(No Model.)

E. NELSON.

FEED WATER HEATER AND CONDENSER.

No. 477,815. Patented June 28, 1892.

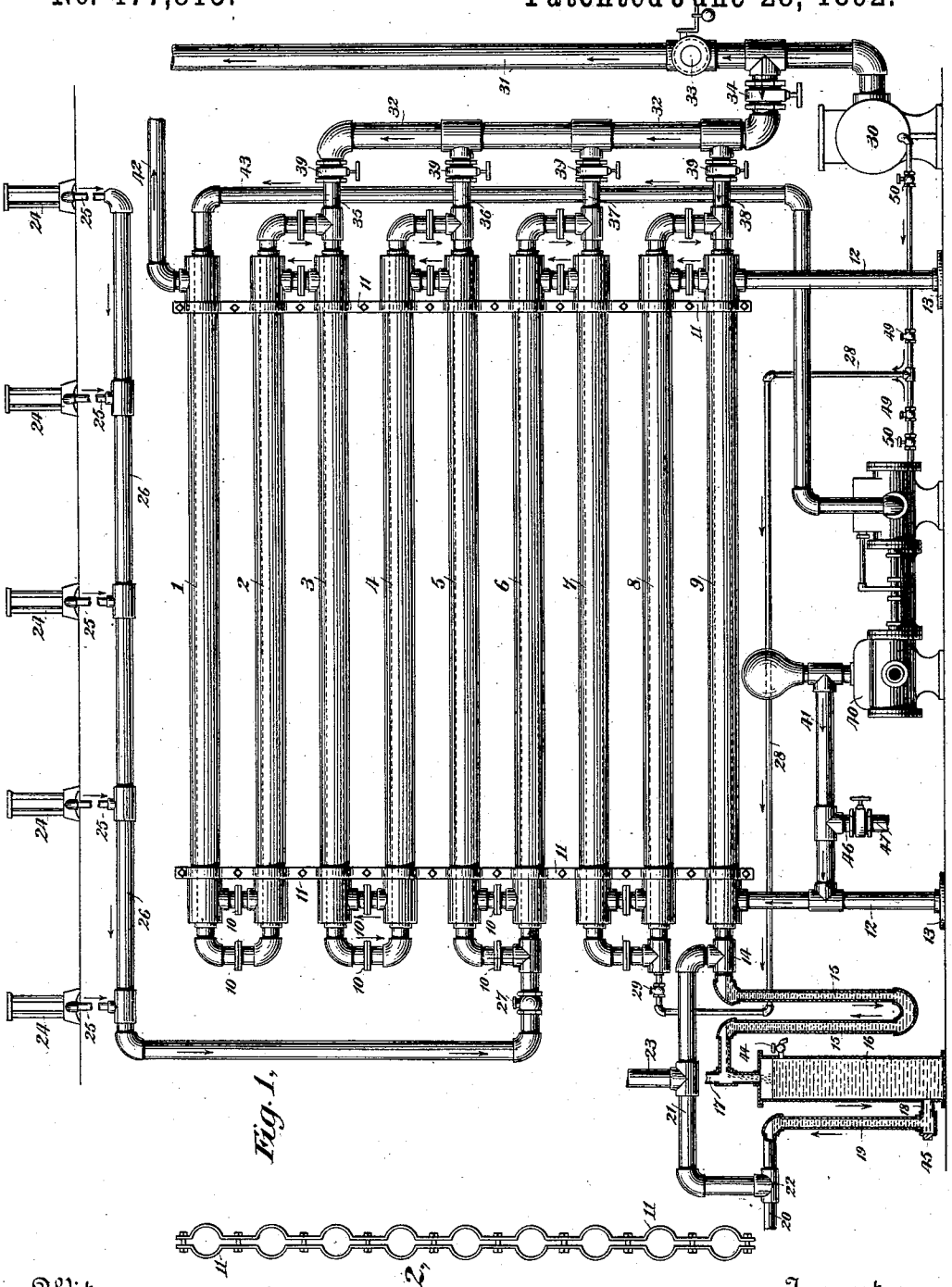

Fig. 1.

Fig. 2.

Witnesses
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UNITED STATES PATENT OFFICE.

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FEED-WATER HEATER AND CONDENSER.

SPECIFICATION forming part of Letters Patent No. 477,815, dated June 28, 1892.

Application filed October 28, 1891. Serial No. 410,132. (No model.)

To all whom it may concern:

Be it known that I, ELIHU NELSON, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Feed-Water Heaters and Condensers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention consists of a combined feed-water heater and condenser; and it constitutes an improvement on the invention patented to me November 11, 1890, the number of the patent being 440,410, and also on an invention which I am seeking to patent, which invention is fully described in an application filed in the United States Patent Office August 31, 1891, Serial No. 404,173.

The improvements covered by the present specification contemplate the securing of a higher temperature for the feed-water than has hitherto been accomplished and a higher temperature than has been obtained by the use of my own apparatus set forth in the patent and the application already mentioned.

The general objects of my present invention are identical with those described in the application of August 31, 1891, and they have regard to doing away with the waste which is now common in the use of engines in buildings where the steam is utilized for heating purposes and for running the elevators and so on. In operating such engines it is now customary to let the drips from the engine and the returns from the radiators pass off without being utilized. Moreover, the exhaust from the boiler-pump is usually carried off to the open air, its heat being in this way allowed to go to waste. I obviate the waste thus occasioned by providing an apparatus wherein the heat of the exhaust-steam from the boiler-pump is utilized for raising the temperature of the feed-water, and also the heat of the engine-drips and the radiator-returns I make use of for the same purpose. Moreover, in buildings which are heated by the exhaust-steam of the engine there is a considerable amount of oil passing through the radiators along with the exhaust, and for this reason the returns from the radiators are ordinarily run into the sewer, the oil making them unfit for use in the boiler. In my apparatus these returns are carried to the feed-water heater and the heat is transferred to the feed-water, as already indicated; but after it emerges from the heater I pass it into a separator to separate the oil from the water, so that the latter can be passed into the sewer or wherever desired. In doing this I pass the heating water in an opposite direction from that taken by the feed-water, the result being that the heating water when it passes out into the sewer or elsewhere is comparatively cool and in such condition that it will not give rise to the noxious vapors which are the cause of much trouble when the sewers are traversed by water at a high temperature. On the other hand, the arrangement described serves to carry the feed-water to the boiler hot, as will clearly appear hereinafter.

In my application of August 31, 1891, I caused the feed-water to meet the drips and radiator-returns after they have become somewhat cool, and when it has taken up some of their heat I cause it to pass constantly along a course which is gradually hotter and hotter (since it travels in proximity to the drips and radiator-returns in a direction toward their source) until it comes to the point where the drips and returns enter the condenser. Beyond this point (still referring to my former application) I arrange to have the feed-water met by the exhaust-steam from the boiler-pump, which also travels in a direction opposite to that of the feed-water, so that the feed-water passes into the boiler at a very high temperature. I also in my former invention connect the exhaust-pipe from the steam-engine to the same section at which the drips and returns enter, the exhaust from the engine being thus made subject to call in case it is needed.

In my present invention I join the exhaust-pipe from the boiler, as before, to the section most removed from that at which the feed-water enters; but instead of connecting the exhaust from the engine at the same point where the drips and returns enter I make several connections from the exhaust-pipe from the engine to different sections and I join the

pipe from the radiator and that carrying the engine-drips to sections which are other than those to which the engine-exhaust pipe is joined. Moreover, the radiator-returns are not carried to the same section as the engine-drips. In practice I join the engine-exhaust pipe to alternate sections at the same end of the apparatus, and I join the pipe carrying the radiator-returns and that carrying the engine-drips to different intermediate sections. By this arrangement I find that it is possible to obtain a temperature several degrees higher than was possible with my old apparatus. I have also made improvements in the oil-separator, which improvements, however, are not claimed in the present specification, by forming a trap for the water of condensation to pass through before entering the separator proper, by providing the vent in the pipe leading into the separator, and by arranging the outlet so that the water in passing off will be several inches below the top of the separator. The object of these alterations will be fully set forth hereinafter.

I have illustrated my invention in the accompanying drawings, in which—

Figure 1 is an elevation of my apparatus, the oil-separator being shown partly in section; and Fig. 2 is a detail view of the straps.

Designating the different parts of the apparatus by suitable characters, I show in Fig. 1 a series of sections 1, 2, 3, 4, 5, 6, 7, 8, and 9, making up my condenser and feed-water heater. Each section consists of two pipes, one within the other, the central pipe forming a chamber for the exhaust-steam from the boiler-pump or the engine or for the engine-drips and radiator-returns, as the case may be. The two pipes are connected together by T's and L's in any suitable manner, preferably as described in my application of August 31, 1891, and succeeding sections are joined, as clearly shown in the drawings, by suitable T's or L's coupled together by means of flanged joints 10 10. It thus appears that each section forms a double chamber, one of which—the central one—is cylindrical in shape and the other annular. Moreover, it is apparent that the central chambers of succeeding sections are joined together continuously to form practically one passage for the steam, and also that the annular chambers are similarly connected to form a passage for the feed-water. The feed-water being passed through the annular chambers, as described, will present a large amount of surface in proportion to its volume, and consequently will take up heat with great comparative rapidity and be heated to the proper degree so much sooner. To facilitate this process, the sizes of the pipes may be graduated in such a manner as to leave the feed-water very thin in the space between the two pipes.

To unite all the sections into one apparatus, I employ straps 11, which are shaped with straight and curved portions in such a manner as to both surround the outer pipes of the different sections and also afford coupling portions, through which bolts can be driven for uniting the whole into one apparatus. I provide a pair of such straps at each end of the sections.

To support the whole structure, I supply legs or standards 12, which are set in bases 13 at the bottom. The flanged joints, or rather the T's or L's united by them, form adequate braces between succeeding sections at one end; but at the opposite ends separate supporting devices are necessary, and for this reason I have provided the straps. The latter serve not only as vertical supports, but also as braces against horizontal displacement. On the end of the inner pipe of the last or lowermost section I secure a T 14, and beyond this I couple on a series of pipes 15, forming a trap. The latter I connect suitably with the top of my oil-separator 16, introducing in the connecting-pipe a vent 17. Near the bottom of the separator a pipe 18 leads off, which is joined by a T with a vertical pipe 19, connected to the exit-pipe 20. A by-pass 21 leads from the T 14 to a T 22, connected with the pipe 20. I may provide a vent-pipe 23 for the pipe 21 or I may dispense with the same.

At 24 24 24 24 24 I show radiators and at 25 25 25 25 25 I show separate return-pipes from the radiator, all of which enter a common return-pipe 26 and are carried to the left-hand end of the inner pipe of section 6 in my condenser and feed-water heater. At 27 I show a check-valve in the pipe 26 for preventing the steam from backing up into the said pipe. The engine drip-pipe is shown at 28, and it enters through a check-valve 29, the left-hand end of the inner pipe in section 8. The valve 29 is present for the purpose of preventing the backing up of the steam in the pipe 28.

The engine 30 has a main exhaust-pipe 31, from which I lead off a branch exhaust-pipe 32. Above the branching-point in the main exhaust-pipe I place a pressure-valve 33, so that whatever steam is necessary may be passed into the branch pipe, while the surplus may pass out through the pressure-valve. In the branch 32 is a valve 34, which may be used to regulate the amount of steam which passes into the branch or to cut it off altogether. The branch pipe 32 is itself branched at 35, 36, 37, and 38. The number of these branches may be increased or diminished, according to circumstances. Each branch enters through a valve 39, the central pipe of one of the condenser-sections. In the present instance the branch 35 is connected with section 3, the branch 36 with section 5, the branch 37 with section 7, and the branch 38 with section 9. The distribution of the engine exhaust-steam in the different sections may be controlled by closing one or more of the valves 39, as may be found desirable.

The boiler-pump 40 is connected through its main exit-pipe 41 with the hollow leg or

standard 12, and through that with the outer pipe of the ninth section of my condenser and feed-water heater. The water from the pump is accordingly forced through the annular chambers of succeeding sections, and finally finds its exit by way of the pipe 42. Through this pipe it is carried back to the boiler. In traversing this course the feed-water has encountered the heat, first, of any steam which may have entered through the branch pipe 38 into the central pipe of section 9; second, of the engine-drip coming into the central pipe of section 8 by way of the pipe 28; third, of the steam which may have come in through pipe 37 into the central pipe of section 7; fourth, of the radiator-drips entering the central pipe of section 6 by way of the pipe 26; fifth, of the steam which may have entered through pipe 36 into the central pipe of section 5; sixth, of the steam which may have entered through pipe 35 into the central pipe of section 3, and, finally, of the exhaust-steam from the boiler-pump itself, which, as has not been before stated, passes through the pipe 43 and enters the central pipe of section 1. Thus the feed-water is acted upon successively by heat proceeding from different sources or entering the heater at different points, and it is in this way raised to a very high degree of temperature. In other words, the feed-water is met at a large number of different points in its circuit by fresh sources of heat, which had not been subjected to the cooling influence of the feed-water itself. I find that the temperature can be raised several degrees higher by this process than where the heating-fluid is simply passed successively from one section to another, or even where the process described in my pending application is followed.

It will be understood that the feed-water passes in an opposite direction from that which is taken by the heating-fluid from whatever source it comes. It will also be understood that the said fluid where it passes out to the oil-separator is in proximity to the water where it is coolest—that is to say, where it is fresh from the pump. Accordingly the water of condensation which passes out through the separator will be comparatively cool, and after traversing the separator it may be run into the sewer or wherever else desired. On the other hand, the feed-water will gradually become more and more heated and will continually meet successive portions of the heating medium, which are little cooled by condensation. In this way both the feed-water and the heating mediums act with very high efficiency, the former exerting its greatest possible condensing effect and the latter its greatest possible heating effect.

Returning now to the waters of condensation which pass out from the lower section, it will be seen that they enter first the trap 15. Beyond this they pass into the top of the oil-separator and out by way of the pipes 18, 19, and 20. If there are any vapors carried along with the water, they will go out by way of the by-pass 21 and pass through the exit-pipe 20 or the vent-pipe 22. The oil will be held at the top of the separator and can be drawn off at intervals through the cock 44; But for the by-pass 21 the vapors might carry some of the oil through the water to the exit; but this is now prevented. I find in practice that there is liable to be some disturbance of the surplus of the liquid in the oil-separator even when the by-pass is present, and it is for this reason that I have introduced the trap 15. For the same reason I have provided the vent 17, so that any vapors which may pass through the trap shall escape before entering the oil-separator.

In the T which connects pipes 18 and 19 I place a plug 45, which can be removed for emptying the oil-separator whenever it is desired.

In a branch 46 from the main exit-pipe 41 of the boiler-pump I locate a blow-off valve 47, which can be used whenever the occasion arises.

It will be observed that I unite the engine drip-pipe 28 with a drip-pipe 48, coming from the boiler-pump. In each drip-pipe before they come to the point of union I place a check-valve 49 and a globe-valve 50. By means of the latter valves the drip-pipes or either of them may be closed altogether, while the valves 49 serve to prevent the drips from opposing each other when the vales 50 are open.

I claim as my invention—

1. The combination, with an engine and a sectional feed-water heater, of an exhaust-pipe from the engine connected to different sections of the said feed-water heater by separate connecting-pipes, each connecting-pipe containing a valve for controlling the amount supplied to each section, as and for the purpose set forth.

2. The combination, with an engine and a sectional feed-water heater, of an exhaust-pipe from the engine joined to different sections of the said feed-water heater, as and for the purpose set forth.

3. The combination, with an engine, a boiler-pump, and an intermediate feed-water heater, of a drip-pipe common to both the engine and the boiler-pump, the said drip-pipe being connected to the said feed-water heater, as and for the purpose set forth.

4. The combination, with an engine, a boiler-pump, and an intermediate sectional feed-water heater, of an exhaust-pipe from the engine joined to different sections of the said heater and a common drip-pipe from the boiler-pump and the engine, the said drip-pipe entering the feed-water heater at the end opposite to that at which the exhaust from the engine communicates therewith and at a section with which the said exhaust from the engine does not directly communicate, as and for the purpose set forth.

5. The combination, with an engine, a boiler-

pump, and an intermediate feed-water heater, the said feed-water heater communicating with the engine-exhaust, of a drip-pipe common to the said engine and the said boiler-pump, the said drip-pipe entering the said feed-water heater through a check-valve, as and for the purpose set forth.

6. The combination, with an engine and one or more radiators, of an intermediate feed-water heater through which the radiator-returns pass, a steam-exhaust pipe from the engine communicating with the said feed-water heater at one end, and a pipe joining the said radiator or radiators to the said heater at the opposite end, as and for the purpose set forth.

7. The combination, with an engine and one or more radiators, of an intermediate feed-water heater joined to the said radiator or radiators by means of a pipe in which is a check-valve, and an exhaust-pipe from the engine communicating with several sections of the said heater, the communication from the steam-exhaust pipe being made at one end of the heater and that from the radiator return-pipe being made at the other end of the heater and at a section with which the steam-exhaust pipe from the engine does not directly communicate.

8. The combination, with an engine and a boiler-pump, of an intermediate sectional feed-water heater and an exhaust-steam pipe from the engine connected to alternate sections of the said heater, as and for the purpose set forth.

In testimony whereof I have signed my name, in the presence of two witnesses, this 22d day of October, A. D. 1891.

ELIHU NELSON.

Witnesses:
G. H. STOCKBRIDGE,
D. E. HERVEY.