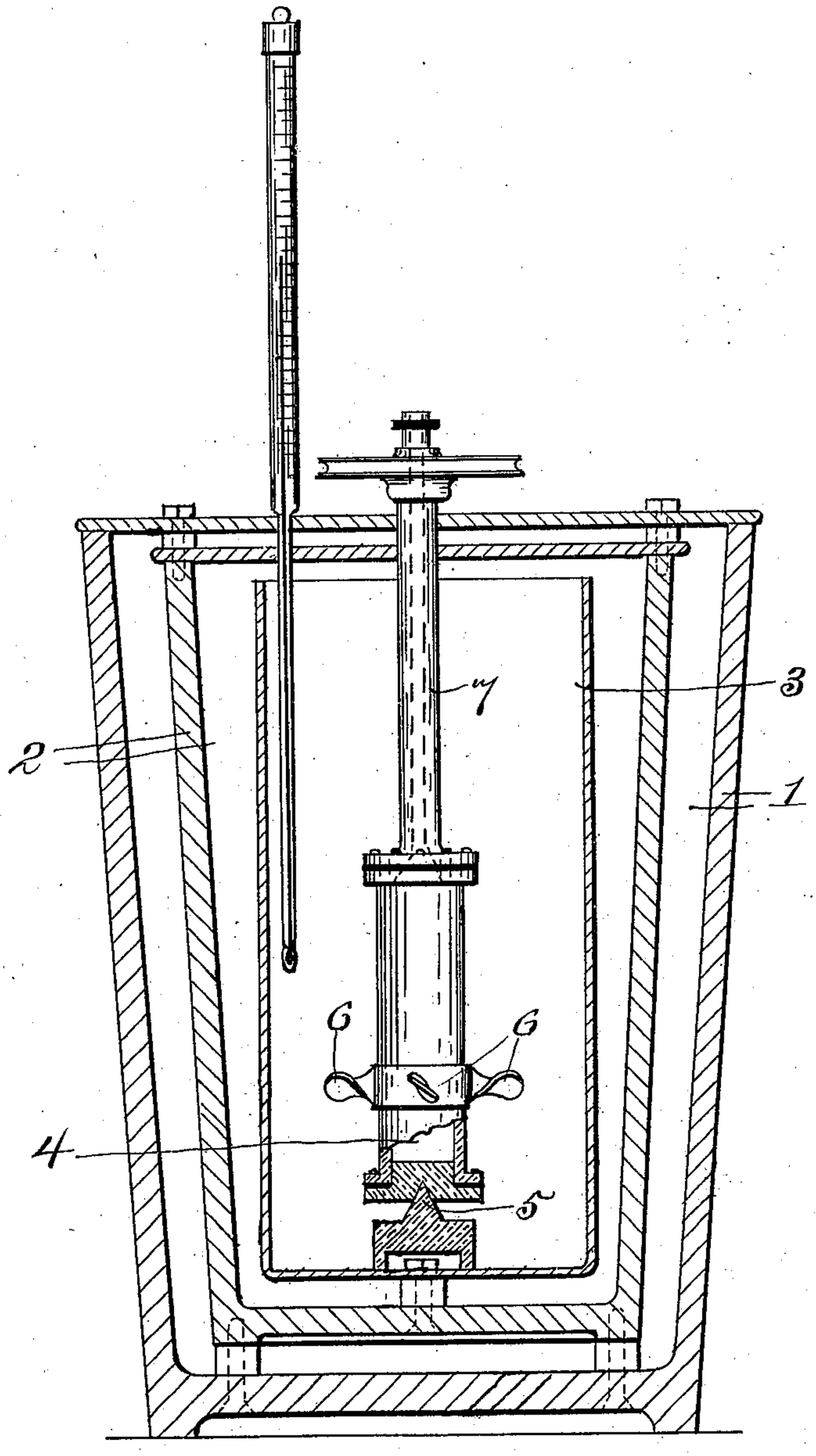
No. 700,555. Patented May 20, 1902.

S. W. PARR.

PROCESS OF DETERMINING THE HEATING CAPACITY OF COMBUSTIBLES.

(Application filed Dec. 24, 1901.)

(No Model.)



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SAMUEL W. PARR, OF URBANA, ILLINOIS.

PROCESS OF DETERMINING THE HEATING CAPACITY OF COMBUSTIBLES.

SPECIFICATION forming part of Letters Patent No. 700,555, dated May 20, 1902.

Application filed December 24, 1901. Serial No. 87,103. (No specimens.)

To all whom it may concern:

Be it known that I, SAMUEL W. PARR, a citizen of the United States, residing at Urbana, in the county of Champaign and State of Illinois, have invented certain new and useful Improvements in Processes of Determining the Heating Capacity of Combustibles, of which the following is a specification.

This invention relates to a method or process for determining the heating capacity of heating-combustibles, such as coal, coke, oils, &c.

The object of the invention is to provide a process for determining the heating capacity of combustibles; and it consists in making a complex reaction of chemicals, the fundamental one of which is peroxid of sodium, produce the heating capacity of combustibles without evolving gases or gas-pressure. In prior processes and methods for this purpose, as far as known to me, oxygen gas is employed either under common pressure or in a closed vessel under high pressure, or a chemical mixture is employed which readily evolves such gas. These and all other methods known to me involve what may be termed a "true combustion"—*i. e.*, the union of oxygen with carbon and hydrocarbon, the products of such combustion being carbon dioxid and water. There is not a true combustion in this improved process, but a complex chemical reaction in which heat is evolved, being in amount altogether different from the heat of a true combustion, but bearing a constant ratio to it. Thus if a is the heat of ordinary combustion and b the heat of reaction with peroxid of sodium, then $a : b :: 73 : 100$.

It is therefore the purpose of this invention to obviate the many objections of prior processes and the disadvantages found therein and to provide a complex chemical reaction the products of which are not gases, but solids developing no pressure and occupying less space after the reaction is completed than before it begins, whereby the extraction of the heat is quicker and the consequent equalization of temperature is far less subject to error from radiation and the influence of extraneous conditions.

In the drawing the figure is a central vertical section of an apparatus best adapted for carrying out the improved process.

The apparatus shown consists of a vessel 1, inclosing a similar vessel 2, housing a can 3 for containing a body of water, a chamber 4 for holding combustibles and the chemical and revoluble in the water upon a cone 5 in the bottom of the can, said chamber having vanes 6 and a hollow stem 7 projecting through the covers of the said vessels.

In carrying out the process a weighed quantity of the combustible—one gram, for example—is placed in the chamber 4. Then a weighed or measured quantity of the chemical—about twenty grams of sodium peroxid—is placed in the chamber with the combustible, and the chamber being closed it is shaken to thoroughly mix the two ingredients contained therein. The chamber is then seated in the can 3, which contains a weighed or measured body of water. The covers of the vessels 1 and 2 are secured in place with the hollow stem 7 projecting through them. The reaction may then be started by introducing into the chamber through the hollow stem a drop or two of water or by inserting a piece of hot wire, or the wire may be inserted in contact with the mixture and heated by a current of electricity. It has been found that the most simple and convenient manner of starting the reaction is to use a short piece of heated wire, dropping it through the stem, which is afterward closed, into the mixture. The reaction thus started continues of itself and is completed in a few seconds. The process of reaction consists of two simultaneous steps: first, the carbon and hydrogen of the combustible (coal) uniting with the oxygen of the chemicals; second, these products again combining with the chemicals to produce still different products. The first step corresponds to the ordinary combustion. The second step is entirely different and is purely a chemical reaction without any resemblance to a combustion; yet the two steps are so close together that they may be considered simultaneous and be called one reaction.

A small correction is necessary for the hot wire used. For wire weighing four hundred milligrams and introduced at a cherry-red heat the correction is .015° centigrade. The temperature of the water being taken before and after the reaction and corrected for the

wire, as just indicated, a simple calculation shows the amount of heat evolved by the reaction. Thus, corrected rise in

$$\frac{\text{temp.} \times \text{wt. of water} \times .73}{\text{wt. of fuel}}$$

equals number of heat units evolved per unit of fuel. The factor seventy-three one-hundredths is introduced because in the case of fuels this is the ratio between the heat of ordinary combustion and the above-described reaction. Other types of combustibles have other ratios.

The chemical process of the ordinary combustion may be represented thus:

$$C+2H+3O=CO_2+H_2O$$

that is, carbon and hydrogen plus oxygen produces carbonic-acid gas and water. The reaction involved in this process may be represented thus:

$$2C+6H+7Na_2O_2=2Na_2CO_3+6NaOH+2Na_2O.$$

This is carbon and hydrogen plus sodium peroxid, which produces sodium carbonate, sodium hydrate, and sodium oxid, all solids.

Sodium peroxid has other advantages. It is comparatively inexpensive and may be contained in any ordinary glass bottle. The quantity needed in a reaction may be simply measured out—for one-half gram of fuel about ten to twelve grams only are required. Moreover, the material is of such stable nature that for a given amount of combustible the decomposition of the chemical is definite for that amount. Thus there are introduced no indeterminate variables. Certain other reagents may be included which do not affect the general principles involved in the use of sodium peroxid, but which simply intensify the reaction. Some substances—as coke, anthracite coal, petroleum, &c.—do not react so readily and completely as other forms of substances. It has been found that the completeness of reaction is promoted by the addition of certain inorganic substances—as percarbonates, persulfates, perchlorates, and chlorates of potassium, peroxids, as of barium, &c.; also by definite organic substances—as tartaric, citric, oxalic acids, sugar, starch, &c. It is evident that these lists of substances may be greatly extended. In practice good results are obtained by the use of potassium persulfate and tartaric acid in the ratio two to one and this mixture used in conjunction with the sodium peroxid in the ratio of one to eight or nine. In this case the added substances possess their own heat of reaction, which must be separately determined for a given amount used and this heat increment subtracted from the total heat indicated. The remaining heat corresponds to the usual reaction with Na_2O_2 alone, seventy-three one-hundredths thereof being the actual calorific value. For example, one and one-half grams of a mixture of potassium persulfate and tartaric acid (one to one-half) with twelve grams of sodium peroxid will alone interact chemically, yielding a definite amount of heat. The said mixture, as represented by one to one-half, is made up of one part of the persulfate to one-half part of the acid, or it may be composed of two parts of the former to one part of the latter. For such a charge using two liters of water in the apparatus, as already described, the correction, including the wire, is .99° centigrade or thereabout, depending upon the purity of the reagents employed, the exact amount of correction being best determined by conducting a separate experiment, using the chemicals, as above noted, without the fuel. This same chemical combination with a combustible added greatly facilitates the reaction with the latter and is especially valuable, therefore, with dense substances, like coke or anthracite and with volatile substances, such as petroleum products. Now, since it has its own definite heat of reaction, this correction factor is substracted from the total heat indicated, leaving the heat of reaction due to the fuel alone reacting with the sodium peroxid. Then of this latter corrected temperature seventy-three per cent. is the constant which corresponds to the heat of the ordinary combustion.

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

1. The herein-described process of determining the heating capacity of combustibles, which consists in mixing sodium peroxid with the combustible in a closed vessel under ordinary atmospheric pressure, placing the vessel in a body of water, igniting the mixture, permitting a reaction of the mixture so that the ultimate products of the reaction will be solid substances, and taking the temperature of the water before and after the reaction.

2. The herein-described process of determining the heating capacity of combustibles, which consists in mixing together in a closed vessel the combustible, sodium peroxid, and other superoxidized substances which yield a maximum nascent oxygen, placing the vessel in a quantity of water, igniting the mixture, permitting a reaction of the mixture from such ignition so that the products thereof will be solid substances, and taking the temperature of the water before and after the reaction.

3. The process of determining the heating capacity of combustibles, which consists in mixing definite organic substances, as herein described, with sodium peroxid, and the combustible in a closed vessel, placing the vessel in a body of water, igniting the mixture, permitting a reaction of the mixture from such ignition, and taking the temperature of the water before and after the reaction.

4. The process of determining the heating capacity of combustibles in a closed vessel with definite organic substances, sodium per-

oxid, and other superoxidized substances, placing the vessel in a body of water, igniting the mixture, permitting a reaction thereof from such ignition so that the products of the reaction will be solid substances, and taking the temperature of the water before and after the reaction.

In witness whereof I hereunto set my hand in the presence of two witnesses.

SAMUEL W. PARR.

Witnesses:
J. D. WALLACE,
A. C. SINGBUSCH.