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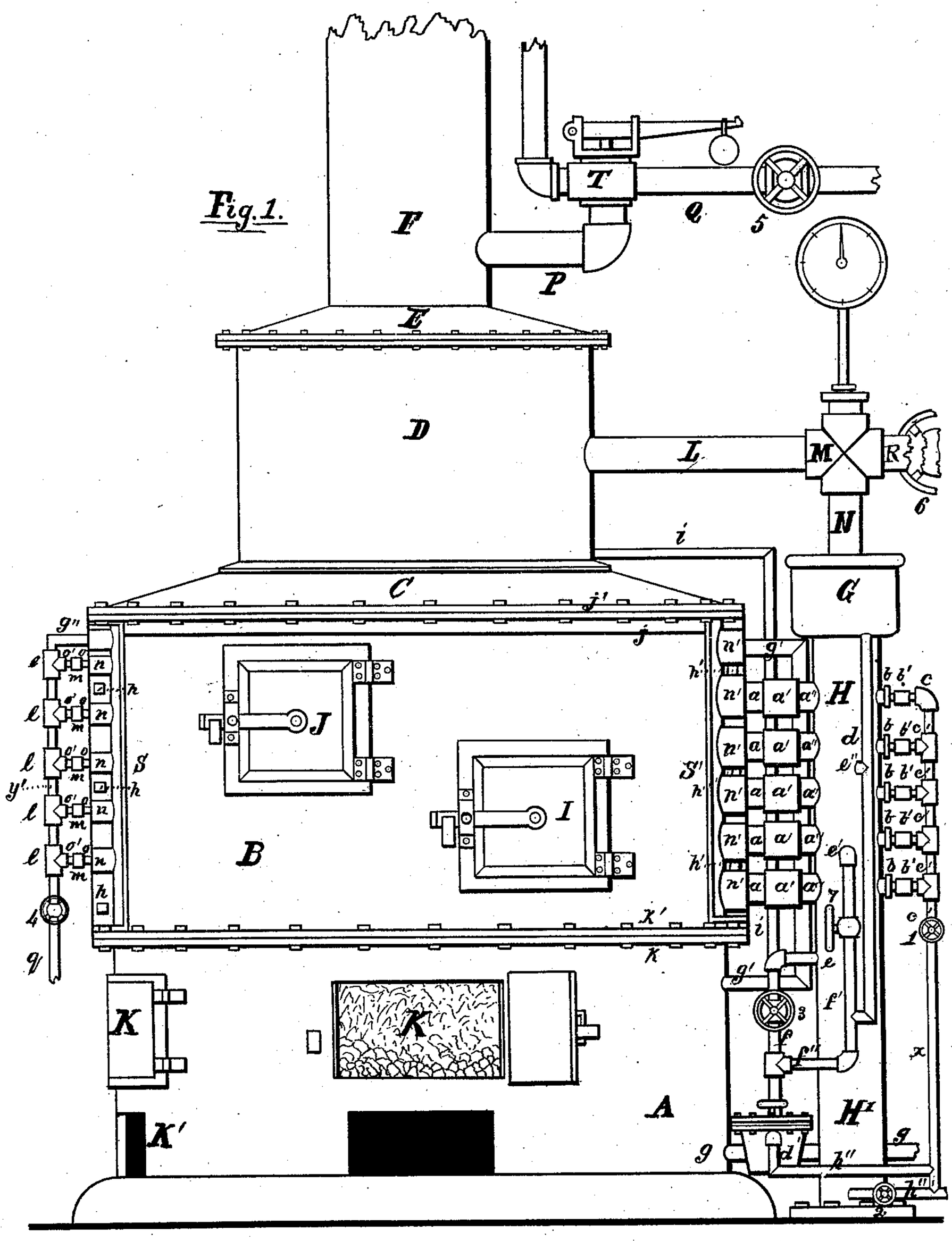
W. F. BROWNE.

Steam-Generating Apparatus.

No. 210,494. **Patented Dec. 3, 1878.**

Fig. 1.



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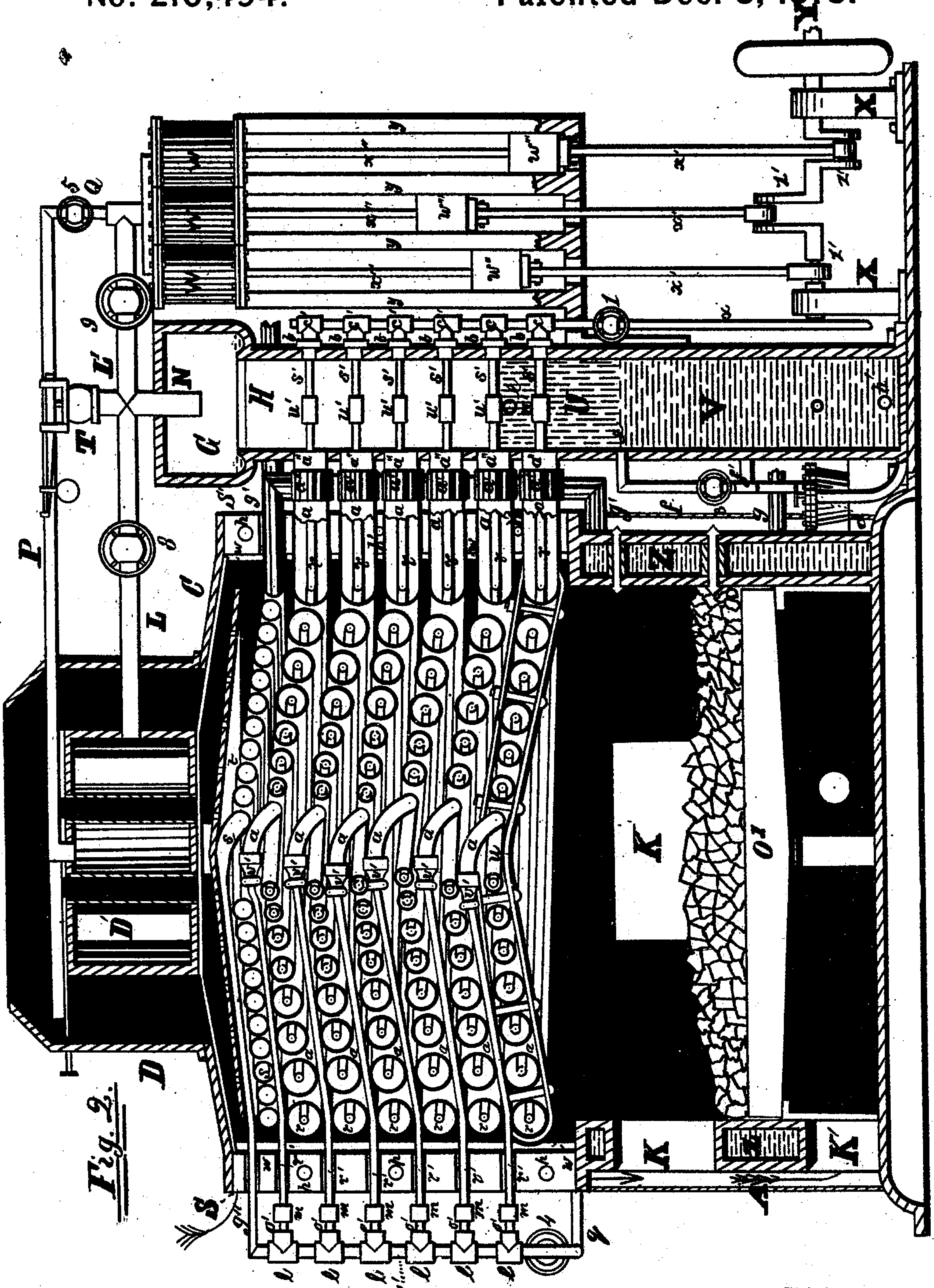

Fig. 2.

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Steam-Generating Apparatus.

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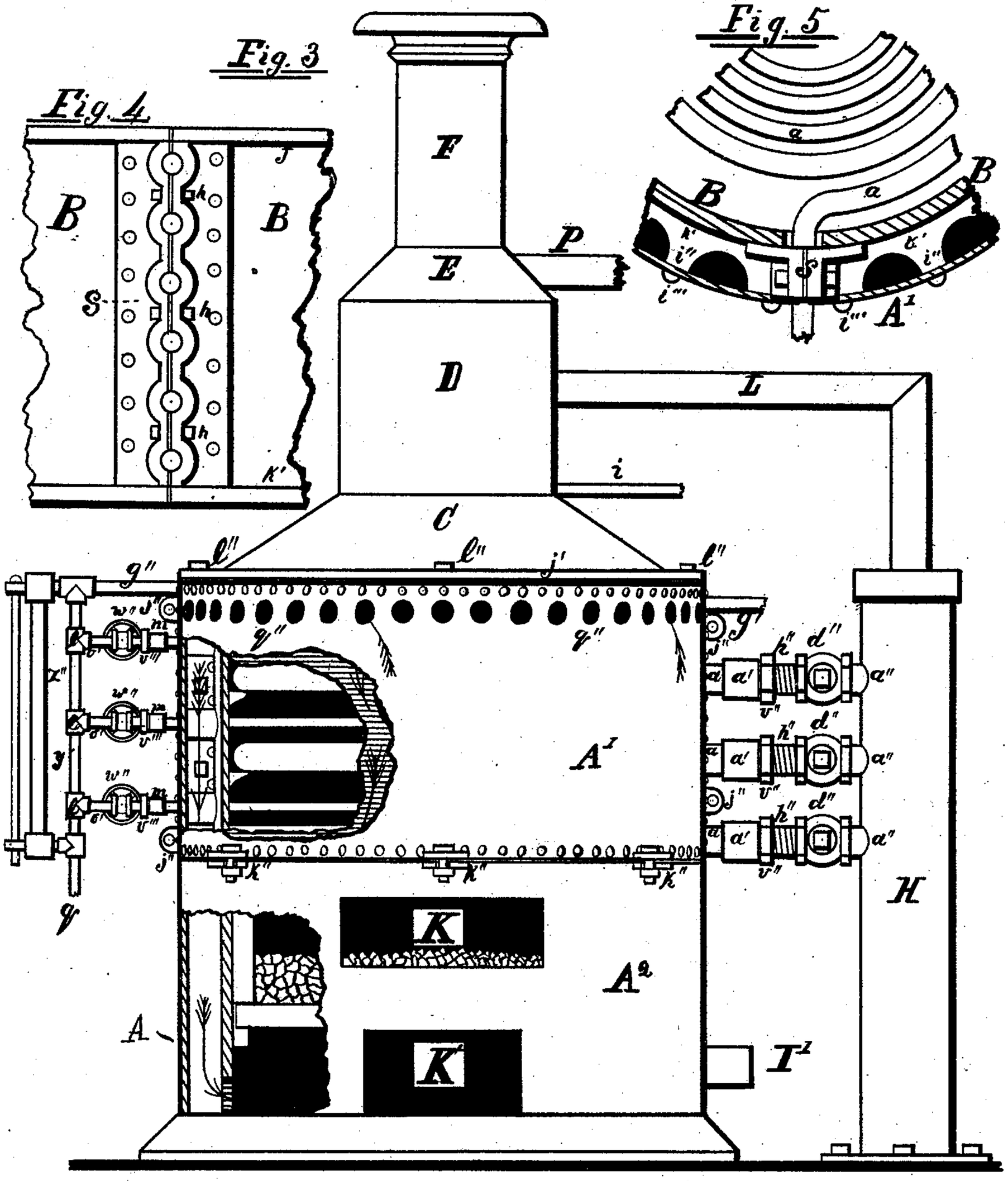
Fig. 3

Fig. 4

Fig. 5



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Steam-Generating Apparatus.

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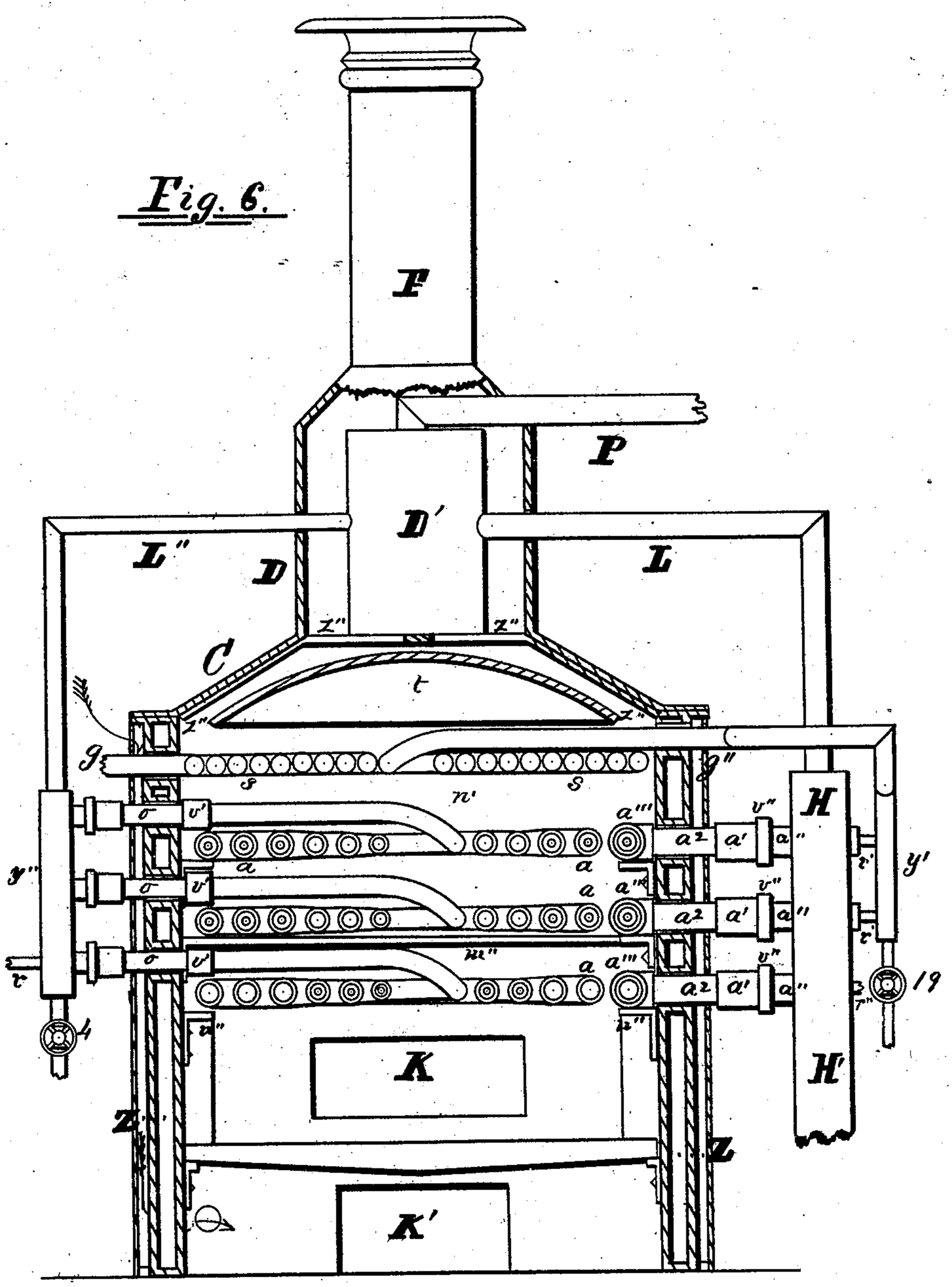
Fig. 6.



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WILLIAM FRANK BROWNE, OF NEW YORK, N. Y., ASSIGNOR TO HYDRO-CARBON STEAM GENERATING COMPANY, OF SAME PLACE.

IMPROVEMENT IN STEAM-GENERATING APPARATUS.

Specification forming part of Letters Patent No. **210,494**, dated December 3, 1878; application filed October 8, 1878.

To all whom it may concern:

Be it known that I, WM. FRANK BROWNE, of the city, county, and State of New York, have invented a new and useful Steam-Generating Apparatus; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, making a part of the following specification.

The object of my invention is to make a steam-generator which shall produce practically a greater amount of steam from a less amount of fuel and weight of metal than has been accomplished heretofore.

The nature of said invention, and its points of difference with other boilers of this class, are as follows: In boilers of this class a great number of lineal feet of pipe are required in order to obtain a sufficient amount of heating-surface; and generally this pipe has heretofore been made, by welding and by couplings or other suitable fittings, into one continuous length. The water is forced into one end, top or bottom, and steam taken out at its other end; consequently a great amount of friction is encountered by the water and steam before it is discharged into the dome or motor.

One serious defect in this class of boilers is this, that the coils near the fire rapidly burn away, after which the coil becomes useless; and in many instances the entire coil is thrown away for the want of proper facilities for repairing the same, and when those facilities are obtained the cost of taking the structure apart and repairing the defects and replacing the same are enormous when compared with the original cost of said boilers, although the original value of the coils which have become defective is not great. The point above raised is considered to be a great objection to this class of boilers.

Another objectionable feature is that they cannot be cleaned of soot, ashes, &c.; nor can wood or bituminous coal be burned beneath these coils to an economical advantage, by reason of the coils becoming clogged with unconsumed carbon, &c.; and, also, a variable steam-pressure cannot be avoided, even with a uniform degree of heat.

My aim has been to overcome all of the above-enumerated defects, as will be seen in the present case, and also by referring to a former one, patented October 8, 1878, No. 208,790. In the first place, instead of putting all of my pipe into one continuous length, I divide the amount necessary for my boiler and generator into several parts, said parts depending upon the size or power I wish to obtain. Each one of these parts is bent into a separate and distinct coil.

In this invention I have adopted the horizontal coil, and when said coils are placed in position each one of them becomes an independent generator; and, by a proper construction of the coil-chamber and the connections connecting the coils with the water and steam stand-pipes, said coils become detachable and attachable, as circumstances require, and as described in the following specification. Now, it will be seen that when one of these coils is burned out or becomes defective from any cause, said coil can be removed without taking the structure apart or disturbing any of the remaining coils; and, furthermore, if the generator is in active operation and a coil should become defective, either on a boat or in a workshop, said coil can be removed and replaced by another one without drawing the fires or even stopping the engine; consequently there will be no loss of time accruing from bursted boilers.

The liability of burning the bottom coils in the two classes of coils are about the same with an equal amount of fire. Although if a difference does exist it should be in favor of the horizontal coil, for the reason that water is discharged into each coil at its center and where the heat is greatest; consequently, as the water will pass around several of the interior turns before its evolution into steam, said water must have a tendency to preserve the coil near its center by the resistance it offers to the great heat at that point. Therefore the cost of replacing a duplicate coil is trifling when compared with other coiled-pipe boilers.

The side of the coil-chamber being provided with doors, and the coils being at a proper distance apart, it becomes an easy matter to clean the same by opening said doors and inserting a brush of suitable material between said coils, and bringing the soot and ashes therefrom. In consequence of this feature of

my invention, wood, bituminous coal, or other highly-carbonized fuel can be used.

One important feature of my invention is my process of introducing the water and evolving said water into steam. I employ coils for the reception of cold water, situated at the greatest distance from the fire, or at a point where the heat is at its lowest degree prior to its escape through the uptake. Now, the water is forced through a sufficient number of these coils, which are so situated that the water will pass in a downward direction from one to the other, and in an increasing temperature, until said water is raised to the boiling-point, or, being under pressure, to a higher degree, after which the hot water is forced into a stand-pipe or its equivalent, where it becomes divided into a number of streams equal to the number of generators, said streams or divisions being controlled by valves, which regulate the requisite amount of water for each coil. Said water is now forced into said generators, which are in the hottest part of the coil combustion-chamber. Here, in consequence of the water being heated before being forced into the several generators, a rapid conversion into steam is the practical result obtained from introducing the water on an increasing temperature; and also, by the aforesaid means, a saving of fuel is gained.

Another important feature of my invention, in the peculiar construction of the jacket, as may be seen, is to convey the heat which is radiated through the wall of the coil-chamber and furnace in a current of air, said air being introduced at the top of the coil-chamber into a space formed between an inner and an outer jacket, and carried downward and discharged beneath the grate, for the purpose of supporting combustion.

Figure 1 represents an external view of a steam-generating apparatus. Fig. 2 is a vertical section of the view shown in Fig. 1, and with a triple engine attached thereto. Fig. 3 is an external view of a steam-generator. Figs. 4 and 5 are detailed views. Fig. 6 is a sectional view of a sectional generator, showing a water-jacket, which surrounds the fire-box and coil-chamber.

Similar letters refer to corresponding parts in all of the figures.

In Fig. 1, A represents the casing surrounding the furnace and ash-pit. The top and bottom of this casing are provided with a suitable flange and base. The base should be provided with legs when the generator is to be set on a wooden floor. K and K′ are doors leading to the furnace and ash-pit.

B represents a removable section of the coil-chamber. This section is provided with flanges *k′* and *j*.

J and I are doors for the purpose of inspecting the coils, and for cleaning them when covered with soot and ashes. Said cleaning can be done while the fuel is burning.

One or more doors can be employed, and upon one or both sides of the coil-chamber, which may be necessary when coils of great character are used.

S and S′ are standards, with recesses *n n′* therein and flanges thereto. Said flanges are secured to casing B, while the recesses receive and support the ends of the coils *o* and *a* upon opposite sides of the coil-chamber. This coil-chamber is divided into two or more sections, as circumstances require. The flanges S S′ are held together by bolts *h h′*.

a′ a′ and *m m* are right and left couplings, connecting the ends of the coils with nipples *a″ a″* and *o′ o′*, said nipples being connected to their respective stand-pipes Y′ and H, whereby a communication is formed with said pipes Y′ and H.

g′ is one end of water-coil *s*, and is connected to a water-space around the fire-box and ash-pit, or directly to an injector, while the other end of said coil, *g″*, upon the opposite side of the chamber, terminates in stand-pipe Y′, from thence to each of the coils, where it becomes converted to steam on its passage through said coils to the steam-stand H.

G is an enlargement of the stand-pipe H, and *d* a drip-pipe thereto, which communicates with trap *d′*. *e″* is a nipple, projecting from stand H and into pipe *d*. The pipes *f f″* are connected to stand H at *e* and *e′*, and communicate with trap *d′*. *h″* is a waste-pipe leading from the trap. *h‴* is a blow-off pipe, attached to the bottom of the stand H′. *b′* are right and left couplings, connecting the ends of the internal pipes *b* with the nipple *e′* and stand-pipe *x*. This connection is for the purpose of blowing off the internal pipes within the coils *a*.

C is a flanged ring, with its flange *j′* resting upon flange *j*. D is a chamber containing a steam-drum, and rests upon ring C, while E is a cover to said chamber, with stack F secured thereto. N, R, and L are nipples connected to cross M, for conducting steam from stand H to a drum or motor. When steam is conducted to the drum it is supplied to the motors by pipes P and Q.

In Fig. 2, A represents the furnace and ash-pit; K′ K K, doors leading thereto, and *z* water-space around said furnace and ash-pit. D′ represents a sectional view of a tubular drum. *a a* represent a sectional view of a series of steam-generating coils, located within a chamber and directly over the grate-surface O′. Said chamber, which contains the coils, is also a combustion-chamber. The ends of the coils are shown to be resting in the recesses formed in the standards. *v′ v′* are fittings turned onto pipes *a a* and interior pipe *r r*, the interior pipe not passing through the fitting, but leaving threads enough to form a connection with pipe *r′*, said pipe being connected to stand Y′ by means of coupling *m* and nipple *o′*. Said pipes conduct water from stand Y′ to interior pipe *r* within coil *a*. The opposite sides of the coils *a* are connected with stand H by means of the couplings and nipples *a′ a′* and *a″*. *a″ a′* are couplings, connecting the inter-

nal pipe *r* with the nipples *s'*, said nipples being connected to the blow-off stand-pipe *x*. The purpose of the nipples *s'* is to disconnect from the internal pipe *r*, in case a removal of one of the coils *a* should become necessary. *d'* represents the trap, for conducting water from the overflow at *e* to a cistern or other place. The stand H is to be kept full of water to the overflow-point, as indicated by horizontal parallel lines. By turning valve 3 the water will rise in stand H until it reaches the overflow *e'*, as indicated by vertical water-lines. The overflow-point being above the lower coil, said coil will be filled with water and protected from the heat. Should it be necessary to flood other coils, the overflow-point can be placed at any of the series of coils *a a*, and operate as shown in the drawing.

W represents a triple group of steam-cylinders, secured to the steam stand-pipe H. Said cylinders are provided with suitable pistons, cross-heads, and connecting-rods. Said connecting-rods are connected to a triple crank-shaft, and communicate motion thereto. This motor receives its steam from either the stand H or drum D. When received directly from stand H, valve 5 should be closed and valve 9 should be opened, thus allowing steam to pass through pipe L to the steam-chest. When the motor receives its steam from the drum, valve 9 should be closed, while valves 8 and 5 should be opened, whereby the steam is caused to pass from stand H through pipe L to the drum, thence through pipe P to the motor.

t is a perforated deflector, located above the top coil *s*, said deflector being for the purpose of retarding and diffusing the heat around the coils. Said coils should be slightly inclined for the purpose of drainage. This inclination is effected by means of straps placed across the diameter of the coil, both above and beneath, and kept in position by bolts, as shown in the figure. Said bolts should not bind the coils too closely, for freedom for expansion and contraction should be allowed.

The coils used in this improved steam-generator are coiled in horizontal planes. The pipe which the coils are made of should be tapering from center to circumference, although pipe of an even gage can be used. Said coils are made by commencing at the center and winding each successive turn about the preceding one until the required diameter is reached, care being observed that the requisite space is maintained between each turn. Therefore it will be seen that each turn, from circumference to center, decreases according to the diameter of the pipe and the space between said pipe, while with vertical coils the diameter of the turns is constant. Thus an advantage is gained by using the horizontal coil over the vertical, by reason of the direct heat impinging upon a greater surface than can be done where the coils are in the same vertical plane.

In Fig. 3, A represents the base of the boiler; K and K', doors leading thereto. A' is an outer case or covering to an inner casing to the coil-chamber. Between the two walls there is an intervening space. At the top edge of casing A' a series of apertures, *q''*, are formed for the purpose of admitting a draft of air into the space formed by the two walls. Said air is drawn downward by the force of the natural draft, or by a jet of steam in the stack, or by applying the exhaust side of a blower to pipe I', and its discharge into another pipe leading into the ash-pit, whereby the cool air is drawn through the aperture *q''*, and becomes heated in its downward passage prior to its coming in contact with the fuel.

By this means of introducing the air an important advantage is obtained, especially where the generators are to be used in comparatively close rooms.

I do not limit myself as regards the location of said apertures, for they may be made within the drum-chamber D, thus causing the air to be drawn downward from that point; and, also, if it is not expedient to supply the furnace with air from this source, and at the same time the heat should be too great within the the room, a series of apertures can be made at the bottom of the ash-pit, whereby the air can enter and pass upward, and discharge the heated air into the stack above the drum, or to any other desirable place.

j'' are lugs projecting from the supporting-standards upon opposite sides of the boiler, and to which the outer and inner casings are secured. By removing the bolts within said lugs, and loosening the bolts in the upper and lower flanges, *j' k'*, one-half of the coil-chamber can be removed and replaced, as circumstances require. The valves *w''* are for determining and controlling the feed-water, said water being forced into stand Y', where it separates and is forced in requisite quantities through the valves into the coils within the coil-chamber. *z''* represents a glass gage, for the purpose of ascertaining the height of the water in stand Y'. By this means we can determine whether all of the coils are being supplied with water.

I do not limit myself to the glass gage as a means for determining that point, as other equivalent means can be adopted—as, for instance, when all of the ends of the coils terminate within one horizontal pipe on a line with or above the uppermost generating-coil, each coil will receive its share of water without the use of the valves. *d''* are plug cocks or valves, for the purpose of closing off the steam in case a coil should get damaged from any cause. By closing said cock and a corresponding feed-water valve, the generator can be kept at work the same as if no accident had happened; but with the loss of the generative power of the damaged coil, where eight or ten of said coils are within one chamber, the loss will not be a serious obstacle. If a duplicate coil is at hand, the side of the coil-chamber spoken of

above can be removed and the defective coil taken out and the new one put in, after which replace the side of the coil-chamber, open the plug cock and valve, and the work of generating steam commences at once.

Another important feature of this generator is as follows: Whenever a less power is required than the full capacity of the boiler will give, it is only necessary to close one, two, or more of the upper valves, *w''*, which prevents the water from entering the corresponding coils, thereby reducing the power in a degree corresponding to the number of valves closed. The plug-cocks should remain open, so as to allow steam to enter said coils, which will now serve as a steam-drum for the coils which are generating the steam. The principle involved in the sectional coiled generator, as above set forth, can be applied to sectional boilers of various sizes and designs, which can be constructed so as to cut off steam and water from a defective section without impairing the use of the remaining sections; and also one, two, or more of its sections can be used where less power is required.

In Fig. 4, B represents the casing which forms the coil-chamber. S is a sectional standard, riveted to casing B, and held together by bolts *h*. The ends of the coils project through these standards, as shown in Fig. 5, in which B represents the casing to the coil-chamber; *k'*, a flange at the lower edge of said chamber. This flange is fluted, as shown at *i''*. To the projections of this fluting an outer case is secured by screws or rivets, thus forming a space around casing B, said space and fluting or draft-holes being for the purpose of heating the air by the radiated heat which is conducted through the inner casing, B, and allowing said heated air to pass beneath the grate for the purpose of supporting combustion.

Fig. 6 represents a vertical section of the generator. The ash-pit, furnace, and coil-chamber are all included within the same casing, which is provided with a water-compartment, Z Z. Apertures are made within said casing for the purpose of receiving nipples, which connect with fittings *v'* and *a'''*, said fittings being turned onto the ends of the coils before their admission into the chamber. After said admission the nipples *o* and a^2 are inserted through the apertures and turned into the couplings *v'* and fittings *a'''*. The two upper steam-coils raise their water from internal pipe *r'*, which is connected to water-stand Y', while the lower coil receives its water from internal pipe *r''*. The steam generated in these coils is discharged from both ends of the pipe forming the coil into the two steam-stands Y'' and H, and is conducted to the drum D' by pipes L'' and L. Z'' Z'' is a bar, extending across the base of the drum-chamber, and deflects downward along the inclined surface of the cover or dome C, to which it is riveted or otherwise secured; and also, another bar, at right angles, or nearly so, should be secured, for the purpose of sustaining said drum D', there being a space between said drum and case D for a free passage of the products of combustion. *t* is a deflector, for equalizing the heat within the coil-chamber. *n''* and *m''* are supports for the coils.

In Figs. 2 and 6 a combined water and air jacket is shown. By this means the radiated heat is nearly all utilized by being returned to the combustion-chamber, when, with a sufficient amount of generator-coils therein, said heat becomes absorbed and passes off in steam.

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

1. In a steam-generator, a series of separate and independent coils located on horizontal planes, or nearly so, one above another, each of said coils receiving water at or near its center, and discharging said water or steam, or both, from the other end of said pipe, from which said coil is made, as set forth.

2. The combination, in a coil steam-generator, of the upper coil or coils, arranged and connected so that the water is first introduced in the uppermost coils, thence to the stand-pipes, and in turn to the steam-generating coils at or near their center, substantially as described.

3. In a horizontal-coil steam-generator, the process, as herein described, of first introducing water through the uppermost coil, thence to the stand-pipe, whereby water is supplied to each coil separately or simultaneously, and then discharging the steam generated therein into the steam-reservoir from the end of said coils, substantially as described and set forth.

4. In a horizontal-coil steam-generator, the surrounding water-jacket, in combination with a surrounding or annular air-jacket, whereby the air is heated and radiation of heat prevented, said air-jacket being provided with apertures for the introduction of pipes, and also air-inlets for supplying air to the furnace, constructed and arranged to operate substantially as shown and described.

5. In a horizontal-coil steam-generator, the coils of which are arranged to allow the heat to pass freely through the interstices between the coils, in combination with a perforated deflector, whereby the heat is evenly diffused, and sufficiently retarded to allow the said coils to absorb the heat, as set forth and described.

6. The combination, in a steam-generator, of the steam-dome, suspended within the uptake, and the steam-reservoir, whereby by suitable connections dry steam from the reservoir and superheated steam from the dome may be commingled and supplied to the engine, or either of them, as set forth and described.

7. In a coil steam-generator the coils of which are arranged on horizontal planes, or nearly so, the pipes increasing in diameter from the center, and resting in recesses in the standard S', and held in position within the combustion-chamber by straps on the same

plane as the coils, whereby said coils are free to expand or contract without hindrance, as set forth and described.

8. In combination with a coil steam-generator, the trap *d*, pipe *f*, one or more, branch pipes *f'*, and their connections, whereby one or more of the series of steam-generating coils may be flooded, as herein set forth and described.

9. A coil steam-generator made up of and arranged in horizontal sections, in combination with a surrounding jacket constructed of vertical sections, whereby the generating-section may be removed and replaced without interrupting the action of the remaining sections while in use, substantially as described.

10. The combination, in a coil steam-generator, of the removable coil-sections, their independent connections *m* and *a'*, the sectional jacket B, and the stand-pipes Y' and H, as shown and described.

11. The combination, in a coil steam-generator made up of removable sections horizontally located, and the vertical sectional jacket provided with doors for the inspection and cleaning of said coil-sections, the section of the jacket being provided with indentations to receive the coils and the flanges for uniting the sections of the jacket together, in the manner and for the purpose set forth and described.

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