

(No Model.)

4 Sheets—Sheet 1.

G. R. SCATES.
FURNACE.

No. 376,785.

Patented Jan. 24, 1888.

Fig. 1.

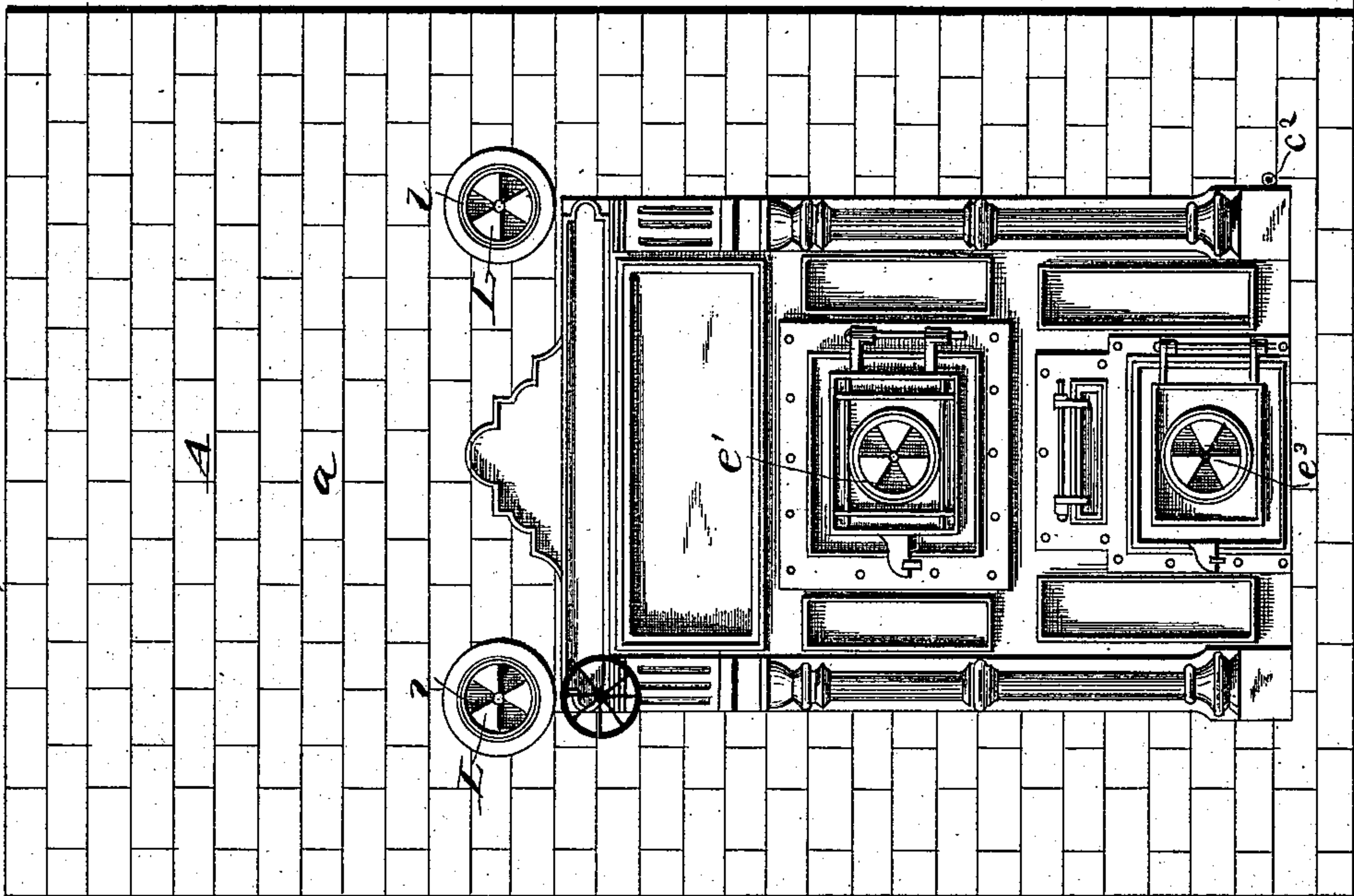
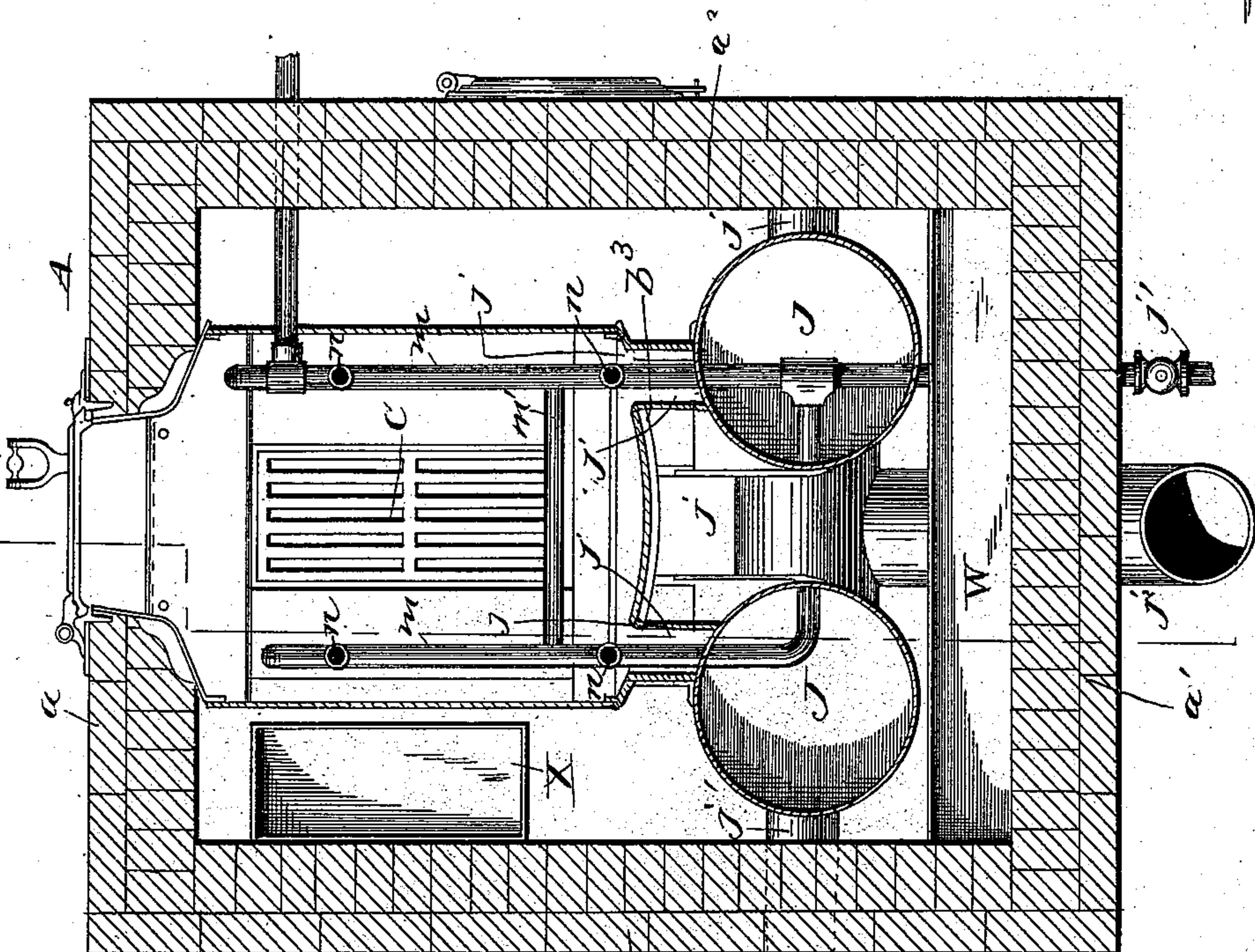


Fig. 4.



Witnesses

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(No Model.)

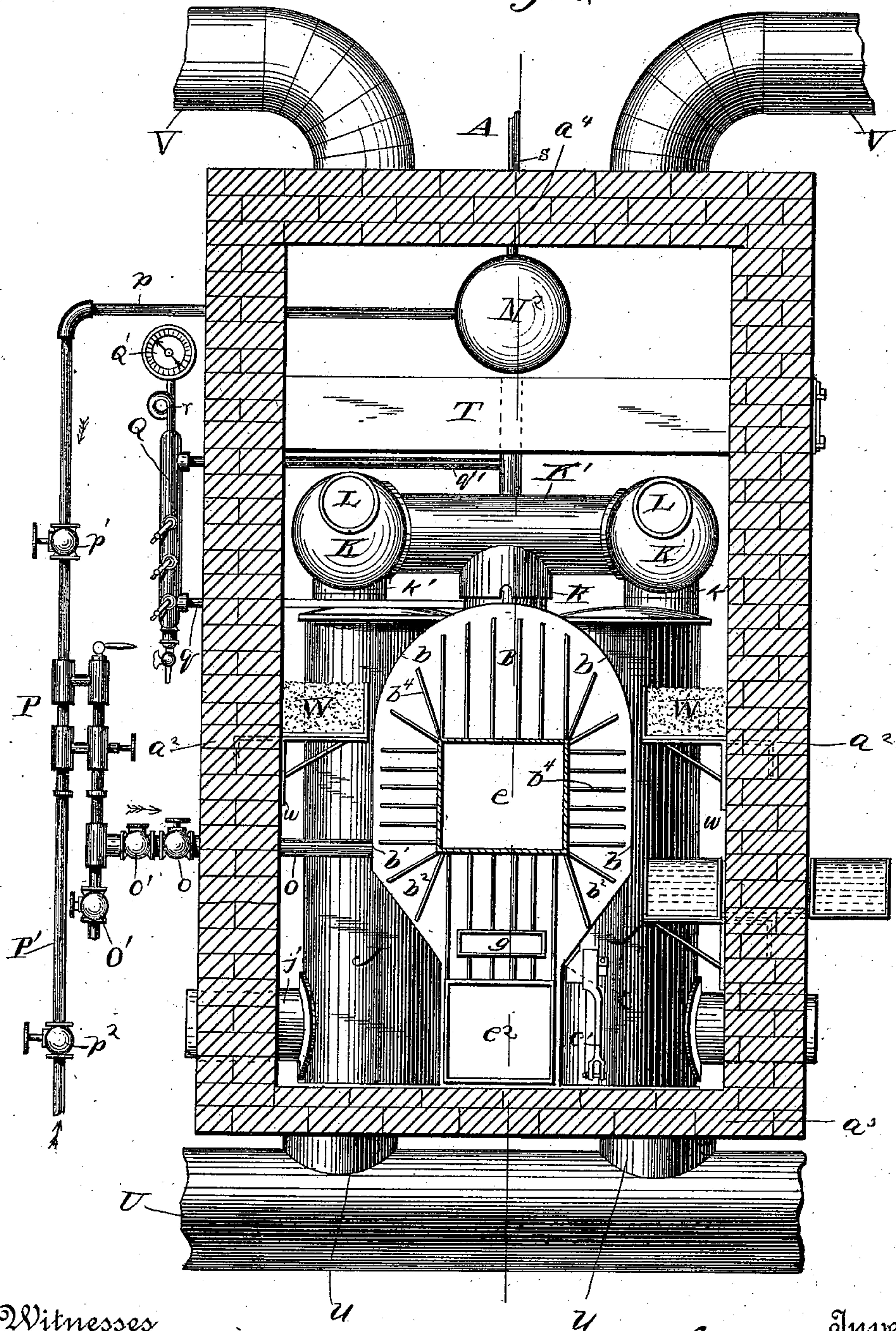
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Fig. 2.



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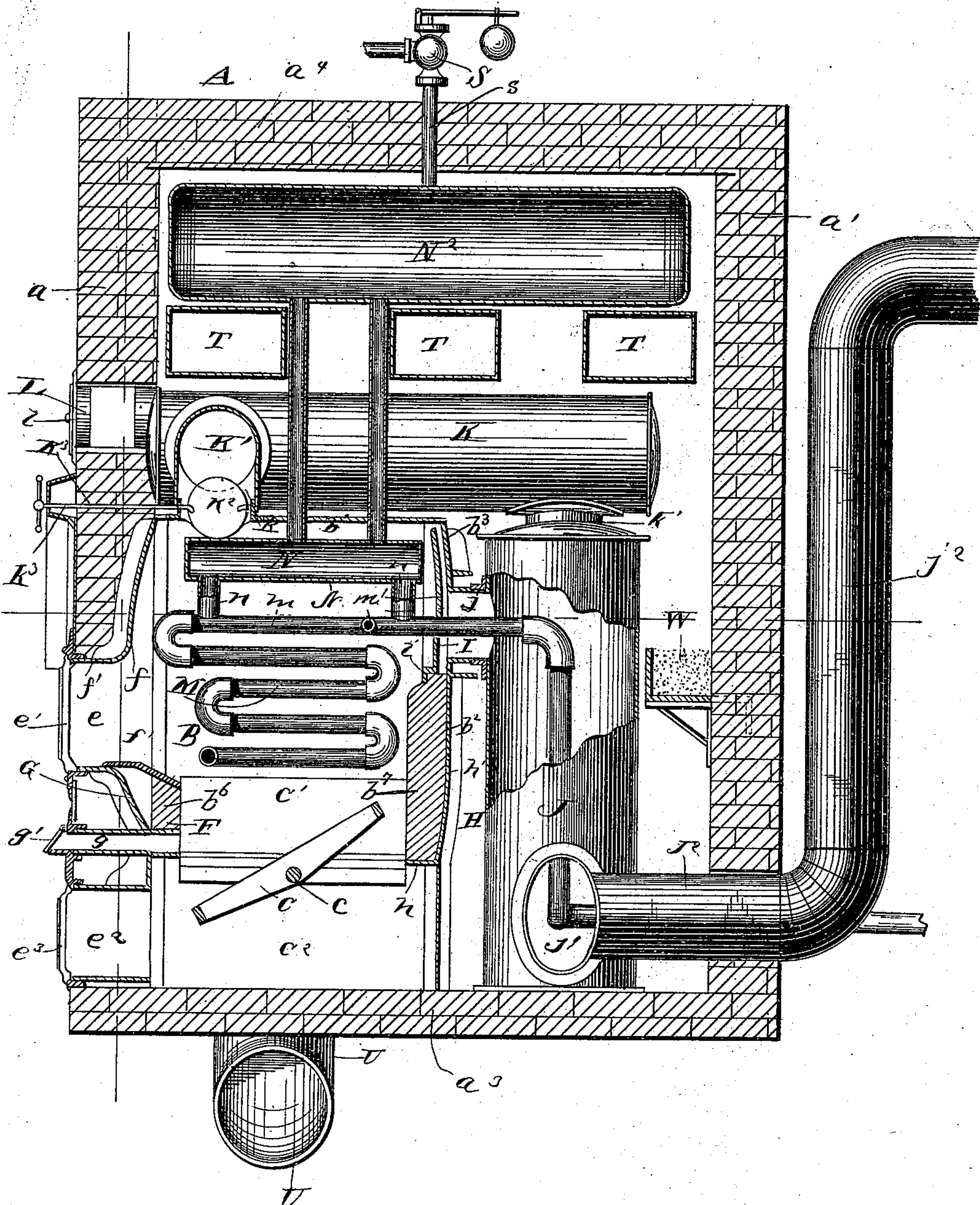
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Fig. 3.



Witnesses

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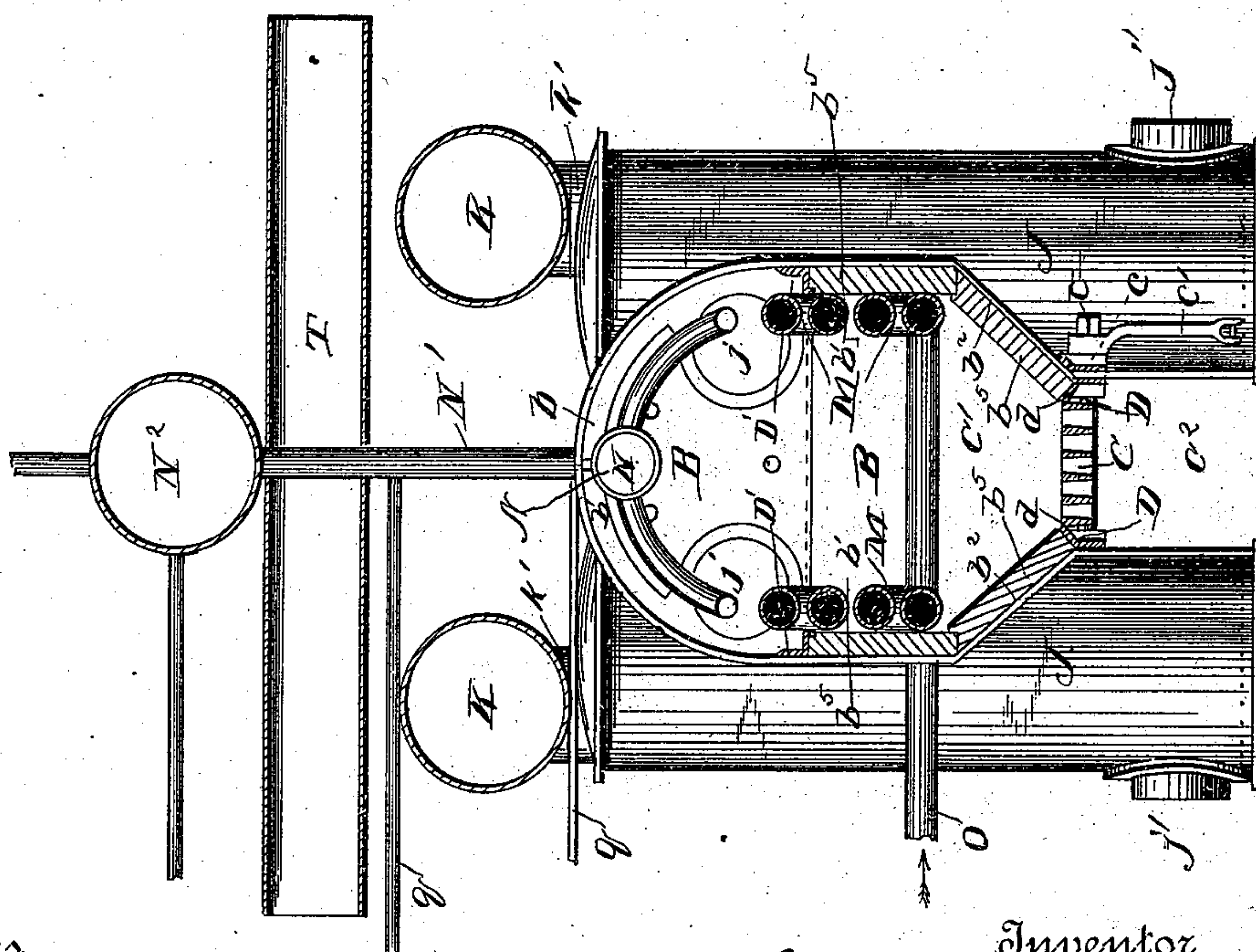
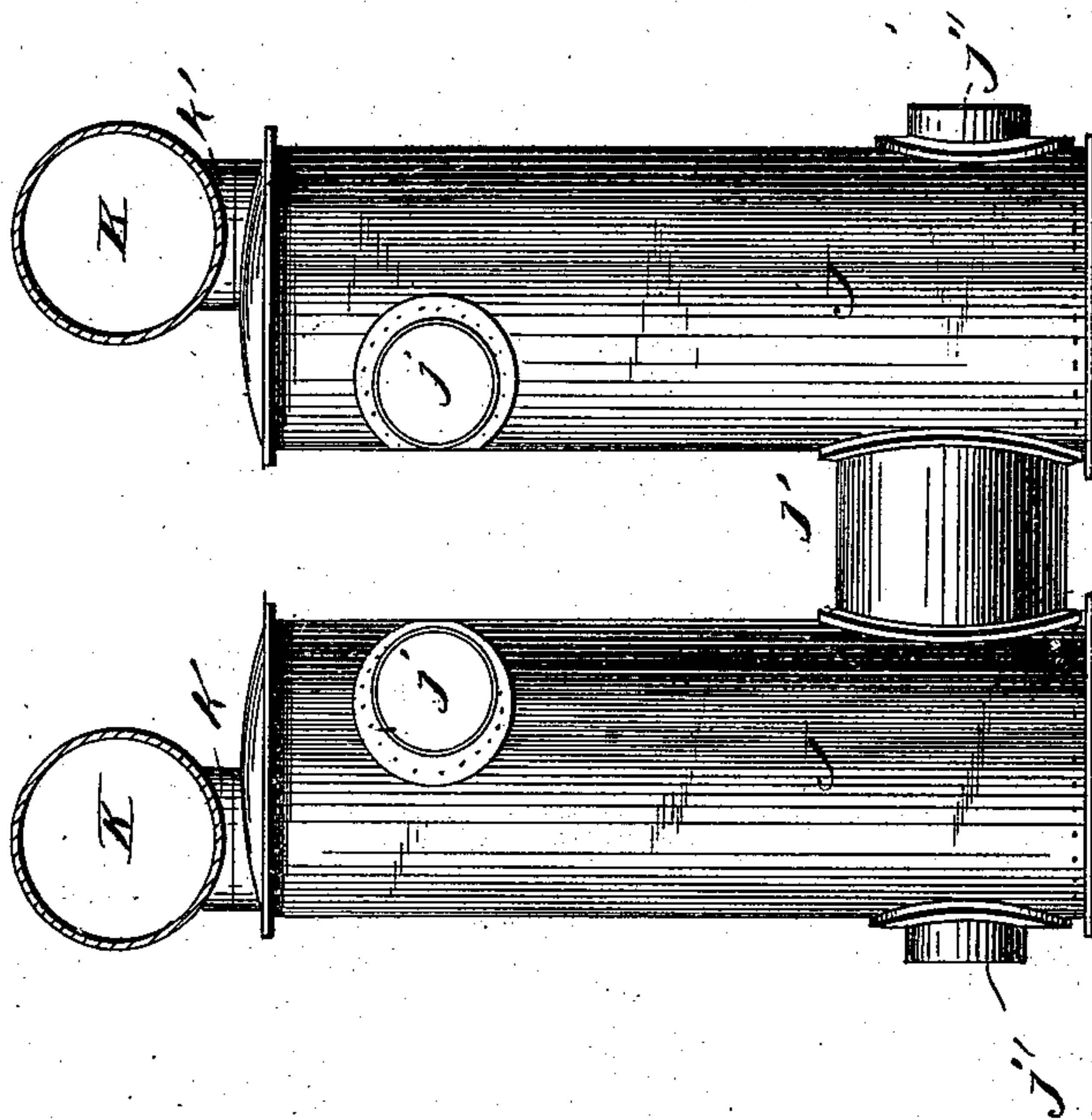
(No Model.)

4 Sheets—Sheet 4.

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UNITED STATES PATENT OFFICE.

GEORGE RANDOLPH SCATES, OF KNOXVILLE, TENNESSEE.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 376,785, dated January 24, 1888.

Application filed August 6, 1886. Serial No. 210,223. (No model.)

To all whom it may concern:

Be it known that I, GEORGE RANDOLPH SCATES, a citizen of the United States, residing at Knoxville, in the county of Knox and State of Tennessee, have invented new and useful Improvements in Furnaces, of which the following is a specification.

My invention relates to improvements in furnaces; and it consists of the peculiar combination and novel construction and arrangement of the various parts for service, substantially as hereinafter fully set forth, and particularly pointed out in the claims.

The object of my invention is to provide an improved furnace, which is especially adapted for domestic purposes, and which shall possess superior advantages in points of the large area or space of heating and radiating surface as compared with the grate-surface, and in the simplicity, durability, and strength of construction, the ease and facility with which it can be operated and regulated and adjusted, and in the cost of manufacture.

A further object of my invention is to provide improved means for obtaining a larger area of heating-surface within a very small space and without requiring additional grate-surface; to provide an improved furnace or fire-box proper of peculiar form, which shall have a small grate-surface and a large area of heating-surface immediately around the same, and so arranged that the coal and fuel that are deposited therein are discharged at the middle of the grate to thoroughly and rapidly consume the same; to provide steam attachments, which are compactly disposed within the inclosing-walls of the furnace in order to utilize the waste heat that is generated by the escaping products of combustion, so that hot water can be supplied to the building or dwelling in which the apparatus is located, and to provide improved reservoirs in which an absorbent material or substance is placed to retain the heat when the furnace is in use, and which will radiate or discharge its heat when the furnace is not in use—as, for instance, at the nighttime, when the fire in the fire-box is extinguished—so that the temperature in the furnace is kept up for a number of hours after the fires are extinguished.

In the accompanying drawings, which illustrate a furnace especially adapted for domestic

uses embodying my present invention, Figure 1 is a front elevation, taken from the outside of the apparatus. Fig. 2 is a vertical longitudinal sectional view, taken on a line to one side of the vertically-disposed radiators or smoke-consumers. Fig. 3 is an elevation taken from the front of the furnace, the front wall thereof being removed, and the side, top, and bottom walls being shown in section. Fig. 4 is a horizontal sectional view, taken on a line above the grate-surface. Fig. 5 is a detached view of the fire-box and the vertical and horizontal radiators or smoke-consumers; the fire-box being shown in section. Fig. 6 is a detached view of the vertical and horizontal radiators.

Referring to the drawings, in which like letters of reference denote corresponding parts in all the figures, A designates the inclosing-walls of the furnace embodying my present improvements, which consist of a front wall, a , a rear or back wall, a' , the side walls, a'' , connecting the front and back walls, a bottom, a^3 , and a top wall or roof, a^4 , all of which are built of brick or masonry, in the usual well-known manner, and therefore need not be described more fully in this specification.

B designates the fire-box or furnace proper, which is inclosed within the walls A, and arranged at or near the front wall, a , thereof. This fire-box is formed of metal and protected at its sides and back with fire-brick, in the manner hereinafter described; and it consists of concavo-convex hood or crown-sheet b , the parallel upper sides, b' , the inclined converging lower sides, b^2 , which incline inwardly toward each other, as shown in Fig. 5 of the drawings, and a curved rear wall, b^3 . The front wall or casting, b^4 , of the fire-box is provided with a series of strengthening-ribs, and with three openings, as shown very clearly in Fig. 2 of the drawings, one of the openings permitting the introduction of fuel into the fire-box, the next the admission of air thereto above the grate, and the lower one for the admission of air beneath the grate and the removal of the contents of the ash-pit. This fire-box is divided into two compartments by means of a grate, C, which is arranged at the lower ends of the converging sides b^2 of the shell or casing, so that an upper combustion-chamber, C' , and an ash-pit, C^2 , are formed above and be-

neath the grate, respectively, as clearly shown in the drawings. This grate C is of any improved pattern or form, and it is supported on a central shaft, *c*, which is journaled at its ends in bearing-plates D, that are rigidly affixed or secured in place on the sides of the fire-box, one end of this shaft being extended beyond the bearing-plates, and provided with a suitable crank, *c'*, which is arranged at right angles with the shaft, and to the free end of which is connected a rod which extends through a suitable opening in the front wall of the masonry A, so that it can be conveniently grasped by the operator or attendant in order to shake or dump the grate, as is obvious.

The bearing-plates D for the shaft of the grate C are provided at their upper side edges with inclined flanges *d*, against which rest the lower edges of the inclined sides *b*² of the fire-box, and the fire-brick *b*⁵, which line the sides of the fire-box at the lower sides thereof, are also supported by the said inclined flanges of the bearing-plates.

The fire-brick *b*⁵ are arranged within the parallel and converging walls of the fire-box, and they are protected at their upper ends by means of angular plates D', which are arranged longitudinally of the fire-box, and suitably secured to the walls of the same in any preferred manner, while the lower ends of the fire-brick rest on and are supported by the angle-plates in which the shaft of the grate is journaled. I attach importance to the peculiar arrangement of the fire-brick within the combustion-chamber, as they are thereby prevented from falling down upon the fire when one or more of the same are broken or dislocated.

It will be observed, by reference to Fig. 4 of the drawings, that the area of grate-surface is very small as compared with the area of the combustion-chamber, the sides of which are diverged and expanded to present a larger area of heating-surface, which is very desirable, as the same grate-surface will effectually heat the larger area of the fire-box. By means of the parallel and converging side walls of the fire-box the coal or fuel that is fed thereto is discharged upon the grate at the middle thereof, and by this arrangement the coal or fuel is at all times discharged at the proper place, where it will be entirely consumed.

The combustion-chamber of the fire-box has an opening, *e*, through which the fuel is introduced or fed, and which is closed by a door, *e'*, and the ash-pit C² has a like opening, *e*², that is closed by a door, *e*³, through which the ashes are removed, as is usual in this class of devices. The front of the fire-box is protected by fire-brick *b*⁶, which is built or placed in the chambers or spaces F at the front formed by the hollow castings *f*, and through this fire-brick is formed the opening for the introduction of fuel to the grate, the lower side of the

opening being protected by a shield, *f'*, as shown in Fig. 3.

G designates a shield, which is arranged in rear of the fire-brick and between the latter and the front of the apparatus to protect the metallic parts at the front from the excessive heat at the bottom of the combustion-chamber, an air-space being left between the shield and the front of the furnace. An air-passage leads from the front of the apparatus to the combustion-chamber to supply air thereto above the grate for the better support of combustion, said passage being lettered *g* and arranged beneath the shield G and the air-space provided thereby, and having its outer end closed by a door or register, *g'*, of any approved pattern.

The back concavo convex wall of the fire-box is also protected by fire-brick *b*⁷, which is supported on the flange *h*, and placed in the space or chamber *h'* formed by the casting H, which is arranged transversely of the fire-box and suitably held or supported in place. The fire-brick is protected at its upper end with the horizontal and depending flanges *i* of a shield, I, that is arranged at the upper part of the furnace and immediately in front of the upper part of the concavo-convex wall of the furnace transversely across the latter. The upper part of the rear wall of the furnace is thus protected from the intense heat which is generated at that point by the fire, and this shield is arranged a short distance in front of and out of contact with the said rear wall, so as to leave an intermediate air-space.

J designates the vertical radiators, two of which are provided, which are arranged a short distance apart from each other and in rear of the fire-box, as clearly shown. These radiators are preferably made in the form of hollow cylindrical vessels, and they are connected at their upper ends with the fire-box, so as to receive the smoke and other products of combustion therefrom, by means of short tubes or pipes *j*, one of these pipes being provided for each of the radiators, and which open into and through the rear wall of the fire-box in rear of the shield I therein. These radiators are connected together at their lower ends by means of a short cross-pipe, J', which opens at its opposite ends into the lower portions of the radiators, and from the middle of this connecting-pipe extends an escape pipe or flue, J², for the smoke and other products of combustion which escape from the fire-box through the pipes *j* and the radiators, and the radiators are further provided, at their lower ends and on opposite sides to the connecting-pipe J', with short nozzles or tubes *j'*, that open into the outer air to supply atmospheric air or oxygen to the smoke and other products of combustion in the radiators to consume the soot or other matter in the smoke and thereby generate a more intense heat therein in addition to consuming the substances in the smoke that escape from the fire-box, the said air-

nozzles being each provided with a damper or register, by means of which the quantity of air that enters the radiators can be regulated and controlled, or the air-supply can be cut off entirely.

K designates the horizontal radiators, which are arranged immediately above the fire-box and exteriorly thereto. Two of these horizontal radiators are provided, one for each of the vertical radiators, and these horizontal radiators are arranged parallel with each other and at a short distance apart. The radiators extend longitudinally of the furnace and above the fire-box therein, so that their outer surfaces are exposed to the heat radiated from the upper wall or roof of the fire-box, and the front ends of each of the horizontal radiators are connected together by means of a transverse pipe, K', which opens at its ends into the said horizontal radiators, and this transverse pipe K' is connected with the combustion-chamber of the fire-box, so as to conduct the smoke and other products of combustion therefrom into the horizontal radiators by means of a short pipe, k, which opens into the fire-box at its upper front end, through the roof thereof, and into the pipe K' at or near the middle of the same, whereby a portion of the escaping smoke from the fire-box is conducted through the pipes K' k into the radiators K, and from thence to the vertical radiators, as presently described.

The rear end of each horizontal radiator is arranged immediately above the upper end of one of the vertical radiators, and the horizontal radiators are connected at their rear ends with the upper ends of the vertical radiators by means of short pipes or tubes k', which open into the said horizontal and vertical radiators to permit the smoke and other products of combustion to escape from one into the other of the said radiators. A damper, k², is arranged in the short pipe k, intermediate of the fire-box and the pipe K', and it is carried by a rotary shaft, k³, which is journaled in the said pipe and extends through the front wall, a, of the furnace, so that the operator or attendant can cut off the escape of the smoke from the fire-box into the horizontal radiators, or leave the communication between the fire-box and the said radiators open, as may be preferred. Each of the horizontal radiators has an air-inlet port or opening, L, which opens into the front end of the same and through the front wall of the furnace, so that atmospheric air or oxygen is supplied to the radiators to consume the carbon or soot in the smoke and other products of combustion, and these air-ports have cut-off valves or registers l, by which the supply of air can be regulated or cut off as desired.

M designates the steam coils, which are arranged within the fire-box on opposite sides thereof, and these coils are each provided with a circulating-pipe, m, which extends rearwardly through the short pipes j.

Each of the steam-coils has the pipe m ex-

tending rearwardly into the vertical radiators J, as shown very clearly in Figs. 3 and 4, and these pipes are then extended or turned downwardly through the radiators, the lower ends of the pipes being finally bent at right angles to the vertical portions thereof, and passing into the short horizontal pipes j, connecting the said vertical radiators, these lower horizontal portions of the circulating-pipes meeting and communicating with each other, so that the water can flow or circulate through the pipes. It will thus be seen that the water in the coils is free to circulate from one coil to the other through the medium of the circulating-pipes m and m', and as the former pipes take a tortuous course through the vertical radiators, and the pipe m' extends across the fire-box, the water from the coils circulating through the pipes m and m' is heated on its passage from one coil to the other.

The horizontal circulating-pipes m of the coils M are connected to a larger pipe or auxiliary steam-reservoir, N, which is arranged above the water-circulating pipes, and into which the steam is free to escape by means of the short pipes or nozzles n. The water-circulating pipes m of the coils M are connected by a transverse pipe, m', (see Fig. 4,) so that communication and flow of water are insured from one series of coils to the other within the fire-box; and the auxiliary steam-reservoir is connected with the transverse pipe m' by the pipes n, so that the steam from both series of coils is conducted into one auxiliary steam-reservoir N, which is common to both coils of water-circulating pipes. This auxiliary steam-reservoir is connected to a larger main steam-reservoir, N², which is supported in an elevated position in the upper part of the furnace and in close proximity to the roof thereof in any suitable manner, by means of steam-pipes N', which open into the main and the auxiliary steam-reservoirs, as is usual.

Water is supplied to the water-circulating coils, so as to have a full supply on hand therein at all times, through a supply-pipe, O, which opens into the transverse pipe m' and leads to the outside of the front wall of the furnace. The water is supplied to the circulating-coils under pressure by means of an injector, P, which is of any approved pattern, and this injector is operated by means of steam that is supplied thereto from the main steam-drum through an intermediate pipe, p, which opens into the upper part of the injector and has a regulating globe-valve, p', which is designed to be operated by hand to supply and cut off the steam from the injector when necessary. A pipe, P', enters the lower part of the injector to supply or convey the water thereto that is to be injected or forced into the circulating-pipes, and this water-supply pipe to the injector is also provided with a regulating or globe valve, p², by means of which the supply of water to the injector P can be regulated or cut off, as may be desired. The supply-pipe O, intermediate of the injector and the circu-

lating-coils, is provided with a regulating-valve, which is to be opened when the water is to be forced into the circulating-coils, and this pipe O is further provided with a check-valve, o' , which prevents the escape or backing of the water from the pipe O and the circulating-coils when the injector ceases to work.

Q designates a water-gage, which is arranged exterior to the furnace, so as to be readily observed by the attendant or operator, and this gage is in communication with the circulating-coils by a suitable pipe, q , and with the auxiliary steam-drum, or the pipes intermediate of the main and auxiliary steam-drums by a pipe, q' . The water-pipe q to the water-gage enters the latter at its lower end, and the steam-pipe q' enters the gage near its upper end and above the water line therein, so as to indicate the steam-pressure in the steam-drums by a steam-gage, Q' , which is mounted on the water-gage and in communication therewith by an intermediate pipe, r , as will be very readily understood. The main steam-drum is provided with a safety-valve, S , of any approved pattern, which is arranged exterior to the furnace and connected with the steam-drum by an intermediate pipe, s , as is usual. The pipe O, intermediate of the circulating-coils and the injector, is provided in rear of the regulating and check valves with a blow-off cock, O' , by which the contents of the circulating-coils can be readily discharged.

T designates the bake-ovens, which are arranged above the horizontal radiators and beneath the main steam-drum r^2 , so as to utilize the waste heat that escapes from the fire-box and the radiators to heat the oven and bake the contents thereof. These ovens are supported in the furnace in any suitable manner, and they can be varied in number and size as may be desired; but the ovens can be omitted, if deemed necessary, as they are only supplied with the furnace when specially ordered by restaurants, hotels, &c.

U designates the cold-air flue, which is arranged beneath and exterior to the furnace, and this flue supplies air to the fire-box to support the combustion therein by means of short vertical branch pipes u , which pass through the floor of the furnace and enter the ash-pit beneath the grate of the fire-box, as shown.

V designates hot-air flues, which enter the furnace through the upper wall or roof thereof, and which lead to any part of the house or dwelling in which the apparatus is located, by means of which the dwelling is supplied with hot air when desired.

W designates the heat-retaining receptacles, which preferably comprise open vessels which are arranged within the furnace, on opposite sides thereof. These vessels are supported on the inside of the side and rear walls of the furnace by means of suitable brackets or brace-irons, w , which are affixed to the walls of the furnace and the vessels. These receptacles

are arranged longitudinally of the furnace, in close proximity to the fire-box thereof, and at their upper ends they are left open for the introduction of a heat retaining and absorbing substance—as, for instance, sand. Any desired number of these heat-absorbing reservoirs may be employed, and the arrangement thereof can be varied without departing from the spirit of my invention. In the practical operation of a furnace tested by me some time ago, I employed two of these heat-reservoirs, which are arranged longitudinally of the furnace and in close proximity to the fire-box therein, and which are filled with sand. I have found that the reservoirs retained sufficient heat to maintain the temperature of the furnace to quite a high degree after the fire in the fire-box had been extinguished and for a number of hours, varying from twenty-four to forty-eight. By means of these heat-reservoirs the furnace and the radiators therein are kept at a uniform temperature when the fire has been extinguished overnight, and steam can be more quickly generated when the fire is kindled, and a constant supply of hot water is kept on hand for immediate use, which is especially desirable in hotels and restaurants for the accommodation of guests, &c.

X designates evaporating-pans, which are supported near the rear wall of the furnace on suitable brackets and in proximity to the fire-box, (see Fig. 4,) to utilize the heat radiated therefrom to convert the water or other liquid contained therein into steam.

The operation of my invention will be readily understood from the foregoing description, taken in connection with the drawings.

Various slight changes in the form and proportion of parts of the apparatus, herein shown and described as an embodiment of my invention, can be made without departing from the principle or sacrificing the advantages of my invention.

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

1. In a furnace, a fire-box comprising the curved hood, the parallel upper side walls, the converging lower side walls, the fixed angle-plates at the upper sides of the parallel walls and lower terminals of the converging side walls, between which the fire-brick is arranged and held, the curved rear wall having the flange h at its lower edge, and the protector plate or shield arranged in front of the upper portion of the rear wall having the depending flange i to hold the rear fire-brick in place, as and for the purpose described.

2. In a furnace, a fire-box having the rear wall thereof provided with an inwardly-extending flange, h , at or near its lower edge and the outlet-openings near its upper end, the shield arranged in front of the rear wall and the outlet-openings therein, and having the angular depending flange i at its lower edge and the fire-brick between the flanges h i , the

side and upper edges of the shield being out of contact with the rear wall to permit the products of combustion from the fire-box to pass around the shield to the outlet-openings, as and for the purpose described.

3. In a furnace, the combination of the fire-box having the shield arranged in front of the outlet-openings, the vertical radiators arranged in rear of the fire-box and communicating with each other at their lower ends by a connecting-pipe, J' , the independent pipe-connections j , intermediate the upper portions of the vertical radiators and the fire-box, and a single escape-pipe communicating with the pipe j' , connecting the radiators, as and for the purpose described.

4. In a furnace, the combination, with the fire-box, of the vertical and horizontal radiators arranged above and in rear of the fire-box, and each having an independent pipe-connection with the same and communicating with each other, and a common smoke-flue communicating with the vertical radiators only, as and for the purpose described.

5. In a furnace, the combination, with a fire-box, of the vertical radiators J , arranged in rear thereof and communicating with the same, the horizontal radiators K , arranged above the fire-box and communicating at their rear ends with the vertical radiators, a transverse pipe connecting the horizontal radiators near their front ends and having a vertical pipe entering the fire-box, and a smoke-flue connected with the lower ends of the vertical radiators, substantially as described.

6. In a furnace, the combination of a fire-box, the independent circulating-coils therein connected by a transverse pipe, an auxiliary steam-reservoir connected with the circulating-coils, an elevated main reservoir connected with the auxiliary reservoir, and an injector connected with the circulating-coils for forcing water therein under pressure, substantially as described, for the purpose set forth.

7. In a furnace, the combination, with a fire-box, of the circulating-coils arranged therein, the vertical connected radiators in communication with the fire-box and having a pipe or pipes from the circulating-coils extending through them, a transverse pipe connecting the independent coils within the fire-box, the auxiliary steam-reservoir in communication with the transverse pipe, the main reservoir connected with the auxiliary reservoir, an injector, a pipe, O , intermediate of the injector and the circulating-coils, and provided with the regulating and check valves, and the steam and water supply pipes to the injector having the regulator-valves, substantially as described, for the purpose set forth.

8. In a furnace, the combination, with a fire-box, of the vertical radiators, the horizontal radiators arranged above the fire-box and in communication with the fire-box and the vertical radiators, the steam-reservoir ar-

ranged above the horizontal radiators, and the ovens intermediate of the steam-reservoir and the horizontal radiators, substantially as described, for the purpose set forth.

9. In a furnace, the combination of a fire-box, the horizontal radiators arranged above the fire-box on the outside of the shell thereof, a pipe connecting the front ends of the horizontal radiators and having a central pipe-connection with the fire-box to conduct a portion of the heat and products of combustion from the fire-box to the horizontal radiators, a valve or damper located in the said central pipe for cutting off communication between the horizontal radiators and fire-box, the vertical radiators arranged in rear of the fire-box and communicating therewith, the pipe J' , connecting the vertical radiators, and a smoke-flue communicating with the said pipe, as and for the purpose described.

10. In a furnace, the combination of a fire-box, the horizontal radiators arranged above the fire-box, and each having an air-flue extending through the wall of the furnace above the fire-box and opening into the front end of the radiators, said flues having the registers for regulating the air-supply to the radiators, a horizontal pipe connecting the front ends of the radiators in rear of points where the air-flues enter the same, a central valve-pipe intermediate the horizontal connecting-pipe and the fire-box, the vertical radiators in communication at all times with the fire-box and the horizontal radiators by independent pipe-connections, the pipe J' , connecting the vertical radiators, and a smoke-pipe communicating with the said pipe, as and for the purpose described.

11. In a furnace, the combination of a fire-box, the horizontal radiators arranged above and exterior to the fire-box, a horizontal pipe connecting the front ends of the radiators and having a central valved pipe-connection with the fire-box, the vertical radiators arranged in rear of the fire-box and having the separate air-inlet nozzles j' at their lower ends, a horizontal pipe, J' , connecting the lower ends of the vertical radiators and arranged substantially in the same horizontal plane with the air-inlet nozzles thereto, a smoke-flue connecting with the horizontal connecting-pipe of the vertical radiators, and the independent pipe-connections intermediate the fire-box and the vertical and horizontal radiators, to thereby establish communication between said parts at all times, as and for the purpose described.

12. In a furnace, the combination of a fire-box, the independent water-circulating coils therein connected by an intermediate pipe, m' , the vertical radiators arranged in rear of the fire-box and communicating therewith, the horizontal pipe connecting the lower ends of the vertical radiators, a smoke-flue connecting with said horizontal pipe, and the circu-

lating-pipe *m*, communicating with the water-circulating coils in the fire-box and extending through the vertical radiators and the intermediate and horizontal connecting-pipes thereof, to establish thereby a constant circulation of water through the fire-box and radiators, as and for the purpose described.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in presence of two witnesses.

GEORGE RANDOLPH SCATES.

Witnesses:

J. E. PRICE,

JOS. R. MITCHELL.