

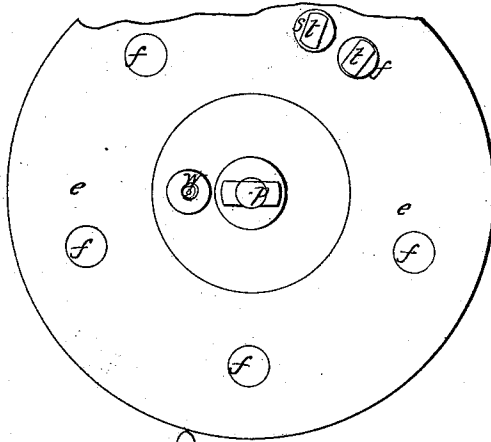
*G. H. Clemens.*

*Safety Valve.*

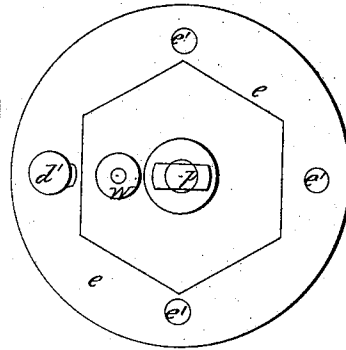
*N<sup>o</sup> 85,792.*

*Patented Jan. 12, 1869.*

*Fig. 2.*



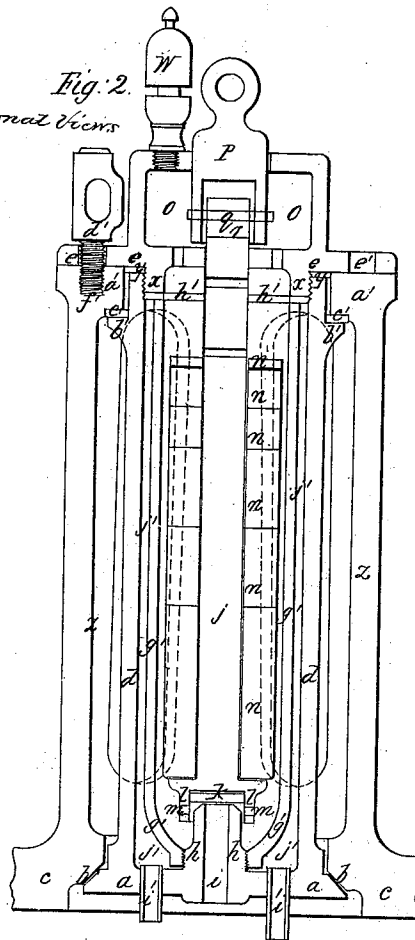
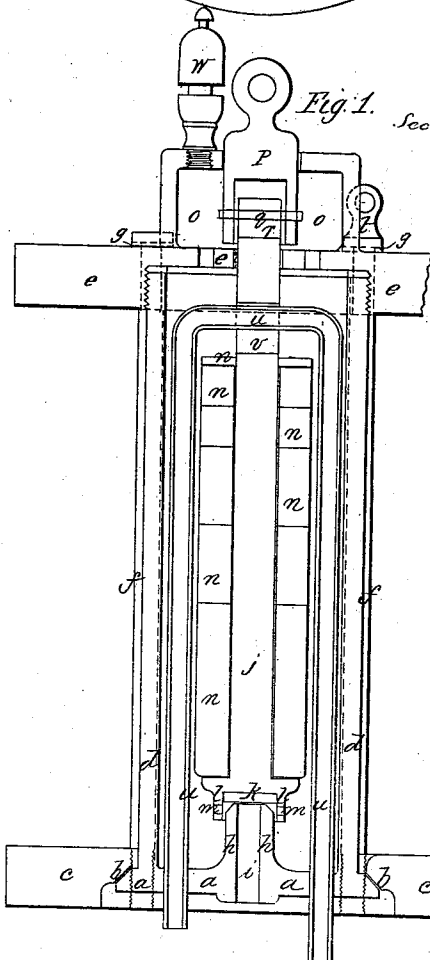
*Fig. 4.*



*Fig. 1.*

*Sectional Views*

*Fig. 2.*



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# United States Patent Office.

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Letters Patent No. 85,792, dated January 12, 1869.

## IMPROVEMENT IN STEAM SAFETY-VALVES.

The Schedule referred to in these Letters Patent and making part of the same.

*To all whom it may concern:*

Be it known that I, GILBERT H. CLEMENS, of New York city, county and State of New York, have invented a new and useful Improvement in Combined Lock-Up Safety-Valves and Low-Water Indicator for Steam-Boilers; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, making part of this specification, in which—

Figure 1 is a vertical central section of one construction of said invention;

Figure 2 is a plan view of the same;

Figure 3 is a vertical central section of another construction of said invention; and

Figure 4 is a plan view thereof.

Like letters refer to like parts in all the figures of the drawings.

The characteristic features of my said invention are chiefly, and in general, as follows, viz:

First. The construction of the safety-valve for steam-generators, whereby it is opened and closed by expansion and contraction of the metal connections therewith, and the arrangement with it of a steam-pressure indicator-valve, which last, at excessive pressure of steam in the boiler, opens, and escapes steam from the boiler, which escape steam acts upon said metal connections to increase their temperature, expanding and lengthening them, and thereby causing them to force open the safety-valve and relieve the boiler of excessive pressure of steam within it.

Second. The construction of the safety-valve devices whereby to open and close the valve by the power due to the expansion and contraction of the metal connections therewith, arranged with reference to the low-water indicator-valve, which last is adapted to escape steam from the boiler at low water in such a manner that the escape steam acts upon said metal connections, to expand and lengthen them, causing them to force open the safety-valve and relieve the boiler at low water.

Third. The combination, with said safety-valve, of both the steam-pressure and low-water indicator-valve so as to relieve the boiler by opening the safety-valve both at excessive pressure of steam and at low water.

To enable others skilled in the art to make and use my invention, I will now proceed to describe its construction and operation, making reference to the drawings, and first describing that construction of my invention shown in figs. 1 and 2.

*a* is a safety-valve, seated, at its periphery, on a valve-seat, *b*, formed at the edge of a circular aperture in a base-plate *c*, which last is fastened to the steam-boiler by a steam-joint, with the aperture placed concentrically over an outlet-port in the boiler.

*d* is a vertical metal cylinder, cast or attached by a steam-joint to the safety-valve *a*, concentric with it, and screwed into or connected at its upper open end,

by a steam-joint, to a circular plate, *e*, which last is supported on vertical rods or ports *f f*, screwed into or attached at their lower ends to the base-plate *a*.

*g g* are rubber cushions between the heads of the bolts *f f* and plate *e*; but they may be dispensed with, and be substituted by suitable spaces left between the bolt-heads and plate *e*, for the hereafter-described upward-lengthening movement of the cylinder *d*.

*h* is a vertical projection on the valve-plate *a*, having a vertical port-hole, *i*, through its centre and the valve-plate *a*, and having a valve-seat formed on its upper end.

*j* is a vertical valve-stem, having a valve, *k*, at its lower end seated upon the valve-seat of *h*.

The stem *j* has a guide-flange, *l*, formed upon its lower end, outside of the valve *k* and projection *h*.

The bearing-surface of the valve *k* is shown made of a glass disk, which makes a non-corrosive valve-bearing surface, which may be applied to valves or valve-seats; but its use is not indispensably necessary.

*m m* are outlet-port-holes through the flange *l*, for free escape of steam from the valve.

*n n* are metal weights, in the form of rings, which are placed on the valve-stem *j*, and supported by a flange at its lower end. The topmost ring is fitted fast on the stem *j* to keep the other weights down in place on the valve-stem.

The upper end of the valve-stem *j* terminates in an annular chamber, *o*, of a dome formed on the plate *e*. Port-holes in the plate *e* form steam-passage ways from the cylinder *d* to the chamber *o*.

Through a circular aperture in the top of the dome is fitted loosely a lifting plug, *p*, which, at its lower end, has a flange, which encircles the upper end of the valve-stem, and has a lifting pin, *q*, secured horizontally through it, and passing loosely through a vertical slot, *r*, in the valve-stem *j*.

By raising the plug, the valve-stem is raised, but, on forcing the plug down, the pin *q* will move down freely in the slot *r* until the bottom of the plug strikes upon and is arrested by the plate *e*, so that the valve *k* cannot be "loaded" by weighting or forcing down the plug *p*.

*S* is a lock-up post, secured to the plate *e* near one of the rods *f*. Through horizontal holes in them, the hasp of a padlock is passed, which prevents turning the rod *f*, to loosen or remove the plate *e*, to "tamper" with the valve.

A novel form of low-water indicator is shown in combination with the described safety-valve and steam-pressure indicator-valve. It consists of a bent pipe or tube, *u*, forming a siphon, with its two vertical and parallel legs passing through and fastened steam-tight to the valve-plate *a*, and extending down into the steam-boiler, so that the shorter leg reaches to low-water line, and the other, longer leg, extends into the water below low-water line.

The upper bent end of the siphon-pipe passes loosely

through and near the upper end of a vertical slot, *v*, in the valve-stem *j*.

*W* is an alarm-whistle, communicating with the dome-chamber *o*, and blown by escape steam, which may be used if required.

To secure the most desirable expansion of the cylinder *d* and the siphon-tube *u*, they may be made of brass, or of metal having still greater expansion. They may be made of iron, but with less degree of utility for the purposes required of them.

In describing the operation of the described device, the combination of the safety-valve *a* and the steam-pressure indicator-valve *k* will first be considered.

The described apparatus is attached, by a steam-joint, to a steam-boiler over a steam-outlet port, after having been adjusted for use by bringing the valve *a* to its seat *b* by tightening the bolts *f f*, or by turning and screwing the cylinder *d* into the plate *e*. The valve *a* opening downward, the pressure of steam in the boiler acts to keep it on its seat.

The indicator-valve *k*, being weighted to resist a given pressure of steam in the boiler, will, when the steam exceeds that pressure, be opened, and will escape steam from the boiler into and up through the cylinder *d* and the chamber *o*, and out into the atmosphere through the whistle *W* and around the plug *p*. This escape steam, in coming in contact with the cylinder *d*, imparts its heat to it, expanding and lengthening it. Part of this lengthening of the cylinder *d* will be by upward movement, as the posts *f f* expand slightly, and as the rubber cushions *g g* are compressible; but most of its lengthening movement will be downward, from the support the cylinder *d* has by the plate *e*, so that, by its described expansion, it will force open the safety-valve *a*.

When steam has escaped through the safety-valve *a* so as to reduce sufficiently its pressure in the boiler, the indicator-valve *k* will reseal, shutting off the escape of steam through the cylinder *d*, upon which its temperature will speedily be reduced, thereby contracting and shortening it, and reseating the valve *a*.

The operation of the described device when the low-water indicator is employed in combination with it is as follows:

The boiler being filled with water above low-water line, and steam generated in the boiler, will cause water from the boiler to rise in both legs of the siphon *u*, filling them in proportion to the capacity of the steam-pressure to compress air in the siphon. The heated water and air in that part of the two legs of the siphon within the cylinder *d* increase their temperature, causing them to expand and lengthen, and they, being fixed to the valve-plate *a*, will have an upward-lengthening movement, but not sufficient to cause the upper side of the bent part of the siphon-tube to come in contact with the upper end of the slot *v* of the valve-stem *j*, thus avoiding lifting the valve-stem *j* and valve *k* by the siphon-tube *u* when the latter is at or below the temperature of boiling water.

When the water in the boiler falls below low-water line, and below the end of the short leg of the siphon-tube, the water in the siphon-tube will flow out of it, down through the long leg, into the boiler, and steam, flowing from the boiler up through the short leg, will take its place, which will give to the siphon-tube *u* a higher temperature, expanding and lengthening it, so that its upper bent end will bear against the upper edge of the slot *v*, and lift the stem *j*, and open thereby the valve *k*. Steam escaping from the valve *k* will then, as before described, expand, and lengthen the cylinder *d*, and open thereby the safety-valve *a*.

While the water in the boiler is below low-water line, steam will be in the siphon-tube, and the latter will continue to keep the valve *k* open until the valve-stem *j* becomes heated by the escape steam which surrounds it, when its lengthening by expansion will re-

seat the valve *k*, and stop the escape of steam into the cylinder *d* until the valve-stem becomes cooled, which, contracting and shortening it, will again lift the valve *k*, and again escape steam into the cylinder *d*.

At each opening of the valve *k*, the alarm-whistle *W* is blown by escape steam.

On pumping water into the boiler, and filling it above low-water line, and immersing the end of the short leg of the siphon-tube, water will again be forced up into the siphon-tube, the steam within it being displaced and condensed, and the temperature of the tube being reduced, it will be shortened by contraction, and the valve *k* will reseal.

I will now describe the construction and operation of the other form of my invention shown in figs. 3 and 4.

This combination differs but in one essential feature from that shown in figs. 1 and 2, which is, that the siphon-tube *u* in the latter is substituted in the former by a secondary cylinder within the cylinder *d*, forming thereby, between the two cylinders, an annular water and steam-chamber, and siphon-pipes connecting it with the water or steam in the boiler at and below low-water line.

In figs. 3 and 4, *a* is the safety-valve, seated at *b* on the plate *e*, and

*d* is the cylinder-connection to the safety-valve *a*, as before described, of figs. 1 and 2.

The cylinder *d* has its upper end screwed to a flange, *x*, of the plate *e*, and has an external annular shoulder, *b'*, which abuts against an internal shoulder of a cap, *a'*, which last is connected to the base-plate *e* by being cast with it to connecting-columns *z z*.

A rubber cushion-ring, *y*, is placed between the upper end of the cylinder *d* and the plate *e*, forming a steam-joint.

There is also a rubber cushion-ring, *c'*, between the shoulder *b'* and the cap, *a'*.

*d'* is a lock-bolt, passing freely through either of the bolt-holes *e' e'* of the plate *e*, and screwed into a screw-hole, *f'*, of the cap, *a'*, nearly down to the plate *e*, a space being left between the head of the bolt and the plate *e* to admit of the hereafter-described necessary upward-expansion movement of the cylinder *d*.

*h* is the valve-seat projection; *i*, the steam-inlet port; *j*, the valve-stem; *k*, the valve; *l*, the valve-guide flange; *m m*, the steam-outlet ports; *n n*, the weights; *o*, the dome-chamber; *p*, the valve-lifting plug; *q*, the lifting pin; *r*, the valve-stem slot; and *W*, the alarm-whistle; all constructed and adapted as before described in figs. 1 and 2.

*g'* is a cylinder, placed concentrically within the cylinder *d*, with its lower contracted end screwed to the valve-seat projection *h*, and its upper open end abutting against the shoulder *x* of the plate *e*, with a rubber cushion between the two, forming a steam-joint.

A steam or water-chamber, *j'*, is thus formed between the cylinders *d* and *g'*.

To secure equal and most desirable expansion of the cylinders *d* and *g'*, they should be made of similar metal of great expansive qualities, and the posts *z z* should be of metal less expansive.

*i' i'* are two pipes, passing vertically through and fastened steam-tight in the valve-plate *a*. One of the pipes leads down to low-water line in the boiler, and the other leads down a little below low-water line, the two pipes opening into the chambers *j'*, and thus forming a siphon-communication from it to the boiler.

In describing the operation of the apparatus shown in figs. 3 and 4, it is only necessary to consider the operation of the low-water indicator-attachment, consisting of the siphon-chamber *j'* and the siphon-tubes *i' i'*, for the other parts of the apparatus operate as before described of the similar parts shown in figs. 1 and 2.

The apparatus being attached, as before described,

to the steam-boiler, and the boiler being supplied with water, and steam generated from it, the steam-pressure will force the hot water of the boiler up through the immersed siphon-pipes *i i* into the chamber *j*, compressing the air within it, and filling it with water from the boiler, in proportion to the pressure of steam within the boiler.

The hot water and air within the chamber *j* will impart their temperature to the cylinders *d* and *g*, expanding and lengthening them. Their lengthening will be by upward movement, while attaining the temperature of the hot water, as the valve *a*, being kept to its seat by pressure of steam in the boiler, supports the lower ends of the cylinders, and the rubber cushion *c* is compressible to the degree required to permit the described lengthening-movement of the cylinders.

When the water in the boiler gets below low-water line, the lower end of the shorter pipe *i* will be out of the water and in the steam, when the water in the pipes *i i* and chamber *j* will flow out through the longer pipe into the boiler, and steam, flowing up through the shorter pipe, will take the place of it. The steam within the chamber *j* will impart a higher temperature to the cylinders *d* and *g* than the hot water did, causing them to expand and lengthen still more; and, as the cushion *c* and shoulder of the cap, *a*, prevent this further lengthening of the cylinders from being by upward movement, it will be by downward movement, which will force open the safety-valve *a*, and relieve the boiler of steam. Steam will continue to escape through the safety-valve *a* until water is supplied to the boiler to fill it above low-water line, when the cylinders *d* and *g* will become reduced in temperature by water from the boiler being forced up the pipes *i i* into the chamber *j*. This reducing of the temperature of the cylinders contracts and shortens them, and the safety-valve *a* is thereby reseated.

The longer leg of the tube *u* may be dispensed with; but using the two legs to form a siphon greatly facilitates the described filling of the tube alternately with water and steam. With like results, the longer one of the pipes *i i* may be dispensed with.

I am aware that valves have been used which only indicate low water in steam-boilers by means of escape steam from the boiler expanding metal connections, which operate, by expansion, to open an "alarm-valve," which only relieves the boiler of steam sufficiently to blow a steam-whistle and give an alarm; but

adapting a "safety-valve" to relieve the boiler of steam sufficiently to prevent explosion of the boiler, either or both at excessive pressure of steam and at low water, by expansion of metal connections operating said valve, I claim as new, and of my invention.

I claim as new, and of my invention—

1. A safety-valve for steam-generators, adapted to be opened and closed by expansion and contraction of metal connections therewith, constructed substantially as herein set forth.

2. The construction of the safety-valve devices for steam-generators for opening and closing the valve by expansion and contraction of the metal connections therewith, combined with the steam-pressure indicator-valve, so that when the latter is opened by excessive pressure of steam in the boiler, steam escaping from it acts to expand said metal connections, and thereby causes them to open the safety-valve, and relieve the boiler of excessive pressure of steam, as herein set forth.

3. The safety-valve devices for steam-generators, constructed as herein set forth, whereby to open and close, by expansion and contraction of metal connections therewith, the valve-ports, in combination with the steam-pressure and low-water indicator-valve, so that, both at excessive pressure of steam and at low water in the boiler, they will operate, and the indicator-valve will open, and steam from the boiler, escaping through it, will act to expand said metal connections, and thereby cause them to open the safety-valve, and relieve the boiler, as herein set forth.

4. The safety-valve devices *a* and the steam-pressure indicator-valve devices *k*, combined and adapted to operate together substantially as described.

5. The siphon-tube *u* and the steam-pressure indicator-valve *k*, combined substantially as described.

6. The combination of the safety-valve *a* with the steam-pressure and low-water indicator-valve *k* and siphon-tube *u*, substantially as described.

7. The arrangement, with the steam-valves, of the glass bearing-surface *k*, as herein set forth.

8. The construction and arrangement of the external valve-guide *l*, substantially as described.

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Witnesses:

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