(No Model.)

C. OBREBOWICZ.

REGULATING DEVICE FOR LOW PRESSURE STEAM HEATING APPARATUS.

No. 556,860. Patented Mar. 24, 1896.

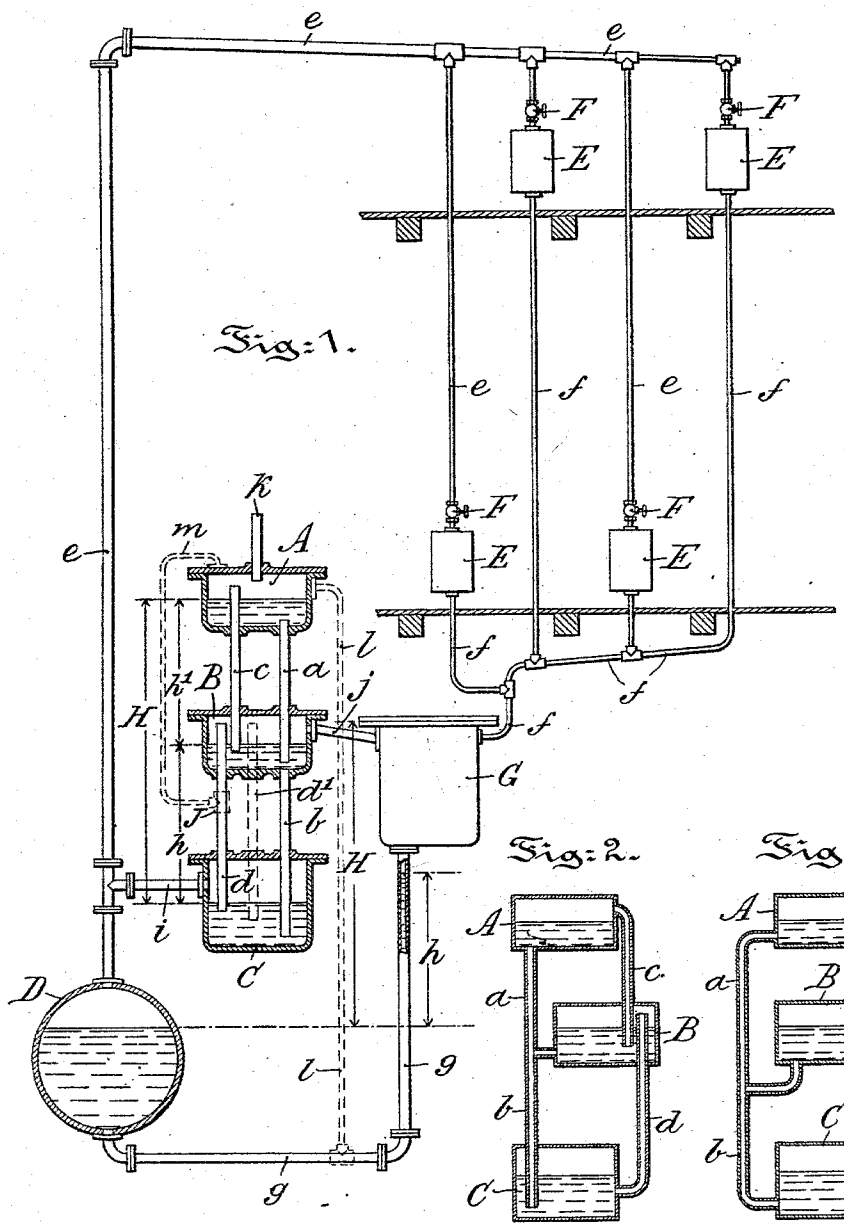
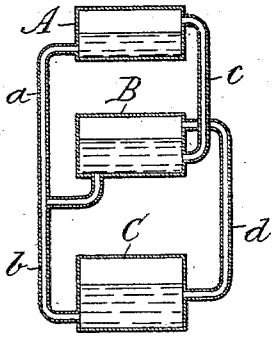


Fig: 2.

Fig: 3.



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CASIMIR OBREBOWICZ, OF WARSAW, RUSSIA.

REGULATING DEVICE FOR LOW-PRESSURE STEAM HEATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 556,860, dated March 24, 1896.

Application filed December 12, 1895. Serial No. 571,855. (No model.)

To all whom it may concern:

Be it known that I, CASIMIR OBREBOWICZ, a subject of the King of Prussia, residing at Warsaw, Province of Poland, and Empire of Russia, have invented certain new and useful Improvements in Regulating Devices for Low-Pressure Steam Heating Apparatus, of which the following is a specification.

My invention has relation to a regulating device for low-pressure steam heating apparatus of a type adapted to maintain a uniform pressure in the heating apparatus and to maintain constant the difference in pressure between the steam-generator and condensed-water collector, which I may briefly call "condenser," and it relates particularly to the construction and arrangement of a device for such purposes.

The principal objects of my invention are, first, to provide a simple and efficient regulating device for low-pressure steam heating apparatus adapted to perform its purpose under ordinary or unusual circumstances; second, to provide a regulating device consisting of three superposed closed vessels or chambers, when at work partially filled with water, the upper of which has an outlet to the open air, the middle of which is connected to the condenser, and the lowermost is connected to the steam-space of the boiler or steam-producer, said three chambers being all connected together by a system of inlet and return pipes, the arrangement whereof is adapted to maintain the water in the chambers at a predetermined height, to maintain a uniform difference of pressure between the boiler and the condenser and to let the surplus of air out of the heating plant; third, to provide in a regulating device of the character described a pipe and an injector adapted to suck air from the top of the upper chamber and discharge the same to the middle chamber, from whence it is forced to the condenser and steam heating apparatus, and, fourth, to provide in a regulation device of the character described, when the same is provided with the air-injecting device, a supplemental pipe or tube connecting the middle and lower chambers, the lower end of said pipe or tube extending farther below the surface of the water in said lower chamber than the same end of the primary pipe connecting the two chambers, whereby the primary pipe may be utilized as an air-injector without disturbing the relationship or equilibrium between the middle and lower chambers of the device.

My invention stated in general terms consists of a regulating device for low-pressure steam heating apparatus constructed and arranged in substantially the manner hereinafter described and claimed.

The nature and scope of my invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof, in which—

Figure 1 is a diagrammatic view illustrating a steam heating plant, showing the relationship between the steam-producer, the regulating device, condenser, and steam heating apparatus, and also showing the construction and connections of the regulation device; and Figs. 2 and 3 are respectively diagrammatic views of the same regulating device, but with methods of connecting together its chambers, the connections being principally the same as in Fig. 1.

Referring to the drawings, A, B, and C represent respectively three closed chambers placed one above another—that is to say, A is the highest, C the lowest, and B the middle chamber. These chambers, when at work, are each partially filled with water. The chamber A is connected to the chamber C by pipes *a* and *b*, the upper end of which is below the level of the water in the chamber A, and the lower end is below the level of the water in the chamber C. These pipes *a* and *b* are also in open communication with the water in the chamber B. The chamber A is connected to the chamber B by means of the pipe *c*, which extends above the water-line in the chamber A and slightly below the water-line in the chamber B. The chambers B and C are connected by a pipe *d*, which extends above the water-line in the chamber B and slightly below the water-line of the chamber C. These connections may be made as shown at Fig. 1 or as shown in either Figs. 2 or 3, or in any preferred manner, the main object being to establish a connection between all three chambers below their water-lines and to establish a connection of the air-space of A with

the water-space of B and of the air-space of the chamber B with the water-space of C.

The steam-boiler D or other suitable source of steam supply is connected by steam-supply pipes *e* to suitable heating-chambers or radiators E, the supply of steam thereto being regulated by the valves F. Each radiator E is connected to a common condenser G by means of pipes *f*, adapted to drain off water of condensation from said radiators to said condenser. The bottom of the condenser is connected with the water-space of the boiler D by means of a pipe or pipes *g*, whereby the condensed water returns to the boiler. The condenser G is also connected at its upper portion with the air-space of the chamber B by means of the pipe *j*. The supply-pipe *e* from the boiler D, or the steam-space of the boiler directly, is connected to the air-space of the lower chamber, C, by means of a pipe *i*. The upper chamber, A, has a pipe *k* or other opening leading from its air-space to the open air.

The difference in levels of the water in the chambers A and C, if measured by a column of water, would equal the distance measured by the arrow or line H. Now by reason of the connections established as above explained this distance H would also be the measure of the momentary steam-pressure of the boiler D.

The difference in levels of the water in the chambers A and B would be represented by the line *h'*, and this distance *h'* would be the measure of the momentary pressure in the condenser G.

The difference in levels of the water in the chambers B and C, which is *h*, would therefore represent the difference between H and *h'*, or the difference in pressure between the boiler D and the condenser G, which difference in pressure it is the object of the present invention to maintain uniform.

Now so long as the pressure H is not smaller than the pressure represented by *h* the latter pressure will always remain independent of the pressure H of the boiler and the height *h* is approximately uniform or equal to the distance between the water-lines of the chambers B and C, the water-lines of which chambers are also approximately uniform. Now the water-line of the chamber C is always between the lower end of the pipe *d* and the mouth of the tube *i*, forming the overflow to the boiler, and the water-line of the chamber B will always remain between the lower end of the pipe *c* and the mouth of the tube *j*, forming the overflow to the condenser G, so long as the pressure of the boiler represented by H is greater than the pressure *h*. A suitable arrangement of the heights of the mouths of the tubes *i* and *j* with respect to the lower ends of the pipes *d* and *c* will permit of keeping the height of the water-levels in the chambers B and C approximately constant and consequently also the difference in pressure *h* between the boiler and condenser in the following manner:

If the chamber C is filled with water to a height shown in Fig. 1 and the pressure of steam in the boiler D is increased as in the charging of the same, the water in said chamber will rise in the pipes *d* and *b*, being forced upward by the excess of pressure of steam in the chamber C, and will fill out or increase the amount of water in the chamber B, which in rising will close the lower opening of the pipe *c* when the pressure of steam has reached a height corresponding to *h*. If the pressure of steam further increases, the water in the pipes *a* and *c* will rise and fill the lower portion of the chamber A until the water reaches the normal height. The water used for filling the chambers B and A up to their normal level is partly stored from the beginning in the chamber C, partly it will be formed from condensing steam.

If now the difference of pressure between the boiler and condenser is smaller than the normal difference *h*, which may happen in two instances—first, if the pressure of the boiler is decreased, and, second, if the pressure in the condenser increases—the device will restore the normal difference in the following manner:

First. If the boiler-pressure decreases, while the pressure in the condenser remains unchanged the water-line in the chambers A and B will, according to the decrease in H, sink uniformly, water flowing through the pipes *a* and *b* to the chamber C, and the lower opening of the pipe *c* will be freed. The surplus of air and steam then escapes from the condenser G through the tube *j* to the chamber B, and thence by the pipe *c* to the chamber A, from which it escapes by means of the pipe or opening *k* to the open air. This surplus will continue to escape until the normal difference in pressure is reached, when the water in the chamber B will rise and close the pipe *c*.

Second. If the condenser-pressure increases, while the boiler-pressure remains unaltered, the water-line of B will sink according to the excess pressure and is forced partially through the pipe *a* to the chamber A and through the pipe *b* to the chamber C until the lower end of the pipe *c* is again opened and the excess of pressure in the condenser G escapes through the pipe *c*, chamber A, and vent *k* to the open air.

If, however, the difference in pressure increases so that it is greater than the normal difference *h*, which results under the following circumstances—first, when the pressure H of the boiler increases while the pressure in the condenser remains unchanged, or, second, the pressure H remains unchanged while the pressure in the condenser decreases—the device will regulate and overcome this increased difference in the following manner:

First. If the pressure of the boiler increases, the pressure in the condenser remaining unchanged, the water in C will be forced through the pipe *b* to B, and partially forced further

from B into A through the pipe *a*. The lower opening of the pipe *d* will thus be freed and the surplus steam escapes through *d* to B and through *j* to the condenser G, and increases the pressure in G until the normal pressure difference is reached. If, however, the excess of H beyond the normal pressure is still too great, the excess in G will become also too great and it will force the water in B through the pipe *a* to A until the pipe *c* is open at its lower end, when the excess will escape to the open air through the vent *k*.

Second. If the pressure *h'* of the condenser decreases, the level of the water in B is raised by the flow of water from both A and C through the pipes *a* and *b*. The lowering of the water in C opens the lower end of the pipe *d*, which, as before described, serves to restore in G the normal difference *h* in pressure. It will thus be seen that by my device the normal difference in pressure *h* can be maintained under all circumstances. It is sometimes necessary or expedient to limit the height of the water in A, and consequently limit the pressure in the condenser G. To accomplish this an overflow tube or pipe *l* (indicated in dotted lines in Fig. 1) can be arranged so that it will conduct the surplus water from A to the pipe *g* or directly to the water-space of the boiler, as preferred. The height of water in B will of course be regulated by the tube *j*, which acts as an overflow, and the water-line in C is likewise regulated by the pipe *i* acting as an overflow.

When the valves F are opened, steam entering the radiators E will force air through the pipes *f* into the condenser G. The increase of pressure in G will, however, be compensated for, as before described. When the valves F are closed, the steam in the radiators E will condense and the vacuum thus created in E will suck in air from the condenser G until the radiators are filled with air. The decrease in pressure in G thereby occasioned will, however, be compensated for by steam from the boiler, as hereinabove described.

It may happen that by a continuous use of my regulating device, as above described, all the air in the system would be completely removed and expelled through the vent *k*, the place of the air being taken by steam. This would necessarily prevent any heat regulation of the radiators, as steam would fill the radiators by the return-pipes *f* yet if the valves F were closed. To prevent the possibility of such an occurrence an air-suction apparatus J, arranged in the manner of an ordinary steam-injector, is secured to the pipe *d*. By means of this air-injector air is sucked from the chamber A through the tube *m* and is forced through the pipe *d* into B, and hence through G and *f* to the entire steam system. As this suction apparatus will decrease the section of the pipe *d*, and thus obstructs a quick re-establishment of the normal difference in pressure *h*, a supplemental pipe *d'* (indicated in Fig. 1 by dotted lines) may be added thereto. The lower end of the pipe *d'* extends farther below the water-line in C than the lower end of the pipe *d*. Under ordinary circumstances the pipe *d*, when freed at its lower end, would act as a regulation, securing also the needed air-suction; but should said pipe *d* be insufficient the water in C will be forced down still farther until the lower end of *d'* is freed, when the normal difference in pressure *h* will be quickly and surely accomplished through said pipe *d'*.

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

1. A regulating device for low-pressure steam heating apparatus consisting of three superposed chambers partially filled with water, when at work, an outlet from the upper chamber to the air, a connection above the water-line of the middle chamber with the condenser, a connection above the water-line of the lowest chamber with the steam-space of the boiler, said chambers being connected together by a system of inlet-pipes adapted to maintain the water in the chambers at a predetermined height and thereby to maintain a constant difference of pressure between the boiler and the condenser, substantially as described.

2. In a pressure-regulating device for low-pressure steam heating apparatus, a boiler, a series of radiators supplied from said boiler, a condenser connected to said radiators, three superposed chambers when at work, partly filled with water, a vent in the upper chamber leading to the air, a tube connecting the middle chamber above its water-line with the condenser, a tube, connecting the lower chamber above its water-line with the steam-space of the boiler, a pipe connecting the upper and middle chambers below their water-lines, a pipe connecting the middle and the lower chambers below their water-lines, a pipe extending from near the water-line of the lower chamber to the air-space of the middle chamber, and a pipe leading from near the water-line of the middle chamber to the air-space of the upper chamber, substantially as described.

3. In a pressure-regulating device for low-pressure steam heating apparatus, a boiler, a series of radiators supplied from said boiler, a condenser connected to said radiators, three superposed chambers when at work, partly filled with water, a vent in the upper chamber leading to the air, a tube connecting the middle chamber above its water-line with the condenser, a tube connecting the lower chamber above its water-line with the steam-space of the boiler, a pipe connecting the upper and middle chambers below their water-lines, a pipe connecting the middle and lower chambers below their water-lines, a pipe extending from near the water-line of the lower chamber to the air-space of the middle chamber, a pipe leading from near the water-line of the middle chamber to the air-space of the upper cham-

ber, and a pipe and injector adapted to suck air from the air-space of the upper chamber and discharge the same to the middle chamber, substantially as described.

4. A regulating device for low-pressure steam heating apparatus consisting of three superposed chambers when at work partly filled with water, an outlet from the upper chamber to the air, a connection above the water-line of the middle chamber with the condenser, a connection above the water-line of the lowest chamber with the steam-space of the boiler, said chambers being connected together by a system of inlet-pipes adapted to maintain the water in the chambers at a predetermined height and thereby to maintain a constant difference of pressure between the boiler and the condenser, and an overflow-pipe leading from the upper chamber above its water-line to the water-room of the boiler, substantially as described.

5. In a pressure-regulating device for low-pressure steam heating apparatus, a boiler, a series of radiators supplied from said boiler, a condenser connected to said radiators, three superposed chambers when at work partly filled with water, a vent in the upper chamber leading to the air, a tube connecting the middle chamber above its water-line with the condenser, a tube connecting the lower chamber above its water-line with the steam-space of the boiler, a pipe connecting the upper and middle chambers below their water-lines, a pipe connecting the middle and lower chambers below their water-lines, a pipe extending from near the water-line of the lower chamber to the air-space of the middle chamber, a pipe leading from near the water-line of the middle chamber to the air-space of the upper chamber, a pipe and injector adapted to suck air from the air-space of the upper chamber and discharge the same to the middle chamber, and a supplementary pipe leading from above the water-line of the middle chamber to the lower chamber, terminating at a point lower than the pipe extending from about the water-line of the lower chamber to the air-space of the middle chamber, substantially as described.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

CASIMIR OBREBOWICZ.

Witnesses:
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H. HASPER.