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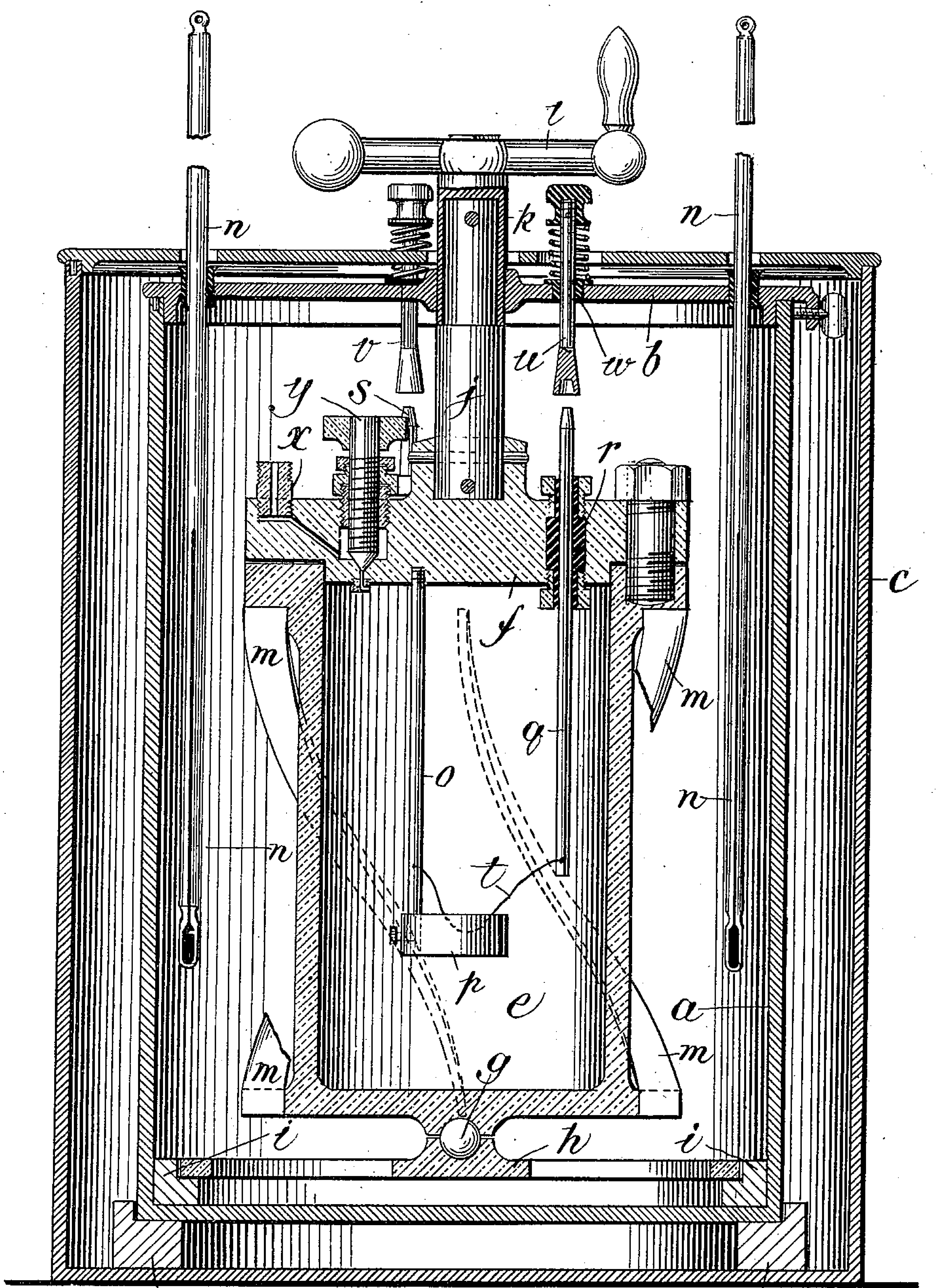
R. C. CARPENTER.

CALORIMETER.

(Application filed June 21, 1900.)

(No Model.)



WITNESSES:

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CALORIMETER.

SPECIFICATION forming part of Letters Patent No. 662,143, dated November 20, 1900.

Application filed June 21, 1900. Serial No. 21,119. (No model.)

To all whom it may concern:

Be it known that I, ROLLA C. CARPENTER, a citizen of the United States, residing at Ithaca, in the county of Tompkins and State of New York, have invented certain new and useful Improvements in Calorimeters; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in calorimeters such as are employed in determining the calorific value of coal or other fuel.

My invention consists in the novel means employed for producing circulation of fluid in the calorimeter, in the novel construction of the calorimeter, whereby the combustion-chamber is almost completely surrounded by the fluid to which the heat generated within such chamber is to be imparted, in the novel means employed for igniting the charge in the combustion-chamber, and generally in the novel combination, construction, and arrangement of the parts.

The objects of my invention are to improve and simplify fuel-calorimeters, to so design the same that the combustion-chamber may be surrounded as completely as possible with liquid, to improve and simplify the means for obtaining thorough circulation of the fluid in the calorimeter, thus insuring a uniform temperature of the fluid, to improve the means employed for igniting the charge within the combustion-chamber, and generally to make the calorimeter durable, simple, compact, easily operated, and comparatively inexpensive. These objects are obtained in the invention herein described and illustrated in the drawing which accompanies and forms a part of this specification, which drawing shows a central vertical section of a calorimeter constructed in accordance with my invention.

In the drawing, *a* indicates the main or fluid chamber of the calorimeter and is a cylindrical chamber closed at the top by a removable cover *b*. This chamber is contained within an outer chamber *c*, somewhat larger than the chamber *a*, so as to leave an air-space between the walls of chamber *a* and chamber *c*. The chamber *a* rests upon pieces of wood or other suitable material *d*.

Within the main chamber *a* of the calorimeter is a combustion-chamber or "bomb *e*," as it is generally termed. This bomb consists, preferably, of a cylindrical vessel made of bronze or steel or some other tough or ductile metal. It is provided with a head *f*, preferably formed of similar material, which head is held in place by bolts. The bomb must be of sufficient strength to withstand an internal pressure of about two hundred pounds to the square inch, and the cap must be so well fitted that it will not leak when such internal pressure is applied. The bomb is provided at the bottom with a spherical recess fitting over a bearing-ball *g*, itself lying in a similar recess in a base-plate *h*, which rests upon blocks *i* of wood or other suitable insulating material, said blocks themselves resting upon the bottom of the chamber *a*. To the head *f* of the bomb is connected a spindle *j*, preferably formed of wood, such as oak or pine, soaked in oil to make it waterproof. Upon the upper end of this spindle is secured a metal cap *k*, forming a journal which rotates in a bearing in the top of the cover-plate *b*. The spindle carries a counterbalanced handle *l*, by which said spindle and bomb may be rotated. The bomb *e* is provided with spiral vanes or blades *m*, which serve to agitate the water or other fluid in the chamber *a* as the bomb is rotated, and so to keep up constant circulation of the fluid in the chamber, thereby insuring efficient transmission of heat from the bomb to the fluid and insuring the maintenance of uniform temperature of the fluid.

For observing the temperature of the fluid I may employ thermometers *n*, passing through apertures in the cover-plate *b*, the space between the thermometers and the outer edges of the apertures being closed by plugs in the ordinary manner.

The rod *o* projects downward from the head *f* of the bomb and carries at its lower end a support or shelf *p*, adjustable up and down the rod *o* by means of a thumb-screw. Another rod *q* projects into the bomb from the outside thereof, being mounted in an electric insulating-bushing *r* in the head of the bomb. The head *f* is also provided with a pin *s*, similar to the upper end of the rod *q*, but in elec-

trical connection with said head. A conducting-wire *t* extends from the rod *q* to the rod *o* and is adapted to pass through a mass of fuel within a suitable receptacle which may have been placed upon the shelf *p*.

The cover *b* carries two spring-elevated plungers *u* and *v*, working through electric insulating-bushings *w* and provided with electric insulating-heads formed of rubber or similar material. These plungers project upward through apertures in the cover of the outer vessel *c*. The lower ends of the plungers are slightly enlarged and are provided with tapering recesses corresponding to the tapering heads of the rod *q* and the pin *s*. The plungers *u* and *v* are so located that when the bomb *e* is in the proper position said plungers may be depressed and caused to make contact, one with the rod *q* and the other with the pin *s*. Said plungers are also adapted to be connected by wires wound around them between the coils of their supporting-springs or otherwise to some source of electrical energy. When they are depressed, as above stated, and are thereby caused to make contact with the rod *q* and the pin *s*, an electric circuit is completed through the wire *t*, which wire then becomes heated sufficiently to ignite a charge of combustible material upon the shelf *p*.

In order that the cover *b* of the chamber *a* and the cover of the outer chamber *c* may always occupy the same relative positions, both covers may be provided with dowels fitting into suitable holes in the walls of their chambers, and the position of the handle *l*, which brings rod *o* and pin *s* directly beneath their respective plungers, may be indicated on the cover of the vessel *c*.

The fuel to be tested is usually burned in the bomb *e* in an atmosphere of oxygen and under considerable pressure. For the purpose of admitting oxygen to the chamber a nipple *x* is provided, in which nipple is a passage communicating with a passage in the head *f* of the bomb leading to the interior of the bomb. To close this passage, a screw-valve *y* is employed.

The manner of using the apparatus is as follows: The fuel to be tested is first carefully weighed, placed in a proper crucible of platinum or porcelain, (not shown in the drawing,) and the crucible placed upon the shelf *p*, the wire *t* being embedded in the fuel. This is usually done before the bomb is placed in the chamber *a*. The cover *b* is then put in place and fastened down so that it is air and water tight. Oxygen is then forced into the bomb, usually until a pressure of about one hundred and fifty pounds to the square inch is produced, after which the valve *y* is closed and the oxygen-pipe disconnected from the bomb. The bomb is then placed in the vessel *a*, the handle *l* having first been moved, and said vessel is filled with water until the bomb is completely submerged. The water thus placed in the vessel *a* must be carefully weighed, so that its amount is accurately known. The cover *b* of the vessel *a* and the cover of the vessel *c* are then put in place, the thermometers *n* inserted, and the electrical connections to the plungers *u* and *v* made. Said plungers are then depressed, so as to make contact with the rod *q* and pin *s*, thereby completing an electrical circuit through the wire *t* and igniting the charge. The handle *l* is then connected to the spindle *j* and the bomb is rotated slowly until the thermometers *n* show no more rise in temperature. The weight of the water placed in vessel *a* being known and the rise in temperature due to the combustion of the charge being observed by means of the thermometers, a simple calculation shows the calorific value of the fuel.

In calorimeters of this sort it is very essential that the water shall be maintained at a uniform temperature in all parts of the vessel, so that the thermometers may give uniform and faithful readings. It is also important that in order to obtain such uniform temperature the water is not so churned as in that way to raise its temperature. The spiral vanes upon the revolving bomb maintain very thorough circulation of the water and at the same time do so with a very small expenditure of energy, so that the water is not appreciably heated thereby.

Having thus completely described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a calorimeter, the combination, with a vessel adapted to contain a medium to which heat may be imparted, of a movable combustion-chamber, within such vessel, provided with stirrers and with means for moving it, whereby circulation may be maintained within said vessel.

2. In a calorimeter, the combination, with a vessel adapted to contain a medium to which heat may be imparted, of a combustion-chamber revolubly mounted within such vessel, and provided with stirrers upon its outer surface, and with means for rotating it, whereby circulation may be maintained within said vessel.

3. In a calorimeter, the combination, with a vessel adapted to contain a medium to which heat may be imparted, of a combustion-chamber revolubly mounted within such vessel, and provided on its outer side with spiral blades, whereby the medium within such vessel may be kept in circulation, said combustion-chamber being also provided with means whereby it may be rotated.

4. In a calorimeter, the combination, with a vessel adapted to contain a medium to which heat may be imparted, of a combustion-chamber within such vessel, having a pivotal support at its base and having at its top a spindle, revolubly mounted in a bearing of the vessel, whereby said combustion-chamber may be rotated, said combustion-chamber be-

ing also provided with stirrers whereby, as it is rotated, the medium within said vessel may be kept in circulation.

5. In a calorimeter, the combination, with a vessel adapted to contain a medium to which heat may be imparted, and having, near its base, a base-plate separated from the walls of said vessel by heat-insulating material, said base-plate having at its center a recess adapted to receive a pivot-ball, of a combustion-chamber within said vessel, provided at its base with a recess adapted to fit over a pivot-ball of the base-plate, and provided at its top with means for steadying and for revolving it, and also provided with stirrers whereby, as the combustion-chamber is rotated, the medium within said vessel is kept in circulation, and a pivot-ball.

6. In a calorimeter, the combination, with a vessel adapted to contain a medium to which heat may be imparted, of a removable combustion-chamber within such vessel, provided with an electric igniting device having external contact-terminals, and contact-pieces carried by said vessel and adapted to make contact with the contact-terminals of the combustion-chamber, but normally out of contact therewith.

7. In a calorimeter, the combination, with a vessel adapted to contain a medium to which heat may be imparted, and having a removable cover, of a combustion-chamber adapted to be inserted into, or to be removed from, said vessel when the cover thereof has been removed, said combustion-chamber being provided with an electric igniting device having external contact-terminals, and spring-retracted contact-plungers carried by the cover of said vessel and adapted, when pressed inward, to make contact with the terminals of said igniting device.

8. A combustion-chamber for calorimeters, consisting of a chamber adapted to be revolubly mounted, provided with means whereby a charge may be introduced, and provided also with external blades or stirrers by which, when the chamber is rotated, fluid around it may be kept in circulation.

9. A combustion-chamber for calorimeters, consisting of a chamber adapted to be revolubly mounted, provided with means whereby a charge may be introduced, provided also with external blades or stirrers by which, when the chamber is rotated, fluid around it may be kept in circulation, and also provided with a connection for the introduction of gas under pressure, and with a valve by which gas so introduced may be confined within the chamber.

In testimony whereof I affix my signature in the presence of two witnesses.

ROLLA C. CARPENTER.

Witnesses:
HORACE MACK,
CHAS. D. BOSTWICK.