No. 802,297. PATENTED OCT. 17, 1905.

K. KÜPPERS.

METHOD OF PRODUCING FLAMES OF HIGH TEMPERATURE.

APPLICATION FILED AUG. 17, 1904.

Fig. 1a

Fig. 1

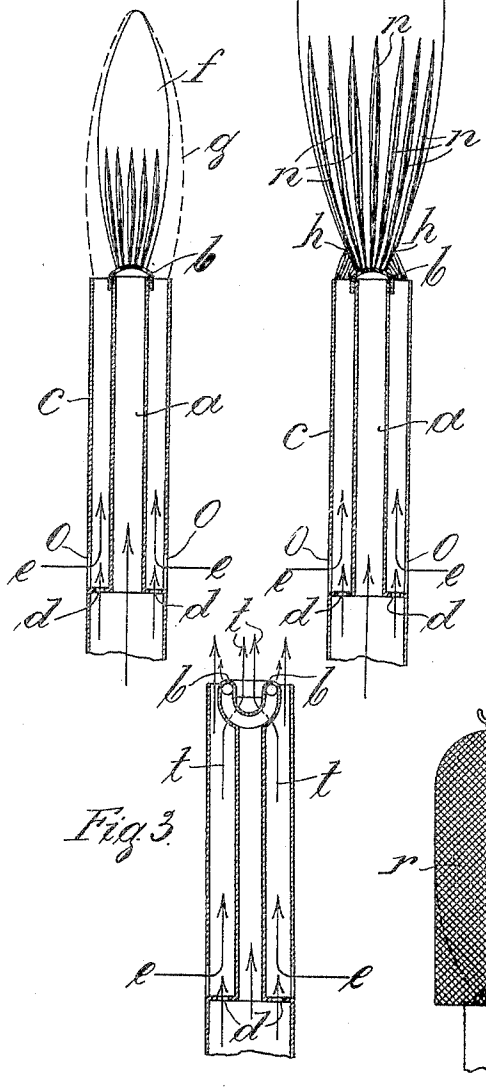

Fig. 2.

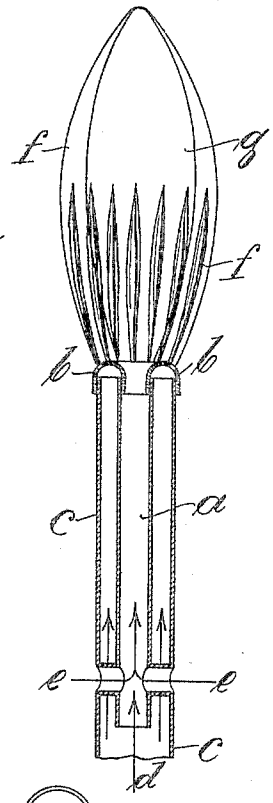

Fig. 3.

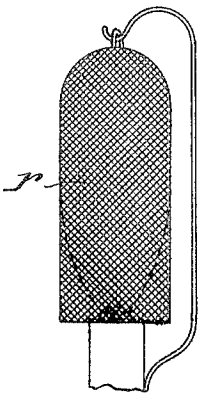

Fig. 4.

Witnesses:
Otto Scholz

Inventor:
Karl Küppers.
by Robert Dexter
Attorney.

UNITED STATES PATENT OFFICE.

KARL KÜPPERS, OF BERLIN, GERMANY.

METHOD OF PRODUCING FLAMES OF HIGH TEMPERATURE.

No. 802,297. Specification of Letters Patent. Patented Oct. 17, 1905.

Application filed August 17, 1904. Serial No. 221,044.

To all whom it may concern:

Be it known that I, KARL KÜPPERS, electrochemist, a subject of the King of Prussia, German Emperor, and a resident of Berlin, in the Kingdom of Prussia, German Empire, have invented certain new and useful Improvements in Methods of Producing a Flame of High Temperature, of which the following is an exact specification.

My invention relates to gas-burners, and has for its purpose to produce a blue flame of high temperature. This is attained by suitably leading a blue flame not containing air into a bunsen-flame, or inversely.

In order to make my invention clear, I beg to refer to the accompanying drawings, in which—

Figure 1 shows a vertical section through a convenient form of my improved burner. Fig. 1ª illustrates the flame produced. Figs. 2 and 3 show two other convenient forms of my burner, and Fig. 4 shows a burner in connection with an incandescent mantle.

In the drawings, *a* is an inner burner-tube with an enlarged part at its lower end. The upper end of the tube *a* carries a cap *b*, which is provided with small circularly-arranged openings, the axis of which is oblique to the tube-axis.

c is a second tube, concentrically arranged around tube *a*.

o o are openings in the lower part of the tube *c*.

d d are openings in the upper part of the enlargement of the tube *a*, which discharge into the tube *c*.

Through the openings *o o* air can pass from the outside into the tube *c*.

The working of this burner is as follows: If the gas only enters into the tube *a* and leaves the same through the obliquely-directed openings of the cover *b*, a blue, non-luminous, comparatively small, but very hot flame is produced. If this flame *f* is not present and only the outer annular bunsen-flame is burning, a small blue flame is also obtained, which is, however, of little effect; but if both the inner and the outer flames *f* and *g* simultaneously burn the following effect (illustrated in Fig. 1ª) is obtained: Both flames *f* and *g* are combined to a single flame *k*, the dimensions of which are three to four times larger than those of the single flames, as the outer glowing gas-mantle of the bunsen-flame *g* is sucked between the single small blue flames *n n n*, Fig. 1ª, generated by the burner-cap *b*, thereby considerably enlarging the whole flame. The suction can best be seen by coloring the flame, which shows outside a restriction *h*. If the outer tube *c* is somewhat raised, so that its end is above the burner-cap *b*, the restriction will disappear and the flame itself becomes broader. The thus-generated flame is if of larger size inside hollow. The favorable effect of this new flame will probably be created by the peculiar chemical processes in the flame.

In considering the processes of combustion taking place at the surface of the bunsen-flame and the *f* flame, Fig. 1, it will be seen that the bunsen-flame itself contains the air of combustion and will therefore not take any oxygen out of its surrounding. This flame is therefore cooled by the surrounding oxygen and nitrogen molecules whereby these molecules are heated, but without benefiting in any way of the heat of these molecules. Also a blue *f* flame is cooled by its surrounding and consequently heats the surrounding oxygen molecules; but as this flame can only take the oxygen from its surrounding the heated oxygen will take part in the burning process, thereby increasing the temperature of reaction of the combining molecules, and consequently also of the whole flame *k* as the properties of the small flames *f* are transferred to the whole flame *k*, which is enlarged by the bunsen-flame. Thereby that the new flame is of a great surface in spite of having a comparatively small quantity of gas the conditions of combustion are so far more favorable, as thereby a comparatively larger surface of combustion-air or greater number of oxygen particles are in contact with the flame.

The above may not be as full an explanation of the processes arising in the flame as might be given, but sufficient, as still other processes can be present between the *f* flame and the bunsen-flame.

In the arrangement according to Fig. 2 another form of burner is shown. *a* is an inner tube provided with lateral openings *e e*. *c* is an outside tube surrounding tube *a*. *d* is an annular cap provided with openings obliquely directed with regard to the burner-axis. In this arrangement the bunsen-flame *g* is in the center and leads into the pure blue gas-flame *f*.

In Fig. 3 another convenient form of burner is shown, in which the burner-cap *b* is of an-

nular shape and leads the gas-flame into the flame containing air. This latter flame enters the bunsen-flame in the center in the direction of the arrows *t* and further surrounds the same.

Fig. 4 shows a burner in connection with an incandescent mantle *r*.

Having now particularly described and ascertained the nature of my invention, what I desire to secure by Letters Patent of the United States is—

1. The method of generating a blue flame for incandescent light or heating purposes, consisting in leading a non-luminous flame not containing air into a bunsen-flame, substantially as described and for the purpose set forth.

2. The method of generating a blue flame for incandescent light and heating purposes, consisting in bringing together into a single flame, a bunsen-flame and a non-luminous flame not containing air, substantially as described and for the purposes set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

KARL KÜPPERS.

Witnesses:

WOLDEMAR HAUPT,

WILLIAM MAYNER.