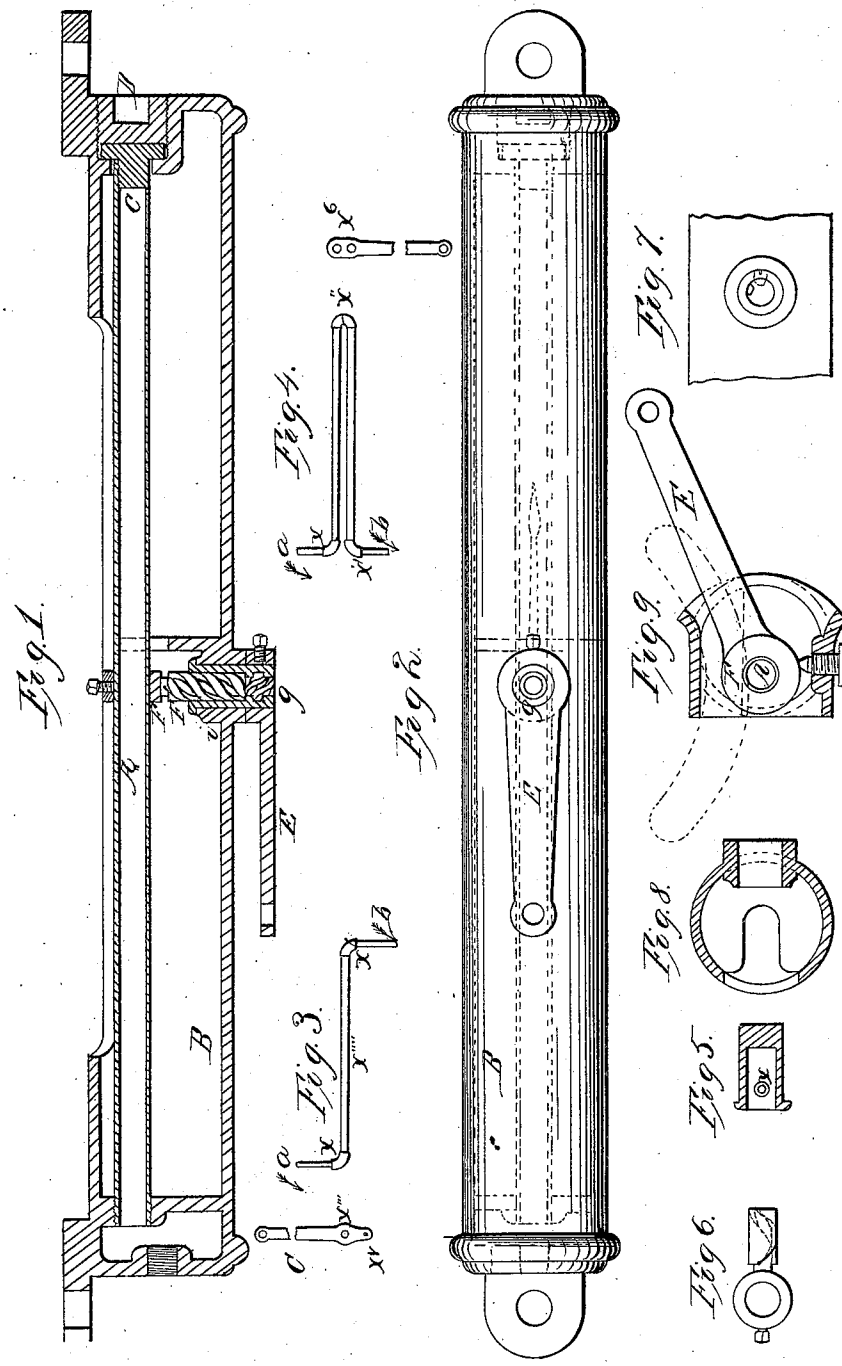
W. Mt. Storm,

Steam-Boiler Indicator.

No. 15,259. Patented July 1. 1856.



UNITED STATES PATENT OFFICE.

WILLIAM McSTORM, OF NEW YORK, N. Y.

STEAM-PRESSURE INDICATOR AND REGULATOR.

Specification of Letters Patent No. 15,259, dated July 1, 1856.

To all whom it may concern:

Be it known that I, WM. McSTORM, of the city and State of New York, have invented a new and useful instrument for regulating the water level and feed to steam-boilers and also for controlling and regulating the dampers and draft of their furnaces according to the pressure within and simultaneously, if desired, indicating what that pressure is; it can also be connected with and sound alarms, as bells, whistles, &c.

The nature of my instrument is such that it can be actuated only by fluids as water, steam, &c., and effects its duties by the expansion and contraction of a metal tube (forming a part of the instrument itself) caused by the varying temperature of the fluid (steam from a boiler for instance) which is allowed to enter within and fill such tube—the employment of which in the peculiar manner set forth constitutes the basing feature and novelty of my instrument which under (substantially) the form of construction I most approve, is shown in the accompanying drawing, in which—

Figure 1, represents a horizontal midsection of the instrument and Fig. 2 an exterior front view.

A, is the "expansion tube" within which the heat imparting or abstracting medium (steam or water) enters, and upon the expansion and contraction of which, by change of temperature, the operation of the instrument simply depends. This tube is fixed at both extremities, whereby on being expanded by heat it is forced to bow out or "buckle" at its middle and vice versa. By this means its middle is moved through a space from 5 to 8 times greater than either of its ends would move if left free to expand lineally.

B, is a tubular shaped casting, closed at each end. One of these ends contains a hollow or space as will be seen by the drawing Fig. 1. Into this hollow, one end of the "expansion tube" is tightly screwed and the opposite end passing through a hole in the corresponding end of the casting B′, is plugged steam tight with the plug *c*, against which presses the key plug *d*, so as to give the tube A, so much "buckle" at the ordinary temperature of the atmosphere, that if the apparatus was reduced far below the freezing point of water, say to 20° Fah. (the freezing point being 32°) it would not bring the tube A more than straight or injure the instrument were it left improperly exposed filled with water, and frozen up.

To obtain the motion of the arm E, which connects the instrument to its work there is a ring or eye F, passed over the middle of the tube and a tang or bolt F′, projecting horizontally from and forming a part of the same piece as F, which has cut upon it a series of spiral grooves like the threads of a screw of very steep pitch which works in a sleeve G, constituting a nut of corresponding pitch, which nut is held in a sleeve or hub *i*, on the casting B. On the outer end of the sleeve or nut G, is attached and carried the arm E. Thus it will be seen on inspection that the arm E, would be rotated up and down by the expansion and contraction of the tube A.

In lieu of a series of spiral grooves on the bolt T′, a single groove would answer, and in lieu of a series of grooves in the sleeve G, a single pin X, Fig. 5, projecting into the single groove in the bolt represented by Fig. 6, would answer. Fig. 7, represents an end view of the bolt and sleeve in this manner.

Fig. 8 shows a cross-section of the casting B, through the middle.

Fig. 9 shows a modification of the instrument in a somewhat cheaper form so far as the method of imparting the motion of the tube A, to the arm E, is concerned, but which would move in a plane at right angles to that in which it would move were the bolt and sleeve F′ and G employed, in lieu of which in this form I enlarge or thicken the eye F (which is made a part of the arm E), and in an indentation or "countersink" on its lower surface bears the conical point of a set screw H, which acts the part of a fixed bearing, and as the eye F of the arm E, is free to turn on the tube A, the "buckling" of the tube will vibrate E, as will be clear on inspection of Fig. 9 which is a cross mid section.

Now, communicating with the hollow in one end of B, are two openings one of which is connected with a pipe leading with a continuous rise of elevation to the steam space of the boiler something above the highest intended water level therein, and from the other opening into the hollow in the end of B, proceeds another pipe down to the floor and along it till it reaches the boiler, then rises upward to just below the lowest line

to which the water in the boiler is ever desired to fall and here communicates with the water space of the boiler. It will thus form the equivalent of an inverted siphon in which there being no circulation the water will lie in a cool state up to the level of that in the boiler and of course rising and falling in the leg next the regulating instrument as it rises or falls in the boiler. The other pipe will be always of course filled with steam.

Now the regulator being located in the plane of the desired water level of the boiler—if the water in the latter falls, steam follows into, and fills the tube A, heating, expanding, and "buckling it, and moving the arm E. On the contrary when the water in the boiler rises, water will fill the tube A, displacing the steam and cooling, contracting and straightening the tube; rotating the arm E, in the opposite direction. Now this arm being connected by rods, chains, or other common device to the inlet cock of the "feed" pump that supplies the boiler or in the case of large engines where a "donkey" or pumping engine is used to the steam throttle valve of the latter or in the case of stationary engines to the usual belt shifter or clutch that throws the feed pump into or out of action—it thus will cause the feed to be let on when the water in the boiler is falling too low and shut off when rising too high.

When used as a damper regulator the instrument is connected by any similar devices to the damper so as to swing it open or shut. It need have however no inverted siphon of water in connection with it, but only a pipe leading with a slight but undeviatingly downward tendency to the steam space of the boiler whose draft it is to regulate. Or the instrument may itself be directly connected to the steam space of the boiler. In either case as the temperature of the steam increases or decreases as its pressure increases or decreases, the corresponding increase or decrease of expansion of the tube A, would cause the damper to more or less open or close and so regulate the force of the fire according to the head of steam in the boiler, keeping it steady, and economizing fuel.

By allowing the arm E, to carry a pointer opposite a fixed scale on which are marked degrees of pressure corresponding to certain degrees of temperature, the instrument becomes at the same time a true and unfailing gage of the pressure existing at any given time.

The only device now in use that I am aware of that has the least similarity to mine in mode of action is what is known as Clark's. This excellent instrument or rather apparatus (for it is not like mine complete in itself) cannot indicate pressure and depends for its operation on the alternate generation and condensation of steam, within itself, by the heat of other steam from the boiler. The quantity of "latent heat" to be imported to generate such steam or abstracted to condense it necessarily renders it less instant of action than mine—in which the heating and cooling of the "expansion tube", and the action of the instrument, is immediate, because the "expansion tube" is a fine conductor of heat,—because it exposes a great heating surface compared to body of metal to be heated,—which is small—and because it is of a moderate "specific caloric". These points have a great influence when the steam is of low pressure (and therefore of low temperature) or what results in the same thing, when the instrument is—owing to any necessity, placed some distance from the boiler. Moreover the other device referred to, operates on the moving lever through the pressure of water acting on an india-rubber diaphragm which being continually distended and contracted, after a time gives out. I have no similar source of evil in my instrument.

That the principle of my invention enables the purpose to be accomplished with the greatest possible economy and simplicity, see Figs. 3, and 4, where no "instrument" whatever is employed but only the water and steam pipe itself, coming from the steam space by the arrow *a*, and continuing to the water space by the arrow *b*. The red lines *x*, *x'*, *x''*, are staples spanning the pipe and fixing it to the wall.

In Fig. 3, the hole *x'''* in the lever C, would be occupied by the middle of the horizontal joint of the pipe *x''''* and the staple (in red) x^5 would be driven into the wall. The operation, then, of the pipe and lever will be evident.

In Fig. 4, there are two horizontal joints of pipe, supposed to be so bent when first fixed up to the wall that one joint will "buckle" one way while the other joint "buckles" in a contrary direction—and the two holes in the butt of the cast-iron lever x^6 being each occupied by one of these horizontal joints of the pipe of Fig. 4. Then, since both the equivalent of the fulcrum of the lever and the equivalent of its fixed point, or bearing (in the other figure) are in motion, a double motion is given to the lever.

It will be seen that two separate communications with the boiler are essential (a hot and a cold "leg") without which any material change of temperature could not be effected, as is necessary, because a single pipe leading to the instrument could only be alternately filled with hot steam and with water nearly if not quite as hot. A single tube so arranged I am aware has been employed to operate by linear extension. I am not

aware, however, that such tube was combined with the double communication (hot and cold) to the boiler, and without which it would be comparatively worthless. Neither am I aware that a tube was ever employed fixed at both ends; and without this an inordinate length of tube would have to be employed, requiring too much time to heat, being too cumbrous, and in no wise having the character of an "instrument." Solid bars have been so arranged as to give the "buckling" motion; but the employment of a bar in this manner is subject to so many objections as to compel its abandonment. A bar, to have the requisite stiffness to bear the "buckling" against the resistance of a large cock or damper, has too great a body to be alternately heated and cooled with sufficient promptitude, and otherwise it is found to assume a waving form, in lieu of a true arc of a circle or bow, when strongly resisted, as per necessity it must be. Further, it has to be inclosed in a steam tight case with a stuffing box or its equivalent through which to communicate the motion to the outside. I have no claim therefore to the use of a tube (which admitting the steam within saves the steam case and stuffing box) nor any claim to the double communication (hot and cold) with any form of thermostat, nor do I lay any claim to the expedient of the buckling motion whether of tube or bar, separately considered, but I claim the joint combination, in the compact and practical form of construction and arrangement, substantially as shown, of all three of these features in the same instrument, and by which combination only, can a satisfactory and perfect instrument be produced—that is to say—

What I claim to secure by Letters Patent is—

The combination of a simple steam-tight metal tube with a fixed and open (not steam tight) frame or support in which both of its extremities are held stationary, while the motion of its middle, left free, is communicated to its work in such manner or by a device combined with the instrument, as to multiply its range of action—the communication of the tube with the steam of the boiler being separate and distinct, moreover, from that to the water space of the boiler and filled with a cold fluid and so arranged as not to allow any circulation through it of the heated water from the boiler—the instrument as a whole being substantially as described and shown.

I also claim in combination with the tube the "key nut" or its equivalent for the purpose explained.

WM. McSTORM.

Witnesses:
WM. H. STORM,
RICHD. WILSON.