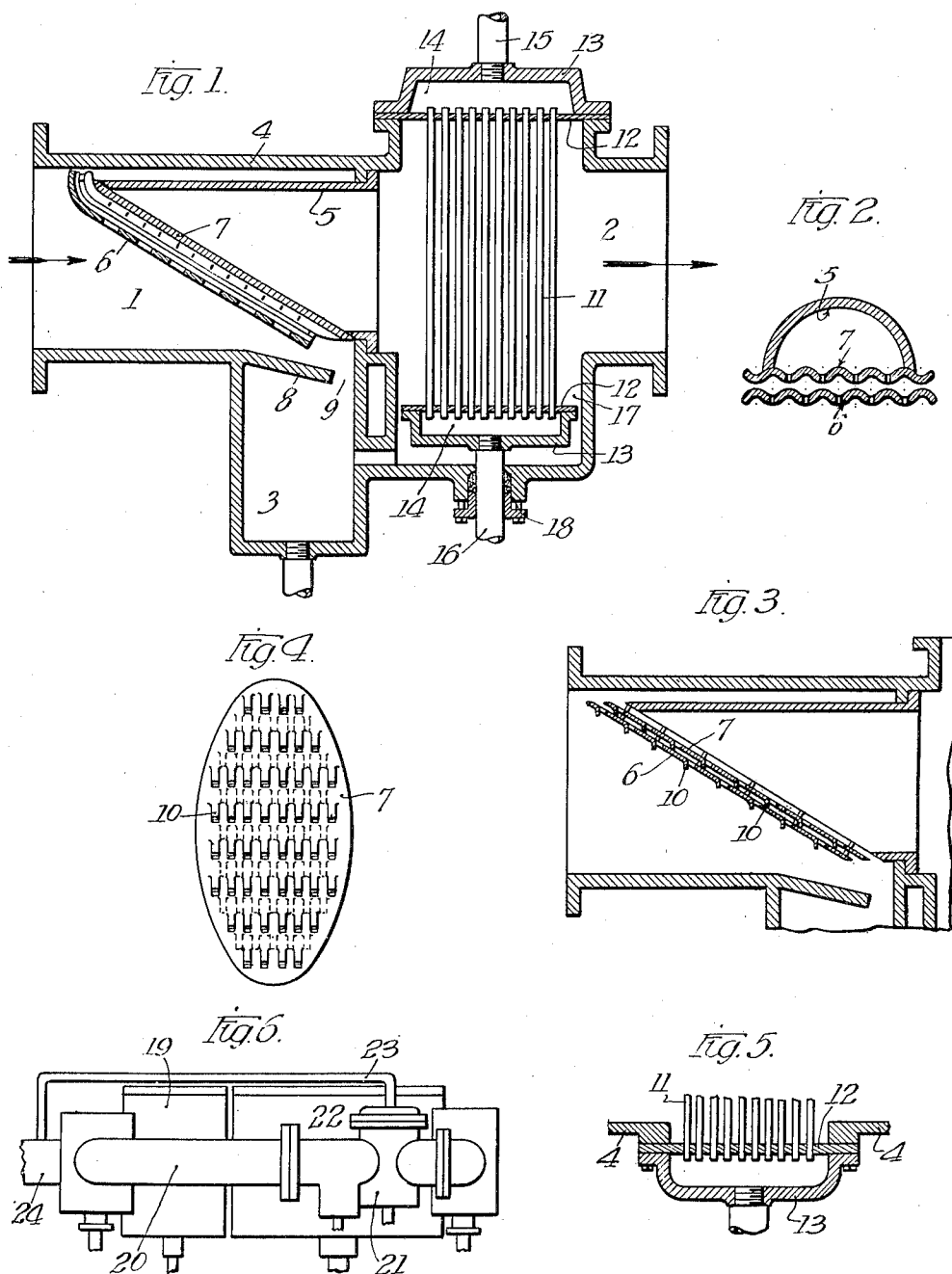


C. C. THOMAS.
STEAM AND GAS DRIER.
APPLICATION FILED NOV. 29, 1915.

1,359,547.

Patented Nov. 23, 1920.



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UNITED STATES PATENT OFFICE.

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STEAM AND GAS DRIER.

1,359,547.

Specification of Letters Patent. Patented Nov. 23, 1920.

Original application filed December 27, 1910, Serial No. 599,456. Divided and this application filed November 29, 1915. Serial No. 64,157.

To all whom it may concern:

Be it known that I, CARL C. THOMAS, a citizen of the United States, residing in the city of Baltimore, State of Maryland, have invented new and useful Improvements in Steam and Gas Driers, of which the following is a specification.

This invention relates to steam and gas driers.

It is particularly applicable for use with meters such as described in co-pending application Serial No. 599,456, filed December 27, 1910, of which the present application is a division. It should be understood, however, that it is capable of use in various other relations.

One of the objects of the invention is to provide an improved means for separating moisture from flowing steam, gas or the like.

Another object is to provide an improved means for separating the moisture from flowing steam or gas and for thoroughly drying the gas.

Another object is to provide improved and simple apparatus for effectively accomplishing these results.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate an embodiment of the invention.

The views of the drawings are as follows:

Figure 1 is a longitudinal sectional view through an embodiment of the invention.

Fig. 2 is a detail transverse sectional view of the moisture collecting plates and the casing with which they are associated.

Fig. 3 is a longitudinal section of a modified form of the separator.

Fig. 4 is a front elevation view of the moisture collecting plates of the separator shown in Fig. 3.

Fig. 5 is a sectional view of a portion of the heater illustrating an alternative heater construction.

Fig. 6 is a diagrammatic view of the device as applied to a compound engine.

The apparatus illustrated comprises, in general, a housing adapted to be connected to a gas main or the like through which flows the steam or gas from which the moisture is to be removed. In the housing is located a separating chamber 1, a drying and heating chamber 2 and a moisture collecting chamber 3 for receiving the moisture

separated from the gas or steam by the separator and drier.

The separator is located in the forward end of the housing 4 in a chamber in said housing which may be called the separating chamber. A casing or conduit 5, preferably of smaller diameter than the housing 4 is located in said chamber and spaced away therefrom so that the inner casing is jacketed by the steam or gas passing through the apparatus and is thus maintained at about the mean temperature of the steam or gas so that free moisture is not added to it by condensation on the walls of the casing. The casing is flanged at its inner end and suitably attached to the housing 4. The annular space between the casing 5 and the housing 4 is closed at the inner end of the casing, so that any moisture or water that may collect within said annular space is forced to drain around the casing 5 to the receiving chamber 3. This latter construction is important for it has been found that when steam or gas flows along a pipe together with water, a large portion of the water may be, and generally is, found flowing along the inner surface of the pipe. The construction described intercepts this water and drains it to the receiving chamber 3.

The inlet end of the casing 5 has an oblique mouth and in front of this mouth are located deflecting and moisture collecting plates 6, 7. These plates are suitably perforated and the perforations of each plate are staggered with relation to the perforations in the other so that the steam or gas is forced to take a tortuous path in entering the separating chamber whereby the moisture is separated therefrom and collects on the plates, down whose inclined surfaces it flows to the receiving chamber 3. The water which flows along the inner surface of the pipe is intercepted by the space between the outer casing 4 and the inner casing 5 and is discharged to the receiving chamber, while the water which is mechanically suspended in the steam or gas is driven down the inclined corrugations of plates 6 and 7, which thus provide for a continuous flow of the water in substantially its original direction of flow, avoiding spattering and remixing with the gas.

A projecting flange 8 covers the mouth of the collecting chamber 3 to prevent the

steam or gas which passes through the apparatus from sweeping over the surface of the water in said chamber. This flange does not meet the opposite side of the chamber so that an entrance opening 9 is formed for receiving the water from the separator. The flange is preferably inclined to drain into the entrance opening.

The plates 6 and 7 for separating the suspended moisture from the steam or gas may be made in various forms. Fig. 2 illustrates one desirable construction in which the plates are corrugated and arranged face to face with the corrugations mismatched. The plates are perforated along the crease of the corrugations. This construction provides a tortuous path for the steam or gas and also provides gutters down which the separated moisture may readily flow.

An alternative construction of plates is shown in Figs. 3 and 4. These plates are approximately flat, but are perforated and have burs or projections pressed out therefrom which burs help to collect the moisture in the drops of sufficient size to drop through the flowing stream of gas or steam to the bottom of the housing without being caught up by said stream. In this construction the perforations of the plates are staggered with respect to each other so that the steam or gas must follow a tortuous course in passing into the chamber 5 as a result of which the bulk of the contained moisture will be thrown against the surface of the collecting plates and will trickle down the surfaces of said plates, collecting into drops thereon and thence dropping or flowing to the bottom of the housing 4 and into the collecting chamber 3.

The heating chamber 2 is provided with a series of pipes 11 through which steam or superheated water, that is, water at a temperature above 212° F., is passed. These tubes are supported by suitable tube sheets 12 in the upper and lower ends of chamber 2. The tube sheets are covered by bonnets 13 which form chambers 14 between themselves and the tube sheets. A pipe 15 supplies steam or superheated water which enters the chamber 14, passes through the pipes 11 into the lower chamber 14 and is carried away by a pipe 16. In the construction shown, the lower bonnet 13 and the tube sheet 12 are within the chamber housing; that is to say, they are located within the pocket 17 in the lower portion of the housing and are free to move up and down therein a short distance to allow free expansion and contraction of the tubes 11, the pipe 16 passing through a suitable gland 18. Various other constructions may be employed for mounting the pipes 11 within the heating chamber. Fig. 5 illustrates a construction in which the lower bonnet 13 is located outside of the chamber housing.

The apparatus operates as follows:

The wet steam or gas entering the separating chamber carries with it a certain amount of water which generally flows along the inner surface of the pipe. This water is caught in the space between the housing 4 and the inner casing 5 and flows into the receiving chamber 3. In order to enter the casing 5, the steam or gas must pass through the staggered perforations in the plates 6 and 7. In following the tortuous path through the openings in the plates, the water which is carried mechanically suspended in the steam or gas is collected on said plates and driven down the inclined surfaces thereof in the same general direction as its original direction of flow to the collecting chamber 3. By changing the direction of flow of the collected water as little as possible the remixing of the water with the steam or gas is avoided. The nearly dried steam or gas in the chamber 5 is thence passed around the heating pipes 11 so that any free moisture which may be present is evaporated and the steam or gas thoroughly dried. It will be understood, of course, that the steam or water supplied to the pipes 11 is supplied at a temperature higher than that of the steam or gas entering the drier. It will be observed that the action of the drier is continuous.

The term "moisture" as used herein is of course intended to include not only water and water vapor but other substances such as tar, etc., the presence of which in the gas is particularly objectionable when the gas is metered.

While the separator and drier is particularly useful in connection with meters it is not limited in its application, but may be used for example, to reheat steam between stages of a compound or a triple-expansion engine, or between stages of a multi-stage turbine and for similar uses.

Fig. 6 illustrates the use of the drier between the high and the low pressure cylinders of a compound engine. The exhaust steam from the high pressure cylinder 19 is conveyed by means of the pipe 20 to the heater and drier 21, and thence to the low pressure cylinder 22. Steam for the drying pipes 11 is supplied by a pipe 23 connected to the main steam pipe 24. The live steam in the pipe 24 is at a much higher temperature than the exhaust of the low pressure cylinder and drier and therefore provides a suitable heating means for the drying pipes.

Similar applications of the drier between stages of a multi-stage turbine will be apparent. The drier may also be used between a reciprocating engine which exhausts into a low pressure steam turbine and the entrance to said turbine.

It should be understood that the structure

shown is for purposes of illustration only and that other structures may be devised which embody the invention and which come within the spirit and scope of the appended claims.

What I claim is:—

1. A steam or gas drier comprising a conduit provided with drying means and, in advance of such drying means, with an inner conduit spaced from the walls of said first named conduit and having at its entrance mechanical moisture-separating means.

2. A steam or gas drier comprising a housing having within it a drying chamber, drying means in said chamber, an inner conduit within said housing leading to said drying chamber, and moisture-collecting means guarding the mouth of said inner conduit.

3. A steam or gas drier comprising a housing having within it a drying chamber, drying means in said chamber, an inner conduit within said housing leading to said drying chamber, and moisture-collecting means guarding the mouth of said inner conduit, said inner conduit being separated from the walls of said housing by a jacketing space.

4. A steam or gas drier comprising a housing having within it a drying chamber, drying means in said chamber, an inner conduit within said housing leading to said drying chamber, said conduit having an oblique mouth, and downwardly inclined moisture-collecting means guarding said oblique mouth.

5. A steam or gas drier comprising a housing having within it a drying chamber, drying means in said chamber, an inner conduit within said housing leading to said drying chamber, and moisture-collecting plates guarding the opening of said inner conduit, said plates being spaced away from each other and provided with staggered openings for the passage of gas or vapor to the drying chamber.

6. A steam or gas drier comprising a housing having within it a drying chamber, drying means in said chamber, and moisture-collecting means in the path of fluid passing to said drying chamber, said means comprising perforated corrugated plates placed in proximity to each other with the corrugations of the two plates mismatched, the perforations of said plates being staggered.

7. A steam or gas drier comprising a cas-

ing having within it a drying chamber, mechanical moisture-separating means in advance of said drying chamber, tube sheets at opposite sides of said chamber, tubes extending from the one tube sheet to the other, and bonnets covering said tube sheets, one of said tube sheets and the corresponding bonnet being located within the casing and adapted to move therein to permit expansion and contraction of said pipes.

8. A steam and gas drier comprising a housing having a drying chamber therein, drying means within said chamber, a separating chamber in advance of said drying chamber, a casing within said separating chamber, said casing being spaced from the walls of said housing and the space closed at the inner end of the casing whereby the casing is jacketed and the moisture flowing along the housing surface intercepted, moisture separating means at the entrance to said casing, and a receiving chamber for collecting the moisture separated from the steam or gas.

9. A steam and gas drier comprising a housing having a drying chamber therein, drying means within said chamber, a separating chamber in advance of said drying chamber, a casing within said separating chamber, said casing being spaced from the walls of said housing and the space closed at the inner end of said casing whereby the casing is jacketed and the moisture flowing along the housing walls intercepted, a plurality of plates having openings therein arranged at the entrance of said casing, said plates being inclined downwardly in the direction of flow of the fluid and being arranged with the openings in one plate staggered with relation to the openings in the adjacent plate whereby moisture is separated from the steam or gas and drained downwardly in the direction of flow, and a receiving chamber for the separated moisture, said receiving chamber having means adjacent the entrance thereto for preventing the flowing stream of steam or gas from coming in contact with the moisture in said chamber.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

CARL C. THOMAS.

Witnesses:

JAMES F. JOHNSON,
L. C. SCHAUTZ.