

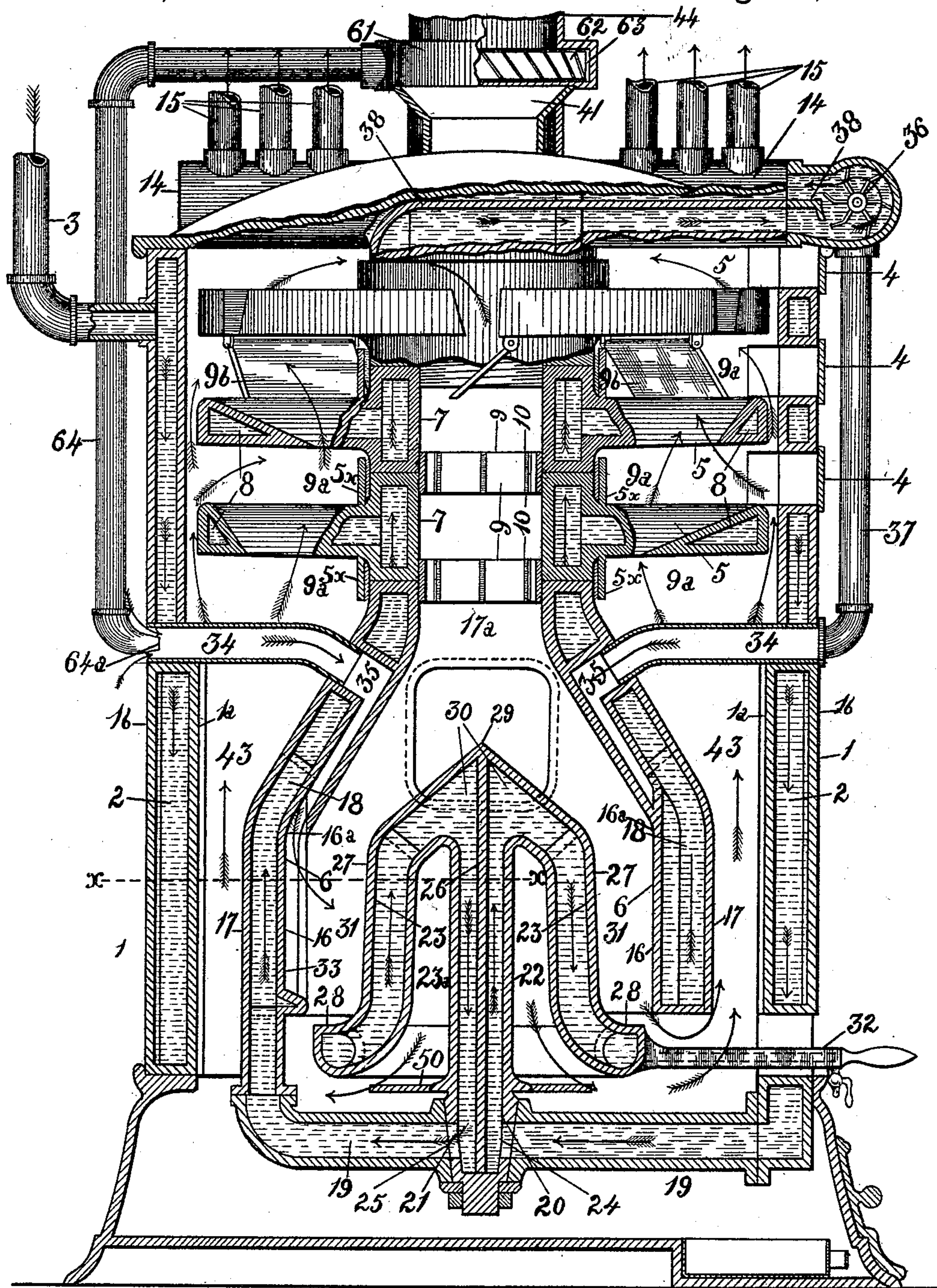
(No Model.)

3 Sheets—Sheet 1.

G. A. WATSON.
APPARATUS FOR HEATING.

No. 481,216.

Patented Aug. 23, 1892.



Witnesses

James M. Adam
Harry. Dixon.

Fig. I.

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(No Model.)

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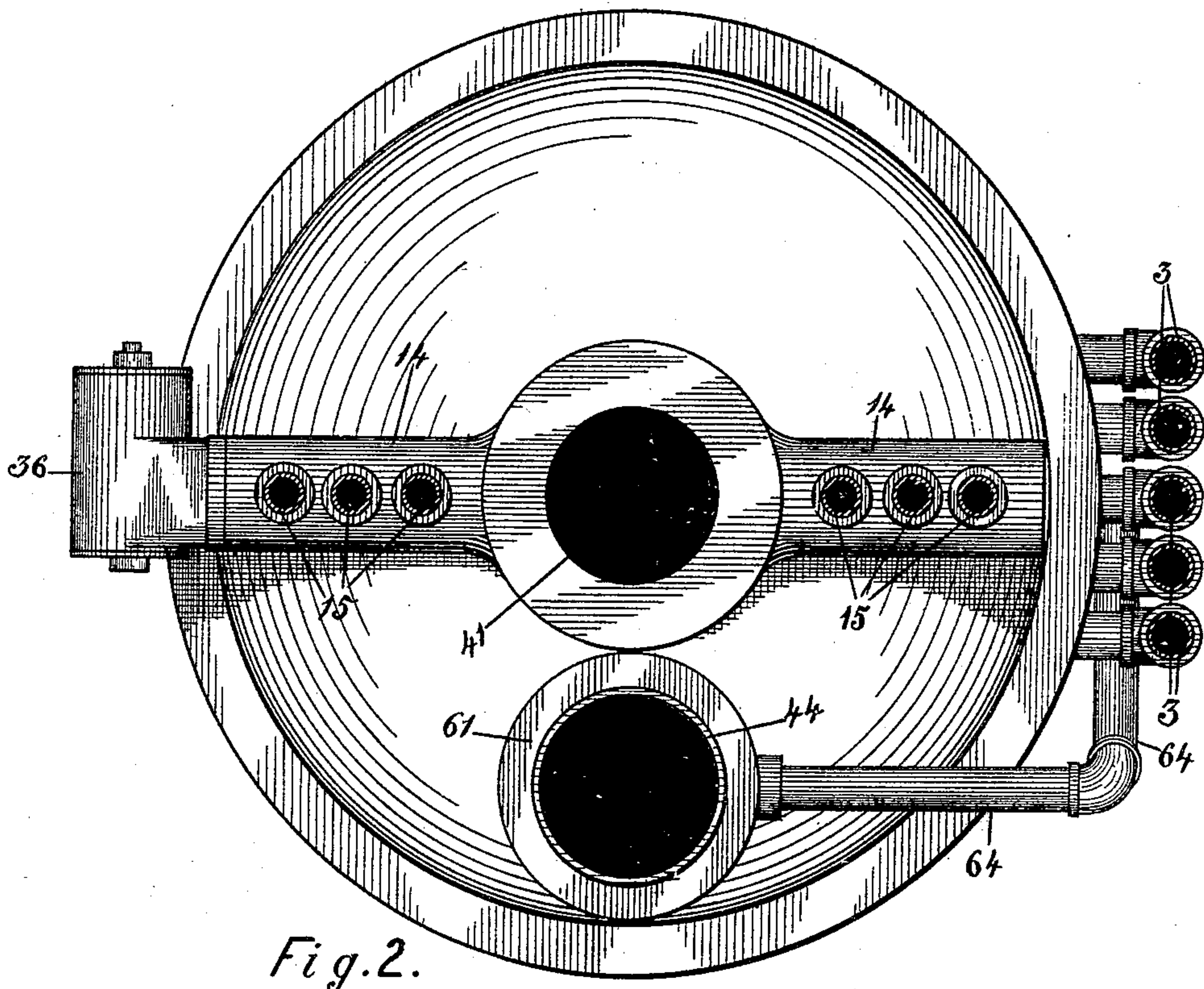


Fig. 2.

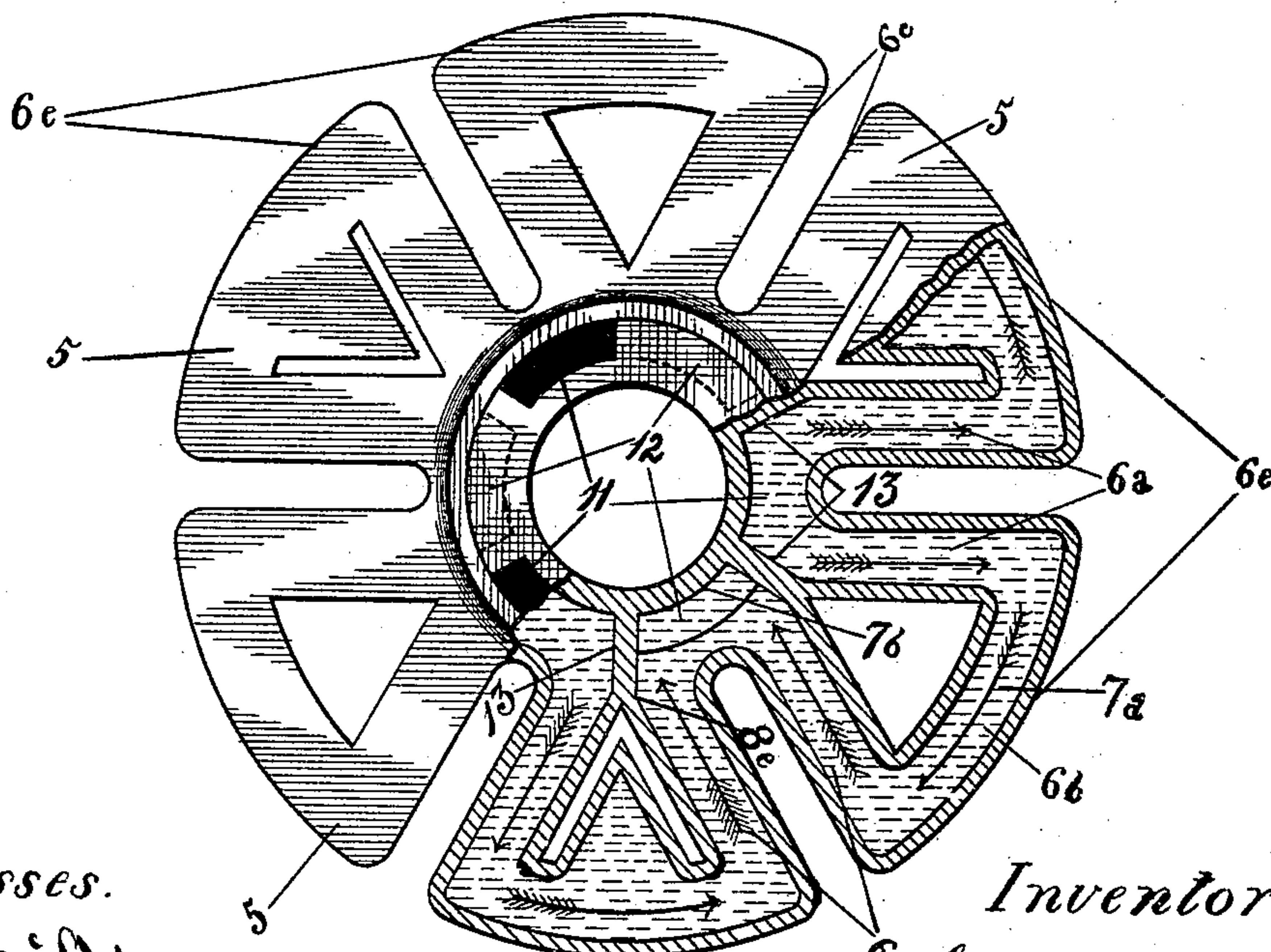


Fig 3

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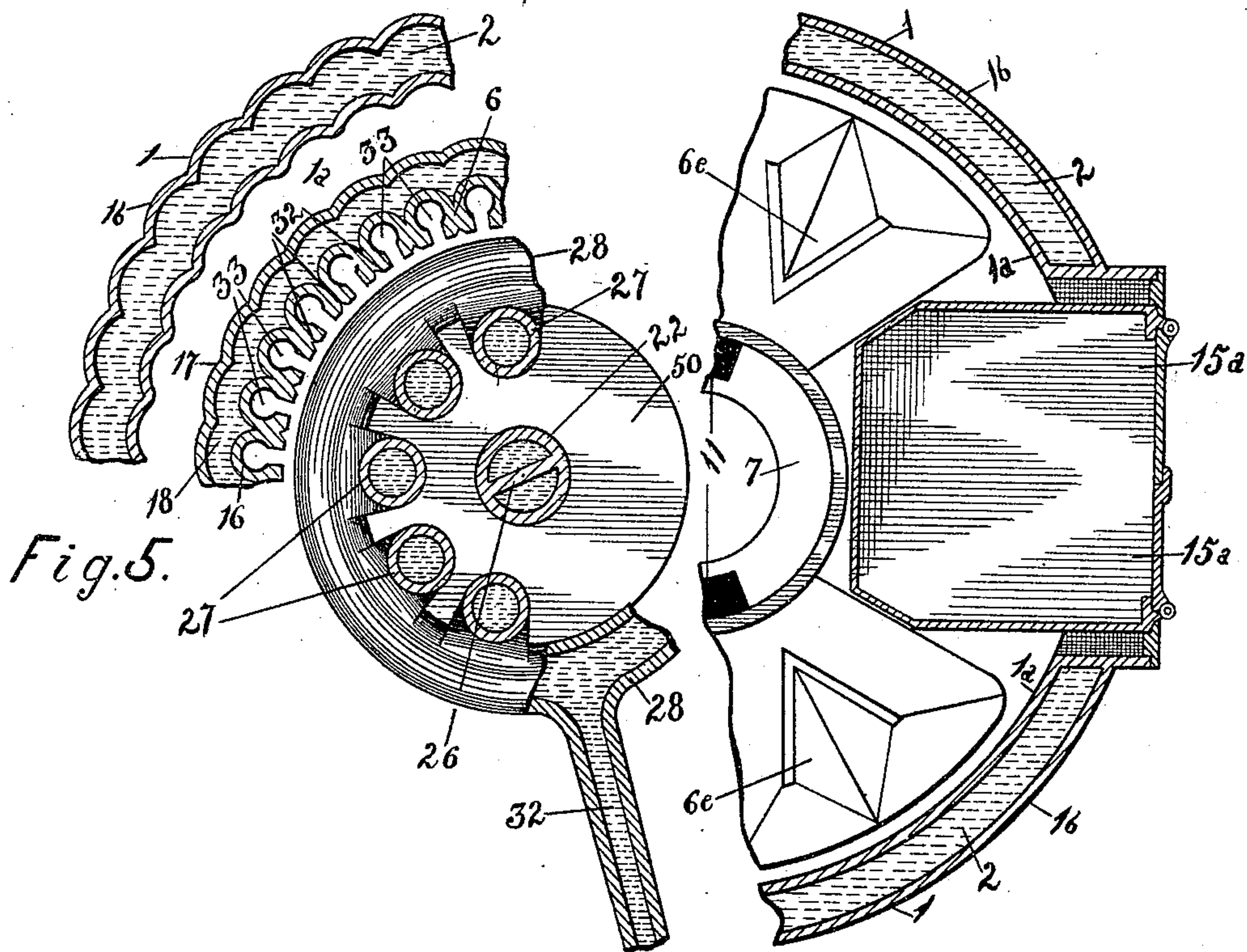
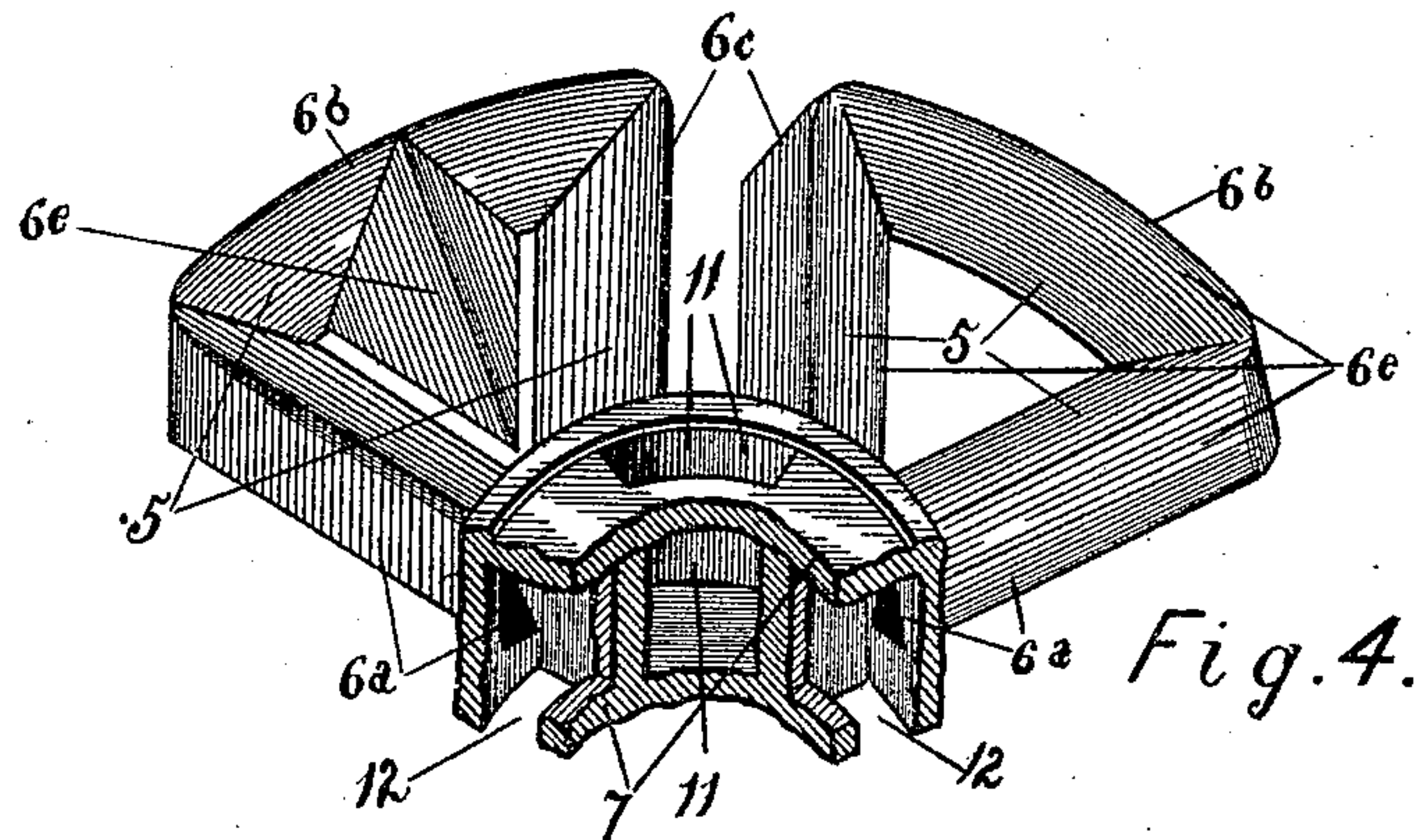
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Attorney.

UNITED STATES PATENT OFFICE.

GEORGE ALFRED WATSON, OF TORONTO, CANADA, ASSIGNOR OF FIFTY-ONE ONE-HUNDREDTHS TO WILLIAM HENRY LAIRD, OF NEW YORK, N. Y.

APPARATUS FOR HEATING.

SPECIFICATION forming part of Letters Patent No. 481,216, dated August 23, 1892.

Application filed August 27, 1891. Serial No. 403,856. (No model.)

To all whom it may concern.

Be it known that I, GEORGE ALFRED WATSON, pattern-maker, of the city of Toronto, in the county of York, in the Province of Ontario, Canada, have invented a certain new and useful Apparatus for Heating Purposes; and I hereby declare that the following is a full, clear, and exact description of the same.

This invention relates to apparatus for heating purposes; and it consists in this instance of an upright tubular grate having a cone-shaped top, the apex of which is directly below the center of the coal-magazine, which magazine is provided at its inner end with a funnel-shaped mouth for the purpose of distributing the fuel evenly to all parts of the fire-box. The walls of said funnel-shaped mouth are continued downward to the base of the fire-box and form the walls of the fire-pot, the walls of which fire-pot are parallel, or nearly so, with the outline of the upright grate, which grate, fire-pot walls, and walls of the coal-magazine are hollow, forming part of the water-sections of the furnace, and are so arranged that they are in direct circulation with the remaining water-sections and the flow and return pipes. The upright grate is supported on a hollow spindle, the lower end of which is journaled in upright water-tight bearings formed in the water-leg passing diametrically across the base of the fire-pot and connecting the water-space in the fire-pot walls with the water-space in the casing of the furnace. The upright grate and hollow spindle are each provided with a diaphragm to divert the flow of the water from the water-space in the casing through said grate to the water-space in the fire-pot wall. Above the fire-pot is arranged a series of water-sections in circulation with the fire-pot water-section and with each other, and located above the series of water-sections is a head, with which all the water-sections of the furnace are in circulation and to which are connected the flow-pipes leading to their respective destinations.

The casing of the furnace consists of double walls, with a suitable space between them, the whole of which space is utilized as water-space and to which are connected the return-pipes.

The circulation of the fluid in this boiler is as follows: The fluid enters the water-space in the casing by means of the return-pipes connected to the top of said water-space and then passes downward to the bottom, to which is connected the water-leg supporting the upright grate. The water passes through said water-leg to the upright grate, through which it is diverted by means of said diaphragm, and circulates through said grate, then through the remaining part of said water-leg to the fire-pot section, through which it circulates to the water-section located above the fire-pot, through each of which water-sections it passes to the head, where it is carried off to the flow-pipes leading to their respective destinations. This furnace is also provided with a downward draft through the fire-pot, which draft assists the decomposition of the fuel and causes the carbonic gases produced by such decomposition to be carried downward through said decomposing fuel and through the spaces between the bars of the upright grate into a combustion-chamber formed on the under side of said upright grate, which combustion-chamber is supplied with an auxiliary draft, said draft combining sufficient oxygen with the carbonic gases produced by the decomposing fuel to cause combustion to take place within said chamber, which combustion entirely destroys the inflammable properties of the combination, thus permitting only the non-combustible elements to reach the outlet to the chimney.

In the drawings, Figure 1 is a vertical sectional view of my improved furnace for hot-water or steam heating purposes. Fig. 2 is a plan view of the same. Fig. 3 is an inverted sectional plan view of one of the water-sections. Fig. 4 is a perspective view of a part of one of the water-sections, showing the arrangement of the inlet and outlet ports. Fig. 5 is a cross-sectional view on the lines *x x*, Fig. 1. Fig. 6 is a view of an oven which may be substituted in the place of one of the water-sections.

Like numerals of reference refer to like parts throughout the specification and drawings.

The furnace-casing 1 consists of an inner shell 1^a and an outer shell 1^b, connected to-

gether at the top and bottom. Between the shells 1^a and 1^b is a space 2, suitable for the purpose of a water-chamber, to which water-chamber are connected the return-pipes 3.

5 Through the furnace-casing 1 are suitably-protected openings 4 for the purpose of removing the soot and ashes from the top of each water-section 5 and for feeding the furnace with fuel when starting the same and for
10 cleaning out the ash-pit, &c. The water-sections 5 are located above the fire-pot 6, each of which water-sections consists of a hub 7, from which radiates a series of water-arms 8, each of which water-arms 8 consists of a tubu-
15 lar pipe triangular-shaped in cross-section and of any desirable form and shown in the drawings in this instance to consist of an isosceles triangle the equal sides of which radiate from the hub 7. The object of making
20 the sections triangular-shaped in cross-section is to allow the ashes, &c., to fall off the arms into the fire-pot.

In Fig. 3 of the drawings each of the water-sections 5 is shown to consist of six water-
25 arms radiating from the hub 7, said hub and water-arms being hollow and cast in one piece, the space between the walls forming a water-chamber 7^a, which is divided into six equal parts by diaphragms 13, radiating from the
30 inner wall 7^b of the hub to the angle 8^c, formed by the junction of the inner tubular sides of said water-arms.

The hub 7 is shown in Fig. 3 to be provided with three ingress-ports 11 and three egress-
35 ports 12, located alternately around said hub and equidistant from each other, the ingress-ports 11 being arranged on the lower side of said hub and located in three alternate spaces between said diaphragms 13 and the three
40 egress-ports 12 arranged on the upper side of said hub in the remaining three spaces.

Again, by reference to Fig. 3 of the drawings it will be noticed that the fluid enters the water-sections 5 by means of the ingress-
45 ports 11, then circulates upward simultaneously through each of the adjacent tubes 6^a of two adjacent arms 6. It then circulates round the base 6^b of said water-arms and then inward through each of the opposite tubes 6^c
50 and enters the water-chamber in the hub, said hub being fitted with egress-ports 12, through which egress-ports the fluid passes to the water-section above and enters said water-section by means of said ingress-ports 11,
55 circulates through each of said water-arms, as before described, and continues to circulate from water-section to water-section until it reaches the water-head 14, to which are connected the flow-pipes 15, from whence it
60 is carried off by said flow-pipes leading to their respective destinations. The inner face of the hub 7 is screw-threaded to engage with the screw-threaded outer face of the coupling-nipple 9, which coupling-nipple 9 is provided
65 on its inner face with a holding-surface 10 for the coupling tool or wrench.

In threading the inner face of the hub 7 I

find it preferable to cut a right thread on the upper end of the hub and a left thread on the lower end of said hub and to provide the up- 70
per half of said coupling-nipple with a right thread and the lower half of said nipple with a left thread, so that as the nipple is turned by the coupling tool or wrench it draws the hubs of two water-sections simultaneously to- 75
ward each other, and by the insertion of any suitable packing between each pair of hubs they are rendered perfectly water-tight. As the nipple and hubs are subjected to the same degree of heat, they expand and contract uni- 80
formly, preventing the leakage that is so common in sectional boilers where the coupling mediums are subjected to a low degree of heat and the water-sections subjected to a high degree. Surrounding each of the joints 85
formed by the union of the water-sections 5 is a circular baffle-plate 5^x to protect said joint from the action of the heat.

The fire-pot 6 consists of an inner wall 16 and an outer wall 17, surrounding said inner 90
wall. Between the walls 16 and 17 is a space 18, which serves as a water-chamber, which water-chamber forms one of the water-sections of said furnace. The walls 16 and 17 are vertical to a point 16^a, which point is also 95
level with the top of the vertical side of the upright grate 23. From the point 16^a the walls 16 and 17 gradually taper inward to the fuel-magazine 17^a, which magazine is formed by the juncture of the hubs 7 of the water- 100
sections 5.

Passing diametrically across the base of the fire-box and connecting the lower end of the fire-pot water-section 18, with the lower end of the water-space 2 in the furnace-shell 1 is 105
a water-leg 19, in which water-leg are formed vertical bearings 20 to receive the lower end 21 of the spindle 22, supporting the upright grate 23.

The lower end 21 of the spindle 22 is pro- 110
vided with an ingress-port 24 and with an egress-port 25, while dividing said spindle 22 into two parts is a diaphragm 26 to divert the course of the fluid in the passage-way across the water-leg 19 from the water-space 115
2 through the upright grate 23, through which upright grate it circulates and becomes heated by the action of the heated products of combustion from the fire above said grate.

The upright grate consists of any suitable 120
number of tubular bars 27, these bars being vertical to a point 16^a level with the top of the vertical part of the fire-pot. The lower ends of these bars are inserted in and connected together by means of a hollow rim 28, while 125
the tops of said bars above the level of the vertical part taper inward to a common apex 29 and form thereat a water-chamber 30. The apex of the grate is directly beneath the center of the middle of the coal-magazine, and 130
the incline of the upper portions of the tubular grate-bars 27 is sufficient to distribute the coal evenly into all parts of the vertical space 31 between the upright grate 23 and the inner

wall 16 of the fire-pot. The space 31 between the upright grate 23 and the fire-pot walls 16 is sufficient to admit the necessary amount of fuel to produce the requisite amount of heat.

5 The rim 28 of the upright grate 23 is provided with a shaker 32, consisting of a hollow tube fitted with a faucet for the purpose of draining off the grate water-section when draining the furnace.

10 The spindle 22 is provided with a circular baffle-plate 50 to protect the bearings 20 and lower end 21 of said spindle against the action of the heated air and heated products of combustion from the fire above.

15 It might here be stated that the walls of the fire-pot 6 are corrugated from the base to a point level with the line 16^a, which corrugations are enlarged at their inner ends 33 to allow any cinders or fuel which might become
20 jammed in said corrugations to fall into the ash-pit beneath the fire-box.

Entering the furnace from the outer wall 1^a is a tubular passage-way or air-duct 34, which extends from said outer wall 1^a to the
25 outer wall 17 of the fire-pot 6, where it connects with a passage-way 35 through said fire-pot, which passage-way leads to the enlarged inner ends 33 of the corrugations on the walls of the fire-pot. The air enters the passage-
30 way 35 by means of the air-ducts 34, said passage-way 35 acting as an air-chest distributing the air equally to all of the corrugations 32 of said fire-pot wall.

The air-ducts 34 and distributing-chamber
35 35 are each located above the level of the top of the fire, and the object of this arrangement of passage-ways is to supply the fire with a downward current, which downward current assists the decomposition of the fuel
40 and carries the gases produced by such decomposition downward from the space between the upright grate-bars 27 into a combustion-chamber 23^a, located on the under side of the upright grate, which chamber is
45 supplied with a secondary draft, said secondary draft combining sufficient oxygen with the gases generated by the decomposing fuel to cause all the inflammable properties of the combination to be entirely destroyed, per-
50 mitting only the non-combustible elements to pass to the outlet to the chimney.

Each water-section 5 is in circulation with the remaining water-sections and with the water-head 14, which water-head is divided
55 by diaphragm 38 to divert the flow of water through said head toward the water-wheel 36 before permitting it to pass through the flow-pipes 15, which flow-pipes lead to their respective destinations. The water-wheel 36
60 operates a blower, (not shown in the drawings,) which blower is connected to the passage-ways 34 by means of a duct 37 (see Fig. 1) and forces a current of fresh air through said passage-way 34 to the air-chest 35, whence
65 it is distributed to the fire-pot.

In place of using a blower operated by the water-wheel I may, if I so desire it, employ a

blower 61, operated by the heated air and gases passing through the outlet 62 to the chimney.

70 Connecting the chamber 63, in which is located the blower 61, with the air-duct 34 is a duct 64, cone-shaped at its lower end 64^a, which end enters the air-duct 34, so that a certain quantity of heated air is forced down
75 said duct 64 and will enter into said passage-way 34, which heated air in entering said passage-way 34 sucks in with it a certain amount of fresh air from the outside. These air-blowers may be of any ordinary style convenient
80 for the purpose.

By reference to Fig. 3 of the drawings it will be noticed that three alternate water-arms have an open middle to permit the free
85 upward current of heated air, while the remaining three water-arms have a closed or partially-closed middle, which act as baffle-plates to divert the upward current of heated air across the under side of each of the water-arms before permitting it to ascend farther.
90

In putting the furnace together the first water-section is coupled to the top of the fire-pot by means of the coupling-nipple 9, the second water-section 5 being coupled to the first water-section by means of a corresponding nip-
95 ple 9. The water-arms of the second water-section having the closed middles are placed vertically above the water-arms of the first water-section having the open middles, and the water-arms of the second water-section hav-
100 ing the open middles are placed vertically above the water-arms of the first water-section having the closed middles, this same arrangement being carried out through all of the water-sections.
105

The object of placing the water-arms with the closed middles vertically above the water-arms with the open middles and the water-arms with the open middles vertically above the water-arms with the closed middles is to
110 give the upward current of heated air a zig-zag course—that is, the heated air is permitted to ascend through the water-arms with the open middles which in its upward course comes in contact with the under sides of the
115 water-arms with the closed middles, said water-arms with the closed middles acting as baffle-plates directing the course of the heated air across the under sides of said water-arms before permitting it to ascend through to the
120 next section.

Between each of the water-arms 8 is a space 9^a to permit the heated air, gases, &c., to ascend, and located on each alternate space 9^a is a baffle-plate 9^b, said baffle-plates being lo-
125 cated alternately vertically above each other.

I may, if I so desire it, provide the furnace with an oven or series of ovens 15^a, as shown in Fig. 6 of the drawings, which ovens are of
130 any desirable shape, fitted with a hub corresponding to the hub 7 of the water-sections 5, which hubs form part of the coal-magazine. The coal is fed through a feeder 41 into the coal-magazine formed by the hubs 7 and is

distributed evenly to all parts of the fire-box by means of the funnel-shaped mouth formed by the walls 16 of the fire-pot 6. The draft or current of air enters the furnace by means of the air-duct 34, connected with an air-chest 35, which air-chest 35 supplies the corrugations 32, through which corrugations the draft is introduced to the fire. By an arrangement of air-passages of this kind a draft of equal force is admitted to all parts of the fire, causing equal combustion and heat at all parts of the fire-box. The air after entering the fire-pot 6 passes downward through the fire, assisting the decomposition of the fuel, and in its downward course forces the gases caused by the decomposition of the fuel to enter the combustion-chamber 23^a, located on the under side of the upright grate 23.

The combustion-chamber 23^a is supplied with an auxiliary current of air, which mixes with the carbonic gases of the decomposing fuel, the inflammable properties of which combination are entirely destroyed in said combustion-chamber 23^a and only the non-combustible elements are permitted to escape to the outlet to the chimney. Said auxiliary current of air may enter the combustion-chamber 23^a from any suitable source. The products of combustion after leaving the combustion-chamber 23^a pass around the lower end of the walls of the fire-pot and then ascend through the chamber 43, formed between said fire-pot walls and the inner shell 1^a of the furnace, which products of combustion in their upward passage heat the water-section 2 in the casing of the furnace and each of the water-sections 5, and said products of combustion after passing upward to the top of said chamber 43 are carried off through the outlet 44 to the chimney.

The course of the water in the furnace is as follows: The water enters the water-section 2 by means of the return-pipes 3, then circulates downward through said water-section 2 to the water-leg 19, through a portion of which water-leg it passes until it reaches the ingress-port 24 in the lower end 21 of the spindle 22, which spindle supports the grate 23. The water after entering the ingress-port 24 passes upward through said spindle to the water-chamber in the top of the upright grate 23, passes down the tubular grate-bars on one side of said diaphragm to the rim 28, around which rim it circulates until it has cleared the diaphragm 26. The water after passing round the rim 28 and clearing the diaphragm 26 passes upward through the tubular grate-bars on the opposite side of said upright grate 23 and then down the egress side of said spindle 22 and out through the egress-port 25 into the water-leg 19, through which water-leg it passes to the fire-pot water-section 18, from which water-section 18 it passes to the first water-section 5 above said fire-pot 6 and then from water-section to water-section until it reaches the water-head 14, from whence it is carried

off by flow-pipes 15, leading to their respective destinations.

The object of providing the grate with an upright spindle journaled in upright bearings in the water-way is to allow of the grate being turned on said spindle by the shaker for the purpose of removing the ashes, cinders, &c., from the grate-bars. By a construction of this kind the flow of water across the water-way and through the grate is not interfered with in the slightest degree, the circulation at all times being the same.

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

1. In a furnace, the combination of a hollow conical grate forming a water-section, a water-section forming a fire-pot surrounding the grate and in circulation therewith, and a series of circular water-sections in the upper portion of the furnace in circulation with the fire-pot.

2. In a furnace, the combination of a casing forming a water-section, a hollow fire-pot arranged concentrically therein and forming a water-section in circulation therewith, and a hollow grate arranged concentrically within the fire-pot and in circulation therewith and with the casing.

3. In a furnace for heating purposes, a fire-grate consisting of any suitable number of upright tubular bars tapering to a common apex at their upper ends, the lower ends of said bars connected together by a rim, and suitable means for supporting said grate within the fire-box, substantially as described.

4. In a furnace for heating purposes, a grate consisting of any suitable number of upright tubular bars, the upper ends of which taper to a common apex and form thereat a chamber suitable for a water-space, the lower ends of said bars connected together by a hollow rim, said bars serving as water-ways between the chamber at the top and the hollow rim, and suitable means for supporting said grate and providing means for circulation of water through the water-chambers in said grate, substantially as described.

5. In a furnace for heating purposes, a grate consisting of any suitable number of tubular bars tapering on their upper ends to a common apex and forming thereon a chamber suitable for a water-space, the lower ends of said bars connected together by a hollow rim, said bars serving as water-ways between the chamber at the top and said hollow rim, said upright grate provided with a spindle, the lower end of which is journaled in bearings formed in a water-leg passing across the base of the fire-box and in circulation with one or more water-sections of the furnace, substantially as described.

6. In a furnace for heating purposes, a grate consisting of any suitable number of upright tubular bars, the upper ends of which taper to a common apex and the lower ends of which

are connected together by means of a rim, and a chamber formed between the inner sides of said tubular bars serving as a combustion-chamber, said grate suitably supported in the fire-box, substantially as described.

7. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which taper to a common apex and form a chamber thereat suitable as a water-space, the lower ends of said bars connected together by a hollow rim, said bars connecting the water-space at top of said grate with said hollow rim and serving as water-ways between them, and a chamber formed between the inner sides of said bars, which chamber is utilized as a combustion-chamber, said grate suitably supported within said fire-box, substantially as described.

8. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which taper to a common apex and form thereat a chamber suitable for a water-space, the lower ends of said bars connected together by a hollow rim, said bars serving as water-ways between said water-space and hollow rim, said upright grate suitably supported within the fire-box, a water-way connecting said grate with one or more of the water-sections of said furnace, substantially as described.

9. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which bars taper to a common apex and form thereat a chamber suitable for a water-space, the lower ends of said bars connected together by a hollow rim, said bars serving as water-ways between said chamber and said hollow rim, said upright grate supported by a hollow spindle, the lower end of which is journaled in suitable bearings, said grate being divided into two sections by a diaphragm, said grate in circulation with one or more water-sections of the furnace, said diaphragm diverting the course of the flow of water through said grate, substantially as described.

10. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which taper to a common apex and form thereat a chamber suitable for a water-space, the lower ends of said bars connected together by a hollow rim, said grate supported by a hollow spindle, said grate and spindle divided into two sections by a diaphragm, the lower end of said spindle journaled in bearings formed in the water-way passing across the fire-box, said diaphragm diverting the flow of water from said water-way through said upright grate, substantially as described.

11. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which taper to a common apex and form thereat a chamber suitable as a water-space, the lower ends of said bars connected together by a hollow rim, said bars serving as water-ways between said

chamber and said hollow rim, and a chamber formed between the inner sides of the upright bars and used as a combustion-chamber, said grate supported by a spindle, the lower end of which is journaled in suitable bearings, said grate and spindle divided by a diaphragm, said grate and spindle being in circulation with one or more water-sections of the furnace, substantially as described.

12. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which taper to a common apex and form thereat a chamber suitable for a water-space, the lower ends of said bars connected together by a hollow rim, said bars serving as water-ways between said chamber and hollow rim, said grate supported by a hollow spindle, the lower end of which spindle is journaled in bearings formed in the water-way passing across the base of fire-box, said water-way connecting the water-space in the casing of the furnace with the water-space in the fire-pot walls, said spindle fitted with an ingress-port and an egress-port in that portion of it in said water-way, said grate and spindle divided by a diaphragm to divert the flow of the water from the water-space in the casing of the furnace across said water-way through said grate to the water-space in the fire-pot walls, substantially as described.

13. In a furnace for heating purposes, a grate consisting of any suitable number of tubular bars tapering on their inner ends to a common apex and forming thereat a chamber suitable for a water-space, the lower ends of said bars connected together by a hollow rim, said bars serving as water-ways between the chamber at the top and said hollow rim, said upright grate provided with a spindle, the lower end of which is journaled in bearings formed in a water-leg passing across the base of the fire-box and in circulation with one or more water-sections of the furnace, said spindle fitted with a baffle-plate to protect the bearings and heated products of combustion from the fire above, substantially as described.

14. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which taper to a common apex and the lower ends forming thereat a chamber suitable for a water-space, the lower ends of said bars connected together by a hollow rim, said bars serving as water-ways between said chamber and said hollow rim, said upright grate supported by a hollow spindle, the lower end of which is journaled in suitable bearings, said grate being divided into two sections by a diaphragm, said grate in circulation with one or more water-sections of the furnace, said diaphragm diverting the course of the flow of water through said grate, said spindle fitted with a baffle-plate to protect the bearings and lower end of said spindle against the action of the heated air and products of combustion from the fire above, substantially as described.

15. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which taper to a common apex and form thereat a chamber suitable for a water-space, the lower ends of said bars connected together by means of a hollow rim, said grate supported by a hollow spindle divided into two sections by a diaphragm, the lower end of said spindle journaled in bearings formed in the water-way passing across the fire-box, said diaphragm diverting the flow of water from said water-way through said upright grate, said spindle fitted with a baffle-plate to protect the bearings and lower end of said spindle against the action of the heated air and heated products of combustion from the fire above, substantially as described.

16. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which taper to a common apex and form thereat a chamber suitable as a water-space, the lower ends of said bars connected together by means of a hollow rim, said bars serving as water-ways between said chamber and said hollow rim, and a chamber formed between the inner sides of the upright bars and used as a combustion-chamber, said grate supported by a spindle, the lower end of which is journaled in suitable bearings, said grate and spindle being in circulation with one or more water-sections of the furnace, said spindle provided with a baffle-plate to protect the bearings and lower end of said spindle against the action of the heated air and heated products of combustion from the fire above, substantially as described.

17. In a furnace for heating purposes, a grate consisting of any suitable number of upright bars, the upper ends of which taper to a common apex and form thereat a chamber suitable for a water-space, the lower ends of said bars connected together by a hollow rim, said bars serving as water-ways between said chamber and hollow rim, said grate supported by a hollow spindle, the lower end of which spindle is journaled in bearings formed in the water-way connecting the water-space in the casing of the furnace with the water-space in the fire-pot walls, said spindle fitted with an ingress-port and an egress-port in that portion of it in said water-way, said grate and spindle divided by a diaphragm to divert the flow of the water from the water-space in the casing of the furnace across said water-way through said grate to the water-space in the fire-pot walls, said spindle fitted with a baffle-plate to protect the bearings and lower end of said spindle against the action of the heated air and heated products of combustion from the fire above, substantially as described.

18. In a furnace for heating purposes, a water-section consisting of a hub, a series of tubular water-arms radiating outwardly from said hub, the water-space in said hub and water-arms divided into any number of cham-

bers, which chambers radiate outwardly from the inner wall of said hub, ingress-ports located on the under side of said hub in each alternate chamber, and an egress-port located on the upper side of said hub in the remaining chambers, substantially as described.

19. In a furnace for heating purposes, a water-section consisting of a hub and any suitable number of water-arms radiating outwardly from said hub, the water-space formed by said arms and hub divided into any number of chambers, and an ingress-port entering into each alternate chamber from the under side of said hub, and an egress-port entering out of the remaining chambers on the upper side of said hub, said water-arms consisting of a tubular pipe triangular-shaped in cross-section, substantially as described.

20. In a furnace for heating purposes, a water-section consisting of a hub from which radiates a series of water-arms, each of which water-arms consists of a tubular pipe triangular-shaped in cross-section, said hub and water-arms being hollow and the space between them divided into any number of water-chambers by diaphragms radiating from the inner wall of said hub, each alternate chamber provided with an ingress-port and the remaining chambers provided with egress-ports, each of said water-arms consisting of two outwardly-radiating water-ways connected together at their outer ends, said ingress-ports so arranged that the water entering the chamber between two diaphragms flows outwardly through two adjacent water-ways of two adjacent water-arms and inward again to the hub through two remote water-ways of said water-arms, substantially as described.

21. In a furnace for heating purposes, a fire-pot consisting of double walls vertical from the base to a point level with the top of the fire-pot, from which point they taper inwardly to the coal-magazine, the space between said walls utilized as a water-space and connected to the water-space in the casing of the furnace by means of a water-leg passing across the base of the fire-box, said water-leg supporting the fire-grate, which fire-grate is hollow and forms one of the water-sections of said furnace, said fire-pot water-section in circulation with the remaining water-sections in the furnace, substantially as described.

22. In a furnace for heating purposes, the combination of a fire-pot, the walls of which taper to form a funnel-shaped mouth on the lower end of the coal-magazine, and a series of water-sections, each of which consists of a hub and any suitable number of water-arms radiating from said hub, said hubs and upper end of funnel-shaped mouth of coal-magazine screw-threaded on their inner faces to receive a coupling-nipple, said coupling-nipple provided on its inner face with a holding-surface for the coupling tool or wrench, said sections and fire-pot coupled by means of said nipples, substantially as described.

23. A furnace for heating purposes, consisting of a casing composed of an inner shell and an outer shell, a water-space between said shells, a fire-grate having a water-chamber 5 formed therein, a water-chamber in said fire-grate connected with water-chamber in the casing of the furnace by means of a water-leg, a fire-pot consisting of double walls with a water-space between them, the water-space 10 in said fire-pot in circulation with water-space in fire-grate, and a series of water-sections in circulation with the fire-pot water-section and with each other and with a water-head, to which are connected the flow-pipes leading 15 to their respective destinations, and the return-pipes connected to water-chamber in said casing, substantially as described.

24. A furnace for heating purposes, consisting of an outer and inner shell having a water-space between them, a hollow fire-grate 20 having formed therein a water-chamber, which water-chamber is connected to the water-space in casing of said furnace by means of a suitable water-leg, a fire-pot having a water-chamber formed therein, which water-chamber is connected to a water-chamber in the fire-pot by means of the water-leg, a series 25 of water-sections located above the fire-pot, each of which consists of a hub and any suitable number of water-arms radiating from said hub, said sections suitably connected together and in circulation with the other water-sections of the furnace and with a water-head, to which water-head are connected the flow- 30 pipes of the furnace, leading to their respective destinations, and the return-pipes entering said water-chamber in the casing of the furnace, substantially as described.

25. In a furnace for heating purposes, consisting of an outer and inner shell with a water-chamber between them, a fire-grate 40 having a water-chamber formed therein, which water-chamber in the fire-grate being in circulation with the water-chamber in the casing of the furnace, a fire-pot consisting of two walls with a water-space between them, which water-space is in circulation with the water-space in the fire-grate, a series of water- 45 sections located above the fire-pot, each of which water-sections consists of a hub and any suitable number of water-arms radiating from said hub, the chamber formed in said hub and water-arms divided into any number of sub-chambers by diaphragms, an ingress-port 50 entering into each alternate sub-chamber, and an egress-port entering out of the remaining chambers, substantially as described.

26. A furnace for heating purposes, consisting of a casing composed of an inner and outer 60 shell, a water-space between said shells, a fire-pot having formed therein a water-space, which water-space is connected with a water-space in the casing of the furnace, a fire-pot having formed therein a water-chamber, 65 which water-chamber is in circulation with the water-space in the fire-grate, the walls of which fire-pot taper inward at their upper

ends and form a funnel-shaped mouth for the coal-magazine, a series of water-sections located above said fire-pot, each of which water-sections consists of a hub and any suitable 70 number of water-arms radiating outward from the inner wall of said hub, said hubs and upper end of fire-pot screw-threaded on their inner faces to receive the coupling-nipple, 75 which coupling-nipple is provided on its inner face with a holding-surface for the coupling tool or wrench, and a water-head in circulation with said water-sections, to which water-head are connected the flow-pipes leading 80 to their respective destinations, return-pipes being connected to the water-chamber in the casing of the furnace, substantially as described.

27. A furnace for heating purposes, provided 85 with a fire-box consisting of a fire-pot, the inner walls of which are corrugated and the inner ends of said corrugations enlarged, a grate consisting of upright tubular bars connected together at the top and bottom, a fuel-space 90 between the bars of said upright grate and the inner walls of said fire-pot, and a combustion-chamber between the inner sides of said grate-bars, substantially as described.

28. A furnace for heating purposes, provided 95 with a fire-box, which fire-box consists of a fire-pot, the walls of which fire-pot are upright to a certain point, then taper inwardly and form a funnel-shaped mouth for the coal-magazine, the inner walls of said fire-pot cor- 100 rugated to the top of the vertical level, said corrugations enlarged on their inner ends, a grate consisting of upright bars connected together at their base by a rim and their upper ends tapered inwardly to a common apex, 105 and a combustion-chamber formed on the inner side of the grate-bars, said grate suitably supported in said fire-box, substantially as described.

29. A furnace for heating purposes, provided 110 with a fire-box consisting of a fire-pot, the walls of which are vertical to a certain point and taper from said point inwardly, forming a funnel-shaped mouth for the coal-magazine, the inner walls of said fire-pot corrugated, the 115 inner ends of which corrugations are enlarged, a fire-grate consisting of upright bars vertical to a point level with the top of the vertical part of fire-pot walls and tapering from said point to a common apex, a combustion-cham- 120 ber formed on the inner sides of said grate-bars, and a fuel-space between said space and fire-pot walls, substantially as described.

30. A furnace for heating purposes, provided 125 with a fire-box consisting of a fire-pot, the walls of which fire-pot are vertical to a certain point and taper from such point inwardly and upwardly, forming a funnel-shaped mouth for the coal-magazine, the inner walls of said fire-pot being corrugated on the vertical portions, 130 said corrugations enlarged on their inner ends, a water-chamber formed in the said fire-pot walls, a fire-grate consisting of upright tubular grate-bars, the upper ends of which taper

inward to a common apex, forming at the top a water-chamber, a hollow rim connecting the lower ends of said grate-bars, said grate-bars serving as water-ways between said chamber
 5 at the top and said hollow rim, said grate supported by a spindle journaled in bearings formed in the water-way passing across the base of said fire-box from the water-chamber in the casing of furnace to water-chamber in
 10 the fire-pot walls, the water-space in said fire-grate being in circulation with water-space in the casing of the furnace and with fire-pot water-space, the casing of the furnace consisting of an inner and outer shell with water-
 15 space between them, which water-space is in circulation with the water-space in fire-grate and fire-pot, a series of water-sections located above said fire-pot, each of which water-sections consists of a hub and any suitable num-
 20 ber of water-arms radiating outward from said hub, and a water-head located above said water-sections, the return-pipes entering water-section in the casing of the furnace, and flow-pipes leading from the water-head, the fire-
 25 grate being provided with a hollow shaker fitted with a faucet, substantially as described.

31. A furnace for heating purposes, consisting of a series of water-sections, which water-sections are composed of a hub and any suit-

able number of water-arms radiating outward 30 from said hub, said hubs screw-threaded on their inner faces and coupled by means of a nipple having a right and left thread cut on its outer face and fitted on its inner face with a holding-surface for the coupling tool or 35 wrench, and a circular baffle-plate surrounding each of the joints formed by the union of the hubs of said sections, substantially as described.

32. A furnace for heating purposes, consisting of a series of water-sections, each of which is composed of a hub and any suitable number of water-arms radiating from said hub, said hubs screw-threaded on their inner faces and coupled together by means of a nipple 45 having a right and left screw-thread cut on its outer face and fitted on its inner face with a holding-surface for the tool or wrench, a baffle-plate surrounding each of the joints formed by the union of said water-sections, and 50 suitable packing between said baffle-plate and hub, substantially as described.

Toronto, July 16, 1891.

GEO. ALFRED WATSON.

In presence of—

CHAS. H. RICHES,
 ROBERT LAIRD.