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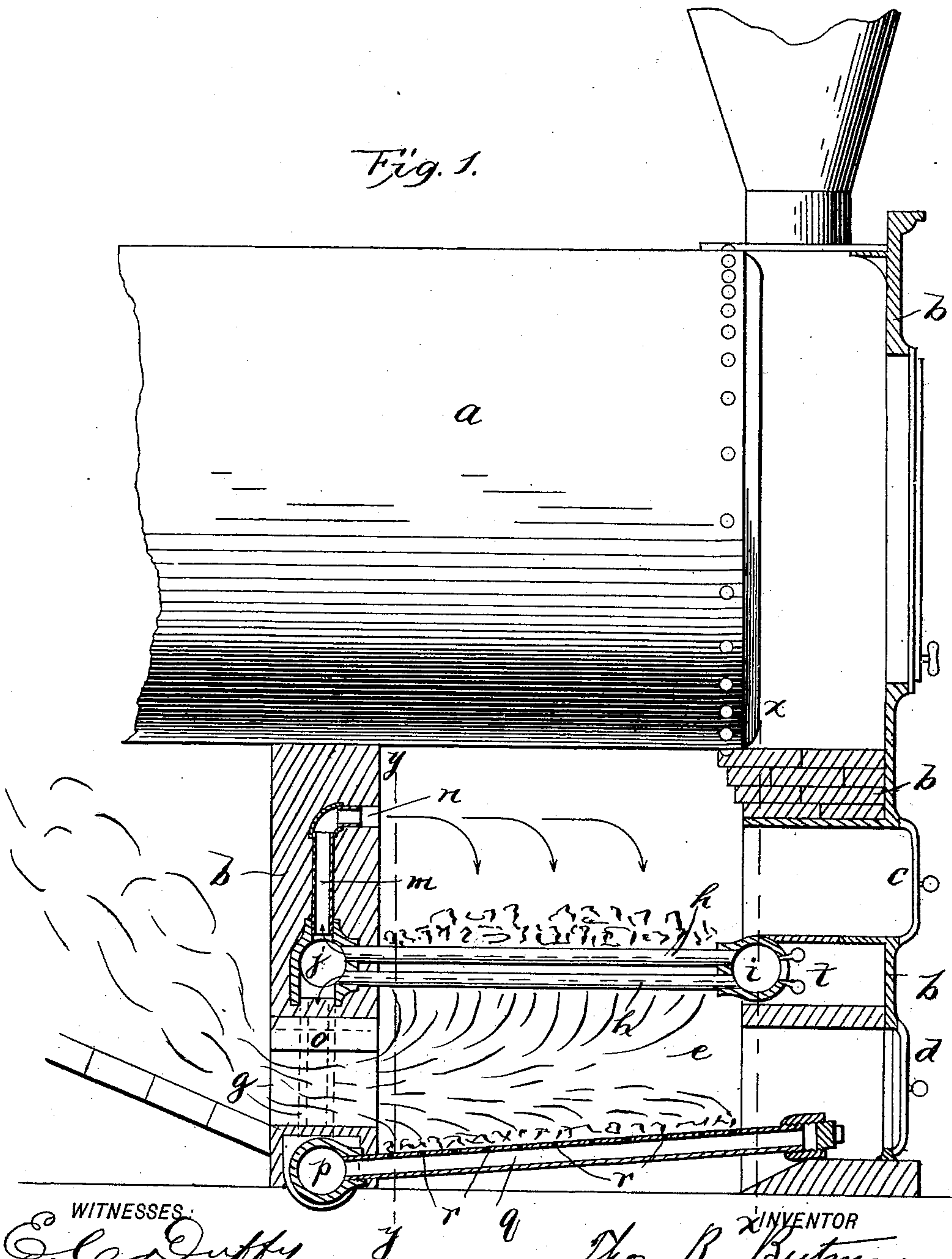
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T. R. BUTMAN.  
STEAM BOILER FURNACE.

No. 479,733.

Patented July 26, 1892.

Fig. 1.



WITNESSES:

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(No Model.)

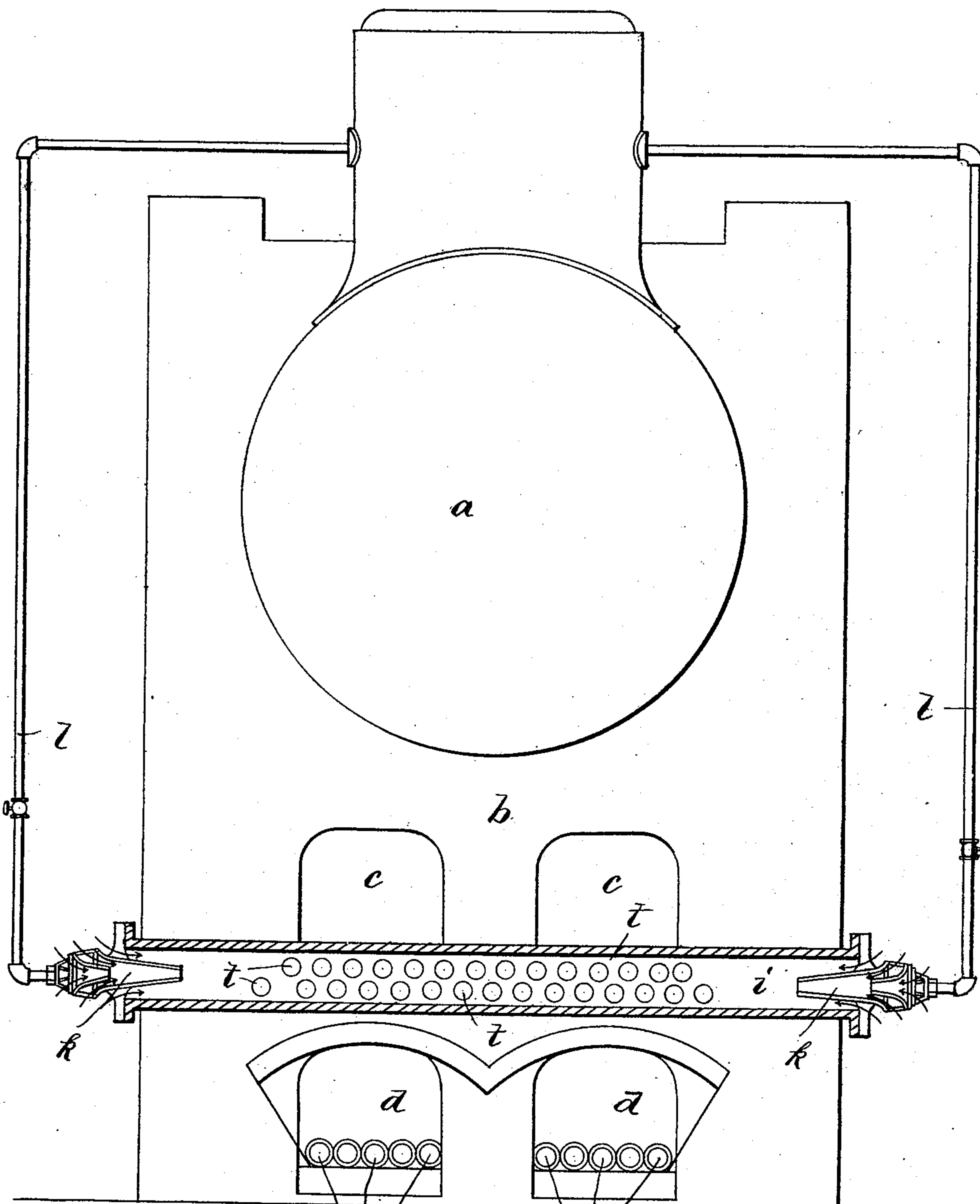
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*Fig. 2.*



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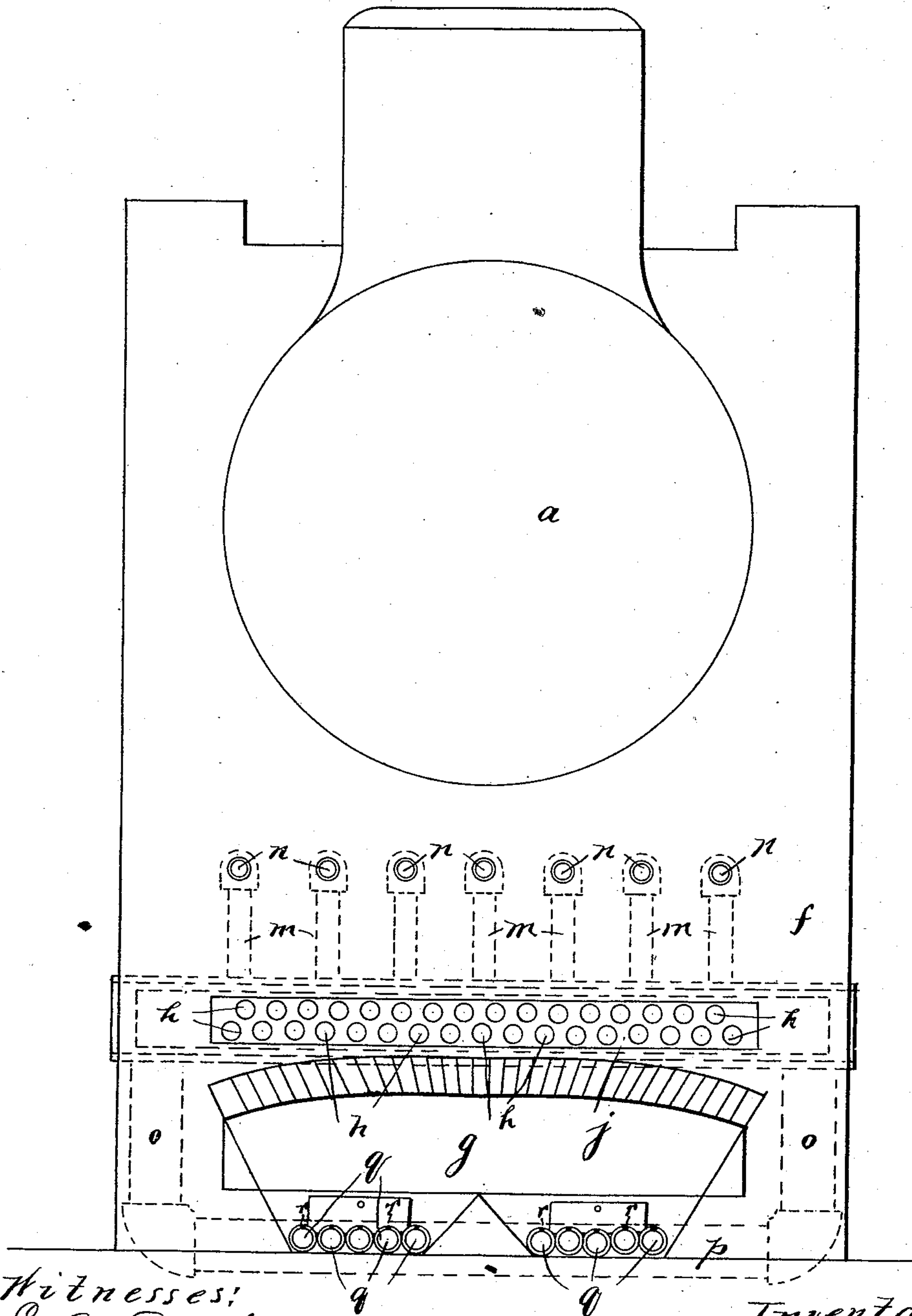
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*Fig. 3.*



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# UNITED STATES PATENT OFFICE.

THOMAS REED BUTMAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE BUTMAN FURNACE COMPANY, OF SAME PLACE.

## STEAM-BOILER FURNACE.

SPECIFICATION forming part of Letters Patent No. 479,733, dated July 26, 1892.

Application filed April 2, 1892. Serial No. 427,466. (No model.)

*To all whom it may concern:*

Be it known that I, THOMAS REED BUTMAN, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam-Boiler Furnaces; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification.

This invention relates to certain improvements in steam-boiler furnaces.

The many and great disadvantages and objections to the immense quantity of smoke and unconsumed gases poured out by the ordinary steam-boiler furnace are well known. In localities where there are a great number of such furnaces congregated the purity of the atmosphere is affected, and clothing, buildings, and almost all kinds of goods and merchandise are injured by the minute floating particles of carbon, &c., which also renders the atmosphere exceedingly unpleasant, uncleanly, and unhealthy. Furthermore, this escaping smoke and gas represents a vast waste of fuel and material, which might be converted into heat and energy. Various unsatisfactory methods and means have been devised to promote perfect and effectual combustion for consuming the smoke and gases, and thereby producing a maximum heat and quantity of steam with a minimum quantity of fuel, and obviating the discharge of great quantities of smoke and gas into the atmosphere.

The object of my invention is to provide improvements in steam-boiler and other furnaces whereby a cheap, simple, and efficient construction is provided to promote perfect combustion and wherein the smoke and gases will be consumed and the heat therefrom utilized. It is well known that water-tube grates have been used for both down and upward draft and that they are open to serious objections, especially when the currents of circulatory water are united with the water of the boiler.

A further object of this invention is to provide an improved construction which will overcome the objections and disadvantageous features of the ordinary downwardly-burning water-grate furnaces.

A further object of the invention is to improve the construction and arrangement of parts in a furnace, whereby the construction is rendered highly efficient and improved in action.

The invention consists in certain novel features of construction and in combinations of parts more fully described hereinafter, and particularly pointed out in the claims.

Referring to the accompanying drawings, Figure 1 is a vertical longitudinal section through a portion of a furnace and boiler. Fig. 2 is a cross-sectional view taken in the plane of the line *x x*, Fig. 1. Fig. 3 is a cross-sectional view taken in the plane of the line *y y*, Fig. 1.

In the drawings the reference-letter *a* indicates part of a tubular boiler.

*b* indicates the wall of the furnace, provided with door *c* and ash-pit door *d*.

*e* indicates the fire-pot, and *f* indicates the bridge-wall, solid except at its lower end, which is provided with the transverse aperture or flue *g* to the rear ends of the flues of the boiler.

*h* indicates a double series of separated parallel tubes forming the grate-bars upon which the fire rests. These grate-bars are located in the fire-pot a distance above the opening in the bridge-wall. The outer ends of the tubes are nested in the horizontal transverse tube or header *i*, located in the furnace-front, and the rear ends of the tubes are suitably secured and open into the rear transverse header or tube *j*, located in the bridge-wall, substantially as shown. The ends of the rear header are closed. The ends of the front header project, preferably, through the sides of the furnace to receive the steam and air injectors *k k*, projecting into the ends of said header. These steam injectors or nozzles *k* are supplied with steam from the boiler through the valved steam-supply pipes *l l*, and they discharge steam into the ends of said header, and thereby draw large quantities



of air into the header, which mingles with the steam, and the mixture passes through the hollow grate-bars or tubes *h*, wherein the mixture is highly heated and fixed, and is then discharged into the rear header. A portion of the highly-heated steam and air passes from said rear header upwardly through the plurality of pipes *m* in the bridge-wall and is discharged into the fire-pot above the grate and fire. The series of parallel pipes *m* extend upwardly from the rear header and at their upper ends are provided with elbows or bends, so that the discharge ends *n* of the pipes are located in the bridge-wall a distance above the grate-bars. By this means a strong downdraft is created through the entire fire and grate. The remainder of the steam, air, &c., from the rear header passes downwardly from the ends thereof through pipes *o o* to the lower rear transverse header *p* in the bridge-wall beneath the opening therein, from thence into the parallel pipes *q*, extending forwardly through the ash-pit at or near the bottom thereof. These pipes *q* are usually inclined upwardly and located below the plane of the discharge-opening through the bridge-wall, and are perforated (see *r*) along their upper sides, so that the highly-heated mixture is discharged upwardly through the combustible material dropping on pipes *q* and meets the burning gases passing downwardly from the grate, whereby intense heat is generated and perfect combustion ensues and the combustible gases and smoke are consumed. The pipes *o o*, connecting the ends of the upper and lower rear headers, pass down through the bridge-wall at opposite ends of the discharge-opening through the bridge-wall.

The various headers are cast or otherwise formed with openings at their inner edges and the tubes are suitably expanded or otherwise secured. The front ends of the perforated distributing-pipes rest in the furnace-front behind the ash-pit door, and said front ends are closed by suitable means, as by removable plugs, so that the plugs can be removed and the pipes cleaned when necessary by blowing or with instruments. The exterior of the various steam-pipes can be cleaned by suitable instruments inserted through the doors.

In starting a fresh fire the doors above the grate should be left open for the admission of air until steam is raised for operating the jet-blowers, or a fan or any other well-known device can be employed to supply initial draft. However, the initial draft should preferably be supplemented by a jet of steam or spray of water by injecting water into the front header through nozzles *t*, supplied with water through a valved pipe from a suitable source. A nozzle *t* is located opposite the end of each hollow tube or grate-bar, and in starting a fire water is turned on and sprayed through squid-nozzles into the front header and the hollow tubes or grate-bars. This water is converted

into steam in said grate-bars, which is sprayed into the fire. When steam is up in the boiler, this water can be shut off and the steam turned on from the boiler. In operation, as before mentioned, the superheated gas or vapor is discharged over and upon the fire and the draft draws the flame and gases down and backward, meeting the flame and gases passing up from the lower perforated pipes, and from thence passing back through bridge-wall under boiler and through tubes of boiler.

Fine particles of fuel drop between the hollow tubes or grate-bars onto the perforated distributing-pipes, where they are ignited and burned with the decomposed steam and air.

The simplicity and extreme cheapness and durability in the construction of this furnace and its effectiveness in operation renders it of the greatest practical advantage and utility.

Parts and constructions and arrangements have for the sake of clearness herein been most specifically described; but it is evident that various changes might be made in the form, construction, and arrangement of the parts described without departing from the spirit and scope of my invention. Hence I do not wish to limit myself to what is here shown and described, but consider myself entitled to all such changes as fall within the spirit and scope of my invention.

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

1. In a furnace, the combination of the tubes forming the grate-bars, having supply-pipes, connections from said tubes, arranged to discharge the heated steam and air therefrom over the fire and produce a downdraft, and connections for conveying part of the heated steam and air from said tubes and discharging the same in the combustion-chamber beneath the said grate-bars, substantially as described.

2. In a furnace, a grate, a combustion-chamber beneath the grate, having a discharge, means, substantially as described, for heating air and steam, connections for discharging a portion of said heated air and steam over and onto the fire, and connections for conveying the remainder of the heated steam and air and discharging the same in the combustion-chamber beneath the grate, whereby the flame-consuming gases, &c., meet and are consumed in said chamber, substantially as described.

3. In a furnace, the combination of the heating-tubes in proximity to the fire, supply connections therefor, distributing-pipes in the combustion-chamber beneath the fire, and connections from said tubes to convey a portion of the heated air and steam to said distributing-pipes and to discharge the remainder thereof onto and above the fire and produce a downdraft, substantially as described.

4. In a furnace, the combination of the tubes forming grate-bars, steam and air supply for said tubes, connections from said tubes, ar-



5 ranged to distribute a portion of the heated air and steam therefrom over the fire on said tubes, and thereby produce a downdraft, and a series of perforated tubes beneath and supplied with heated air and steam from said grate-bars, for the purpose described.

10 5. In a furnace, the means, substantially as described, for heating air and steam and discharging the same over the fire to produce a downdraft and distributing-pipes beneath the fire to distribute air and steam into the downwardly-passing burning gases and flame, substantially as described.

15 6. In a furnace, the combination of the hollow grate-bars, the rear header thereof, means for supplying air and steam to said bars, the perforated pipes in the combustion-chamber beneath the grate-bars, the header for said perforated pipes, and the pipes connecting  
20 said headers, substantially as described.

7. In a furnace, the combination of the hol-

low grate-bars, the headers therefor, air and steam supply openings in one header, and the water-nozzles projecting into said header and having a supply pipe or pipes, substantially  
25 as described.

8. In a furnace, the bridge-wall having the bottom opening, the furnace-front, a header in the furnace-front, having steam and air injectors in its ends, a header in the bridge-  
30 wall, the hollow grate-bars connecting said headers, and the distributing-pipes in the bridge-wall from the rear header to produce a downdraft, substantially as described.

In testimony that I claim the foregoing as  
35 my own I affix my signature in presence of two witnesses.

THOMAS REED BUTMAN.

Witnesses:

JENNIE E. ENGLAND,

HANS P. G. NORSTRAND.