No. 788,492. PATENTED APR. 25, 1905.

E. F. OSBORNE.

CONDENSED WATER RETURN APPARATUS FOR STEAM HEATING SYSTEMS.

APPLICATION FILED APR. 30, 1904.

Fig. 1.

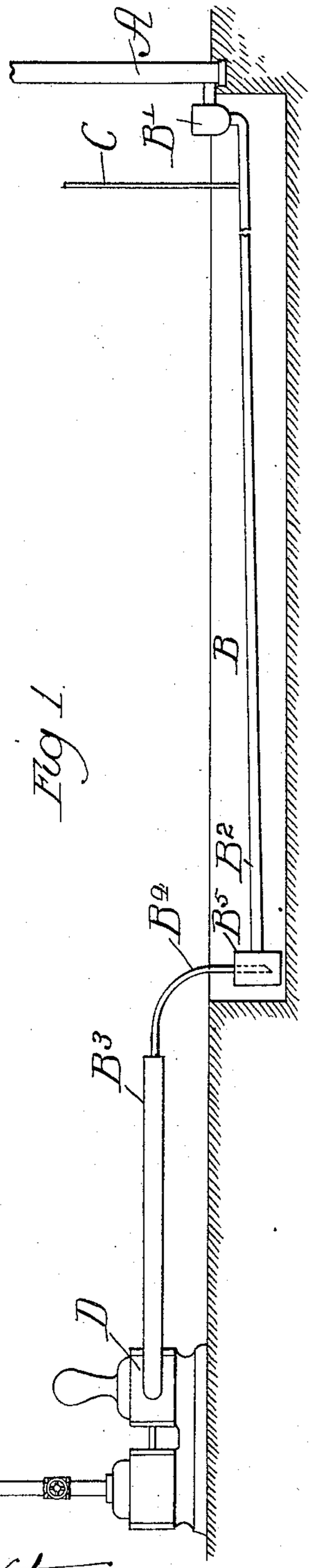


Fig. 2.

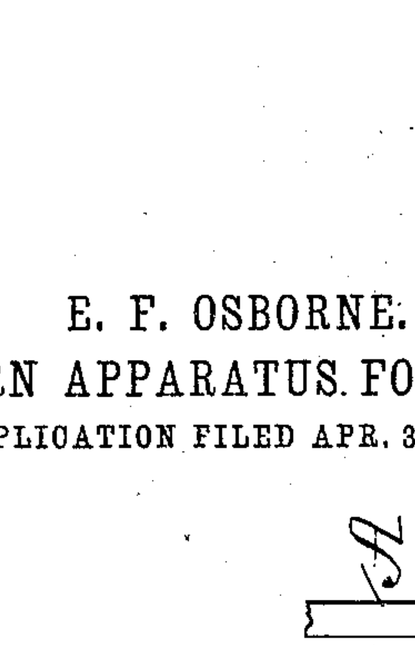


Fig. 3.

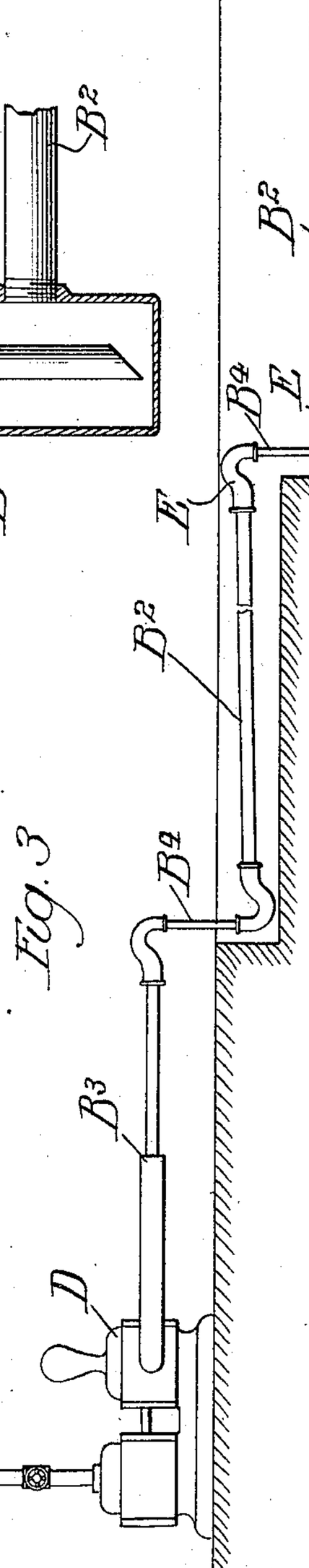
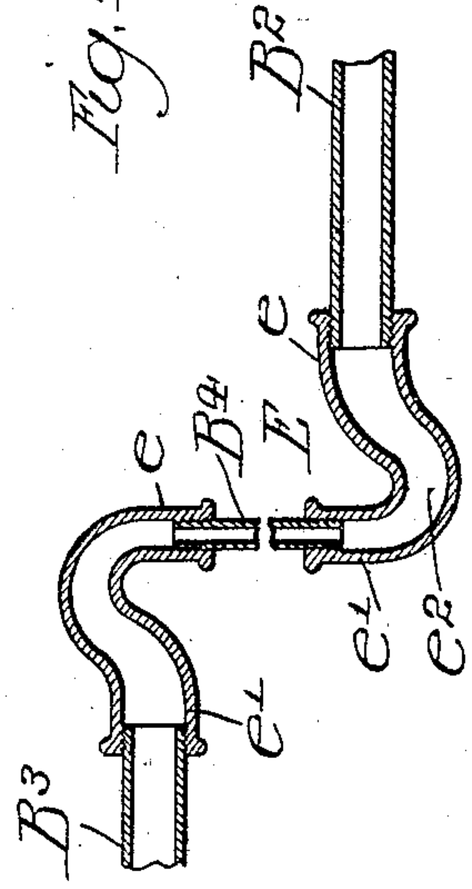


Fig. 4.



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No. 788,492. Patented April 25, 1905.

UNITED STATES PATENT OFFICE.

EUGENE F. OSBORNE, OF CHICAGO, ILLINOIS.

CONDENSE-WATER-RETURN APPARATUS FOR STEAM-HEATING SYSTEMS.

SPECIFICATION forming part of Letters Patent No. 788,492, dated April 25, 1905.

Original application filed February 23, 1904, Serial No. 194,927. Divided and this application filed April 30, 1904. Serial No. 205,727.

To all whom it may concern:

Be it known that I, EUGENE F. OSBORNE, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Condense-Water-Return Apparatus for Steam-Heating Systems; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in steam-heating systems, and refers more specifically to an improved apparatus for returning the water of condensation from the several drip-pipes of the system to a central pumping device located at a level higher than the lowermost point at which the water is collected in said drip-pipes.

The invention has been designed more especially for use in returning water through a return-pipe which contains as well as vapor more or less air or another non-condensing gas, and is constructed with a view to utilize the kinetic energy and the expansion of the gaseous mixture confined in the return-pipe with the water to aid in lifting the water from the lower to the higher level.

The invention consists in the matters hereinafter set forth, and more particularly pointed out in the appended claims.

Among the objects of my invention is to provide an apparatus of the general character set forth by which the water of condensation when contained in a return or conveying pipe, together with a gaseous fluid, as stated, may be conveyed from a lower to a higher level by an economical expenditure of pumping power and with a minimum reduction of the temperature of the water. In steam-heating systems the water of condensation is generally used to supply the steam-generator, so that the maintenance of the temperature of the condense or return water economizes in the fuel for heating the generator.

My improved apparatus is admirably applicable to that class of heating systems wherein the admission of steam to the heating devices or units is regulably controlled by the admission of air to the heating devices in a manner to limit the steam capacity of the heating devices, and therefore their heating capacity, and wherein the air after having performed its regulating function is discharged into the return-pipe of the system and is therefore contained in the same conduit as the water of condensation, though unmixed therewith. Such a system is shown in my copending application for United States Letters Patent, Serial No. 194,927, filed February 23, 1904, of which this application is a division. In all vacuum systems more or less air leaks into the system, and my improvements may be employed in connection with any vacuum system wherein there is contained in the water-of-condensation-return pipe a quantum of air mixed with vapor, the properties of which may be utilized in the general manner stated. So, also, my improvements may be employed when pumping a liquid of greater than normal temperature when conveyed through a pipe having therein a quantum of air or other non-condensing gas. By the term "non-condensing" gas is meant a gas which does not condense under the conditions of operation of the system—that is to say, if the temperature of the apparatus be maintained high the gas or gaseous mixture may be other than air or even steam or vapor.

As shown in the drawings, Figure 1 is a view, principally diagrammatic in its nature, showing my improved apparatus for returning the water of condensation from a heating system and illustrating the condense-water drip-pipe and the air-pipe which discharges thereinto. Fig. 2 is an enlarged detail showing a fitting in the return-pipe by which the condense-water is lifted from a lower to a higher level. Fig. 3 illustrates a modification of the return-pipe. Fig. 4 is a detail of a fitting which is a modification of the fitting shown in Fig. 2.

The conditions usually prevailing in a steam heating system wherein my improvements are usefully applicable is one or more return-pipes for conveying the condense-water from

the drip or return pipes of the system to a central pumping apparatus, the water being thus collected to be subsequently supplied to the steam generator or boiler. The pump is often located at a level considerably higher than the lowermost parts of the drip or return pipes of the system, thereby rendering it necessary to lift the condense-water. The main return-pipes leading to the pumping apparatus are often of considerable horizontal length, and my improvement contemplates that the pipe shall be provided with one or more vertical rises or offsets, (depending upon the length of the pipe and the total height of the lift.) The vertical offset portions of the return-pipe are restricted as compared to the conveying capacity of the horizontal portions of the pipe, and located at said vertical portions of the pipe, preferably at the lower ends thereof and at the junctions of the smaller and larger portions of the pipe, are what may be termed "inverted weirs" or "traps," whereby the larger horizontal and smaller vertical parts of the pipe are at times sealed off from each other against the passage of the gaseous fluid. When so sealed, the draft of the pump lifts water through the restricted vertical offset, and when the water drops below the weir air passes upwardly through said restricted pipe. These alternate bodies or slugs of water and gaseous fluid thus pass upwardly through the upward offsets of the return-pipe. Two physical properties of the gaseous fluid are utilized to assist in lifting the water—to wit, kinetic energy and the energy of expansion of the gaseous fluid. In this manner I am enabled to effect the lifting of the water with comparatively small difference in gage-pressure between the lowermost part of the return-pipe and the induction side of the pump and comparatively small piston displacement. The water of condensation handled by my apparatus when part of a steam-heating system is returned near its correlative boiling temperature, and it is important, when pumping water at such temperature, to keep the pressure as high as is practicable in order to avoid undue vaporization and consequent cooling of the water. The pump is operated at an appropriate speed greater than that required to lift a solid column of liquid to keep moving the liquid and gaseous fluid in alternate slugs through the vertical or upward offset of the pipe. The moving fluid column in the vertical part of the conveying or return pipe at any given time is composed of alternate slugs of liquid and the gaseous fluid and for a column of a given height is lighter than a like column of liquid and may be raised with correspondingly less power. In fact, the power required to raise the said mixed column is actually less than that required to raise a column of liquid which equals in length the aggregate or total length of the slugs of liquid in said column, this being true by reason of the lifting effect produced by the kinetic and expansive energy of the gaseous fluid.

As shown in Fig. 1 of the drawings, A designates the drip-pipe of a steam-heating system which carries the condense-water back to the return-pipe B of the system and which is adapted to be connected with one or more heating devices of a system of which it forms a part. C designates an air-pipe through which in this instance the regulating-air is adapted to be conducted from the heating device or devices to said return-pipe. The connection of said pipes A and C with the radiator may be as shown in my aforesaid pending application, Serial No. 194,927, or otherwise. The return-pipe B is connected with the drip-pipe A of the system through the medium of a trap B′ and discharged at its other end above the level of the trap into a pump D, which affords the vacuum for returning the water and gaseous fluid through the pipe B. The return-pipe B consists generally, as shown in Fig. 1, of two horizontal sections B^2 B^3, the lengths of which depend upon the particular installation, and an upright offset part B^4. The internal diameter of said vertical offset part B^4 is about one-half of that of the horizontal part B^2 or that connected with the drip-pipe, while the part or section B^3 which discharges into the pump is made about twice the internal diameter of the part or section B^2. The inverted weir or trap between the innermost horizontal part of the return-pipe and the vertical part thereof is shown in Fig. 1 as made as follows: The part or section B^2 of the condense-water pipe discharges condense-water therethrough into an open-topped cup-shaped receptacle B^5, which is illustrated more clearly in Fig. 2. The said section B^2 of the pipe enters the cup B^5 at a distance above the bottom thereof. The vertical part or section B^4 enters the open end of the cup and extends a distance thereinto below the level of the discharge end of the part B^2. The lower end of the vertical portion B^4 of the return-pipe is shown as beveled at one side, whereby one side of said pipe is uncovered by the liquid when the liquid-level lowers before the other side. The same results may be effected by somewhat deeply serrating the lower end of said vertical part of the pipe. The oblique end of the vertical portion B^4 of the pipe constitutes, in effect, an inverted weir and is alternately covered and uncovered by the water within the cup. When covered, water passes upwardly into the vertical part of the pipe, and this continues until the lower end of the said vertical pipe is sufficiently uncovered to permit gaseous contents of the pipe to pass therethrough. Thus alternate slugs of water and gaseous fluid pass upwardly through the restricted vertical portion of the pipe B.

Water is supplied continuously to the cup through the part B^2 of the pipe, and when the lower end of the vertical part of the pipe is temporarily uncovered water flows into said cup and again covers the lower part of the vertical portion of the return-pipe. The section B^3 of the return-pipe, enlarged, as it is, at the pump-cylinder, constitutes a storage-reservoir from which the pump-cylinder is supplied, thus furnishing a steady body of water to the pump and preventing the transmission to the moving column of liquid and air in the part B^4 of the return-pipe of the impulses of the pump-piston. If the pump be made of a rotary type, the enlargement may be omitted, inasmuch as there will be no cylinder impulses to provide against.

In Figs. 3 and 4 the inverted weir at the lower end of the vertical portion B^4 of the return-pipe is changed in its construction. In this construction the cup B^5 is replaced by a fitting E of elbow shape. One branch *e* thereof is made larger than the other branch, *e'*, the former receiving the horizontal part B^2 of the return-pipe and the latter the lower end of the vertical part B^4 of said pipe. Between the horizontal and vertical parts of said fitting it is formed to constitute a bend. In the lower fitting the upper wall of the downwardly-curved part e^2 constitutes the inverted weir. The upper fitting is made like the lower fitting.

The action of the apparatus shown in Fig. 2 is substantially like that shown in Fig. 1, the form of the trap or weir only being changed.

It will be observed that in Fig. 3 I have shown two vertical offsets in the return-pipe; but more may be employed, depending upon the horizontal length of the pipe and the length of the total rise of the liquid or elevation from the lowest part of said return-pipe to the induction side of the pump. Each section of the horizontal pipe inclines downwardly. The two horizontal sections of the pipe shown in Fig. 3 between the lift nearest the pump and the drip-pipe A bear the same reference-letter as the lowermost horizontal part of the pipe shown in Fig. 1, while the horizontal parts of the pipes at the pump in both figures bear like reference-letters.

As before stated, the apparatus may be employed for pumping or lifting liquid, together with a gaseous fluid, from a lower to a higher level where practically the same conditions in the conveying-pipe obtain, as hereinbefore described. The term "non-condensing" gas herein employed is intended to designate a gas or gaseous mixture which does not, in fact, condense during the usual or normal operation of the apparatus. In the apparatus herein described it consists of air mixed with a certain quantum of vapor. If the conducting-pipes be maintained sufficiently hot, the steam may constitute such gaseous mixture, as before stated.

It is apparent from the foregoing that the apparatus may be considerably varied in its structural details without departing from the spirit of my invention. I do not wish to be limited thereto, therefore, except as hereinafter made the subject of specific claims.

I claim as my invention—

1. In a steam-heating system, a return-conduit receiving and conducting condense-water and gaseous fluids, a pump located at a level higher than that of the receiving end of the conduit into which the other end of said conduit discharges, and means located intermediate the ends of said conduit for dividing said water and gaseous fluids in alternate slugs, whereby the lifting force of the pump is aided by the kinetic and expansive energy of the gaseous fluids to raise the water to the pump.

2. In a steam-heating system, means for raising the heated condense-water and associated gaseous fluids, comprising a return-conduit receiving and conveying condense-water and gaseous fluids, a pump communicating with the higher end of the conduit, said conduit being provided intermediate its ends with an upright part and means located at the base of the upright part for dividing the contents of the conduit in alternate slugs of liquid and gaseous fluids, whereby said contents rise through the upright part of the conduit in such alternate slugs.

3. In a steam-heating system, the combination of a return-conduit receiving and conducting water and gaseous fluids, a pump located at a level higher than that of the receiving end of said conduit into which the other end of said conduit discharges, said conduit being provided intermediate its length with an upright restricted offset portion and means located at the base of the said offset portion for dividing said water and gaseous fluids in alternate slugs, whereby the contents of said conduit rises through said offset portion in such alternate slugs.

4. In a steam-heating system, the combination of a return-conduit receiving and conducting condense-water and gaseous fluids, a trap interposed between said conduit and system, a pump located at a level higher than that of the trap into which the other end of said conduit discharges, said conduit being provided intermediate its length with an upright restricted offset portion and means located at the base of the said offset portion for dividing said water and gaseous fluids in alternate slugs, whereby the contents of said conduit rise through said offset portion in such alternate slugs.

5. In a steam-heating system, the combination of a return-conduit receiving and conducting water and gaseous fluids, a pump lo-

cated at a level higher than that of the receiving end of said conduit into which the other end of said conduit discharges, said conduit embracing a plurality of generally horizontal parts joined by restricted upright offset portions, and means at the bases of said offset portions for dividing said water and gaseous fluids in alternate slugs, whereby the contents of the conduit rise through said offset portions in such alternate slugs.

6. In a steam-heating system, the combination of a return-conduit receiving and conducting water and gaseous fluids, a pump located at a level higher than that of the receiving end of said conduit into which the other end of said conduit discharges, said conduit being provided intermediate its length with an upright restricted offset portion and means located at the base of the said offset portion for dividing said water and gaseous fluids in alternate slugs, whereby the contents of said conduit rise through said offset portion in such alternate slugs, the end of the conduit immediately adjacent to the pump being enlarged.

7. In a steam-heating system, an apparatus for raising condense-water associated with air and vapor comprising a return-conduit having one end higher than the other and receiving at its lower end condense-water and gaseous fluids, a pump into which the higher end of the conduit discharges, said conduit comprising generally horizontal and vertical parts, the latter of which are restricted, and traps at the lower ends of said vertical parts of the conduit.

8. In a system for raising heated water associated with a gaseous fluid from a lower to a higher level, the combination of a source supplying such heated water and gaseous fluid, a conduit communicating with said source at its lower end, a pump communicating with the other or higher end of the conduit, said conduit embracing a plurality of relatively long horizontal parts connected by short upright parts, the latter of which are restricted relatively to the horizontal parts, and means at the lower ends of said vertical parts for dividing the water and gaseous contents of the conduit in alternate slugs, whereby the contents of the conduit rise through said upright parts in such alternate slugs.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 28th day of April, A. D. 1904.

EUGENE F. OSBORNE.

Witnesses:

WILLIAM L. HALL,

GERTRUDE BRYCE.