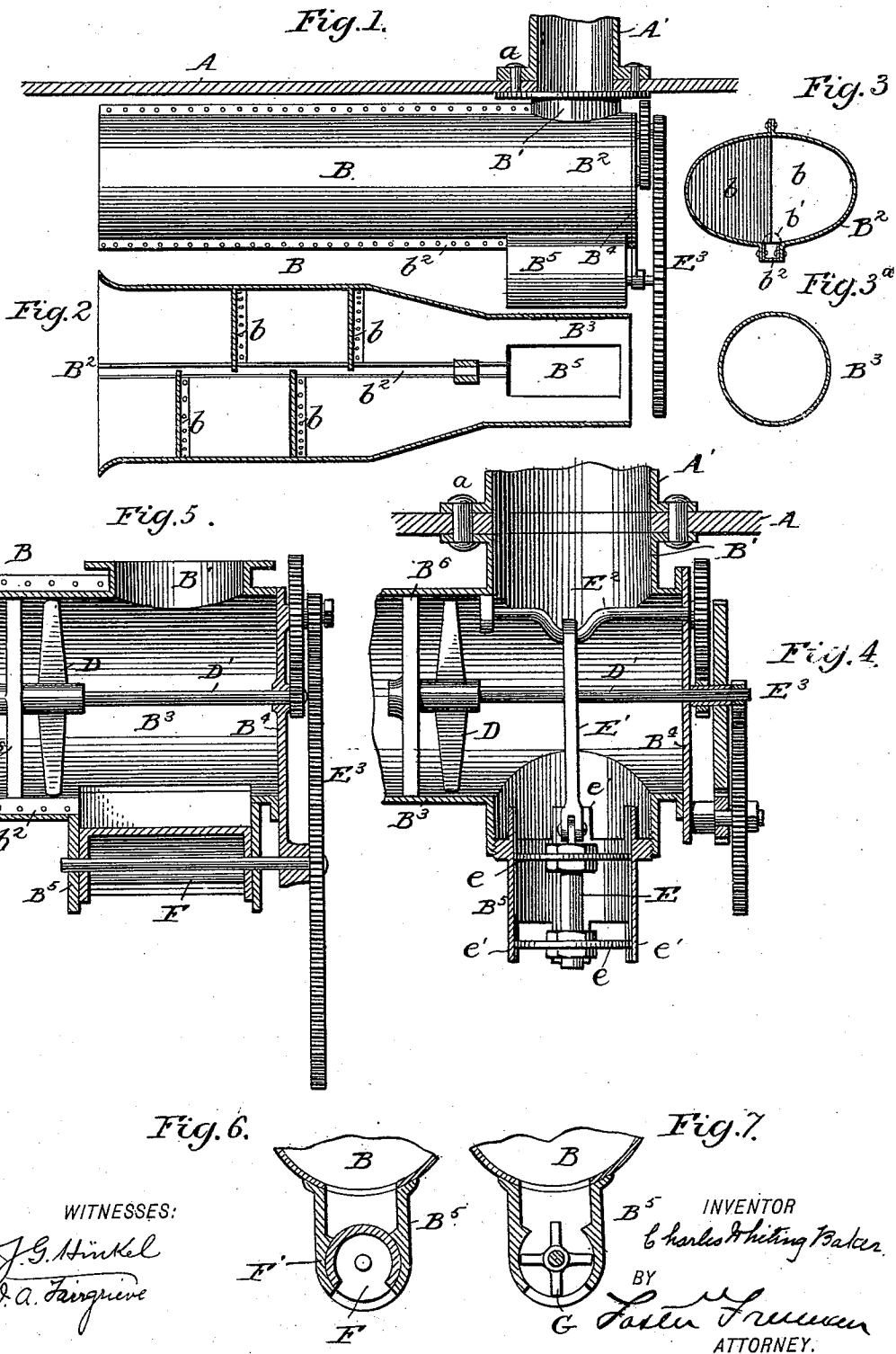


(No Model.)

C. W. BAKER.
STEAM SEPARATOR.

No. 553,892.

Patented Feb. 4, 1896.



UNITED STATES PATENT OFFICE.

CHARLES WHITING BAKER, OF MONTCLAIR, NEW JERSEY.

STEAM-SEPARATOR.

SPECIFICATION forming part of Letters Patent No. 553,892, dated February 4, 1896.

Application filed October 5, 1894. Serial No. 524,978. (No model.)

To all whom it may concern:

Be it known that I, CHARLES WHITING BAKER, a citizen of the United States, residing at Montclair, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Steam-Separators, of which the following is a specification.

My invention relates to an improved method of and apparatus for drying steam prior to its exit from the steam-generator; and it has for its object to improve the method and means of drying steam, so that it may be effected in boilers having a very small amount of steam-room; and it consists in the various features of construction, arrangement, and mode of operation substantially as hereinafter more particularly pointed out.

In the accompanying drawings I have illustrated a preferred embodiment of my invention which is sufficient to explain the principles thereof and to enable others skilled in the art to make and use the same, and in which—

Figure 1 is a vertical section along the top sheet of a boiler, showing my internal separator in elevation. Fig. 2 is a horizontal longitudinal section of the separator. Figs. 3 and 3^a are transverse sections of the same. Fig. 4 is a vertical longitudinal section through the outlet end of the separator, showing one form of mechanism for returning the collected water to the main body of water in the boiler. Fig. 5 is a vertical longitudinal section of the outlet end of the separator, showing a different form of valve; and Figs. 6 and 7 are cross-sections through the valve, showing different embodiments.

The waste due to entrained water in steam has long been known to engineers, and the difficulties and dangers of priming or foaming in boilers have been commonly understood since the earliest use of steam for power. For both these reasons, ability to furnish dry steam and freedom from priming have long been considered among the most important requisites of a steam-boiler, and two devices have long been used to secure these ends. The first of these devices consists of a dome attached to the boiler, which increases the steam-space and enables the steam to be taken from a point higher above the water-level. In

the second the steam is drawn from the boiler through an internal pipe, which extends along the roof of the boiler and is perforated with small holes on its upper side. Each of these devices merely serves to draw the steam from that part of the boiler where it is likely to be driest. In recent years more effective methods and means of securing dry steam have come into general use by the employment of separators connected to the steam-pipes, and through which the steam is passed before it reaches the engine. Such separators, however, as generally constructed have to withstand the full boiler-pressure of the steam, and hence must be made very heavy and expensive in order to be safe, and in addition they cause loss of heat by the amount of surface which they expose, and they are seldom so located that the condensed water which they accumulate can run back to the boiler by gravity. Thus added mechanism becomes necessary to return the condensed water to the boiler or else this water is thrown away, involving additional loss.

It has been proposed to place separators inside the boiler, thus doing away with these various objections; but such propositions have contemplated merely the return of the water from the separator to the boiler by gravity, through an ordinary U-trap. The difference in pressure between the steam in the separator and that in the steam-space of the boiler, although slight, is sufficient to require a greater height between the water-level and the roof of the boiler than is ordinarily available.

My invention overcomes these difficulties and makes practicable the insertion of a separator inside boilers of any type, and with very little steam-room, thereby increasing the amount of water stored in the boiler. Such increased water capacity not only increases the amount of heat stored in the boiler and thus enables it to work more steadily with a variable load, but also in internally-fired boilers gives a greater depth of water over the furnace-plates and diminishes the risk of overheating and explosion.

My improved method consists in drying the steam by passing it through a separator arranged in the interior of the boiler and causing the flowing steam to operate mechanism

to return the collected water to the water in the boiler; and my invention further consists in a separator provided with suitable mechanism, impelled by the flowing steam, which
 5 returns the separated water to the steam-space of the boiler, regardless of what difference of pressure may exist between the interior of the separator and the boiler steam-space.

10 While my invention may be embodied in many and various forms of separators and styles of mechanism, and my invention is not limited to the particular form of mechanism shown, I will now proceed to describe in detail what I consider a preferable construction
 15 for carrying out my invention, but not with the intention of limiting my invention thereto.

I have not deemed it necessary to show in the drawings a complete illustration of a boiler,
 20 but have deemed it sufficient to show a vertical section along the top sheet of a boiler, as at A, having a steam-outlet A'. The separator B, as shown, consists of a tube or pipe arranged inside the boiler, and is preferably
 25 connected to the opening A by any suitable means, as by a flanged extension B', which may be secured to the boiler-plate by the same bolts *a* as are used for securing the outlet-pipe A'. This separator may be made of any
 30 suitable material, and as it is arranged inside the boiler and subjected to pressure practically equal on the interior and exterior, it need not be of heavy material. This separator is preferably arranged horizontally or
 35 parallel with the top of the boiler, although it may be otherwise arranged if desired, and furthermore it is preferably elliptical in cross-section throughout the greater portion of its length, as B², while its portion B³ is preferably
 40 cylindrical in cross-section.

Arranged within the portion B² are a series of baffle-plates *b*, and as these are arranged alternately on opposite sides of the tube or pipe, the advantage of making this portion of
 45 the pipe elliptical will be apparent in that it gives a greater width of diversions of the course of the steam, without reducing the cross-section of the pipe at any time below the cross-section of the outlet, so that the steam
 50 will not be throttled in its passage through the pipe, although the particles of entrained water in the steam are thrown by inertia against the baffle-plates as the steam pursues its winding course around the obstructions.
 55 The entrained water thus separated by the baffle-plates falls by gravity to the bottom portion of the separator, and some provision is made so that it can flow freely along the bottom from end to end. This may be accomplished by cutting away a section of the
 60 baffle-plates, as indicated at *b'*, Fig. 3, furnishing a channel at the bottom of the separator, but I prefer to construct the separator in the manner indicated—that is, in two
 65 halves, made of sheet metal, each half having its baffle-plates riveted in place, and the two halves riveted together by their longitudinal

flanges on top, and at the bottom provide a rolled channel-iron *b*³, to which the bottom flanges are riveted and which forms a conduit
 70 in which the collected water flows, this conduit being below the general line or contour of the tube. This I find to be an exceedingly practical construction, in that the parts may be readily made and put together without
 75 difficulty, and it furnishes a satisfactory separator for the steam and conductor for the water.

It will be understood that there may be any desired number of baffle-plates and they may
 80 be arranged in proper relations to each other, according to the requirements of any particular case.

The portion B³ of the separator, as above intimated, is preferably cylindrical and is
 85 closed at its end by a suitable header B⁴, and has an outlet B⁵ at its bottom for the discharge of the entrained water, and this outlet is shown as immediately below the steam-outlet A'.
 90

My invention contemplates the use of some sort of mechanism which is operated by the flowing steam in the separator and which positively returns the separated water to the steam-space of the boiler under all conditions,
 95 and while many and various mechanisms may be used, I have shown what I consider to be a preferable form and which is simple and practicable. This mechanism consists essentially of a propeller D, shown in the form of
 100 a screw or fan propeller, which is mounted on a shaft D', supported in the header B⁴ and on a strut or cross-piece B⁶ or in any other suitable way. Mounted in the outlet B⁵, which, as shown, forms a sump or reservoir for the collection of the water, is some sort of a valve,
 105 which is connected to be operated by the propeller. Thus, in Fig. 4, I have shown a compound valve E, comprising two plain disks *e e*, which operates in the discharge-outlet B⁵, which in this instance is in the form of a cylindrical chamber open at the top and bottom and having guides *e'* projecting above and below,
 110 as shown, and it will readily be seen that as the valve is reciprocated and moved upward it allows the water collected in the reservoir to flow into the chamber below the upper plate, and as it moves downward the opening into the chamber from the reservoir is closed, and the water can flow from the
 115 chamber into the boiler-space, regardless of any difference of pressure there may be between the boiler-space and the reservoir.

Suitable means are provided for operating the valve, and in this instance I have shown
 120 a pitman E' connected to a crank-shaft E², which is driven by a suitable train of reducing-gears E³, which in this instance are shown as mounted outside the header B⁴.

In Fig. 5 I have shown another construction, and which in some instances is preferable, in which I provide a hollow rotating cylinder F, which is parallel with the axis of the main pipe of the separator and which rotates
 130

in a bushing F' (best shown in Fig. 6) formed in the outlet B⁵. In this instance the bushing is cut away both at the top and bottom for a section of about ninety degrees, (90°,) more or less, and the cylinder or valve is also cut away on one side a like amount, so that when the cylinder or valve is turned in one position it forms a cup to receive the water and when it is turned in the position shown in Fig. 6 it discharges the water to the boiler-space and at the same time closes the direct passage through the outlet.

In Fig. 7 substantially the same construction is shown, except that there is a rotating valve G mounted in the bushing, as before, and which has a series of chambers, each of which, as the valve rotates, is alternately in communication with the interior of the separator and with the steam-space of the boiler.

It will be seen that in each of these constructions there is a chamber which opens toward the separator in one position to permit any water in the separator to flow into the chamber by gravity, and as it continues its operation the chamber opens toward the steam-space and the water contained therein falls out. It is advisable that the valve should have a comparatively slow movement to operate in this manner, and it is for this reason that I preferably use a reducing-gear between the propeller and valve, as the propeller operates at comparatively high speed, and as by the use of the reducing-gear the propeller increases its leverage so greatly that the retardation due to the friction of the mechanism is scarcely felt by the propeller, which runs quite free in the current of steam, and thus presents comparatively little obstruction to its flow. As a further means of reducing friction, I prefer to make the valve of such size that there will be a slight clearance all around between the valve and the bushing, so that the valve will run practically free, as the water in the small amount of steam which may possibly leak through such clearance-spaces is too insignificant to be of any practical importance. It will be understood, of course, that in order to further avoid friction the bearings of the shafts may be formed of any suitable antifriction material, or may be ball-bearings, or otherwise arranged in any well-known manner for this purpose, it being desirable, of course, that this mechanism shall be able to run freely without attention, and it should therefore be constructed with the usual and known appliances for preventing wear.

From this general description of the preferred embodiments of my invention it will be seen that the details of construction and arrangement of parts may be varied without departing from the principles thereof and to suit the various conditions under which the invention is to be used, and in all cases the same general method or mode of operation will be carried out and the same results produced.

The operation of the mechanism will be understood from what has been stated above, and it will be seen that the steam from the boiler enters the open mouth of the separator and in flowing through it is forced to take a tortuous course by the baffle-plates, and in making the sudden changes of direction in the separator the entrained water contained in the steam is thrown by its inertia against the baffle-plates and the sides of the separator, and running down them is collected in the channel and runs along the bottom of the separator from end to end. After passing the baffle-plates the steam impinges against the blades of the propeller and any water still contained in the steam is caught on the blades of the fan and thrown off them by centrifugal force, the propeller being rotated by the flowing steam. The propeller is connected through the chain of gearing to the valve device by some suitable mechanism, as above indicated, and this valve alternately opens communication with the interior of the separator or the reservoir thereof and the steam-space in the boiler, and the separated water flows into the boiler by gravity, while the dry steam passes out of the boiler through the outlet A'.

What I claim is—

1. A steam-separator, provided with means for separating the water from the steam, and devices for positively discharging the separated water from the separator, said devices being operated by the steam flowing through the separator, substantially as described.

2. A steam-separator comprising means for separating the water from the steam, devices for positively discharging the water from the separator, and a propeller driven by the flowing steam and operating said discharging devices, substantially as described.

3. A steam-separator comprising a tube provided with means for separating the water from the steam, a valve, and a propeller driven by the flowing steam and connected to operate the valve, substantially as described.

4. In combination with a steam-boiler, a steam-separator placed in the interior of said boiler and comprising means for separating the water from the steam, valve-chambers communicating alternately with the interior of the separator and the steam-space of the boiler, and mechanism driven by the flowing steam for effecting such alternate communication, substantially as described.

5. The combination with a steam-boiler, of a steam-separator arranged in the interior of said boiler, a valve arranged to communicate alternately with the interior of the separator and with the steam-space of the boiler, a propeller driven by the steam, and connections between the propeller and valve, substantially as described.

6. The combination with a steam-boiler, of a separator arranged in the interior of the boiler and connected with the outlet thereof, the separator being provided with baffle-plates, a valve and valve-chamber, a propeller

ler driven by the flowing steam, and reducing connections between the propeller and valve, substantially as described.

7. In a steam-separator, a tube having a
5 portion in the form of an ellipse and provided with baffle-plates and a channel, and a portion in a cylindrical form, a propeller mounted in the latter portion, and a valve connected to be operated by the propeller, substantially as
10 described.

8. A steam-separator comprising a tube provided with baffle-plates and a channel for the water, an outlet for the steam, an outlet
15 for the water, a valve arranged in said latter outlet, a screw-propeller arranged in the tube,

and connections between the propeller and valve, substantially as described.

9. The combination with a steam-boiler, of a separator and a water-collecting chamber attached thereto, and automatic means for
20 placing said chamber alternately in communication with the separator and with the steam-space of the boiler, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of
25 two subscribing witnesses.

CHARLES WHITING BAKER.

Witnesses:

FRANCIS W. FROST,
MOSES NELSON BAKER.