W. Mont. Storm,

Steam-Boiler Superheater.

No. 18,613. Patented Nov. 10, 1857.

Fig. 1.

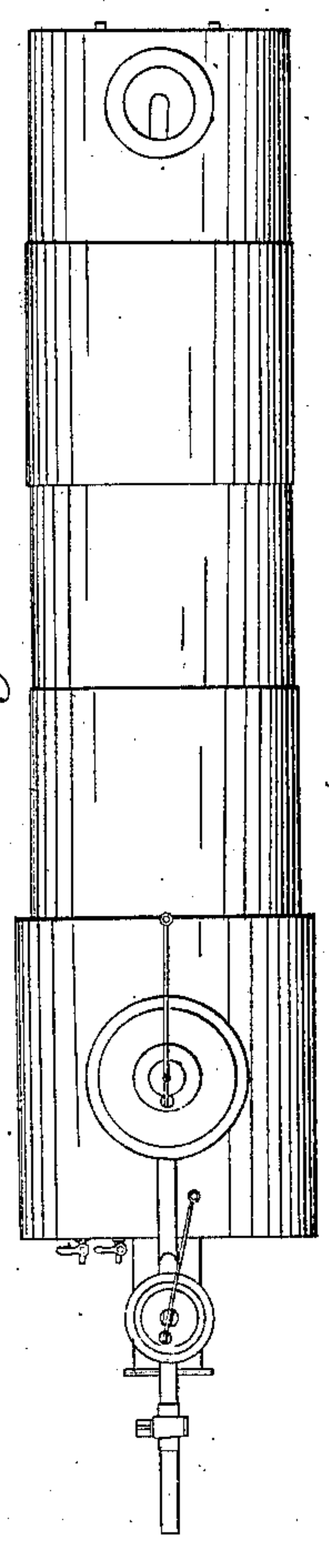


Fig. 2.

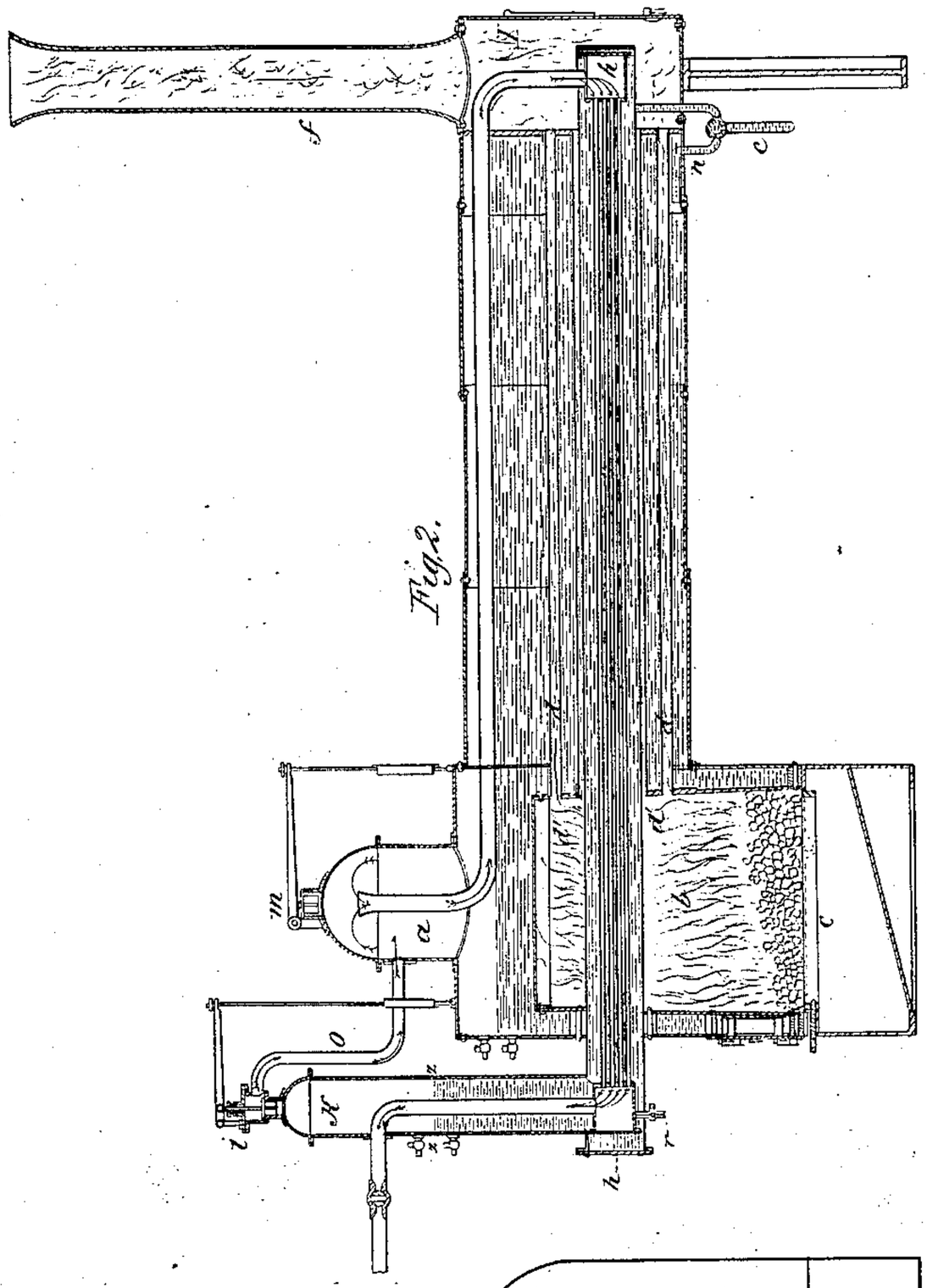


Fig. 3.

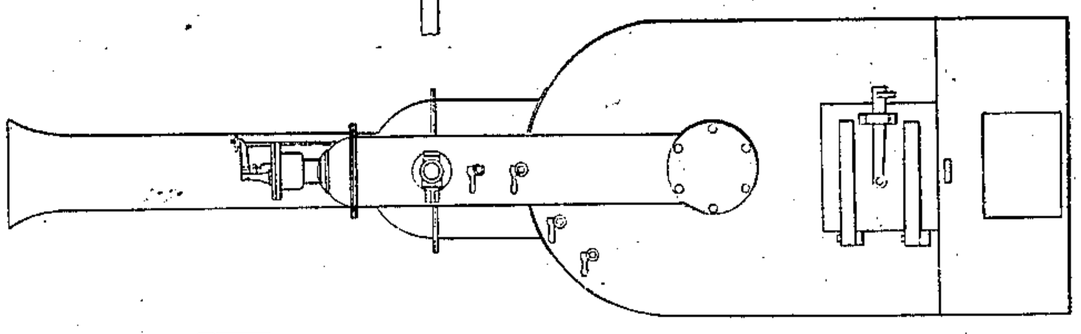


Fig. 4.

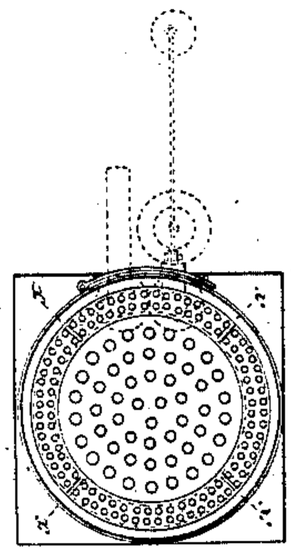
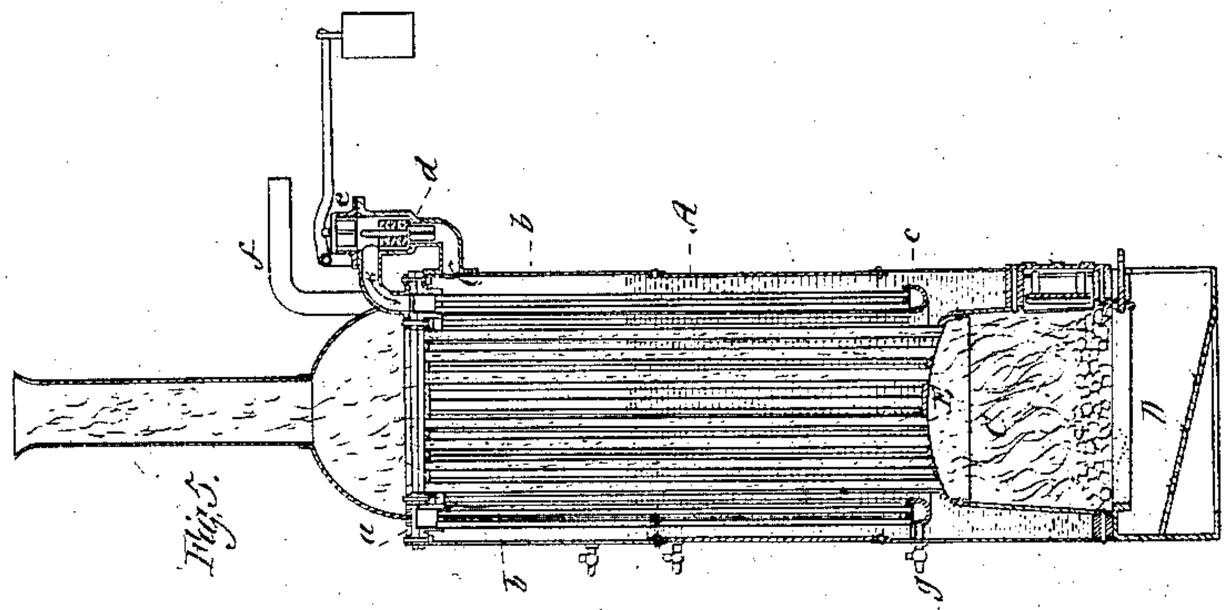


Fig. 5.



UNITED STATES PATENT OFFICE.

WILLIAM M. STORM, OF NEW YORK, N. Y.

IMPROVEMENT IN GENERATING ANHYDROUS STEAM.

Specification forming part of Letters Patent No. **18,613**, dated November 10, 1857.

To all whom it may concern:

Be it known that I, WILLIAM M. STORM, of the city, county, and State of New York, have invented certain new and valuable Improvements in Generating Anhydrous Steam, which I believe to be in all respects properly described in this schedule.

The economy of "anhydrous" or dry steam as compared with that ordinarily used, and which carries a large amount of finely-divided water in "suspension," is too well ascertained and admitted among engine-men to demand any corroborative argument here. The water in suspension in ordinary steam is so abundant and so detrimental to its motive action, especially in the case of steam supplied from boilers whose steam-space is comparatively moderate, that in general an advantage of fifty per cent. may be obtained by rendering such steam anhydrous, or converting the water it holds in suspension into vapor possessed with "latent heat," the only source of elasticity, expansion, or motive power. Yet it is not customary to attempt this because the pipes, vessels, or apparatus employed for drying the steam after it is generated and previous to its use have in every attempt been exposed to the hot products of combustion and burned out in so short a time as to overbalance by this loss and the delay and annoyance entailed the saving in other respects effected, in addition to which it has been found practically impossible to prevent thus far the steam passed through the pipes or vessels employed for drying it from becoming at times suddenly and unexpectedly "superheated" to such an extent as to seriously and incurably injure the packing, joints, valve-surfaces, &c., about the engine, the destruction being thus spread even beyond the drying apparatus frequently and as far as this always. For these reasons it has become a point considered almost finally settled among experienced engine-men that the economy of dry or anhydrous steam, however great and alluring, is an economy they must forego as being in effect unavailable, as the vessels or pipes exposed to the fire heat and through which the steam passes to be rendered anhydrous (in all methods yet known) cannot stand. Now the object of my invention is to remove every obstacle of this nature by removing the cause—viz., the exposure of the superheating-pipes directly or dry to the fire-heat, and which is not essential (as has generally been taken for granted) to producing the desired effect.

My method about to be described assumes to render the production of anhydrous steam as easy, certain, and controllable as the production of ordinary steam, while the apparatus to effect this shall be as lasting as any boiler, and its construction require no further knowledge or experience from the boiler-maker than he already possesses, and no ability on the part of the engine-man or stoker than they already possess and ordinarily exert in present steam tactics.

The principle of my invention is applicable to boilers of almost any kind; but I will here illustrate it in connection with a boiler of that kind in general use, (which I consider as best, all things weighed, for almost every purpose,) the proportions of parts of course being varied to suit each case.

In the drawings, Figures 1, 2, and 3 represent a horizontal tubular-flue boiler. Fig. 1 is an exterior plan view, Fig. 2 a horizontal section, and Fig. 3 a front end elevation.

a is the steam-space; *x*, water-line; *b*, fire-box; *c*, grate; *d*, flues; *e*, feed-pipe for supplying water to boilers; *f*, chimney.

d' is a large flue in all respects like the others, except its great diameter.

h is a long cylindrical vessel (or boiler, in fact) passing from the front of the main boiler through the fire-box directly on through the great flue before mentioned (the size of which still admits a free annular passage for the flame or hot products of combustion from the fire-box to the chimney) until it reaches the smoke-box I.

h also has a steam-dome *k* at the front of the main boiler, and is provided with a safety-valve, or, more properly, a pressure-valve *l*, the safety-valve *m* of the main boiler acting as the common "safety-valve" to both. *h* has also gage-cocks, feed-pipe, &c., and in fact whatever may be necessary to render it complete as a separate boiler. The branch *n* of the feed-pipe supplies *h* with water, yet a separate supply-pipe and means of supply is better. *z z* is the water-line of *h*.

It will be observed that *h* from its cylinder form and small diameter can readily stand many times the pressure that the main boiler

constructed of the same quality and thickness of metal could resist, however much this may be. Now *h* being thoroughly exposed to the action of the fire, as shown, it will generate steam rapidly, and the pressure-valve *l* being loaded to, say, one hundred pounds pressure per square inch, as soon as steam has accumulated to sufficient pressure this valve will lift, allowing any excess after this to escape into the main boiler through the pipe *o*, especially provided for that purpose, such excess being so saved and added to the common stock in the main boiler.

Now if we suppose the pressure in the latter to be forty pounds per square inch, (this being the pressure at which we suppose the engine to be supplied,) its safety-valve will be correspondingly loaded, and this pressure will react upon the pressure-valve *l* in addition to the weight with which it is already loaded, and the steam will accumulate correspondingly in *h* before escaping into the main boiler, so that the pressure in the former *h* having been, by means of its weighted valve, regulated to be a given amount above that in the main boiler, it remains so, whatever fluctuation may occur of the pressure in the latter, and to the pressure in each there will be a corresponding temperature, about 290° Fahrenheit in the latter and about 370° Fahrenheit in *h*, so that steam of which 290° Fahrenheit is the natural temperature, or steam emanating from water boiling under a pressure of forty pounds to the square inch, may not only be rendered anhydrous by the conversion of the water held by it in suspension into pure steam, but could even be considerably superheated, if necessary, by passing through such a vessel (properly proportioned) equivalent to *h*.

The latter operation is effected as follows: From the steam-dome of the main boiler passes a large pipe or a multitubular conduit *p*, (which I prefer of copper,) and entering the chimney, as seen on the drawings, passes into the top of the rear portion of *h*, and traversing its entire length, as seen, comes out at the steam-dome of the latter. At this termination starts the pipe *q*, which supplies the engine with steam. It will be seen that the pressure in *h* being once fixed by the agency of its pressure-valve, the excess of temperature over that in the boiler is also thereby fixed, or rather limited, and can never pass a certain point, and no destruction of packing, &c., by the supply-steam to the engine becoming overheated by any amount or intensity of the fire can ever occur, as in the old method, or any burning out of the desiccating apparatus itself. As steam after being generated in the usual way is dried or rendered anhydrous by its exposure to a still greater heat with astonishing ease and rapidity by passing over hot and dry metallic surfaces, the moderate surface shown for this purpose will be generally sufficient when the boiler has an ordinary allowance of steam-space, and is not, in technical terms, "pushed." Yet it will be seen that if more surface be deemed desirable for this purpose the boiler may be so constructed, or, in other words, the boiler and desiccator may be so proportioned as to provide any amount of desiccating-surface wished relatively to the boiler proper.

r is a small cock for examining the condition of the steam in the desiccating-vessel *h*.

Of course the reheater *h* could be provided with a separate fire-box and the whole be set up independently, as would be the case where my invention was applied in connection with boilers already set up and in use, and where, as is sometimes the case, several boilers are worked in conjunction one of the series, if strong, could be devoted to the purposes of *h* and the exit-pipes of the others conducted through this one to perfectly the same end and in the same manner.

Figs. 4 and 5 in the drawings show another form of my invention, in which the steam is rendered anhydrous by the same boiler from which it first emanates by providing means to keep the pressure in the boiler relatively greater than that in the desiccator.

A is an ordinary upright tubular boiler, of which C is the fire-box, D the ash-pit, E the tubes or flues, and F the chimney. Into A in the clear space between the flues and the shell is inserted the desiccator, composed of the hollow annular head *a*, the tubes *b*, and bottom annular chamber *c*. *d* is a pressure-valve loaded to the difference of pressure per square inch which is desired to be maintained in the boiler over and above that in the desiccator.

e is an ordinary safety-valve opening to the atmosphere and loaded a little above the pressure at which steam is intended to be supplied to the engine. The steam in the boiler having accumulated sufficiently to raise the valve *d* passes into and through the desiccator.

f is the supply-pipe for delivering the steam to the engine after it is rendered anhydrous in the desiccator or reheater.

g is a cock for drawing off any water which may accumulate in the desiccator from condensation after fires are put out and previous to again getting up steam.

The top and bottom castings of the desiccator are formed with partitions (see *x*, Fig. 4,) so arranged that the steam is obliged to pursue a course alternately up and down the tubes *b*, and so travel entirely round the desiccator till it arrives at the pipe *f*, thus coming in contact with the entire surface of the desiccator before reaching *f*.

In all vertical tubular boilers, if the tubes are placed with sufficient space between them so that circulation is provided for and the separation of the rising steam from the water so that they shall not "prime," there is never any difficulty in obtaining dry steam, but the contrary; and for this reason, although the vertical cylindrical tubular form is naturally the best, yet having a compara-

tively limited water-surface for the steam to escape from, therefore to prevent "priming" a greater height of steam-space above the water must be left than in a horizontal boiler, and since for strength and simplicity of construction it is desirable that the fire tubes or "flues" should run straight through each head of the cylinder constituting the shell of such boiler a considerable portion of such fire-tubes of course must pass through the steam, which is constantly liable to be superheated on the one hand (if the water is low) to an extent detrimental to packing and lubrication, even though still far below the point that would injure the tubes as mere flues; or, on the other hand, if the water is high, the steam is for reasons indicated very wet and of inferior motive quality, for reasons explained.

Now it will be seen that in the fluctuation of the water-level both of these disadvantages could occur alternately in an upright tubular boiler, so as to be a very serious drawback on the otherwise admitted superiority of that form for general purposes; but the application of my device removes this fault, because on the one hand the steam, if wet, (the water-level being high,) in passing through the desiccator receives more heat and is made anhydrous by the conversion of its water in suspension into steam, whereas, again, on the other hand, if overheated, (the water-level being low,) in passing through the desiccator the excess of heat is removed and imparted to the water in the boiler to make more steam.

I am aware that in some locomotives the mere steam-pipe has been passed from the interior of the steam-dome directly on through the boiler and out next to the cylinders to protect the steam from condensation by the cold air outside; but this could merely prevent the forming of additional water in the steam and effect nothing toward the sole purpose of my invention—viz., to convert the water already "suspended" into steam.

I am also aware that steam from one boiler or "evaporating-pan" has been passed into and admixed with the steam in another boiler or evaporating-pan; but even had not such second boiler contained water in a state of ebullition, thus in itself throwing up water in suspension, yet in addition to this, since the steam of each was admixed and not thereafter subjected to more heat, it would contain the water of suspension of both in common, and is rather antagonistic than otherwise to the object of my invention.

What I claim and desire to secure by Letters Patent, is—

The arrangement of means substantially such as hereinbefore set forth for rendering steam anhydrous without the exposure of the tubes or drying-vessel to the direct action of the fire or hot products of combustion.

WM. M. STORM.

Witnesses:
WM. H. BISHOP,
J. F. CASE.