

SUBSTITUTE FOR MISSING XR

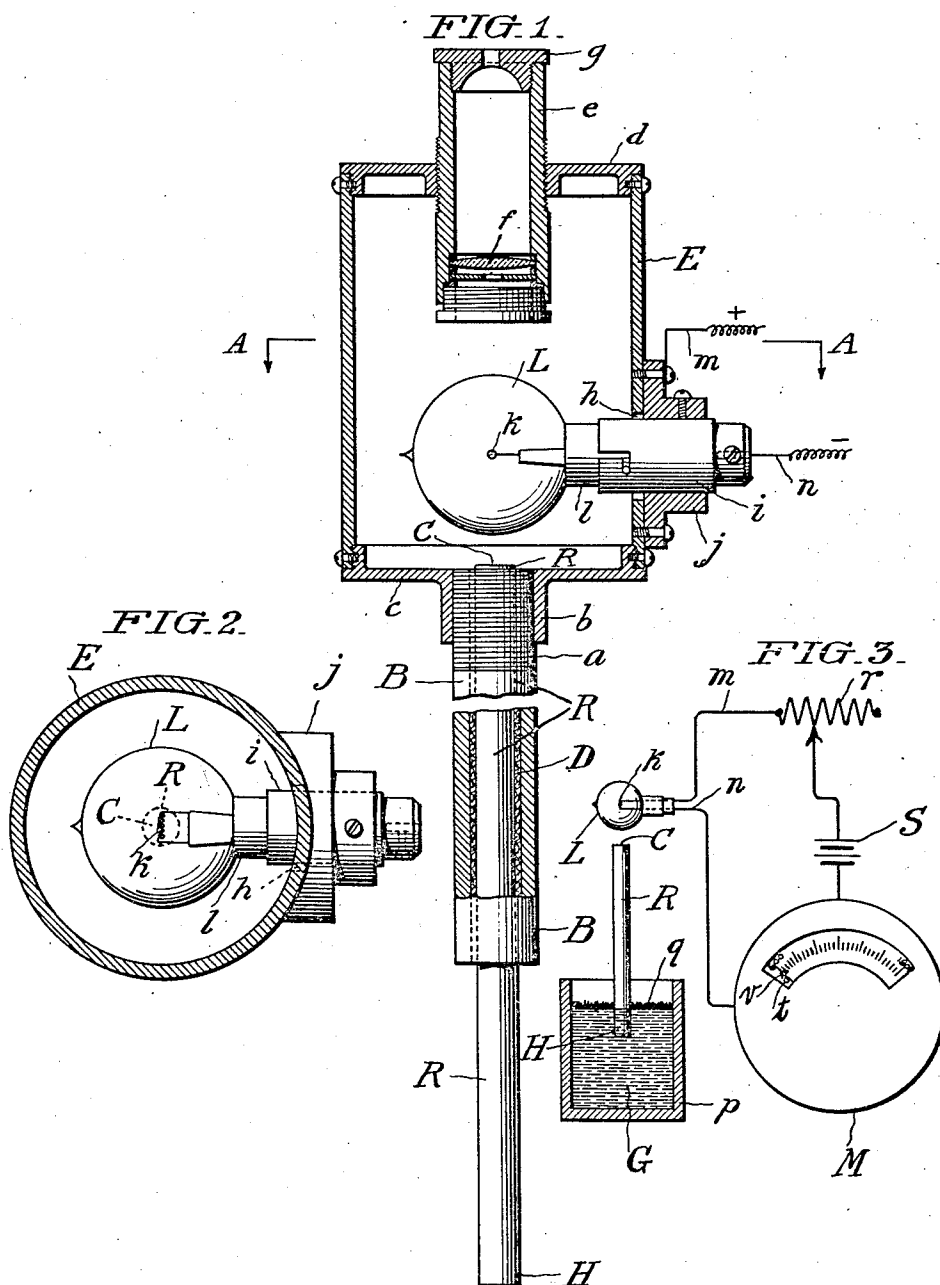
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PYROMETRIC METHOD AND APPARATUS.

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1,323,309.

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PYROMETRIC METHOD AND APPARATUS.

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To all whom it may concern:

Be it known that I, EDWIN F. NORTHRUP, a citizen of the United States, residing at Princeton, county of Mercer, State of New Jersey, have invented new and useful Pyrometric Methods and Apparatus, of which the following is a specification.

My invention relates to optical pyrometry wherein temperature is determined by comparing with the brightness of a glowing or incandescent body whose temperature is to be found the brightness of another incandescent body, as a lamp filament through which passes a current whose strength is an indication or measure of the temperature sought.

My invention resides in an optical pyrometer comprising a member adapted to be directly inserted into the hot zone or mass whose temperature is to be determined, said member consisting of transparent or light transmitting refractory material whose one end partakes of the temperature to be determined and accordingly glows, light waves from the glowing end being transmitted through the material itself to a point or region at a substantial distance from the hot end and preferably disposed outside of the hot zone or mass whose temperature is to be measured, the light so transmitted causing the distant end of the material or member to reproduce, except as affected by absorption within the material, the same brightness existing at the hot end. With the brightness of this illuminated cold end may be compared the brightness of an incandescent lamp filament, the current through which is adjusted until the brightness of the lamp filament corresponds with the brightness of the cold end of the refractory material or member, the current in the lamp filament when equality of brightness has been obtained, being measured and serving as an indication or measure of the temperature of the hot end of the refractory member.

My invention resides in pyrometric method and apparatus of the character hereinafter described.

For an illustration of one of the various forms my invention may take, reference is to be had to the accompanying drawing, in which:

Figure 1 is a longitudinal sectional view,

partly in elevation, of pyrometric apparatus embodying my invention.

Fig. 2 is a horizontal sectional view, partly in plan, taken on the line A—A of Fig. 1.

Fig. 3 is a diagram of an electrical circuit which may be employed, and an elemental indication of the relation of a lamp to the refractory member.

Referring to the drawing, R is a rod of suitably transparent or light transmitting refractory material capable of withstanding at its lower or hot end H the high temperatures to be measured. By preference, the rod R is of quartz and may be of circular or any other suitable cross section. The rod R is made of any suitable length, and preferably of length great enough to have its upper or cold end C sufficiently remote from the hot zone or mass whose temperature is to be measured for the comfort and convenience of the observer.

The rod R is preferably housed within the tube B of any suitable material, as metal. A lining D of asbestos or similar packing intervening between the rod R and the inner wall of the tube B may be employed. The tube B may be threaded as indicated at *a*, into the lug *b* on the bottom *c* of a light excluding box or chamber E having the cover or upper end closure *d* in which is threaded the threaded barrel *e* of the optical system comprising the lens *f* and eye piece *g*, this optical system being adjustable longitudinally by rotating the same with respect to the cover *d*, for focusing purposes.

In the chamber E is an aperture *h* through which extends a lamp socket *i* longitudinally disposed in the sleeve *j* secured to the chamber E. Held in the socket *i* is the incandescent lamp L having the filament *k*. One terminal of the filament *k* communicates with the lamp base *l* which is in electrical communication with the socket *i* and through it with the metal chamber E, with which is connected one circuit conductor *m*. The other circuit conductor *n* communicates with the other terminal of the filament *k*.

As indicated in Fig. 3, the lamp is in circuit with any suitable source of current, as a battery S, ammeter or milliammeter M and adjustable resistance or rheostat *r*.

The galvanometer or current measuring

instrument M may be of the well known D'Arsonval type. Since substantial current can flow through the filament k without causing it to glow and therefore to be use-

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ful in a relation of the character herein described, the spring control of the moving coil of the instrument M may be so adjusted that the actual zero of the instrument is suppressed or to one side of the low end of the instrument scale, the needle or pointer v of the instrument coming to rest against a stop t when pointing at the low end of the scale.

The mode of operation is as follows:

The hot or fire end H of the rod R is disposed or thrust into the hot zone or into the material whose temperature is to be measured. The end H eventually attains a temperature equal to that obtaining in the hot zone or mass. It is then glowing, and light from its hot end is transmitted upwardly through it, and causes the upper or cold end C, which may be roughened or etched, like ground glass, to appear as a luminous spot whose brightness is dependent upon the brightness at the lower or hot end H. The observer places his eye to the eye piece g and focuses upon the filament k whose background is the luminous cold end C of the rod R. The resistance r is then adjusted to cause such current to pass through the filament k that it glows and attains a brightness equal to the brightness of the cold end C, this coincidence of brightness being obtained when the impression upon the observer is that the filament k is not distinguishable from the surface C. The current for this particular brightness of the filament k is measured or indicated by the instrument M, whose needle deflects toward the right to such point on the scale whose reading indicates the temperature of the hot end H.

The brightness of the cold end C will not be equal to the brightness at the hot end H, due to absorption of light in transmission from the hot end H to the end C through the material of rod R. This absorption, however, is taken care of in calibrating the instrument as a whole.

For such calibration the end H may be thrust into molten copper, for example, whose temperature of fusion is known, and as the copper cools off a mark opposite the needle of the instrument M is made upon its scale at the moment the copper solidifies, this mark upon the scale corresponding then with the known temperature of fusion of copper. This may be done with several other materials, including for example, platinum, for obtaining another point on the scale at considerably higher temperature.

Obviously, and as understood in radiation pyrometry, the particular filament or lamp used affects the readings, but the various

lamps in the different instruments may be compared with a suitable standard or sub-standard, and accurate calibration obtained in well known manner.

The rod R has been described as and is preferably of the same material throughout its length from the hot end H to the cold end C.

However, my invention comprehends also a change of material from the hot end H to the cold end C, so long as the rod or member R as a whole is sufficiently light transmitting or transparent. The upper end of the rod in the case of such composite structure may be of glass or less refractory material than the lower end H.

Notwithstanding the fact that the lower end H may on its external surface become roughened and opaque, the operation will nevertheless be that above described, because the interior of the material at the lower end H will partake of the temperature to be measured and will glow at a brightness corresponding with that temperature; and it is the condition of the interior of the end H which produces the effect at the cold end C.

As indicated in Fig. 3, the rod R may be thrust directly into a mass of molten metal G in the container p . Even in the case where upon the surface of the metal G there is a coating or layer of slag or other material q , which is at lower temperature than the interior of the mass G, the rod R is thrust through the slag into the hot metal itself, and so an accurate reading of temperature of the metal G may be obtained without effect by the slag q .

Apparatus of the character described is suitable for measuring temperature throughout a range at whose lower limit is the duller glow and whose upper limit may be anything which is not beyond a temperature destructive of the material of which the end H of the member R is composed, and which is not beyond the temperature destructive of the filament k or other incandescent material used for comparison purposes.

For example, the range of an instrument of the character described may be from 600 degrees C. to 1800 degrees C.

It will be understood that apparatus embodying my invention may be portable, or may be of such structure that the rod R and suitable associated elements may be permanently built into a furnace, ceramic oven or other heating structure whose temperature is to be measured.

When desirable the hot end H of the rod R may be suitably protected by refractory material of any suitable character, as alundum, zircite, etc. This may be desirable where temperature is to be measured under circumstances where gases or liquid into which the end H must be inserted are of a

character to attack the material of the rod R.

While herein I have shown the refractory light transmitting member to be in the form of a rod, as R, it will be understood my invention comprehends any other suitable form or structure for that member.

What I claim is:

1. The method of measuring temperature, which consists in subjecting a part of a mass of refractory light transmitting material to the temperature to be measured, and producing a temperature indication dependent upon the light due to said temperature and transmitted through said material to another part of said mass.

2. The method of measuring temperature, which consists in subjecting a portion of a refractory light transmitting mass to the temperature to be measured, and producing a temperature indication by varying the brightness of an incandescent body to coincide with the brightness at a remote portion of said mass due to light transmitted through said mass and resulting from the temperature to be measured.

3. Optical pyrometric apparatus comprising a mass of light transmitting material having a portion adapted to be subjected to the temperature to be measured and having a surface remote therefrom to which light is transmitted through said material, and temperature indicating means whose indications are dependent upon the brightness at said remote surface.

4. Optical pyrometric apparatus comprising a refractory light transmitting structure having a portion adapted to be subjected to the temperature to be measured and a surface remote therefrom to which light is transmitted through said structure, and an incandescent body whose brightness is variable to coincide with the brightness at said surface.

5. Optical pyrometric apparatus comprising a light transmitting member having an end adapted to be subjected to the temperature to be measured and having a remote end to which light due to the temperature of the hot end is transmitted through the material of said member, and temperature indicating means whose indications are dependent upon the brightness at said cold end.

6. Optical pyrometric apparatus comprising a member of refractory light transmitting material having an end adapted to be subjected to the temperature to be measured and a remote end to which light due to the temperature at the hot end is transmitted through the material of said member, and an incandescent body whose bright-

ness is variable to coincide with the brightness at said remote end.

7. Optical pyrometric apparatus comprising a quartz rod having an end adapted to be subjected to the temperature to be measured, and means for determining the temperature of the hot end by observing the brightness at the remote end of said rod due to light transmitted through said rod from the hot end thereof.

8. Pyrometric apparatus comprising a refractory light transmitting member having an end adapted to be subjected to the temperature to be measured, and means for determining the temperature to which said end is subjected comprising indicating means whose indications are dependent upon the light transmitted through said member from said end to a remote portion of said member.

9. Pyrometric apparatus comprising a refractory light transmitting member having an end adapted to be subjected to the temperature to be measured, a light excluding housing from whose interior a remote end of said member is visible, an incandescent filament having said remote end for a background, means for viewing said filament and said remote end, means for varying the current through said filament, and a galvanometer whose deflection is dependent upon the current through said filament.

10. Pyrometric apparatus comprising a rod of light transmitting material, a light excluding housing within which an end of said rod is observable, a tube carried by said housing through which said rod extends, the other end of said rod adapted to be subjected to the temperature to be measured, and means for determining said temperature from the brightness at said first named end of said rod due to light transmitted there-through from the other end thereof.

11. Optical pyrometric apparatus comprising a refractory light transmitting member having a part adapted to be subjected to the temperature to be measured, an incandescent filament, a source of current therefor, means for varying said current to vary the brightness of said filament to match the brightness of light transmitted to another part of said member through the material thereof, and a galvanometer having a scale whose readings are dependent upon the light transmitting characteristics of said member and the brightness-current characteristic of said filament.

In testimony whereof I have hereunto affixed my signature this 26 day of February, 1919.

EDWIN F. NORTHRUP.