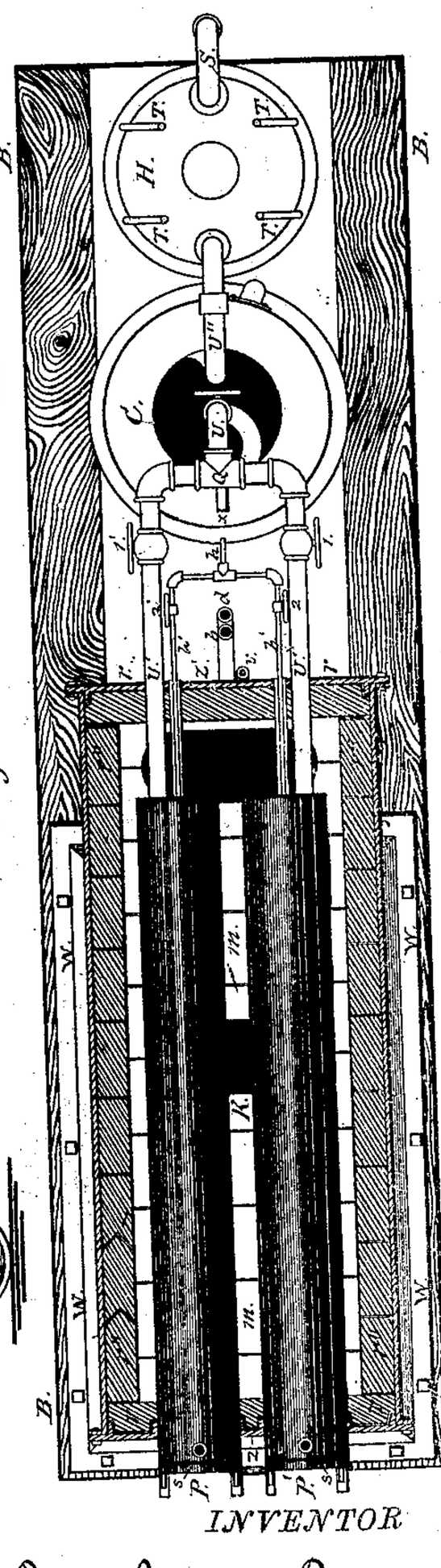


Fig. 2.



WITNESSES

W. E. Kenyon Jr.

E. W. Woodruff.

INVENTOR

Wm Frank Browne

4 Sheets--Sheet 2.

W. F. BROWNE.

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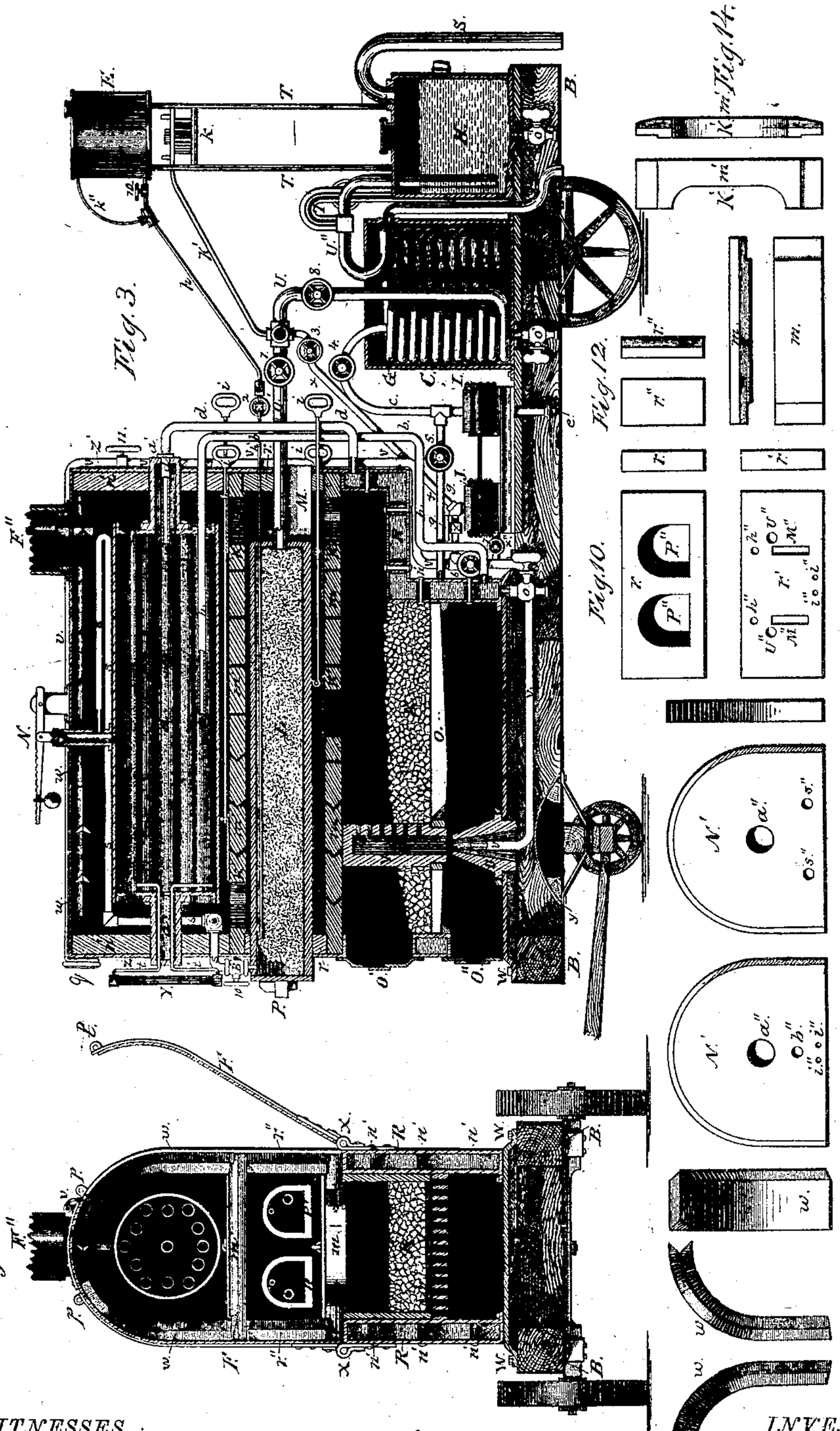

Fig. 3.

Fig. 4.

Fig. 13.

Fig. 12.

Fig. 10.

Fig. 11.

Fig. 9.

Fig. 8.

Fig. 7.

WITNESSES

W. E. Kynaght

E. W. Woodruff.

INVENTOR

Wm Frank Browne.

4 Sheets--Sheet 3.

W. F. BROWNE.

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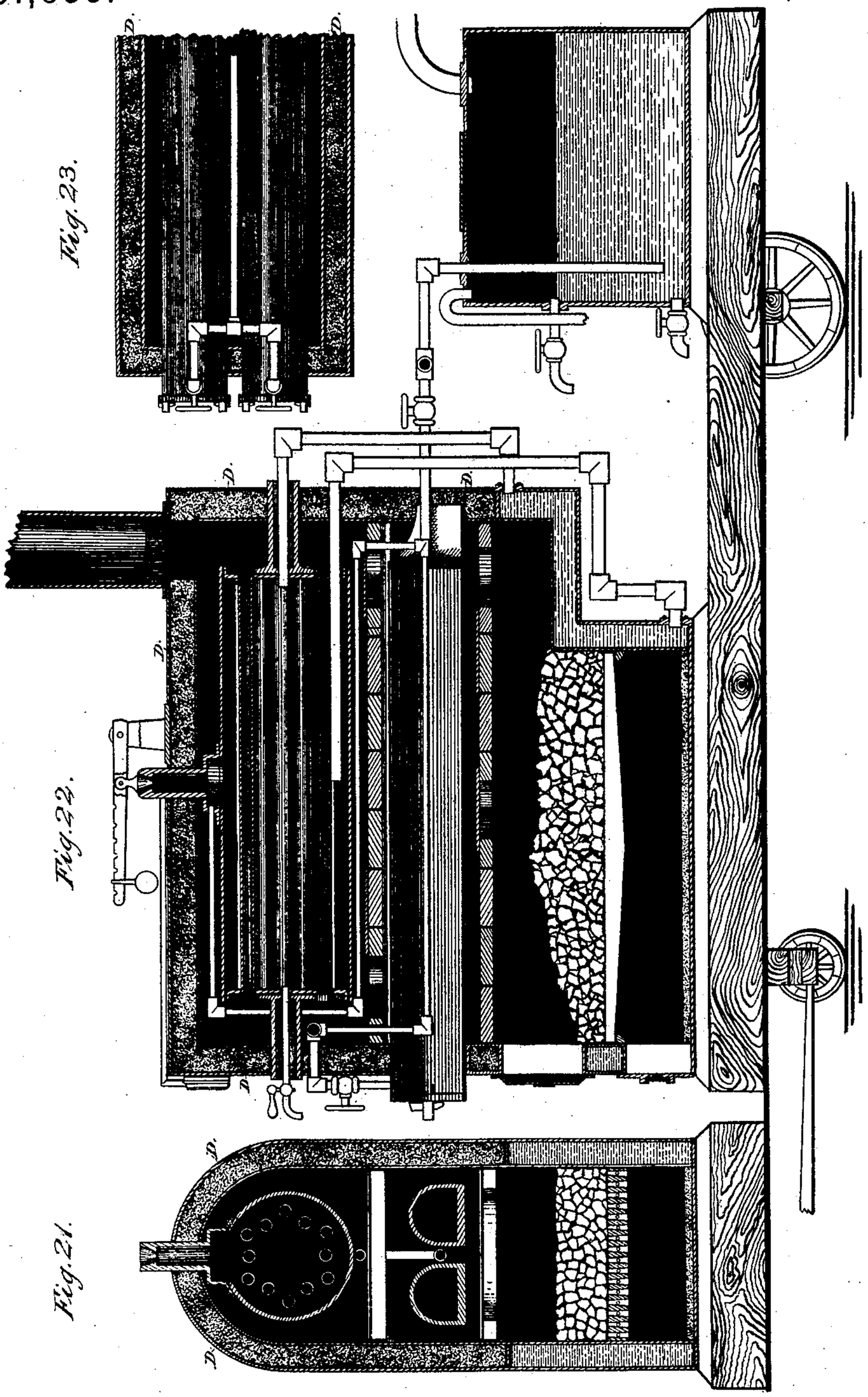

Fig. 23.

Fig. 22.

Fig. 21.

WITNESSES

E. W. Woodruff.

INVENTOR

Wm Frank Browne.

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W. F. BROWNE.

Apparatus for the Manufacture of Water Gas.

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Fig. 17.

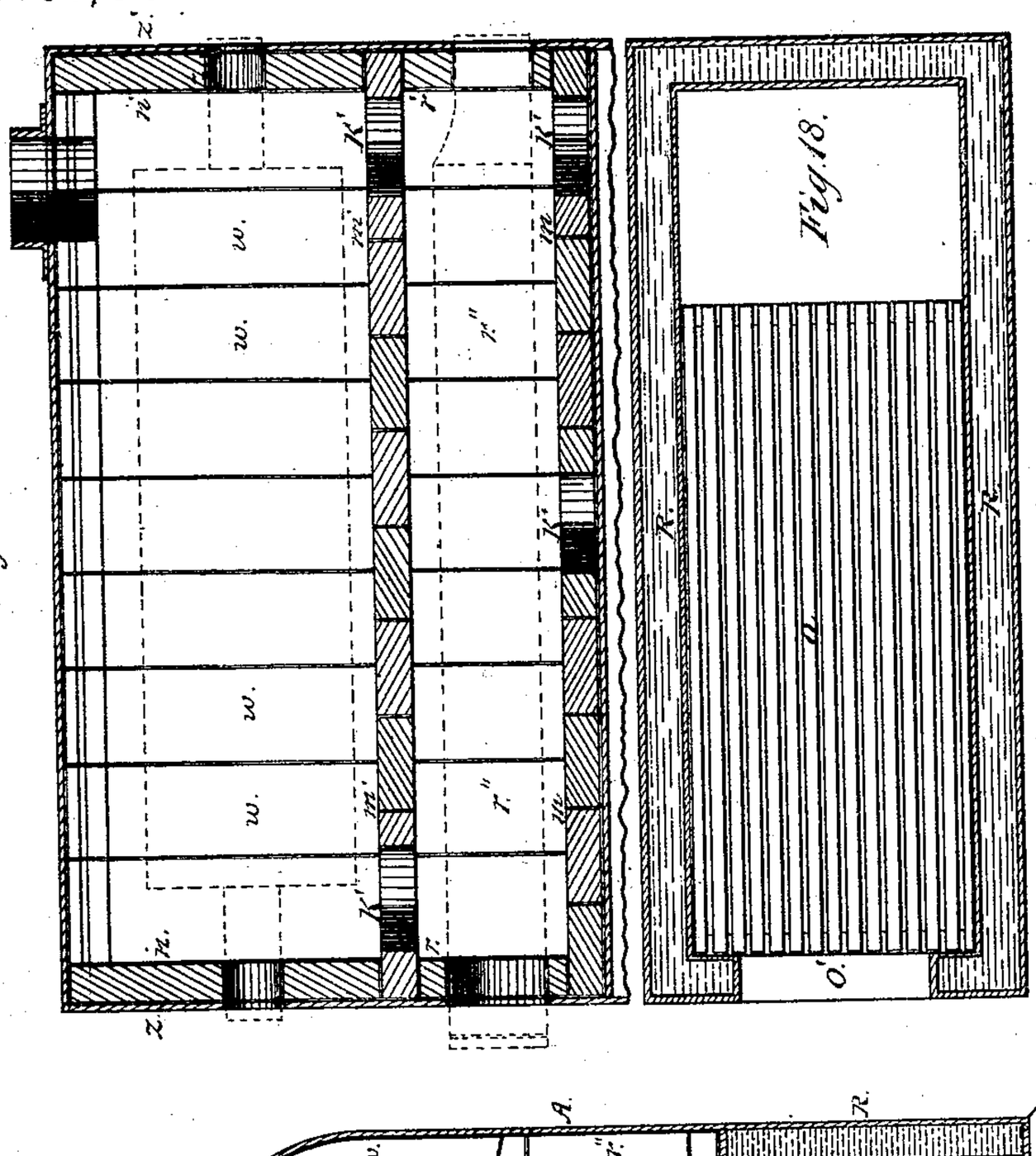


Fig. 18.

Fig. 19.

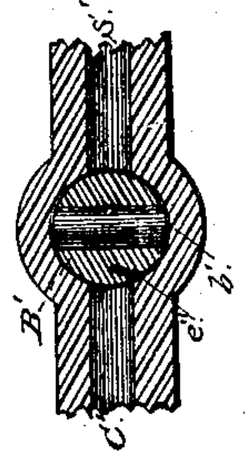


Fig. 20.

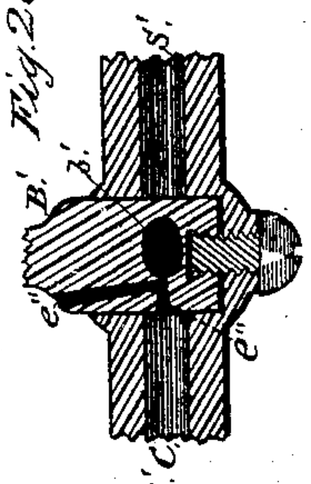


Fig. 16.

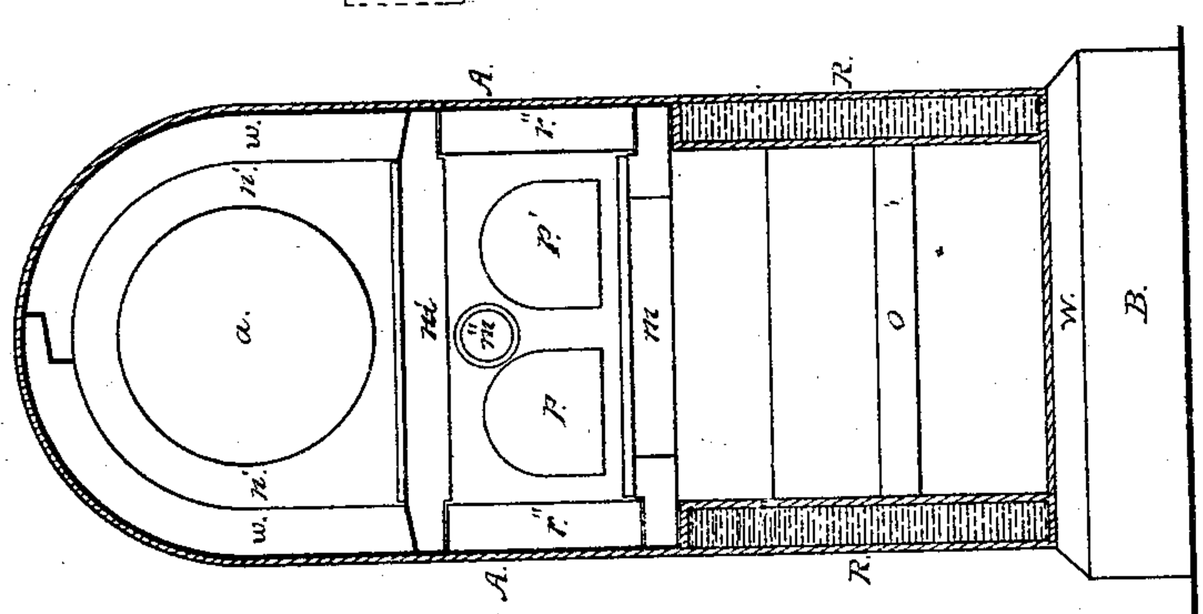
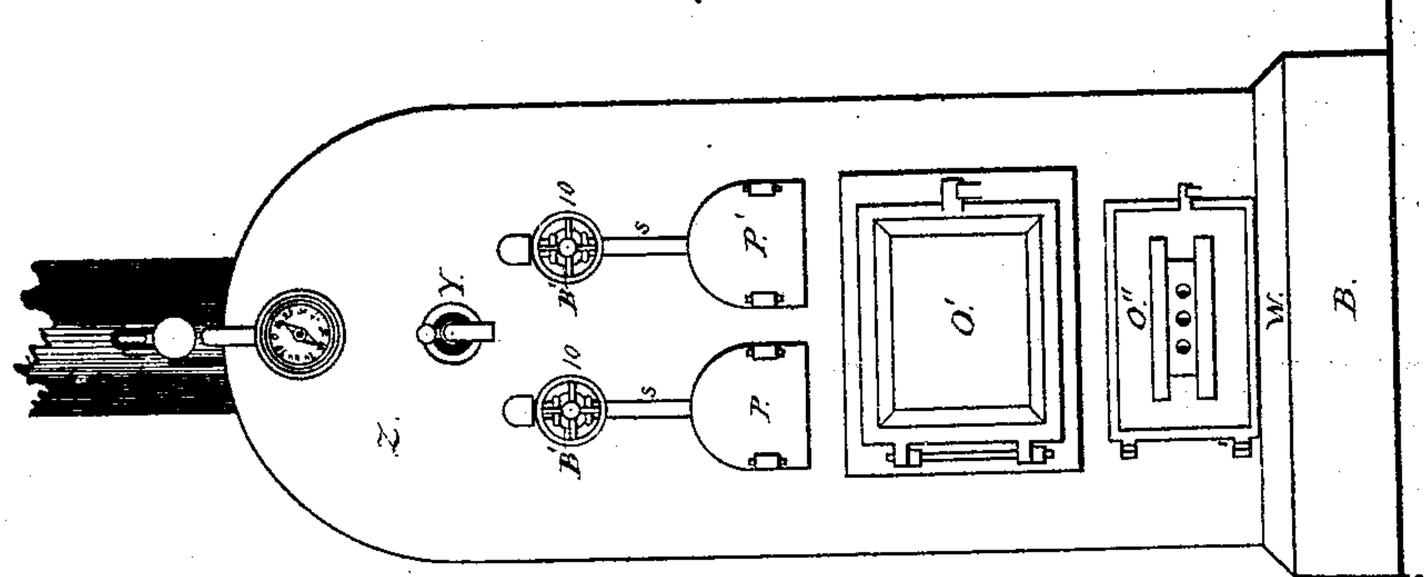


Fig. 15.



WITNESSES

E. W. Woodruff.

INVENTOR

Wm. & Frank Browne

UNITED STATES PATENT OFFICE.

WILLIAM F. BROWNE, OF NEW YORK, N. Y.

IMPROVEMENT IN APPARATUS FOR THE MANUFACTURE OF WATER-GAS.

Specification forming part of Letters Patent No. **151,833**, dated June 9, 1874; application filed May 28, 1874.

To all whom it may concern:

Be it known that I, WILLIAM FRANK BROWNE, of the city, county, and State of New York, have invented some new and useful Improvements in Hydrogen and Carbureted-Hydrogen Gas Machines or Apparatus; and do hereby declare that the following specification is an exact description thereof, being fully illustrated in the accompanying drawing.

Figure 1 represents a side elevation of a transferable carbureted-hydrogen gas apparatus. Fig. 2 represents a horizontal section and top plan of Fig. 1. Fig. 3 represents a vertical longitudinal section of Fig. 1. Fig. 4 represents a vertical cross-section of the same. Fig. 5 represents a cast-iron front-end plate, secured to the front end of the gas apparatus. Figs. 7, 8, 9, 10, 11, 12, 13, and 14 represent internal parts of the gas-machine, made of fire-clay. Fig. 15 represents an end elevation of the gas machine or apparatus. Fig. 16 represents a cross-section of the same. Fig. 17 represents a broken vertical section of the same, with the boiler and retorts removed. Fig. 18 represents a horizontal section cutting through the boiler which surrounds the fire-box and ash-pit. Figs. 19 and 20 represent a safety stop-cock. Figs. 21, 22, and 23 represent a modification of the gas apparatus.

Like letters designate corresponding parts in all of the figures.

In Fig. 1, A A represent a boiler-plate case or covering for that portion of the apparatus in which the gas is generated. F is a door, provided with suitable flanges F F F, and fastenings *p p*, to hold the same in its place.

In Fig. 4 there is shown a door upon each side of the machine, one being closed and the other partly open. These doors swing downward upon their hinges X X X. F″ is a smoke-pipe; N, a safety-valve. Z Z′ are two cast-iron end plates, provided with flanges and necessary apertures for the working parts of the machine. The flange is for the purpose of giving additional strength to the cast plate, and additional support to the covering A A. The ends of the covering A A are bent upward at right angles, to which are secured the end plates Z Z′ by small bolts, as shown in Figs. 1 and 2.

In Figs. 1 and 3, Y represents a water-gage, connected with the boiler by the pipes *t t′*.

In Figs. 1 and 2, C represents a condenser, which contains a coil, as shown in sectional view, Fig. 3.

In Figs. 1 and 2, D represents a desulphurating-tank, partly filled with lime-water H, as shown in Fig. 3. T T T T are rods, shown in Figs. 1, 2, and 3, for the purpose of supporting the oil-tank E. P P P P are retorts, shown in Figs. 1, 2, and 3. *n′ n′ n′ n′ n′* represent stay-bolts, as shown in Fig. 1. W W W W is a cast-iron bed-plate, on which the main portion of the machine rests, and serves as a bottom to the ash-pit. This base is bolted to the timbers B B composing the frame-work, on which the entire apparatus rests. J and I represent a steam-cylinder and pump, as seen in Figs. 1 and 3.

In Fig. 1, *i i i i* are handles, connected to rods operating four dampers within the machine, thereby controlling the heat. *a′ a′*, in Fig. 1, represent the ends of two trunnions or supports, secured to the two heads of the boiler within. *d* and *b* are pipes for hot-water circulation. U U′ U″, in Figs. 1, 2, and 3, are pipes, through which the gas flows from the retorts to the gasometer. *h h′ h′* are pipes for conveying the carbon from the tank E to the retorts P P′. *v v v* is a pipe for conducting the steam from the boiler to the steam-cylinder J; also to the furnace, when desirable. The pipe *x x* is for conducting the gas from the pipe U to the engine; also through the pipe *v v v v* to the furnace. Figures 1 1′ 2 2′ 2″ 3 4 5 6 7 8 9 10 10′ are cocks, used to regulate the steam, gas, and oil.

Fig. 2 represents a horizontal section of that part of the machine in which the gas is generated, cutting through the machine just above the retorts P P′, and a top plan, showing the oil-pipes *h′ h′* and *h* broken—the gas-pipe U U′ U′, steam-pipe *o*, hot-water pipes *d b*, in section—condenser C, desulphurating-tank D, with its eduction-pipe S, and four supporting-rods T T T T, on which the oil-tank rests. B B is a plan of the frame on which the apparatus rests. W W is a cast-iron base bolted to the frame B B. To this base the gas-generator is secured. A A represen-

the boiler plate or covering. Z Z′ represent cross-sections of the cast end plates, showing their flanges, with corresponding recesses in the fire-clay lining *r r′*. *m m* represent a row of tiling beneath the retorts, extending across the interior of the generator, and resting upon the top of the boiler, R R, as shown in Figs. 3, 4, and 16. K′ K′ are drafts or flues, to be covered by dampers, and controlled by rods and handles, as shown in Figs. 1, 3, and 4. *r″ r″* represent fire-clay lining, resting upon the tiling *m m* and within the end pieces *r r′*, as shown in Figs. 2, 4, 16, and 17.

In Fig. 3, *a* represents the section of a tubular boiler; *a′ a′*, its supports; *t t′*, two bent pipes, the pipe *t* extending to the highest point of the steam-boiler, and the pipe *t′* to the lowest point. These pipes extend through the support *a′*, and are bent upward and downward, and connected with the water-gage Y, as shown in Figs. 3 and 1, thereby indicating the height of the water in the boiler *a*. *d d* is a pipe connecting the boiler *a*, through its support *a′*, with the boiler R at its highest point, or just beneath the tiling *m m*. The pipe *b b* connects the bottom of the boiler *a* with the bottom of the boiler R, thereby uniting the two highest and two lowest temperatures by their respective pipes. By this arrangement we have a constant circulation of water from one boiler to the other. *s s* is a pipe for conducting steam from the boiler *a* to the front end of the retorts P P′. *m′ m′ m m* show a cross-section of the tiling above and below the retorts P P. N N show a vertical section of the two end pieces, formed as shown in Figs. 8 and 9. These end pieces rest upon the upper row of tiling *m m* and within the outer casing A A. *r r′* are the end pieces, fitting between the two rows of tiling *m m m′ m′*. L shows the interior view of the retort P; also showing the pipe *h′* as extending nearly the entire length of the retort P. M is a projection cast to the retort, extending backward and through the end piece *r′* and cast-iron end plate Z′, for the purpose of support; also shown in Fig. 2, M M. O′, O″, and O represent the fire-box, grate-bars, ash-pit, and doors, as seen in Figs. 4, 16, 18, 21, and 22. K is the fuel. R R represent a boiler surrounding the fire-box O. This boiler is made of boiler-plate iron, and is about four inches in thickness, and strengthened by stay-bolts *n′ n′ n′ n′*, and also shown in Figs. 1 and 4.

In Figs. 1 and 3, *e* represents an induction-pipe, to convey water to the pump I. *c c* is the eduction-pipe, leading from the pump I to the condensing-tank C. The pipe *g* is connected with the boiler R and pipe *c c*, for the purpose of supplying the boilers R and *a* with water by means of the pump I. The pipe *x′* is an induction-pipe, for conducting the steam from the pipe *v* to the steam-cylinder J. The pipe *x″* is an eduction-pipe, conveying the exhaust steam to the pipe *v v v*. The pipe *x x x* is to connect the gas-pipe U with the cylinder J, and connected by stop-cocks with induction-pipe *x′* and steam-pipe *v v v*. V represents a hollow cylinder, closed at one end, with its side next to the flue full of small perforations. This cylinder is secured to the grate O in any desirable manner. Directly beneath this cylinder there is a conical hollow cylinder, resting upon and secured to the base W W. These two cylinders V and *u* are made of fire-clay, for a purpose hereinafter described. Within the cone the steam-pipe *v* terminates. *y* is a sheet-iron shield, placed beneath the cone *u*.

In sectional view, Fig. 3, *o o′ o″* represent stop-cocks and pipes connected with the bottom of the boiler R, condensing-tank, C, and desulphurating-tank D.

In Fig. 1, *e* represents the induction-pipe to the pump.

Fig. 4 shows a vertical cross-section of Fig. 1, showing in section the internal parts. Figs. 5 and 6 are views of the cast-iron end plates Z Z′.

In plate Z, *a″* is the aperture in which the trunnions or support *a′* of the boiler *a* rests. *s′ s′* are holes for the steam-pipe *s*. P″ P″ are openings for the retorts P P′.

In plate Z, Fig. 6, *a″* is an aperture for the trunnion *a′* on the rear end of the boiler *a*. *b′* is a hole for the pipe *b*, connecting the boiler *a* with the boiler R. *i′ i′ i′ i′* are holes for the damper-rods. *n″ n″* are holes through which the pipes *n′ n′* pass to the retorts P P′; also communicating with the oil-tank E by means of the pipe *h*. U″ U″ are two holes, through which the pipes U U′ pass to the retorts P P′, thereby connecting the retorts with the reservoir for receiving the gas. M′ M′ are openings to receive the projections M M, and support the rear end of the retorts. Fig. 7 shows three views of a section of the internal lining of the generator. These sections are molded from fire-clay, in the form as shown; the V-shaped ends put together, as shown in Fig. 4, with their lower ends slightly beveled, and resting upon a corresponding bevel on the ends of the tiling *m′ m′*; this is to prevent the sections from working inward while being transported from place to place. It is not necessary that the V-shaped ends and sides should exist, as square ends and sides will hold equally well; but whenever the V shape is used the angle projecting outward should be more obtuse than the angle projecting inward. In consequence of this difference in the two angles there will be an internal open space between the ends and sides. This space should be filled with asbestus, or other non-conducting substances, to prevent the escape of heat. These sections are made about eight inches in width, four inches in thickness, and of sufficient length and curvature to fit closely to the outer case or covering while standing upon the tiling *m′ m′*. In Fig. 8, N′ represents the end linings in the rear of the gas-generator. It is molded of fire-clay, with its necessary apertures *a″ b″ i″ i″*. This is made four inches in

thickness, and of sufficient width and height to occupy an area bounded by the covering A and tile *m'*, as shown in Figs. 4 and 19. Fig. 9 is a view of the front-end lining, corresponding to Fig. 8, with its necessary apertures *a''* S'' S''. Figs. 10 and 11 are portions of the end linings placed between the tiling M M M' M'. In Fig. 10, *r''* is provided with openings P'' P'', through which the retorts P P' pass. In Fig. 11, *r'* is provided with holes *h'' h'' u'' u'' i'' i''*, and openings M'' M''. In Fig. 12, *r'''* shows a section of lining between the tiling M M M' M'. In Fig. 13 two views of the tiling *m m* are shown, with a rabbet in each of their ends. The length of this rabbet is equal to the thickness of the side lining *r'' r'' r'' r''*. This lining stands upon the rabbet, which is on the tiling M M, while the rabbet on the ends of the tiling M' M' rest upon the lining *r'' r'' r'' r''*. The rabbet is for the purpose of keeping the lining in its place when the gas apparatus is moved about from one place to another. Fig. 14 represents a view with a portion of the tiling removed, so as to form one-half of the flue-opening. In placing two tilings together the whole flue is formed, as shown in Fig. 2 at K' K'. These tilings are all molded from fire-clay, and burned in kilns, the same as ordinary fire-bricks. Fig. 15 is a front-end elevation, showing all of the parts that are to be seen externally. Fig. 17 is a vertical longitudinal broken section, unshaded, showing the interior lining *w w w w n n r r' r'' r''* and the tiling M M M' M', with the boiler and retort in dotted lines. Fig. 18 is a horizontal longitudinal section, cutting through the boiler R R, and showing the top of the grate O. Fig. 19 is a cross-section of a stop-cock. Fig. 20 is a vertical section of the same. This stop-cock is what I call a safety-cock. Its office is twofold: First, it provides against accident or explosion, which might be the case, if other devices were used, in consequence of neglect or carelessness of the operative in charge of the apparatus. In Figs. 19 and 20, B' B' represent that part of the cock that turns; C' C', the part in which B' turns. S' is the orifice, which connects with the steam-pipes *s s*. *b' b'* are the openings in the part B', through which the steam passes. The orifice *e''* is drilled into the part B' until it communicates with a side orifice, *e''*, as shown in the figures. This orifice *e''* is for the purpose of charging the retorts with air immediately before the steam is let on. The retorts being filled with air while the orifice *e''* passes the orifice *s'*, as shown in Fig. 19, the orifice *e''* leaves the opposite side of the orifice *s'* just as *b'* commences to communicate with *s'*.

When the hydrogen gas is to be carbureted, the carbon is allowed to first fill the retort, and the steam let on afterward. As this apparatus is intended to manufacture both hydrogen and carbureted-hydrogen gas, as circumstances require, it will be seen that it will be necessary to charge the retorts with air before admitting the steam when pure hydrogen gas is to be made; and, to insure the remaining charge of air, the safety-cock should be used. A slow motion can be given to the cock by the addition of a small toothed wheel working in a toothed wheel several diameters larger, the large wheel being secured to the cock, and the motion given through the small wheel.

In Figs. 21, 22, and 23, I show a modification in the construction of the apparatus, the difference being this: I construct two walls of boiler-plate iron with an interval of about four inches between them. In this interval or space I put asbestus, D', or any other inflammable and non-conducting material, to prevent the radiation of heat. All other parts are similarly arranged, as in Figs. 1, 2, and 3.

The following will describe, first, the operation, and, second, the application, of the portable hydrogen and carbureted-hydrogen gas apparatus:

First, I mount upon wheels the necessary apparatus and fixtures for manufacturing gas, as shown in Figs. 1, 3, and 4, Fig. 1 being an external side elevation, showing all of its parts complete and ready for operation. To generate the gas, the boilers R R and *a* are first supplied with water—the boiler R R being entirely full, while the boiler *a* should be only about one-half full, which will be known by consulting the water-gage Y. The water is forced into the boiler R R from the pump I through the connecting-pipe *g*, and the boiler *a* being filled through the cold-water pipe *b*, connecting the lowest two points of the boilers R R and *a*. The unfilled part of the boiler *a* is for a steam-chamber. The steam-pressure gage *q* and safety-valve N connect with this chamber; also the pipe *s s*, for conducting the steam to the retorts P P'. As the hydrogen gas made by this apparatus is made from water, it becomes necessary to convert the water into steam, and then decompose or separate the two gases, oxygen and hydrogen, by introducing the steam into retorts, the retorts being charged with substances having an affinity for the oxygen contained in the steam, and none for its hydrogen. The retorts after being charged are heated at a very high temperature, the heat being generated in the furnace below the row of tiling *m m*. The fire is built upon the grate O, the heat passing up through the open flue in the tiling *m m* at the back end of the retorts, and filling all of the space between the tiling *m m m' m'* and side linings *r'' r'' r'' r''* not occupied by the retorts. It then passes from this chamber through the open flue in the tiling *m m* into the space surrounding the boiler *a*, and it then passes through this space and the tubes in the boiler to the rear end of the generator, making its exit through the draft-pipe F. If at any time the steam should generate too rapidly, the damper at the rear end of the boiler should

be opened, and allow a portion of the heat to pass across the rear end of the boiler to its exit F. If, after the damper being closed, the heat is too great, it will be necessary to close the front damper, thereby making all of the heat pass through the rear flue to its exit F″. By a judicious management of these two dampers it will be seen that they are very effective in controlling the heat, and consequently the generating of steam, within the boiler. The two dampers in the tiling M M are for controlling the heat about the retorts.

To make hydrogen gas, turn either of the safety stop-cocks 10 or 10′, allowing first a current of air and then a current of steam to fill the retort. The steam in passing through the front to the rear end of the retort will become deprived of its oxygen, in consequence of the affinity possessed by the incandescent material or substance through which it passes on its way to the pipe U′, and the hydrogen, being liberated from its oxygen, is left free to make its exit through the pipe U′ to the condensing-coil G. As it is not necessary to run this gas through the desulphurating-tank D, it can pass off through the branch pipe T′, and be directed through flexible or inflexible pipes, or any other method of transmitting the same, to a reservoir, or any place desired.

This hydrogen gas may be used as a motive power for driving machinery by means of gas-engines, it being far superior to carbureted-hydrogen gas on account of its producing a greater volume of heat at less cost. It is also used for inflating balloons, and may be used for any other purpose desirable.

To use the hydrogen gas for illuminating purposes, such as houses, streets, manufactories, &c., it becomes necessary to carburet the same. This carbureting process is accomplished by introducing fluid carbon into the retorts through a pipe or pipes, or by any other means.

In Figs. 1 and 3, there is shown a can or receptacle for holding any of the products of coal-oil or any other fluid carbon, or to hold any solid carbon that may be rendered fluid by a chemical process, or by the application of heat, as is shown in Figs. 1 and 3, at K, which represents a lamp that can be used in the first stages of liquefying the solid carbons, after which the gas that is generated can be substituted by means of the pipe K′. It is not altogether necessary to use a lamp, as the heat can be derived from the furnace for converting the solid carbon to a fluid. As the carbon becomes heated, a gas will be generated which may press with too much force within the receiver. To remedy this defect, the pipe K″ is employed, which communicates with the top of the receiver and the pipe *h*, allowing the gas to escape and pass to the retorts, and become utilized.

Now, to carburet the hydrogen gas, turn the stop-cock 11, which fills the pipe *h*. After this, turn either or both of the stop-cocks 2 2′, allowing the gas to pass through the pipes *h′ h′* to the front of the retorts, where it is converted into a fixed gas, and, united with the hydrogen, forming carbureted-hydrogen gas, which passes off, through the pipes U′ U′, branch pipe T′, and pipe U″, to the desulphurating-tank C, where it becomes desulphurated, after which it passes off, through the pipe S, to the gasometer, or to whatever receiver may be employed.

The engine J and pump I are employed to pump and force water into the condenser; also, to inject water into the boiler R R and *a*, when desired. In order to force the water into the boilers the cock 5 must be opened and cock 4 closed. After the boilers have received a sufficient quantity, reverse the position of the cocks 4 and 5.

The engine is worked by steam taken from the boiler *a*, through the pipe *v v v*, and is admitted to the engine through the pipe *x′*. When it is not convenient or desirable to use steam, gas may be used in place thereof, as it is only necessary to close the cock 9 and open the cock 3 in pipe *x x x*, and allow a portion of the gas that is being generated to pass from cross-pipe Q, through pipe *x x x*, to the cylinder J, the exhaust being through *x″* to pipe *v v v*, the same as for steam.

When great heat is desired, the device shown in the fire-box and ash-pit is employed in combination with the steam, gas, and atmosphere, superheated steam being forced from the boiler *a*, through the pipe *v v v v*, to the hollow cone *u* in and under the grate O. This pipe terminates a short distance below the exit of the cone, for the purpose of creating a draft as the steam escapes from the pipe *v v v* to the perforated cylinder above. This arrangement will produce a powerful blast and heat, and should a more powerful heat be required a jet of gas can be introduced from the cross-end pipe Q, through the pipe *x x x*, and, by opening the cock 9, allowing it to pass, through the pipe *x′*, to the steam-pipe *v v v v*, and then uniting with the steam and passing on to the exit in the cone-cylinder *u*, thereby producing within the furnace an oxyhydrocarbon flame. When steam is not employed, and gas is desired, close the cock 11, in pipe *v*, keeping cocks 9, 3, and 6 open.

The boiler R R, around the fire-box, is for the purpose of holding a large supply of water, and to economize the heat. Were it not for this boiler, a great amount of heat would escape through the walls surrounding the furnace and ash-pit.

Should the heat in the furnace be too great for the inner side of this boiler, the furnace can be lined, as shown in Fig. 4. Also, the grate-bars the same, as shown.

All of the interior linings above the boiler R R are made of fire-clay, molded into proper forms, and then burnt. They are made in the forms as shown in the drawings, and as de-

scribed above, for the purpose of transporting them from one place to another without their becoming disarranged, as would be the case were the lining formed of ordinary fire-brick.

The doors F F, attached by hinges X X X to the case or covering A A at the top of the boiler R R, and adjacent to the row of tiling *m m*, are for the purpose of opening and adjusting the parts within.

All of the lining may be taken out and replaced, with the exception of the end lining N′ N″ and *r r′*, which are held to their places by the retorts, boilers, pipes, &c. Whenever it becomes necessary to remove them, or the boiler, retorts, or any of the other parts, remove the end plates *z z′*, which may be done after the pipes at each end of the gas-generator have been removed. After this has been accomplished, the boiler and retorts can be easily removed, and all of the parts replaced, without disturbing any other part of the apparatus.

The above-described gas apparatus may be used for supplying cities, towns, and country villages with illuminating-gas; also, manufactories with hydrogen gas for motive power, being admirably adapted for the manufacture of both kinds of gas; also, it can be easily transferred from place to place, and manufacture gas and fill gasometers to order.

Where two villages are within a few miles of each other, this apparatus may be used to fill gasometers in each village, as two horses can easily draw the same from one to the other. This apparatus may be drawn about, and fill private or individual gasometers as a matter of business by the parties owning the same. Factories, work-shops, churches, hotels, private houses, &c., having their own gasometers or receivers, may be filled by this means.

What I claim, and desire to secure by Letters Patent, is—

1. The combination of a portable frame or base with the hydrogen-gas generator, carbureter, and condenser, substantially as described, whereby the apparatus is adapted to be transported from place to place, and supply gasometers.

2. The tubular boiler *a*, having hollow trunnions *a*, in combination with the casing and lining, or the hydrogen-gas apparatus, substantially as shown and described.

3. The combination of the boiler *a* and R R, with the pipes *d b*, substantially as and for the purpose described.

4. In combination with the case A and end plates Z Z′, the sectional fire-clay lining *w n′ r r′ r″*, and tiling *m m′*, constructed and secured in position as shown.

5. The perforated fire-clay cylinder V, conical cylinder *u*, and pipe *v*, in combination with the fire-box O′ and ash-pit O″, as substantially shown.

6. The dampers *i* and flues K′, formed by the tiling *m m′*, in combination with the chambers of the gas apparatus.

7. The doors F, in combination with the sectional fire-clay lining of the case A, substantially as and for the purpose set forth.

8. The safety stop-cock B′, in combination with a gas-generator, as described.

9. The pipe *x*, in combination with the pipe U, engine J, and pipe *v*, substantially as shown and described.

WM. FRANK BROWNE.

Witnesses:
W. S. KENNAUGH,
E. W. WOODRUFF.