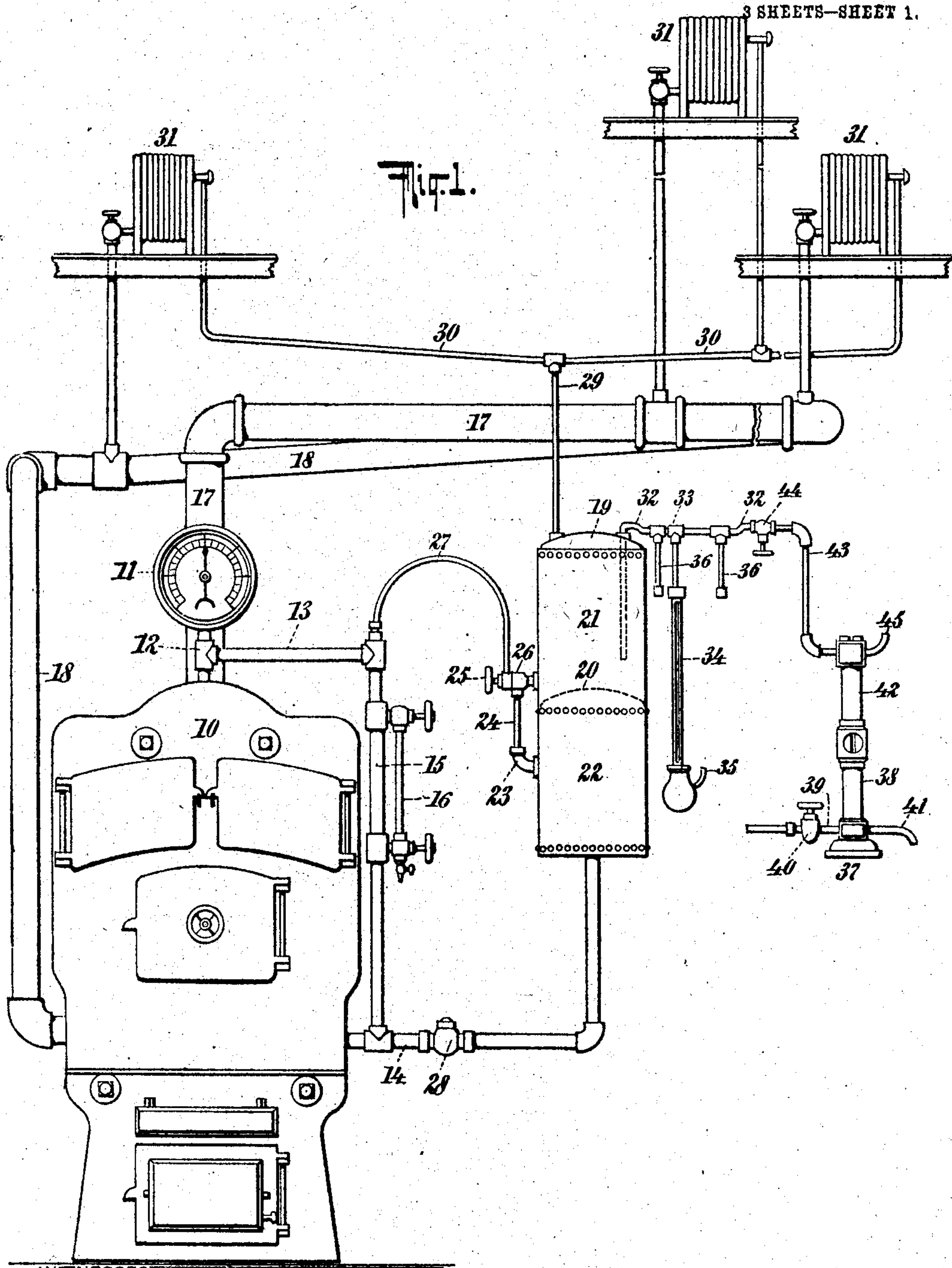


No. 796,077.

PATENTED AUG. 1, 1905.

J. H. KNUDSEN.
STEAM HEATING APPARATUS.
APPLICATION FILED APR. 25, 1904.

3 SHEETS—SHEET 1.



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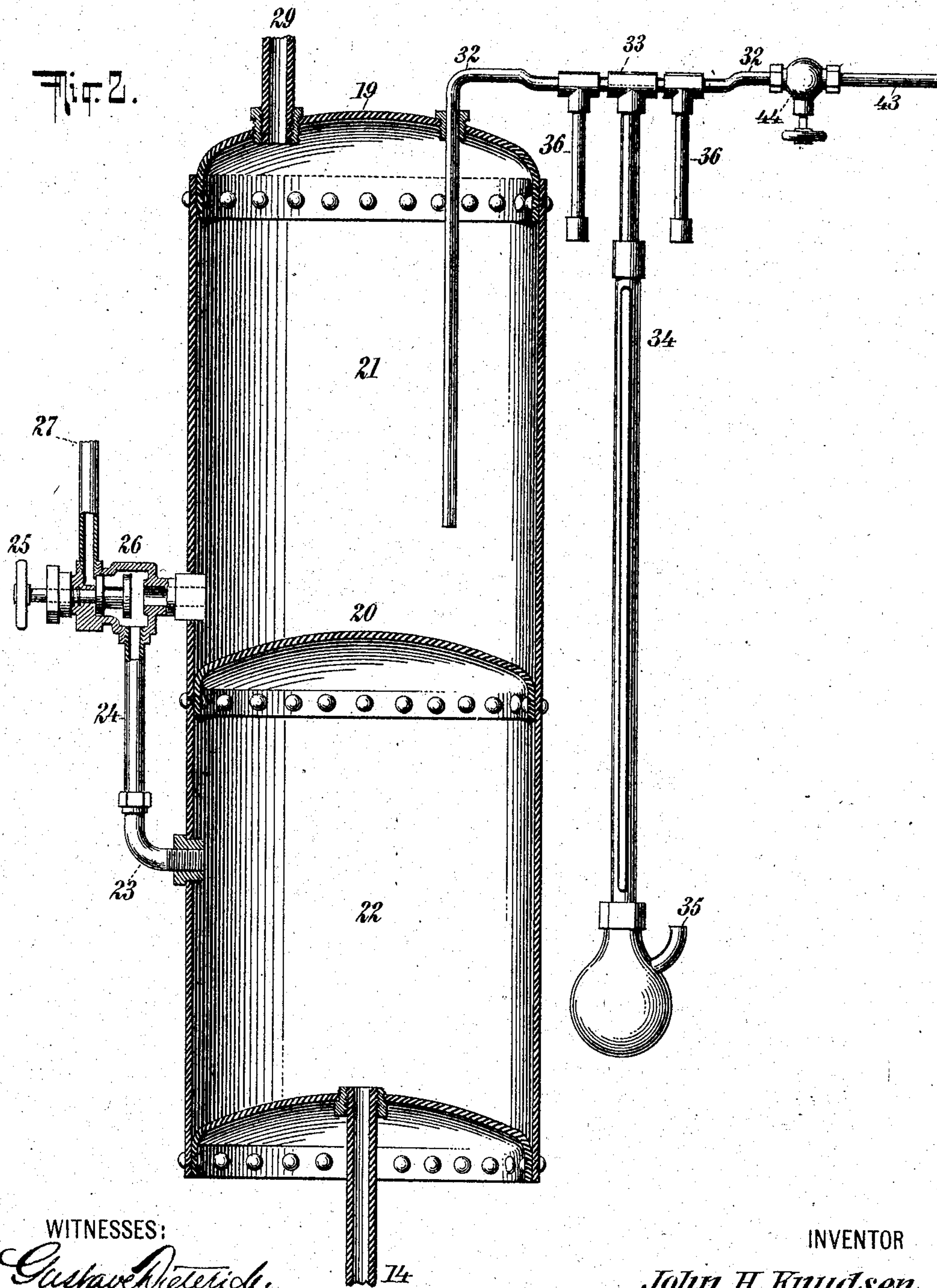
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3 SHEETS SHEET 2.



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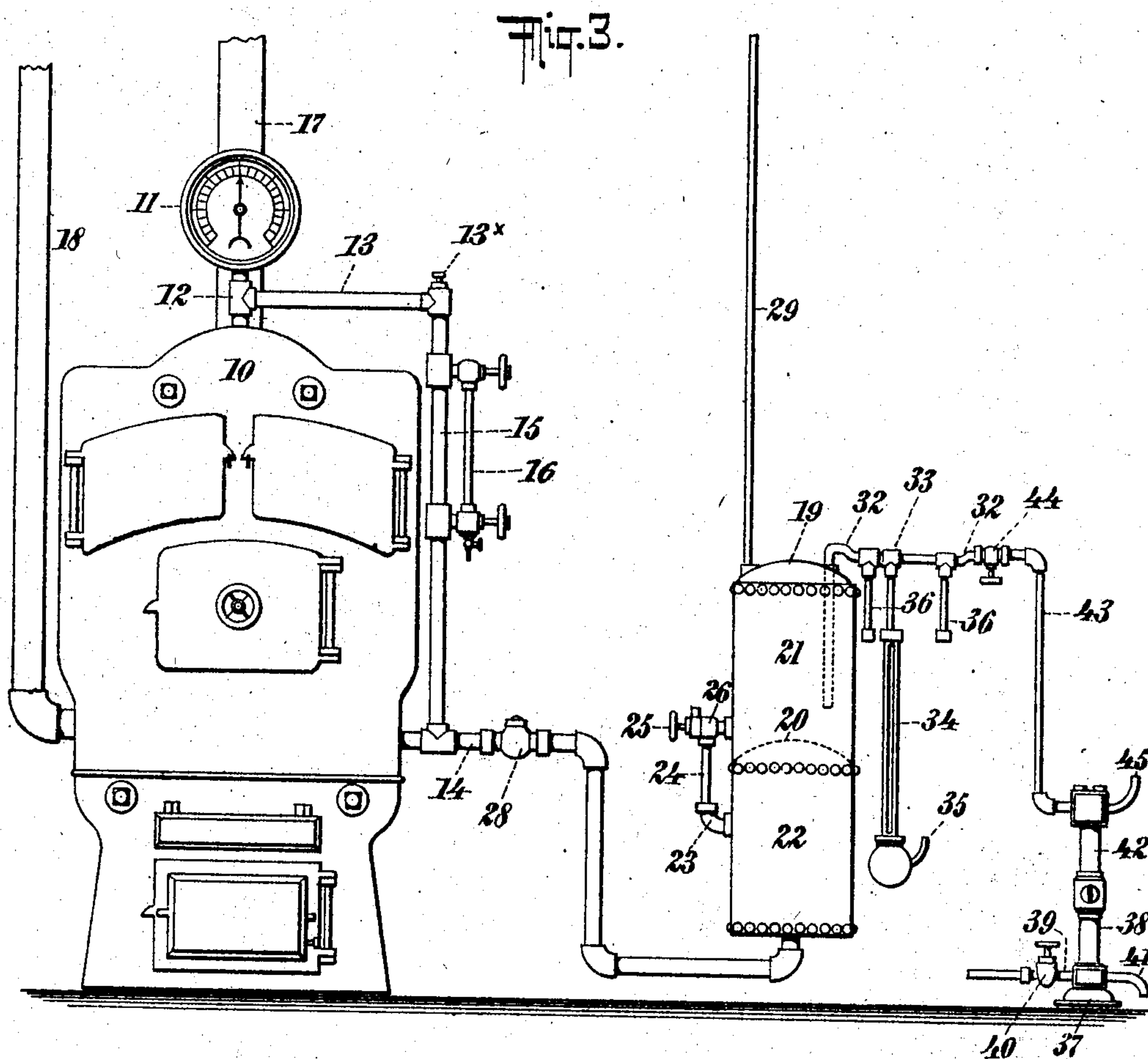
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JOHN H. KNUDSEN, OF CARTHAGE, MISSOURI.

STEAM HEATING APPARATUS.

No. 796,077.

Specification of Letters Patent.

Patented Aug. 1, 1905

Application filed April 25, 1904. Serial No. 204,709.

To all whom it may concern:

Be it known that I, JOHN H. KNUDSEN, a citizen of the United States, residing at Carthage, Jasper county, in the State of Missouri, have invented certain new and useful Improvements in Steam Heating Apparatus, of which the following is a full, clear, and exact specification.

My invention relates to improvements in steam heating; and the same has for its object more particularly to provide an efficient, positive, and convenient means whereby steam at lower pressure may be readily generated and uniformly circulated through the entire heating system and supplied to radiating apparatus communicating therewith.

Further, the invention has for its object to provide certain novel means for maintaining the heating system under vacuum and to automatically conduct the water of condensation therefrom to the boiler, where the same may be again converted into steam and recirculated.

To these ends my invention consists in the novel details of construction and in the combination, connection, and arrangement of parts hereinafter more fully described and then pointed out in the claims.

In the accompanying drawings, forming part of this specification, wherein like numerals of reference indicate like parts, Figure 1 is a diagrammatic view illustrating a vacuum steam-heating system constructed according to and embodying my said invention; Fig. 2 is an enlarged detail central section showing the construction of the vacuum and storage tank; and Fig. 3 is a view similar to Fig. 1, showing a modified arrangement of parts.

In said drawings, 10 designates a steam-boiler which may be of any suitable or convenient form and construction and provided with a compound vacuum and pressure gage 11, which is connected with the steam-space of the boiler by a pipe 12, having a lateral branch 13 extending therefrom, and 14 denotes a return-pipe communicating with the water-space of the boiler 10. Between said return-pipe 14 and the end of the lateral branch pipe 13 is connected a vertical section 15, provided with a water-gage 16.

17 denotes the main steam-pipe, extending from the top of the boiler 10; and 18 the main steam-return pipe, communicating with the boiler to near the bottom thereof.

19 denotes a storage and condensation tank having a horizontal partition 20 arranged

therein, whereby the interior of said tank is divided into an upper receptacle or vacuum-compartment 21 and a lower receptacle or water-compartment 22, which said compartments are connected together by a pipe 23, arranged without the tank 19 and extending from the lower portion of the upper receptacle or vacuum-compartment 21 to the upper portion of the lower receptacle or water-compartment 22. The said pipe 23 is provided intermediate its ends with a glass section 24 and adjacent to its upper end, which communicates with the compartment 21, with a valve 25, having a by-pass outlet 26, which is connected by a pipe 27 to the branch pipe 13, and communication established between the steam-space of the boiler 10 and the compartment 21 and the upper portion of the compartment 22, while the lower portion of said compartment 22 is connected to the water-space of the boiler 10 by the pipe 14, which is provided with a check-valve 28, whereby to prevent the passage of the water from the boiler 10 to the water-compartment 22 of the tank 19.

29 denotes an inlet-pipe which is connected at one end at a convenient point to the air-pipe system 30, extending from the radiators 31 31, and at its other end to the top of the vacuum-compartment 21 of the tank 19, and 32 denotes the air-outlet pipe secured in the top of said vacuum-compartment 21 and having its inner end extending downwardly within said vacuum-compartment 21 to a point adjacent to the partition 20 of the tank 19 and its upper end extending outwardly from the top of said compartment 21, the said air-outlet 32 having an offset portion 33, to which are connected mercury vacuum-gage 34, having an outlet 35, which serves as an air-outlet for the tank 19 when the system is operated without an air-pump, and to each side of said vacuum-gage 34 are mercury traps 36 36. Said mercury-gage consists of an inner glass tube and an outer metal tube having a longitudinal slot therein to show the column of mercury in the inner glass tube.

37 denotes a suction-pump which may be of any suitable or convenient form and operated by any suitable or convenient agency. In the diagram Fig. 1 the said pump is shown as of the type operated by water-power, and in said construction water is caused to enter the water-chamber 38 by way of the water-inlet pipe 39, controlled by the automatic pressure-regulator 40, actuate said pump-piston, and pass from said chamber 38 by the

waste-outlet 41, while the suction-chamber 42 is connected to the air-outlet pipe 32 on the tank 19 by a pipe 43, provided with a valve 44, and the air exhausted thereby from the system and discharged through the air-outlet 45 to the atmosphere.

The operation of the apparatus is as follows:

In an ordinary high-pressure steam-heating plant as usually constructed the water must be heated to about 220° Fahrenheit in order to raise steam of sufficient pressure to expel the air in the pipes and radiators. With my apparatus, however, it simply becomes necessary to start the pump, which is operated by water power, and by the time the temperature of the water in the boiler 10 has reached 150° Fahrenheit the entire system will be under vacuum and steam at said temperature caused to be circulated through the same and all the radiators communicating therewith. By this means I am enabled to produce and properly circulate steam at a low pressure, which is especially desirable in mild weather, when to raise several pounds of steam and circulating the same would result in overheating the apartments and wasting fuel. When the air-pump 37 is set in operation, it will carry from radiators and pipes all the cold air, together with more or less water and vapor. This will be caused to enter the tank 19 by the pipe 29, the water being caused to fall to the bottom of the vacuum-compartment 21 and thence conducted therefrom through the outlet-pipe 23 and valve 25 to the water-compartment 22, where the same will remain as long as the vacuum in the upper compartment 21 is more perfect than in the boiler, while any steam entering the upper compartment will float therein on top of the stratum of air, which latter will be drawn off from a point near the bottom of the vacuum-compartment 21 through the pipes 32 43 and discharged to the atmosphere from the air-outlet of the pump. Assuming the vacuum-pump to be operating properly and maintaining a steady vacuum in the storage-tank and air-pipes, as indicated by the vacuum-gage 34, and that the gage-glass 24 on the storage-tank 19 shows the lower or water compartment 22 thereof to be full of water, the valve 25 should then be closed and the by-pass outlet 26 thereby opened, thus connecting the top of the water-compartment 22 with the steam-space of the boiler through the pipe 27, and communication between the bottom part of water-compartment and bottom of the boiler 10 established through the pipe 14 and the water caused to pass from said water-compartment 22 to the boiler 10 by gravitation.

In case it becomes necessary for any reason to set the storage-tank 19 lower than the water-line of the boiler 10, as shown at Fig. 3, the valve 25 should be closed, and thus open the by-pass outlet 26 and then disconnect the pipe 27 (seen at Fig. 1) therefrom and seal the

pipe 13 at 13^x, (the by-pass outlet 26 now becoming the air-inlet,) and whenever a vacuum occurs in the boiler the water will be drawn from the water-compartment of the storage-tank to the boiler 10.

Without limiting myself to the precise details of construction, which may be varied within the scope of the invention, what I claim, and desire to secure by Letters Patent, is—

1. In a steam-heating system, the combination with a steam-generator and a system of air-pipes adapted for communication therewith, of a receptacle adapted for communication with said system comprising a vacuum-compartment connected to said system of air-pipes, and a water-compartment connected to the steam-generator and communicating with the water-space thereof, a connecting-pipe uniting the vacuum and water compartments of said receptacle, a pipe leading from said connecting-pipe and connected to the steam-generator and communicating with the steam and water spaces thereof, means arranged in said connecting-pipe whereby to connect the vacuum and water compartments to and with each other and the steam and water spaces of the steam-generator, and an exhausting apparatus connected to the vacuum-compartment of the receptacle, substantially as specified.

2. In a steam-heating system, the combination with a steam-generator and a system of air-pipes adapted for communication therewith, of a receptacle adapted for communication with said system comprising a vacuum-compartment connected to said system of air-pipes, and a water-compartment connected to the steam-generator and communicating with the water-space thereof, a connecting-pipe connecting the lower portion of the vacuum-compartment with the upper portion of the water-compartment, a valve in said connecting-pipe whereby to connect the vacuum and water compartments to and with each other and the steam and water spaces of the steam-generator, and an exhausting apparatus connected to the vacuum-compartment of the receptacle, substantially as specified.

3. In a steam-heating system, the combination with a steam-generator and a system of air-pipes adapted for communication therewith, of a receptacle connected to and communicating with said system comprising a vacuum-compartment and a water-compartment, a pipe connecting said vacuum-compartment with the air-pipe system, a pipe connecting the water-compartment with the water-space of the generator, a check-valve in said pipe, ports in said vacuum and water compartments, a pipe connecting said ports, a valve for closing the port in the vacuum-chamber, a by-pass outlet in said valve, a pipe connecting said by-pass with the steam-space of the generator, an outlet-pipe secured in said vacuum-compartment and extending downwardly into the same, a valve in said

pipe, an exhausting apparatus connected to said outlet-pipe, and a vacuum-gage in said outlet-pipe intermediate the vacuum-compartment and said exhausting apparatus, substantially as specified.

4. In a steam-heating system, a condensation and storage tank consisting of a receptacle having a partition therein whereby to separate said tank into two independent compartments, ports arranged in said compartments, a pipe arranged without said tank and connecting said ports, and provided with a valve having a by-pass outlet, an inlet-pipe and an

outlet-pipe arranged in the top of said tank, said outlet-pipe having one end extending downwardly within its upper compartment, and its other end extending outwardly therefrom and provided with an offset, and a vacuum-gage and traps connected to said offset, substantially as specified.

Signed at Carthage, Jasper county, in the State of Missouri, this 18th day of April, 1904.

JOHN H. KNUDSEN.

Witnesses:

E. M. PEEBLES,

B. M. DEARINGER.