No. 719,439. PATENTED FEB. 3, 1903.

# N. CURTIS.

## BOILER.

APPLICATION FILED APR. 27, 1900.

NO MODEL.

Fig. 1.

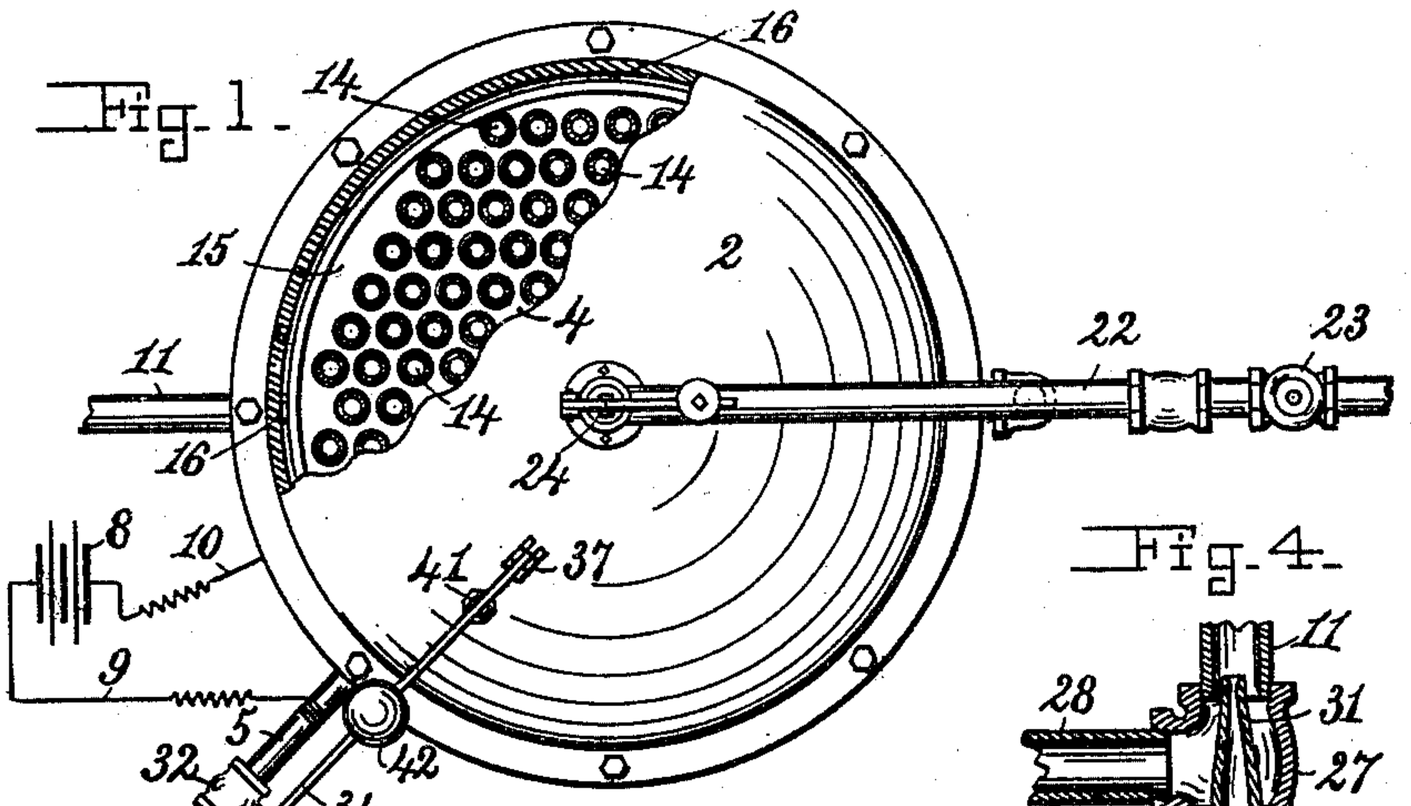



Fig. 4.




Fig. 3.

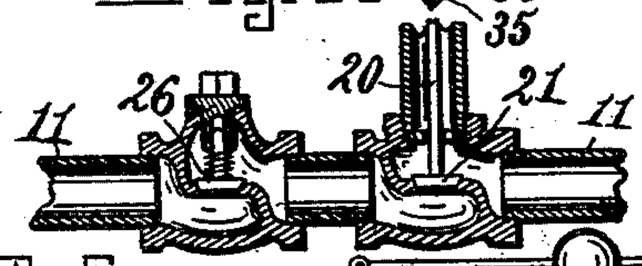



Fig. 2.

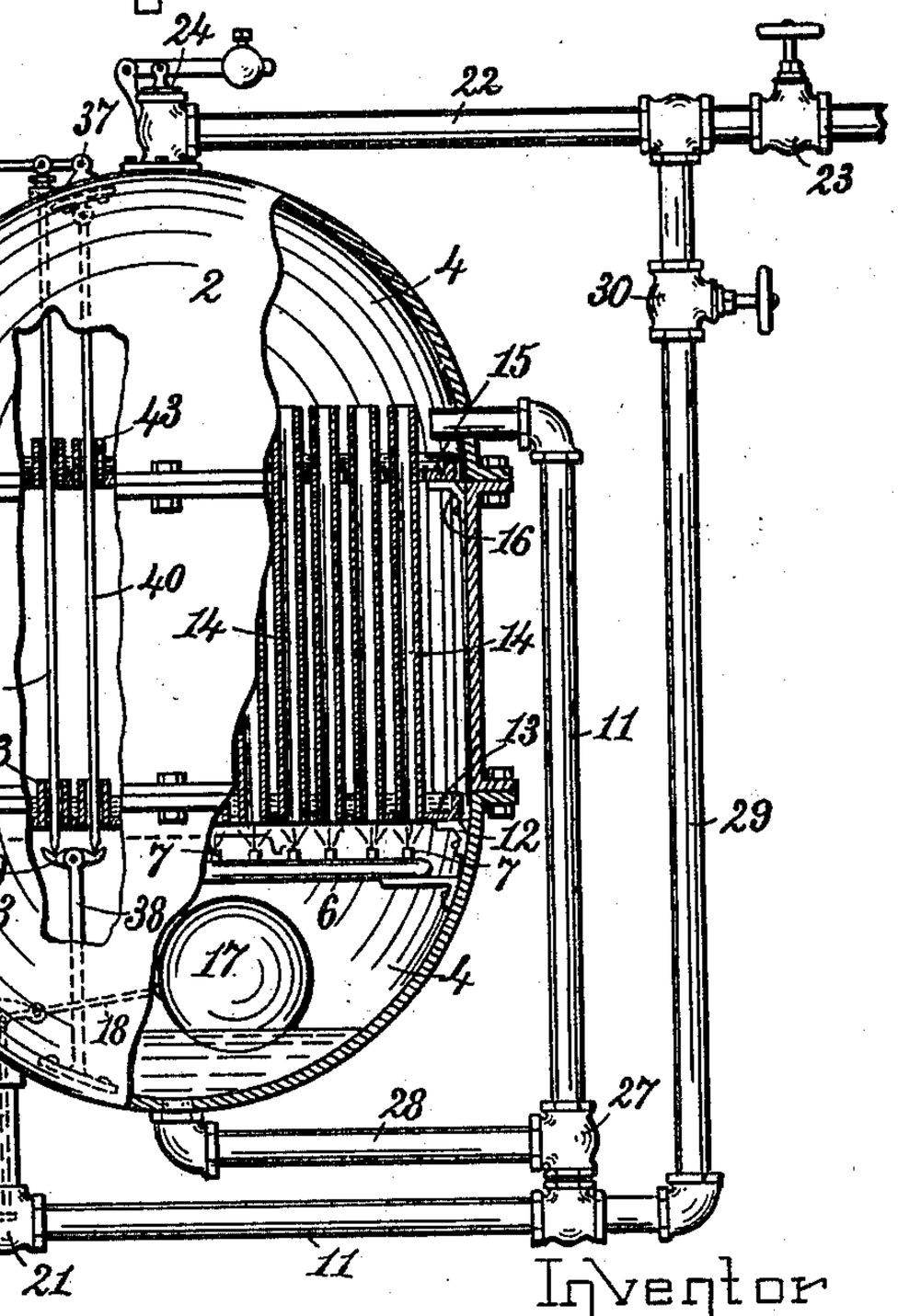
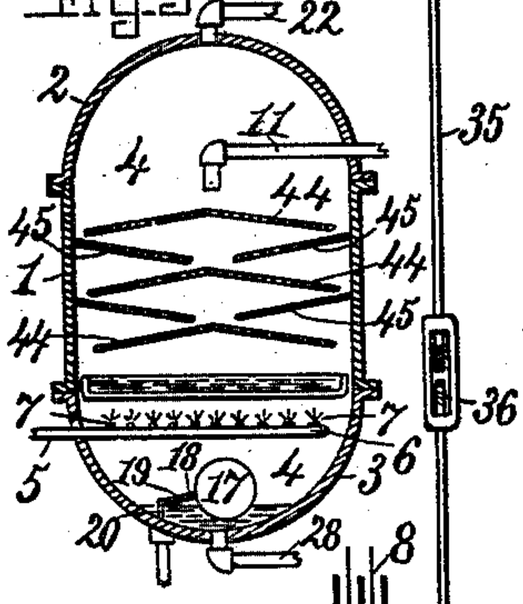



Fig. 5.




Witnesses
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# UNITED STATES PATENT OFFICE.

NELSON CURTIS, OF BOSTON, MASSACHUSETTS.

## BOILER.

SPECIFICATION forming part of Letters Patent No. 719,439, dated February 3, 1903.

Application filed April 27, 1900. Serial No. 14,611. (No model.)

*To all whom it may concern:*

Be it known that I, NELSON CURTIS, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Boilers, of which the following is a specification.

This invention relates to improvements in boilers in which power is generated from the combustion of inflammable material; and it has for its object to provide means whereby the entire products of the combustion will be converted into power within the boiler, thus obviating the usual wasting of such products; and it has also for its object to provide means whereby water or other fluid may be quickly converted into vapor or gas by the heat generated by the combustion of the inflammable material, and thereby increase the efficiency of the boiler.

The invention consists of a casing containing the generating-chamber, a supply of inflammable material carried into said casing and chamber, being provided with suitable burners located within the generating-chamber and at which it is burned, the inflammable material supplied either being a combination of gases or other material which will unite chemically when ignited at the burners or being of such a nature that it will combine chemically with the contents of the generating-chamber when ignited at the burners.

It consists also in the combination, with the above generating-chamber, its contained burners, and supply of inflammable material, of a series of either or both partitions and tubes through which the products of the combustion of the inflammable material are conveyed from the burners and also in a fluid-supply entering the generating-chamber and brought into contact with the heating partitions and tubes in small quantities, whereby it is quickly converted into vapor or gas by the heat in the heating partitions and tubes; and it consists, further, in means whereby there will be a constant circulation of the fluid from the upper to the bottom part of the boiler and then from the bottom to the upper part of the boiler; also, in minor details of construction, arrangement, and combination of parts, fully described hereinafter and claimed.

The invention is carried out substantially as illustrated on the accompanying drawings, forming an essential part of this specification, and whereon—

Figure 1 represents a plan view of my improved boiler, showing a portion of the casing broken away to disclose internal construction. Fig. 2 represents a side elevation of my improved boiler, also showing portions as being broken away to disclose internal construction. Fig. 3 represents a detail longitudinal section of the valves used to control the supply of fluid to the boiler. Fig. 4 represents a detail longitudinal section of a portion of the device used to cause the continued circulation of the fluid in the boiler. Fig. 5 represents diagrammatically a section of a modified form of the interior of the boiler.

Like characters of reference refer to like parts wherever they occur on the different parts of the drawings.

The casing as shown is made with the cylindrical central portion 1 and the respective upper and lower dome-shaped portions 2 and 3; but it may be made in any other desired and convenient shape. The entire interior of the casing forms the power-generating chamber 4. A pipe 5 leads from a supply of inflammable material and enters the generating-chamber through the dome-shaped portion 3 of the casing, where it is supplied with a burner 6, having any desired number of tips 7, and at which tips the inflammable material is burned, it being ignited, preferably, by means of an electric spark from a source of electricity 8, conveyed to the burner-tip by the electric circuit consisting of the conductors 9 and 10 and a part of the pipe 5, or it may be ignited by any other suitable means. The inflammable material supplied through the pipe 5 may be of such a nature that it will combine with the contents of the generating-chamber when ignited, or it may be a proper combination of materials which will themselves combine with each other when ignited and produce heat.

A supply-pipe 11 leads from a supply of fluid and enters the upper part of the generating-chambers through the dome-shaped portion 2, which pipe is supplied with the neces-

sary valves and fitting, as hereinafter described. The fluid supplied to the boiler through the pipe 11 may be water or any other desired fluid; but I shall explain it in this specification as being connected to a supply of water.

Upon brackets 12 or other means of support within the generating-chamber is placed the perforated partition 13, which is preferably upwardly dished, as shown, and which is of such a size as to nearly extend to the walls of the generating-chamber. Within the perforations in this partition are attached the lower ends of the heating-tubes 14 14 in such a manner that the tubes project upward in the generating-chamber, and by having the partition dished, as shown, and the tubes tightly secured therein the dished partition may be kept filled with water, any surplus overflowing into the lower part of the generating-chamber. The upper ends of the tubes 14 project loosely through perforations in a second partition 15, which is also preferably dished, as shown, and which is supported on suitable brackets 16 on the casing or otherwise. This partition, like the partition 13, nearly fills the cross-sectional area of the generating-chamber, for a purpose to be understood by a further description of the device. The fluid from the pipe 11 is delivered into the dished partition 15, and it flows through the perforations in said partition around the tubes 14, which pass loosely through said perforation, and follows the tube downward to the dished partition 13, from which latter partition it overflows into the lower part of the casing. Any surplus water in the upper partition also overflows to the lower partition or to the lower part of the boiler.

The tubes 14 are so arranged that they convey the greater part of the products of combustion of the inflammable material from the burner to the upper part of the generating-chamber, while the remainder of said products ascend through the space between the partitions 13 and 15 and the walls of the casing.

As the dished portion of the partitions is shallow and the volume of the water which passes from the upper partition downward around the tubes is thin, it will be understood that the effect of the heat generated by burning of the inflammable material is to quickly convert the greater part of the water thus exposed to steam. Any water which is not converted to steam fills the dished partition 13 and then overflows into the bottom of the boiler, where substantially a uniform amount of water is maintained by means of a float 17, attached to one end of a float-rod 18, which is fulcrumed at 19 to the casing and is connected at its opposite end to the valve-stem 20 of the valve 21, which it controls by the movements of said float and which is introduced within the supply-pipe 11 and opens or closes said supply-pipe. The float is so arranged that it opens the valve 21 when the water in the lower part of the boiler falls below a certain level and closes said valve when that level is reached.

The top of the boiler is provided with an outlet or discharge pipe 22, by which the power generated in the boiler is conveyed to an engine or other motor or to any other place where such power is to be used or is needed, and this discharge-pipe is provided with a suitable valve 23 to control the flow of motive power through said pipe. The boiler is also supplied with a suitable safety or relief valve 24 of any desired construction.

The fluid-supply pipe 11 is provided with a valve 25, whereby the flow of fluid through said pipe may be controlled by hand, if so desired. Said pipe is also provided with a check-valve 26 of any suitable construction to prevent a flow in said pipe in a direction away from the boiler.

Interposed within the fluid-supply pipe 11 is a T-fitting 27, which is also connected to and in open communication with the bottom of the boiler by means of the pipe 28. The discharge-pipe 22 is connected to and in open communication with the supply-pipe 11 on the supply side of the fitting 27 by means of the pipe 29, which is controlled by a valve 30. Within the fitting 27 is placed a nozzle 31, substantially as shown in Fig. 4, and which is so arranged that the flow of fluid through the pipe 11 will pass through said nozzle, and by its influence the water in the bottom of the boiler is drawn through the pipe 28 into the pipe 11 and delivered from the pipe 11 into the top of the boiler. It will thus be seen that the flow of water through the pipe 11 from the water-supply will act to cause a circulation of the water from the bottom of the boiler to the top of the boiler through the pipes 28 and 11; but as there is not a continual flow of water through the pipe 11 I introduce a supply of motive fluid from the discharge-pipe 22, through the pipe 29 and into the pipe 11, so that this motive fluid will pass through the nozzle in place of the water from the water-supply and act upon the water in the bottom of the boiler in the same manner as the water from the water-supply acts. This supply of motive fluid through the pipe 29 may be controlled by the valve 30. In order to regulate the temperature within the boiler, I provide the same with a suitable regulating device acting upon the supply of inflammable material in order to increase or diminish it, as necessary. This regulating device is perferably constructed substantially as follows and shown on the drawings: A valve 32 is placed within the supply-pipe 5 and has its operating-handle 33 connected to the outer end of a lever 34 by means of a connecting-rod 35, which connecting-rod is made adjustable in length by means of a right and left threaded turnbuckle 36 for a purpose to be understood by

a further description of the device. The lever 34 is fulcrumed at 37 to the exterior of the boiler.

Within the boiler and preferably at the bottom of the same is placed a standard 38, the upper end of which forms the fulcrum for a short lever 39. Two rods 40 and 41 extend from this short lever up through perforations in the partitions 13 and 15 to the top of the boiler, the upper end of the rod 40 being pivotally attached to the inside of the top of the boiler, while the rod 41 passes through a stuffing-box 42 in the casing of the boiler and is pivotally attached to the lever 34. The rods 40 and 41 are made from metal which expands to a great degree when heated, as does also the support 38. It will thus be seen that as the heat within the boiler increases the support 38 and rods 40 and 41 will be increased in length by the expansion of the metal from which they are made. As the rod 40 is held stationary at its upper end, its expansion will cause the lever 39 to turn upon its fulcrum on the support 38; but as the support 38 is also increased in length by the heat it will cause a further turning of the lever upon its fulcrum, and therefore the end of the lever supporting the rod 41 will be raised. This raising of the end of the lever 39 will cause the rod 41 to be forced upward through the stuffing-box in the boiler-casing and turn the lever 34 upon its fulcrum, so as to raise its outer end, and this movement of the lever 34 will be increased by the expansion of the rod 41. The upward movement of the outer end of the lever 34, through the connecting-rod attached thereto, will cause the handle of the valve 32 to be moved and to gradually shut off the supply of inflammable material through the pipe 5. The lowering of the temperature within the boiler will cause the support 38 and rods 40 and 41 to gradually return to their normal condition or length and allow a weight 42 to gradually turn the outer end of the lever 34 downward, so as to gradually increase the supply of inflammable material through the pipe 5. It will thus be seen that by means of the regulating device above described I am able to automatically maintain substantially a uniform temperature within the boiler, and as the turnbuckle 36 adjusts the length of the connecting-rod, so as to cause the operation of the valve by a greater or less expansion of the rods 40 and 41, it will be seen that I can adjust the degree of temperature which is to be automatically maintained within the boiler by the adjustment of the length of the connecting-rod 35.

In order that the rods 40 and 41 should be exposed to the general temperature within the boiler and not be exposed to the increased temperature of the products of the combustion of the inflammable material while they are conveyed through the heating-tubes, I dispense with the tubes in connection with the perforations in the partition through which the rods pass, but supply said perforations with short thimbles 43 43, tightly secured within the perforations in the partitions and projecting upward sufficiently to retain the desired amount of water upon the partitions.

From the above description of my improved boiler it will be seen that the products of the combustion are entirely contained within the power-generating chamber, that a suitable fluid supplied thereto and quickly expanded by the heat produced by the combustion of the inflammable material may be used in order to add to the efficiency of the boiler, and that by having the partitions placed loosely within the boiler and the tubes attached to one of the partitions I can easily remove the tubes and partitions, when desired, to repair or to clean said parts.

In order to retain the entire heat products of the combustion and prevent radiation of the same through the casing of the boiler, I may inclose the entire boiler within a jacket of asbestos, felt, or other material which is not a conductor of heat.

In Fig. 5 I have illustrated a modified arrangement of the heating-surfaces upon which the fluid from the fluid-supply pipe is delivered and over which it travels on its path to the bottom of the boiler. In this modified form I use a series of partitions or plates 44 44, which are inclined so as to cause the fluid to flow from the center of the boiler, at which place it is delivered from the supply-pipe toward the outside of the boiler, which partitions have a space between their lower edge and the casing of the boiler, allowing the fluid to pass to the next partition or plate. Within the spaces between the partitions 44 I place a second series of partitions or plates 45 45, which are inclined from the outside of the boiler toward the center of the boiler and so that the fluid delivered from the partitions 44 upon the partitions 45, near the casing, will flow toward the center of the boiler and be discharged upon the next lower partition 44. It will thus be seen that the heat from the burners has a zigzag path upward in the boiler, and the fluid has a similar path downward, and are brought into close contact while the fluid is flowing from one partition to the next lower. It will thus be seen that I do not wish to limit myself to the exact construction of the interior of the boiler, that a number of partitions may be used, and that the heating-tubes may be dispensed with, if so desired, the object being to submit a thin sheet of fluid to the action of the heat generated.

Having thus fully described the nature, construction, and operation of my invention, I wish to secure by Letters Patent and claim—

1. In a boiler, a casing, a power-generating chamber therein, a supply-pipe for inflammable material carried into the generating-chamber, a burner on said supply-pipe within the generating-chamber at which the inflammable material is burned directly in

contact with the vapor and gases under pressure within said boiler, and a supply-pipe for fluid carried into the generating-chamber and expanded by the heat from the burners therein, for the purpose set forth.

2. In a boiler, a casing, a power-generating chamber therein, a supply-pipe for inflammable material carried into the generating-chamber, a burner on said supply-pipe within the generating-chamber at which the inflammable material is burned with the vapor and gases under pressure within said boiler, a supply-pipe for fluid carried into the generating-chamber,and partitions and tubes detached from and loosely fitting the interior of said casing placed within said generating-chamber, leaving a space entirely surrounding said partitions and tubes, whereby the fluid from the fluid-supply is submitted in a thin sheet to the action of the heat from the burning of the inflammable material, for the purpose set forth.

3. In a boiler, a casing, two removable perforated partitions within the casing, heating-tubes firmly secured to the perforation in the lower partition and passing loosely through the perforations in the other partition, and a heat-generating device within the casing below the lower partition, for the purpose set forth.

4. In a boiler, a casing, dished and perforated partitions within the casing, heating-tubes tightly secured within the perforations in the lowest partition and passing loosely through the perforations in the other partitions, a heat-generating device within the casing below the lowest partition and a supply-pipe for fluid entering the top of the casing and discharging upon the upper partition, for the purpose set forth.

5. In a boiler, a casing, a power-generating chamber within the casing, a heat-generating device within said chamber, a fluid-supply pipe entering said chamber, a valve controlling said supply-pipe for fluid and a float within said chamber controlling said valve, whereby a given amount of fluid is maintained within the chamber, for the purpose set forth.

6. In a boiler, a casing, a power-generating chamber within the casing, a heat-generating device within said chamber, a fluid-supply pipe opening into the upper part of said chamber, a discharge-pipe from said chamber for the power generated therein, a pipe connecting the discharge-pipe with the fluid-supply pipe, a pipe also connecting the lower part of the generating-chamber with the fluid-supply pipe, and an injector-nozzle within the fluid-supply pipe, whereby a circulation of the fluid in the generating-chamber is obtained, for the purpose set forth.

7. In a boiler, a casing, a power-generating chamber within the casing, a heat-generating device within said chamber, a fluid-supply pipe opening into the upper part of said chamber, a valve within the fluid-supply pipe controlling the flow of fluid in said pipe and controlled by the fluid in the generating-chamber, a pipe connecting the lower end of the boiler and the fluid-supply pipe, and an injector-nozzle in the fluid-supply pipe so arranged that the flow of fluid through the supply-pipe will cause a circulation of the fluid in the boiler, for the purpose set forth.

In testimony whereof I have affixed my signature in presence of two witnesses.

NELSON CURTIS.

Witnesses:
HENRY CHADBOURN,
ARTHUR C. JONES.