P. BALESTRIERI.

Apparatus for Collecting the Rays of Light and Heat.

No. 162,263. Patented April 20, 1875.

Fig: 1

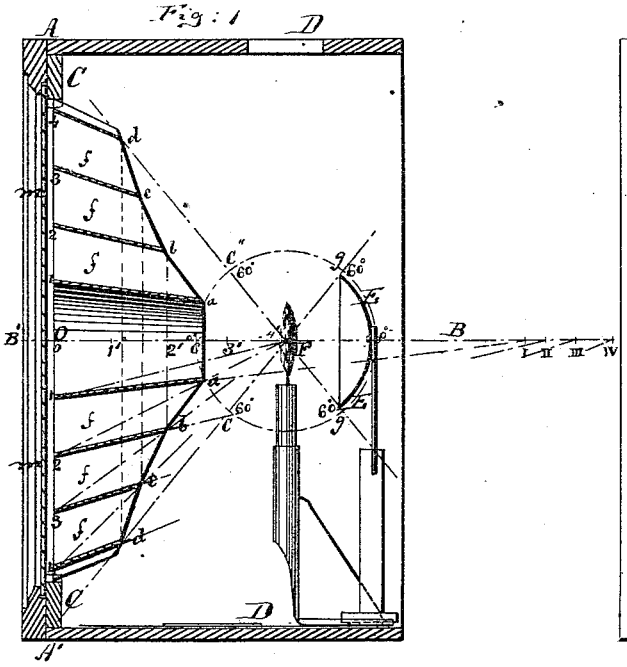


Fig: 3

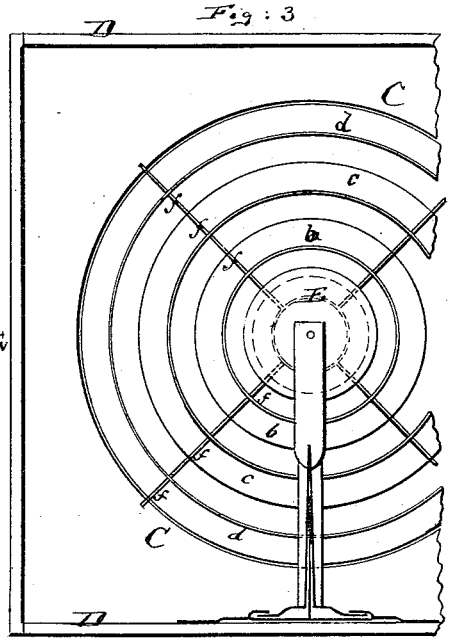


Fig: 2

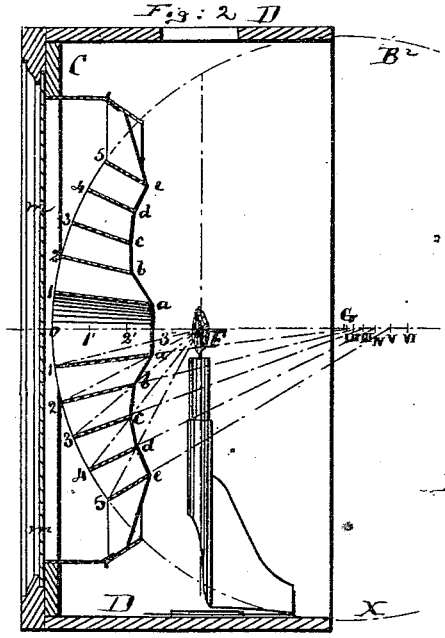
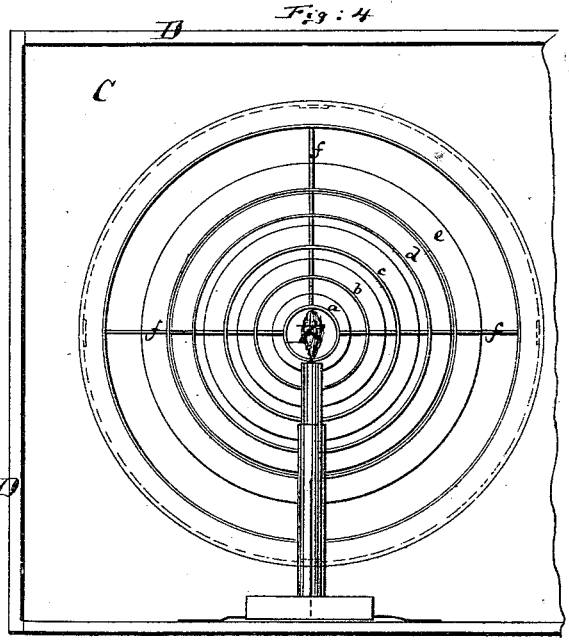


Fig: 4



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PASQUALE BALESTRIERI, OF ROME, ITALY.

IMPROVEMENT IN APPARATUS FOR COLLECTING THE RAYS OF LIGHT AND HEAT.

Specification forming part of Letters Patent No. **162,263**, dated April 20, 1875; application filed March 30, 1875.

To all whom it may concern:

Be it known that I, PASQUALE BALESTRIERI, of Rome, Italy, professor, have invented an Improved Apparatus for Collecting Rays of Light and Heat; and I do hereby declare the following is a full, clear, and exact description of the same, reference being had to the annexed sheet of drawings, making a part of the same, in which—

Figures 1 and 2 are vertical central sections of my improved apparatus, and Figs. 3 and 4 back views of the same.

This invention relates to apparatus to which I give the name of armillary-photo-thermo collector, for collecting the rays of light and heat radiating from a luminous center.

The collector of this invention may be constructed according to two arrangements—the one based on a plane, the other on a spherical surface—and each arrangement may be composed of two parts, the anterior and posterior. The anterior portion is that placed between the center of radiation and the point on which the collection of rays is projected, while the hinder portion is placed on the other side of the luminous center, and reflects the rays back toward the said center.

For example, let O B, Fig. 1 of the accompanying drawing, be a horizontal line, at one end of which is drawn a line, A A′, perpendicular thereto. The line O B will be the axis of the apparatus of the plane arrangement. The point O in this line is the optical center, and the point F, at which is placed the luminous or calorific center, (according as it is desired to project rays of light or of artificial heat to a distance,) is termed the focus; consequently, if the rays from the focus be projected toward B′, any apparatus placed between F and B′ would be termed the anterior apparatus, and another placed between F and B the posterior apparatus.

I will first describe the construction of the anterior apparatus of the plane arrangement: Let A A′ be a line drawn perpendicular to the axis, divided into equal parts, 1, 2, 3, 4, and upward on either side of point O, similar divisions, 1′, 2′, 3′, 4′, and upward, being made along the axial line O B, commencing at point O. I then take one of these latter divisions—4′ for example—as the focus, and from this point 4′ (which is coincident with point F) to points 1, 2, 3, &c, I draw the right lines F^1 F^2 F^3, &c., which I term radiuses. These lines F^1 F^2, &c., I then apply to line O B, making one end coincide with point F, and mark off their length by points I, II, III, &c., from which points I, II, III, &c., I draw other right lines to the points 1, 2, 3, &c., respectively, these latter being called generating-lines.

The portions of the generating-lines 1*a*, 2*b*, 3*c*, 4*d*, &c., comprised between any two successive radiuses, I term segments.

This being understood, let it be supposed that the perpendicular O A turns on the optical center O; it will, while still remaining perpendicular to axis B′ B, describe a plain perpendicular to the axis, and the linear segments 1*a* 2*b*, &c., will describe right segments of cones, all of which have a common axis, O F.

Thus the bases of these cones are all in the same plane perpendicular to the axis, and the divided lines O^4 in Fig. 1 represent the profile of this plane, the lines 1*a*, 2*b*, 3*c*, &c., similarly representing the profiles of the segments of cones; hence I have termed the above the plane arrangement. These segments of cones constitute the "armillary collector," as will be now explained.

If these conical segments be of sheet metal and made specular, that is to say, polished on their inner faces, for the purpose of reflecting the light from their inner surfaces—the combination of segments will constitute what I term the anterior apparatus of the armillary collector on the plane principle, and each segment of a cone will be an annulus. To complete the apparatus there must be added what may be termed its complement. This is a luminous body, if light is to be collected, or a heated body, if heat is to be concentrated. This luminous or heated body is placed in the focus F in such manner that the center of its anterior surface shall correspond exactly to the point 4′, if it is desired that the rays shall be parallel. This I term the radiating center. By slightly advancing or withdrawing this center the rays may be made to converge or diverge, as may be desired. The dimensions of the apparatus are determined by the area of the radiating body, and should be such that the posterior

diameter *a a* of the central segment is equal to the diameter of the radiating body.

To practice, in order to combine these rings or annul usesto form an apparatus, ribs or intermediate supports *f f* would be employed to hold them together, beginning at the central or first ring, *a*, which is connected by ribs to the next or second one, *b*, the second to the third, *c*, and so on to the outermost ring or periphery.

Preferably, four such ribs are disposed at equal distances around the periphery of the central ring *a*, on which is superposed the polished surface of the second polished ring, *b*. The latter is similarly provided with four ribs on its periphery, on which the third ring, *c*, is fitted, and so on, care being taken that the front edges of the rings shall all be in the same plane, for which purpose the ribs of each part are made to correspond in form to the trapeziums 1 *ab* 2, 2 *bc* 3, &c.

The number of the ribs should be increased as the diameters of the cones become greater, in order to afford sufficient support to the rings, which fit the one in the other, and the whole in the outermost one, which is fixed in a solid rim, *e*, as shown in Fig. 1, which is itself inclosed by a copper or other sheet-metal cylinder or casing. (Shown at D.) Any number of rings may be combined in the above manner. The apparatus is inclosed at front of the cylinder or casing D by glass *m*, and preferably also at the back, so as to protect the flame and the polished surfaces from external influences; and the cylinder or casing may be supported by gudgeons hung in bearings in a forked stand, so as to be capable of being inclined at any angle to the horizon. The forked stand may be also made to swivel on a vertical axis, in order to admit of the apparatus being turned toward any point of the horizon. The construction of the apparatus is shown in Figs. 1 and 3. The metal of which the rings are composed should be selected according to the use to which the collector is to be applied. The best kinds would be made of copper with its surface silvered and burnished; but they may also be constructed of tin plate or German silver, each of which will retain their polish when protected from air charged with moisture or oxidizing vapors. When any given number of degrees of light are to be collected, these degrees are measured as follows:

A circle, C C′ C″, is described from F as a center, with a radius, F *a*.

One-half of the given number of degrees, say sixty degrees, is then marked off on either side of line O B, *i. e.*, from C′ to C, and C′ to C.″ From the center F, through the two points C and C″, right lines are drawn to the plane A A′, which thus determines the extent of this plane. It will thus be evident that the anterior apparatus A A′ collects twice sixty degrees, or one hundred and twenty degrees of light.

In the above manner apparatus may be constructed of very large diameter, which will collect the greater portion of the rays from a luminous center, or which will collect a very large quantity of solar rays.

The posterior portion of the plane arrangement consists simply of a concave mirror, E, made of the same metal as the rings before mentioned. It is, however, not required except it be desired to collect the rays of the posterior hemisphere, and this is, in the majority of cases, unnecessary, as the anterior apparatus alone will answer all requirements.

This posterior apparatus serves to double the amount of light, which, when collected, is measured on the same circle as shown in Fig. 1, where it will be seen that the mirror E collects one hundred and twenty degrees of light. The mirror may be arranged in two different ways, according to the effect desired. I may here mention that the effect produced by the anterior apparatus alone is that of a series of concentric rings of light corresponding in number to the section alternating with as many dark rings.

This arrangement would be particularly useful in many cases, such as in light-houses, for example, as it would enable mariners to distinguish the light from any other. I therefore deem it essential to retain this same arrangement, even when the posterior apparatus is added, in which case the mirror is so disposed that the focus F shall be coincident with its center of curvature, as is the case with the reflector E. (Shown in Fig. 1.) In this case the mirror will collect all the degrees of the arc *g g*. Thus the anterior and posterior apparatus *m m′ m″* together collect two hundred and forty degrees of light.

When applied for other purposes it may be requisite to have a uniform plane of light, in which case the mirror would be arranged at a distance from focus F of one-half its radius of curvature.

The plane arrangement before described could not collect one hundred and eighty degrees of light except theoretically—that is to say, by supposing the plane of the rings to be extended to infinity, which is impossible in practice, as it is only possible to extend the plane or to increase the number of annuluses to a limited extent; but the plane arrangement is of especial advantage when it is desired to project to a distance a very considerable luminous surface. A large collector of above six feet in diameter has been constructed according to this plane arrangement.

This plane arrangement is also to be preferred for collecting the solar rays in the focus. The grouping being as the square of the diameters, a collector of six feet diameter could be made to condense the solar light thirty-one thousand four hundred times, supposing the area of the focus to be .1550 of a square inch.

It is, however, of advantage to sometimes collect the whole one hundred and eighty degrees of the anterior hemisphere in as limited a space as possible, for which purpose I prefer to use the spherical arrangement illustrated in Figs. 2 and 4. I take a point, G, as a center,

from which I describe a circle, XOB², having a radius, O G, which is determined in advance. The radius O G of this circle is the axis of the reflector. The said radius is then divided into two equal parts at point F, which is the focus. The distance O F is then divided into as many equal parts as desired—for example, into four parts, indicated by the points 1′ 2′ 3′—similar divisions being laid off on the arc XOB² on either side of point O, as indicated by the numbers 1, 2, 3, 4, 5, &c., in Fig. 2. At point F is erected, on either side of the axis O G, a perpendicular, said perpendicular being the chord of the arc XOB², which determines the sphericity of the collector, which will contain as many conical rings as there are graduations on the arc, less one. From point F are drawn right lines or radiuses to points 1, 2, 3, 4, &c., which lines are then marked off from point F, (their common center,) at points I, II, III, &c., from which are drawn right lines 1I, 2I, &c., to serve as the generating-lines of the cones, the parts 1*a*, 2*b*, &c., representing the segments of which the rings are composed. For the rest the same method is adopted as in the plane arrangement.

The area of the radiating center, which is placed at point F, being known, the posterior diameter *a a* of the central ring is determined thereby. It will be seen that this arrangement, which measures nearly one-fourth of the circle, will collect the whole, or nearly the whole, one hundred and eighty degrees of light or heat, and it is only the area of the luminous source which determines the effect obtained. The diameter of the luminous source determines more or less exactly the radius of the circle XOB², which defines all the rest, as above mentioned. A posterior apparatus or mirror may also be combined with this spherical arrangement, the optical center of which mirror should be placed at point G, which is the center of circle XOB²; but in the majority of cases the anterior apparatus only is used, it being sufficiently powerful for most purposes.

I claim—

The armillary-photo-thermo collector, consisting of conical concentric rings *a*, *b*, *c*, *d*, &c., arranged and constructed upon the principles herein described, and made with reflecting-surfaces on their inner sides, substantially as and for the purposes specified.

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