(No Model.) 2 Sheets—Sheet 1.

R. R. ZELL.

PLANT FOR SUPPLYING HEAT AND POWER.

No. 386,862. Patented July 31, 1888,

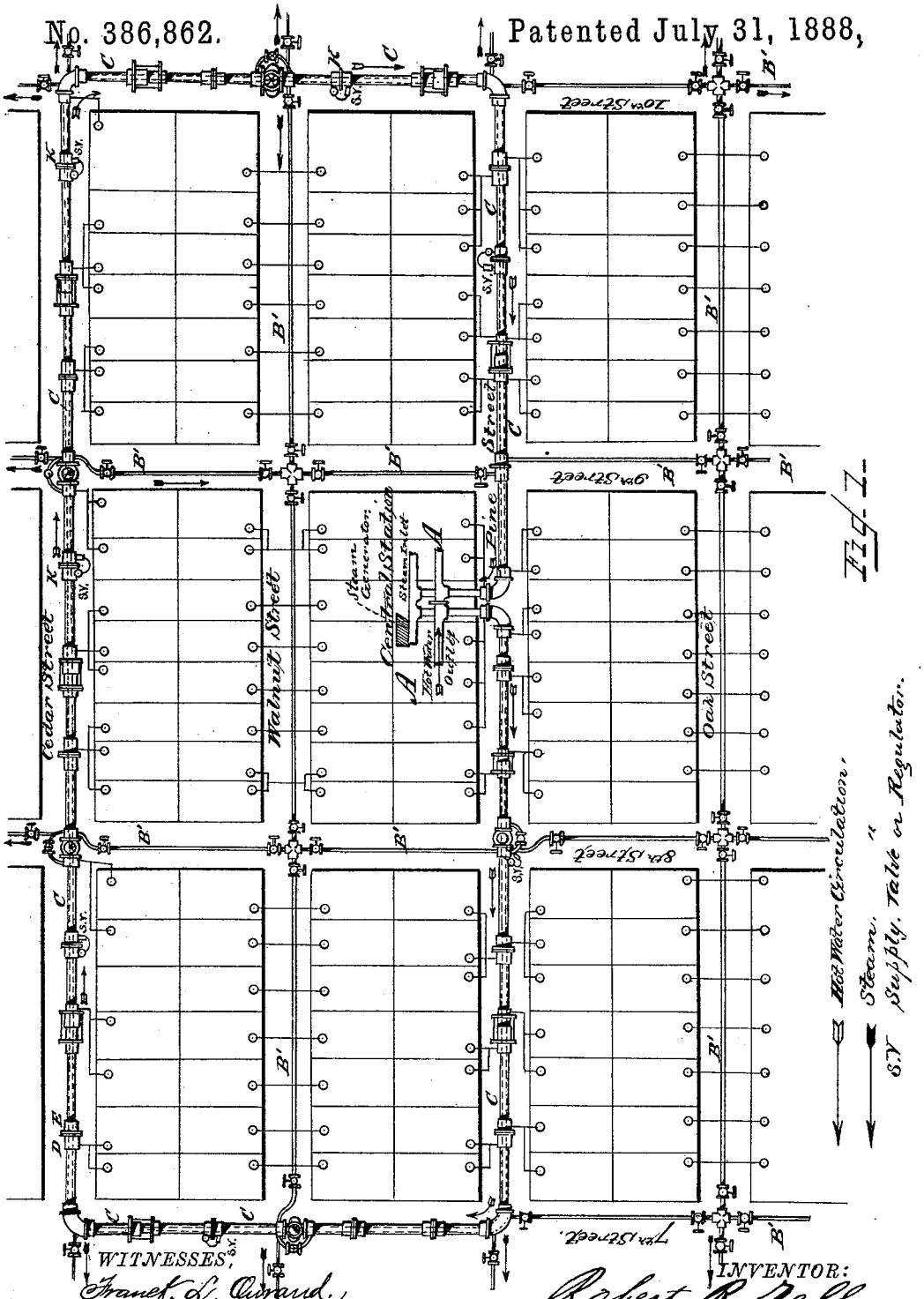

FIG. 1.

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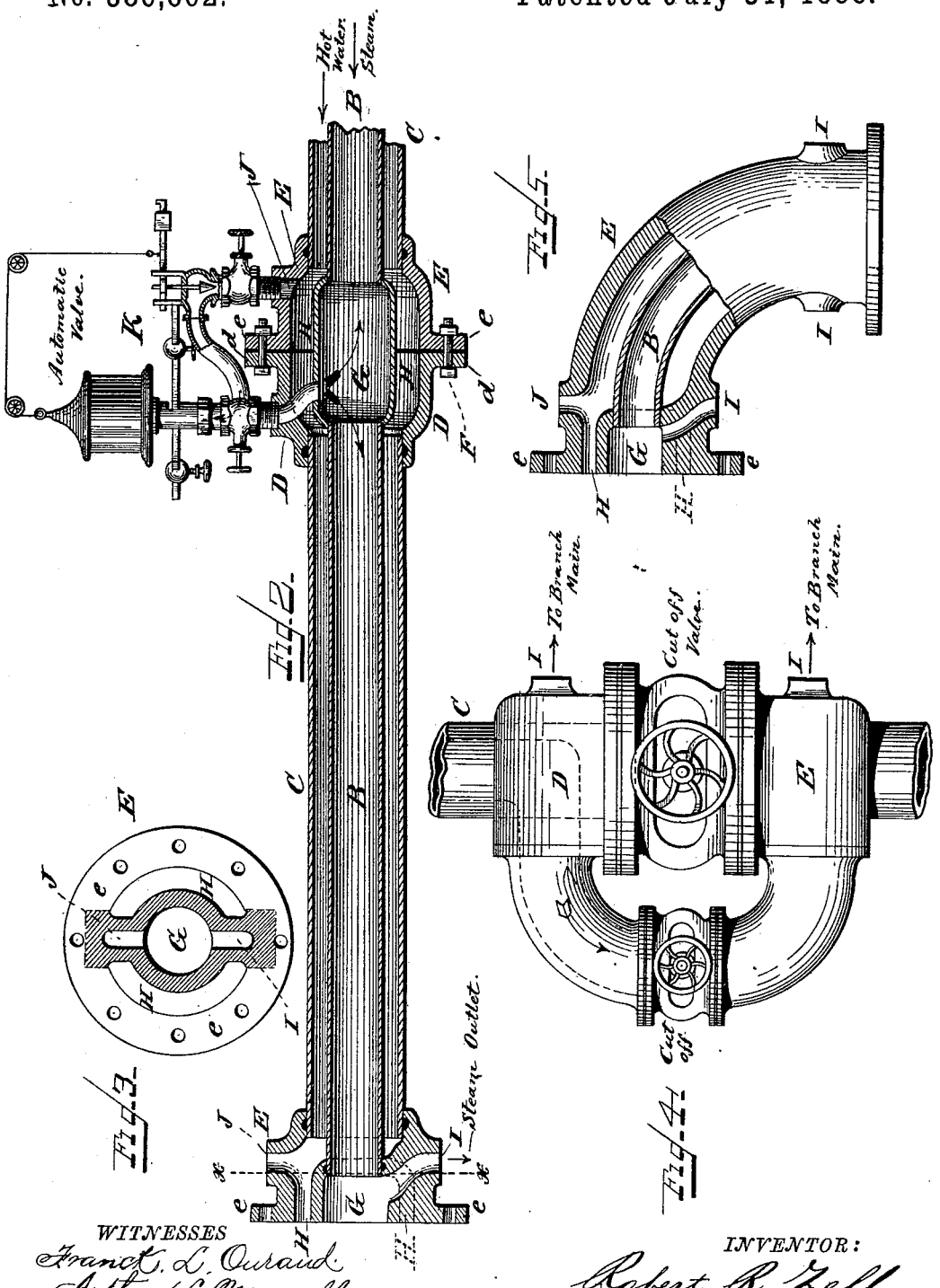

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

WITNESSES

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UNITED STATES PATENT OFFICE.

ROBERT R. ZELL, OF NEWARK, NEW JERSEY.

PLANT FOR SUPPLYING HEAT AND POWER.

SPECIFICATION forming part of Letters Patent No. 386,862, dated July 31, 1888.

Application filed January 21, 1887. Serial No. 225,020½. (No model.)

To all whom it may concern:

Be it known that I, ROBERT R. ZELL, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Plants for Supplying Heat and Power; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying two sheets of drawings, which form a part of this specification.

My invention relates to means for supplying the dwellings and other buildings in cities with heat and power. Of late years several of these so called "heat and power systems" have been developed, some of which have been patented, their object being to economize in the use of fuel and also relieve housekeepers and other users of heat and power within the district or territory embraced in one of the so-called "systems" from the care and annoyance of attending to fires for heating, cooking, or steam-generating purposes.

In this method of supplying individual users with heat and power as heretofore practiced one of two plans has generally been adopted, viz: Steam for generating heat and power has been supplied through suitable pipes and in the form of steam from a central station to the buildings embraced in the system, ready for immediate use, as in the so called "Holly system," means being provided for replenishing the supply of steam in the delivery pipes or mains, as these are tapped, from the central station; or, instead of supplying steam, water heated under pressure to a temperature considerably above the boiling-point is supplied to the users, and this superheated water is converted into steam on the premises where it is to be used. An illustration of this method will be found in the so-called "Prall system." Without discussing the merits or demerits of these different methods or systems, it is proper and pertinent to bear in mind in the consideration of my improvement that in supplying steam to consumers from a central station in the form of steam much loss is caused both in the pressure and volume of steam so supplied by condensation in the conveying-pipes, the steam being supplied to consumers in the form of "wet" steam, which is not adapted for use in engines, and where hot water is supplied instead of steam this necessitates the use of special apparatus in each building supplied with hot water for converting the same into steam, and as an example of such apparatus reference may be had to Letters Patent of the United States No. 208,633.

Now the object of my improvement is to avoid the use of any such auxiliary apparatus located within the premises to be supplied by supplying "dry" steam direct to the consumers, or steam free from any water of condensation and under a full and even "head" or pressure, which is regulated automatically, so that the steam may be taken into the cylinder of an engine without preparation of any kind and without the danger of undue "priming;" or the steam may be fed directly to the radiators when it is to be used for heating purposes without intermediate apparatus of any kind.

On the accompanying two sheets of drawings I have illustrated my improved method or system, as follows:

Figure 1 is a diagram of the complete plant, showing the central station, the mains with their couplings and automatic regulators, and service-pipes. Fig. 2 is a longitudinal sectional view of one of the mains supplied with one of the automatic regulators. Fig. 3 is a cross-section through the coupling on line *x x*, Fig. 2. Fig. 4 is a plan view of one of the couplings for connecting the branch steam-pipes B′ with the main; and Fig. 5 is a detail view, partly in section, of one of the elbow-couplings used in turning corners.

Like letters of reference denote corresponding parts in all the figures.

In carrying out my invention each district to be supplied with heat and power is provided with a so-called "central station," (indicated in the diagram, Fig. 1, by the letter A,) which is supplied with one or more steam-generators of any approved construction, but preferably the so-called "Zell safety steam-generator," the same being particularly adapted for this purpose, because it admits of drawing superheated steam and water from the same boiler.

The superheated steam is fed from the boiler or steam-generator into the steam-mains B, made in lengths of eighteen feet, (more or

less,) and connected so as to form one continuous length by means of specially-constructed couplings, to be hereinafter described. Each length or section of steam-pipe B is incased or jacketed within another larger pipe, C, which constitutes the hot-water main. This hot-water main is made in lengths or sections a little shorter than the interior steam-pipe, and are coupled together to form one continuous main by means of the specially-constructed couplings hereinbefore referred to. Each of these couplings or connections is made in two parts or sections, D and E, having flanges *d* and *e*, by means of which they are connected so as to form a steam-tight coupling-box by means of suitable packing inserted between the flanges, said flanges being held firmly together by the bolts F, so that the two parts or sections when united form an inclosed box having a central chamber, G, registering with the steam-pipe, the ends of which are inserted steam-tight into said central chamber, and another annular chamber, H, concentric with the central chamber, G, and having openings into which the ends of the outside or hot-water pipe, C, are fitted steam-tight. Thus it will be seen that the ends of the several lengths of steam-pipe B are united steam-tight by means of the coupling-boxes D E to form one continuous main, which may be tapped at suitable intervals by means of branch pipes screwed into outlets I, provided in the castings D E, which may be provided with suitable valves or stop-cocks. In like manner the lengths of hot-water pipe C are united by the annular chambers H in the coupling-boxes D E, to form a continuous main, which may be tapped at suitable intervals into the central steam-pipe through the ducts J and a suitably-constructed automatic differential valve, K. These valves—one of which is shown in Fig. 2—may be of any approved pattern or construction, and are located at proper intervals along the line of pipe, and are so adjusted that they will let hot water from the outside pipe into the inside pipe whenever the steam-pressure in the latter falls below a certain point.

The hot water is forced through pipe C by means of pumps located at the central station at a higher temperature than the steam which is fed into the interior mains, B, direct from the steam-generator, said steam-mains returning to the gentrator after completing the circuit of the district. I have found that the hot water as taken from the boilers at the central station may be forced by pumps economically inside of a radius of five miles. With a pressure of one hundred pounds to the square inch the hot water would contain 338° Fahrenheit of heat, while the steam as fed into pipes B at an initial pressure of eighty pounds to the square inch (which is ample for all practical purposes) would contain 324° Fahrenheit, or fourteen degrees less than the hot water, so that the steam-mains are through the entire circuit jacketed by hot water of a higher temperature than that of the steam. By incasing the hot-water mains in suitable non conducting material or inserting them into wooden tubes or tubes made of material adapted for the purpose and circulating the hot water through the mains very rapidly by using pumps of the requisite power it will be found that only a comparatively small amount of heat will be lost on the circuit, while the loss of steam in the inside mains from condensation is entirely overcome.

As the pressure of the steam in the mains B is gradually reduced by tapping to supply the branch pipes and service-pipes, this loss of pressure is promptly compensated for by means of the automatic valves K, which will then open and feed hot water into the steam-main until the original steam-pressure (say, eighty pounds) has been restored; but as the pressure in the steam-mains is always below that of the hot-water mains, and as the temperature in both is considerably above the boiling-point, (212° Fahrenheit,) it follows that the hot water will be converted into steam the moment it enters the inside main, thus restoring both the volume of steam and the pressure within the mains. By disposing these valves at proper points along the line the equilibrium may readily be maintained within the steam-mains throughout the entire line of circuit.

At all or some of the couplings D E, I provide connections I for supplying buildings, as briefly mentioned above, and these connections are so constructed as to require no stuffing-boxes or packing-boxes, the branch pipes or service-pipes being screwed into the castings and provided with expansion-joints and suitable cut-off valves for regulating the flow of steam into the service-pipes.

By reference to Fig. 1 of the drawings it will be seen that the main is laid to surround a fixed district and that all cross-streets and intermediate streets and alleys are supplied from this main by branch steam-pipes B′, so that if from leakage or any other cause it should be necessary to shut off one or more of the branch pipes this will not affect service on the remainder of the circuit, and, owing to the excess of heat in the outside pipe, all water which is carried into the steam-pipe mechanically is evaporated and converted into steam instantly.

Although, as a matter of convenience, I prefer to employ a single steam pipe or main inside of each hot-water main, yet it is obvious that more than one steam-pipe may be used, if desired, without deviating from the spirit of my invention. For example, where it is desired to cover and supply very large areas from a single plant, it might be found advantageous to use two or more steam-pipes inside of the hot-water main, tapping one of said steam-pipes only for a certain distance or district, so that the other or others, as the case may be, could be carried to greater distances untapped for tapping at remote points. Again, where the valves for supplying hot water to the in-

side steam-pipe to be converted into steam are located along the route or between tapping-points the steam-chambers G have no lateral outlets, whereas at points where steam is to be served I construct the chamber G with branch pipes or outlets, as shown at I, for connecting said chambers and the steam-main to the branch pipes or service-pipes, as hereinbefore set forth. On Fig. 2 of the drawings I have illustrated both these forms of construction of the central steam-chamber, G.

It is apparent that the advantages of this method of supplying steam to distant points are numerous. Absolutely dry steam is at all times maintained in the interior steam pipe, which travels by its own expansive force without the necessity of a pump, and which is at all times superheated by reason of the fact that the exterior water is at a temperature greater than the temperature which steam would ordinarily have at the pressure within the interior pipe. The entire water necessary to be used as steam likewise does not have to be pumped through a pipe, but a large amount of it passes naturally by its pressure through the interior pipe, while the exterior pipe merely supplies sufficient hot water to maintain the desired pressure within the interior pipe.

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

1. The hereinbefore-described method of supplying dry steam to consumers from a central plant or station, said method consisting in, first, heating water to a high degree of heat under pressure; second, generating steam; third, conveying the steam within the body of the superheated water to distant points by means of a steam-pipe located within a hot-water pipe, and, fourth, introducing some of the hot water into the steam along the route of the pipes.

2. The process of conveying steam in a gaseous form or dry state from a central plant or station through pipes to distant points of service, which involves the following steps: first, heating water to a high degree of heat under pressure; second, generating steam; third conveying a part of the hot water through pipes from the generator to distant points; fourth, conveying the steam within the body of hot water to distant points, and, fifth, introducing some of the hot water into the steam along the route of the pipe-mains.

3. The combination, in a pipe-circuit for supplying steam from a central plant or station, of a steam-generator, a steam-pipe, a hot-water pipe surrounding said steam-pipe, automatic differential valves disposed along the pipe-circuit, and pipes connecting said valves with the steam-pipe and the hot-water pipe, substantially as and for the purpose set forth.

4. The coupling-boxes consisting each of two flanged parts or sections, provided with an interior chamber adapted to receive the ends of the steam-pipes, an annular chamber surrounding and concentric to said central chamber and adapted to receive the ends of the hot-water pipes, and ports or outlets communicating with the interior of the central chamber and adapted to be connected to branch pipes or service-pipes.

5. The coupling-boxes consisting each of two flanged parts or sections, provided with an interior chamber adapted to receive the ends of the steam pipes, an annular chamber surrounding and concentric to said central chamber and adapted to receive the ends of the hot-water pipes, ports or outlets communicating with the interior of the central chamber and adapted to be connected to branch pipes or service-pipes, a port adapted to connect said central chamber with a pipe communicating with the annular hot-water chamber, the said connecting-pipe, and an automatic differential valve located on the same, substantially as and for the purpose set forth.

6. The combination, with the couplings comprising the following elements, viz: a central chamber open at both ends, an annular chamber surrounding said central chamber and open at both ends, ports adapted to connect said central chamber to outside service pipes, ports adapted to connect said central chamber with its surrounding annular chamber, and a pipe or opening connecting the aforesaid ports, of an automatic differential regulating-valve, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my own I have hereunto affixed my signature in presence of two witnesses.

ROBERT R. ZELL.

Witnesses:
JOHN W. LAFFEY,
J. A. CROUTHERS.