G. B. DIXWELL.

Pyrometrical Indicator for Steam-Engines.

No. 160,401. Patented March 2, 1875.

Fig. 1.

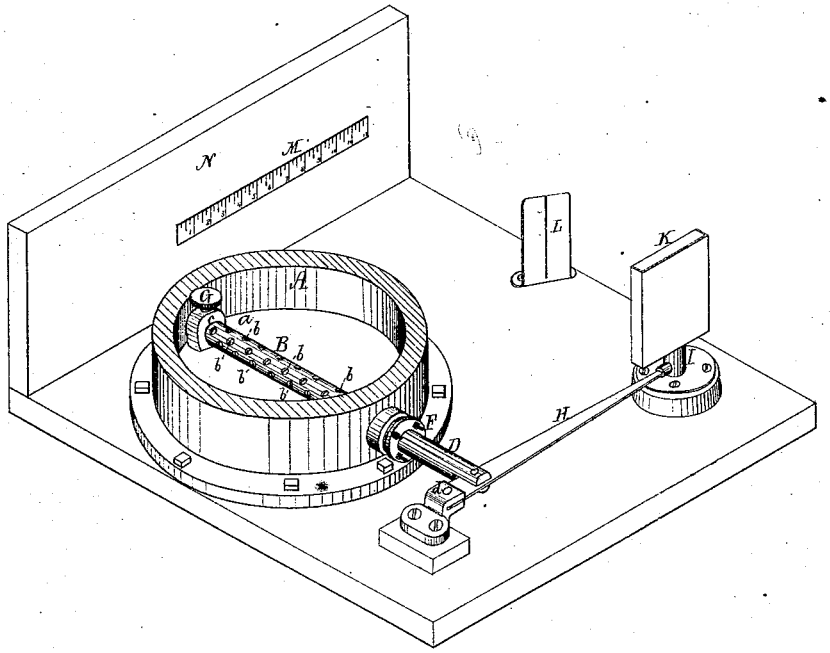
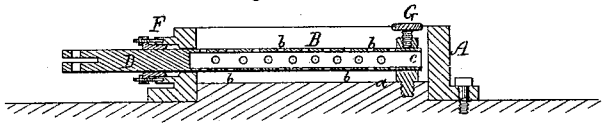


Fig. 2.



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GEORGE BASIL DIXWELL, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN PYROMETRICAL INDICATORS FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. **160,401**, dated March 2, 1875; application filed January 12, 1875.

To all whom it may concern:

Be it known that I, GEORGE BASIL DIXWELL, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Thermometric Apparatus for Steam-Engine Cylinders; and do hereby declare the same to be fully described in the following specification, and represented in the accompanying drawings, of which—

Figure 1 exhibits a perspective view of the lower part of a steam-engine cylinder with my invention applied to it. Fig. 2 is a vertical section of the tubular expander and the cylinder.

My invention embraces an improved cylinder-pyrometer or heat-measurer, by means of which the temperature of the steam or vapor, and, consequently, the temperature of the internal surfaces of the cylinder, may be promptly and correctly ascertained in engines using superheated steam or vapor.

I have ascertained from experiments that superheated steam upon entering the cylinder of an engine parts with its excess of heat to a thin film of the internal metallic surfaces with immense rapidity, and that the metal exceeds so many times the weight of the steam that the two together come to an equilibrium, or nearly to an equilibrium, at a temperature only slightly above the original temperature of the interior surfaces in question. If, for instance, the cylindrical internal surfaces had before the stroke a temperature of, say, 300° Fahrenheit, and the steam a temperature of 500° Fahrenheit, the two together will be found at the point of cut-off with a temperature but slightly above 300° Fahrenheit—say, 315° to 330°.

I have also found from experiments that the metal thus elevated a few degrees in temperature is capable of giving out to the expanding steam the heat thus accumulated or stored up, in such a manner as (if the quantity of heat thus stored be sufficient) to counterbalance the refrigerating effects of radiation, and of the conversion of heat into power, during the portion of the stroke made after the cut-off. If, for instance, the refrigerating causes, in the case above supposed, had been equivalent to 200° Fahrenheit, measured by the specific heat of steam, then the 15° to 30° excess of heat existing in the metal and steam at the point of cut-off would counterbalance the effect of the said refrigerating causes, and the cylinder at the end of the stroke would have returned to its original temperature of 300° Fahrenheit, and so on indefinitely; but, if, in such case—when the refrigerating causes were equivalent to 200° Fahrenheit, measured by steam—the said steam had received a further amount of heat, elevating it, say, 50°, so that its temperature would be 550° instead of 500° Fahrenheit, then the cylinder would, after a short time, be found to have attained a further elevation of 50°, and to be at the temperature of 350° Fahrenheit, and would so continue indefinitely. And, if, in such case—when the refrigerating causes were equivalent to 200° Fahrenheit, measured by the steam—the said steam had received a still further amount of 50° of heat, elevating it to, say, 600° Fahrenheit instead of 500° Fahrenheit, then the cylinder would, after a short time, have been found to have attained a further elevation of 50°, and to be at the temperature of 400° Fahrenheit, and would so continue.

I have found from experiments of long duration made with large engines that this temperature of 400° Fahrenheit may be safely maintained in the cylinder; but many engines are known to have been injured by using a much higher temperature, so that 400° Fahrenheit in the cylinder appears to be all that can be safely used under present conditions of practice. But to maintain 400° Fahrenheit, or thereabout, in the cylinder requires a higher temperature in the superheater, as shown above; and this excess of temperature must be greater or less, according as the refrigerating causes in the cylinder are greater or less, and these, experiment has shown to be greater with a large measure of expansion, and less with a smaller measure of expansion.

If, then, steam which has been superheated to the temperature most advantageous to a cut-off of two-thirds be used at a cut-off of one-third, only a portion of the advantages obtainable from superheating will be obtained; and, on the other hand, if steam which has been superheated to the temperature most advantageous for a cut-off at one-third stroke be used at cut-off at two-thirds stroke, the engine will be overheated and injured.

From the above it will be perceived to be a matter of primary importance to possess an instrument by which the temperature of the

steam in the cylinder may be watched and accurately and expeditiously ascertained; an instrument which, if it differ at all from the steam, shall differ in the same direction and to the same extent as the internal metallic surfaces of the cylinder differ, for it is in reality their temperature which it is necessary to maintain at a safe point.

Mercurial thermometers have been found to be exceedingly unreliable, sometimes showing a very much lower temperature than the truth, and being always sluggish; and the usual metallic pyrometer does not give settled indications until sufficient time has elapsed for the external cylinder to communicate its temperature to the internal rod, which is of a different metal.

Neither of these instruments are satisfactory for the purpose in view, and I had spent much money, labor, and time, in vain efforts to find one that would fully answer the purpose, when the following form of pyrometer suggested itself.

It is very necessary to have, in combination with the cylinder, a thermometric apparatus of extreme sensibility—one readily affected by very slight changes of temperature. A metallic rod will not answer, as its heat absorbing and conducting powers are generally too slow for the purpose. I therefore make use of an extremely or very thin mass of metal having extensive surfaces, and although a thin and wide plate of metal will in most cases suffice, I prefer to use the expander in the form of a tube, open, so that the steam can gain ready access to its inner as well as its outer surfaces.

The accompanying drawings represent this feature of my invention.

In such drawings, A is a horizontal and transverse section of a steam-engine cylinder, with the pyrometer or thermometric apparatus attached. B is the pyrometer or expander, it being in part a thin metallic tube, open at the end *c*, next to where it is fixed to the cylinder-head *a*, and also pierced laterally with numerous holes *b b*, &c., through which, and through the open end *c*, the steam has free access to the interior surface of the tube. The outer part D is solid, but may be tubular, and filled with a heat non-conducting substance to the point where the tube reaches the next adjacent part of the internal surface of the cylinder. F represents a stuffing-box, through which the tubular rod or pyrometer moves, and G denotes a screw, by means of which the tube or expander is attached to the cylinder-head. H is a lever, to which the pyrometer B is pivoted in advance of the fulcrum *d*.

By this lever the expansive movement of the pyrometer is multiplied, and conveyed to a short vertical spindle, I, surmounted by a mirror, K, which moves with and is turned by the said spindle, the two being firmly attached together.

L is a screen, with a vertical slit through it, through which a beam of light, proceeding from a lamp or other suitable source, may be thrown upon the mirror K, and thence reflected upon a graduated arc or scale, M, placed upon the wall of the engine-room, or upon a screen, N, for the purpose.

Now, as the tube B may be expanded by heat, it will move the lever H, which, in turn, will move the spindle I and the mirror K, so that the beam of light falling upon the mirror from the slit in the screen, will be reflected upon the graduated arc or scale M, and there indicate the change of temperature. Of course a graduated scale provided with a vernier attached to the spindle I, may be used instead of the graduated arc on the wall, or the two may be used together, if desirable.

So, also, the spindle I may carry an arm by means of which the circuit of an ordinary electric bell shall be completed at the selected maximum temperature, and another be completed at the selected minimum temperature. The tube B may be attached to the cylinder by a screw proceeding from the outside, so that the whole pyrometer may be detached and withdrawn from the cylinder for examination and repair.

The multiplying parts may be of other forms, as a series of cog-wheels, or a combination of toggle-joints.

The pyrometer itself may be of other forms than the cylindrical, as, for instance, it may be a rectangular, or elliptical, or flat tube. All these are details of construction relating to my invention, which has for its object the arrangement of the surface or surfaces exposed to the action of the steam, in a thin and extensive form, analogous to that in which the internal surfaces of the cylinder and piston are exposed to the steam, so as to give prompt and reliable information as to the temperature of the said surfaces.

The pyrometer may be entirely inclosed in the cylinder, and convey its information by means of the insulated wire proceeding through the cylinder, and completing the circuit of an electric alarm or bell, when the maximum temperature is reached, and another circuit of another bell at the point when the selected minimum temperature is reached.

Thus it will be seen that the registering or heat-indicating portion of my apparatus may be variously constructed, and the expander may be varied in form so long as the described principle of its action be preserved.

I claim—

The rod B, tubular and perforated, as described, applied to the cylinder and to the lever H, in manner, and to operate therewith as specified.

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Witnesses:
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