(No Model.)

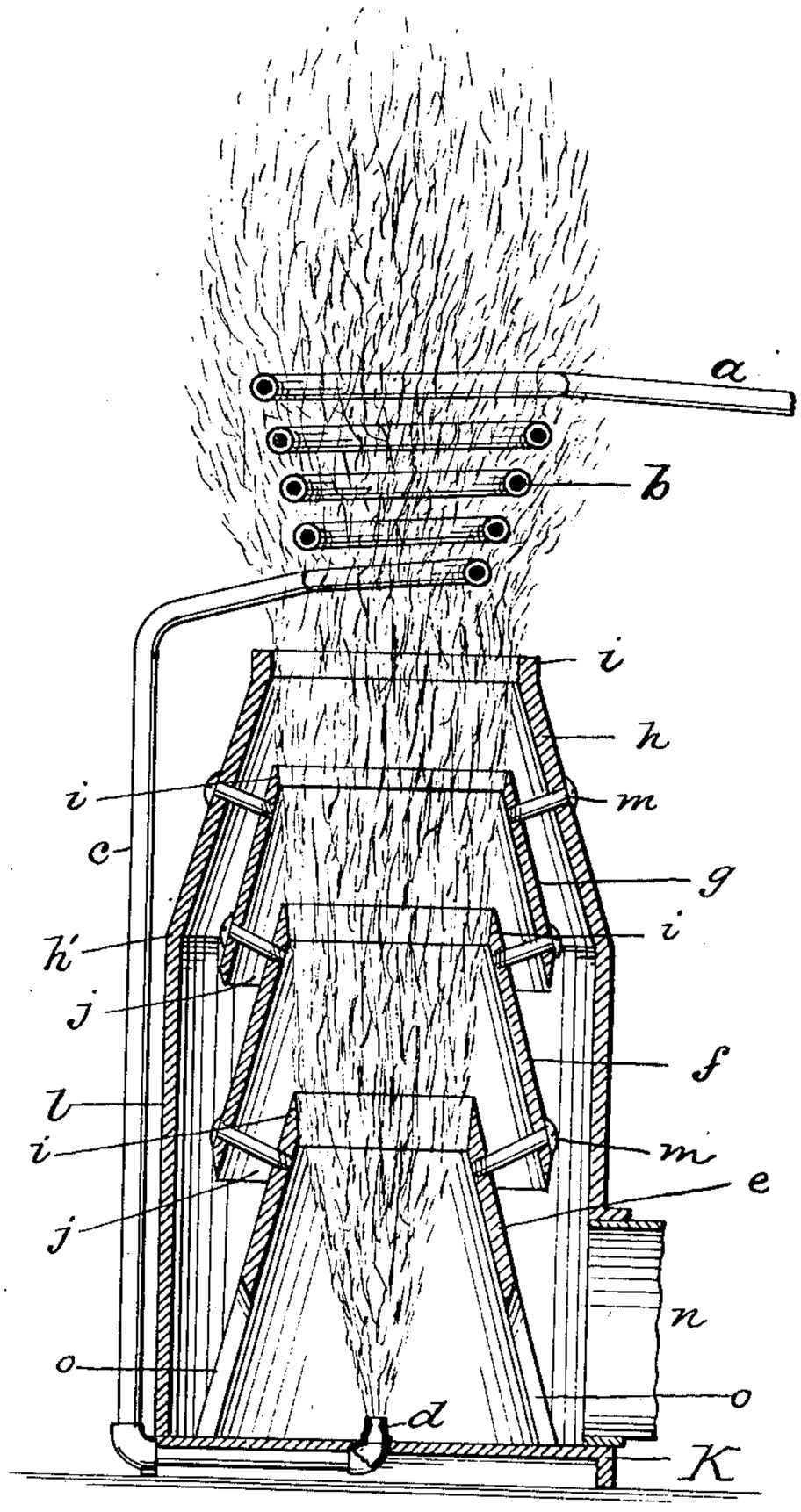
2 Sheets—Sheet 1.

E. BAKER.

APPARATUS FOR BURNING HYDROCARBONS.

No. 267,052. Patented Nov. 7, 1882.

Fig. 1.



Attest;
F. W. Howard
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Inventor;
Elbridge Baker
by H. Bailey
his Attorney

(No Model.) 2 Sheets—Sheet 2.

E. BAKER.

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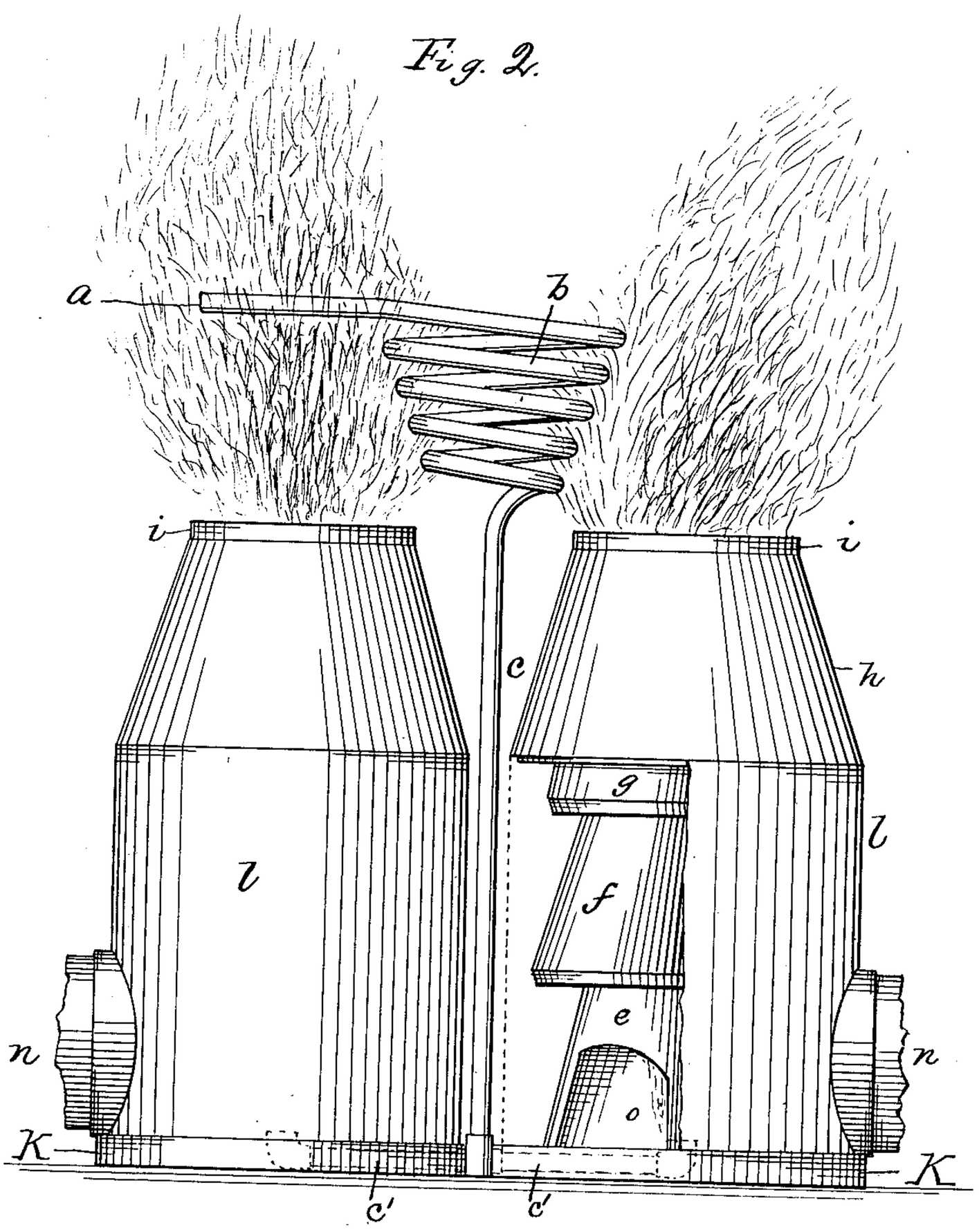
Fig. 2.



Attest;
H. W. Howard
E. F. Dick

Inventor;
Elbridge Baker
by Alex Bailey
his Attorney.

UNITED STATES PATENT OFFICE.

ELBRIDGE BAKER, OF MALDEN, MASSACHUSETTS.

APPARATUS FOR BURNING HYDROCARBONS.

SPECIFICATION forming part of Letters Patent No. 267,052, dated November 7, 1882.

Application filed February 23, 1882. (No model.)

To all whom it may concern:

Be it known that I, ELBRIDGE BAKER, of Malden, Middlesex county, Massachusetts, have invented certain new and useful Improvements in Apparatus for Burning Hydrocarbons, of which the following is a specification.

The object of my invention is to burn economically and effectively crude petroleum and other hydrocarbons with a view to the production of heat.

The invention has been designed more particularly with reference to the needs of boiler and other furnaces, but is susceptible of ready application to stoves and any other forms of heating devices, whether on a large or on a small scale.

My invention belongs to that class of hydrocarbon-burners in which the hydrocarbon fuel is vaporized or gasified by heat before issuing from its jet or nozzle, in contradistinction to that class of apparatus in which the liquid fuel is injected as spray into a combustion-chamber, where it is to be consumed. It is my design to obtain, as far as practicable, entire combustion of the hydrocarbon, and to use the latter as the sole agent by which the requisite current or currents of air needed to effect this combustion are induced and supplied to the flame. I avail myself, in obtaining this result, of the principle involved in one well-known form of injector; but in so doing I employ as the motive power for inducing the air-supply, not gas or steam, but the flame itself.

The nature of my invention and the manner in which the same is or may be carried into effect can best be explained and understood by reference to the accompanying drawings, in which is represented one form of apparatus which I have used with excellent results in practicing my invention.

Figure 1 is a vertical central section of the apparatus. Fig. 2 is a side elevation, partly in section, of a modified form of apparatus differing from the apparatus represented in Fig. 1, in that it contains two burners, or "combustion-injectors," as they may be termed, combined with a single fuel-supply pipe.

The fuel, which may be any suitable hydrocarbon—*e. g.*, crude petroleum—is contained in a suitable tank or receptacle, (not shown,) whence it flows in measured quantity, determined by a suitable valve or stop-cock, through the pipe *a* to the coil *b*, in which it is vaporized or gasified. The gas thus generated passes down through a pipe, *c*, which forms a continuation of the coil *b*, and finally issues under pressure and with force from the nozzle *d*. The coil *b* is one convenient form of heater or retort in which the liquid hydrocarbon can be vaporized, and it is heated for this purpose by the flame from the burner, as indicated. The hydrocarbon flashes into vapor as soon as it reaches the coil, and this vapor is, by its passage through the successive turns of the coil, further heated and expanded. Within certain limits, the feed of the oil or hydrocarbon to the coil can be varied without affecting the flame, save in size. Beyond those limits smoke will be produced. It is further essential that the coil should not be too long, for if the gas or vapor be heated beyond a certain point a carbon deposit (similar to retort-carbon) is apt to accumulate in the coil. A coil so proportioned that it will, when in action, have a low or dull red heat can be used with excellent results. It is further desirable that the folds of the coil should have a gentle uniform downward inclination, as indicated in the drawings, with a view to prevent clogging or local accumulation of impurities which may be contained in the hydrocarbons employed as fuel. The tip or discharge-nozzle from which the hydrocarbon gas issues has a discharge opening or passage having a double-cone shape. The outward flare of the discharge-opening causes the gas-jet, as it issues, to spread and expand.

Surmounting the discharge-nozzle is a passage formed by a number (four in this case) of superposed conical or tapering funnels, *e f g h*, terminating each in a nozzle or mouth, *i*. The nozzle *i* of each funnel is wider than that of the funnel below, and all the nozzles are comparatively short and flare a little outwardly. Each funnel is placed above the one below in such manner as to leave between the two an annular passage, *j*, for entrance of air. I find that in order to produce the best results the area of each passage *j* should be somewhat less than that of the one next below, so that the amount of air supplied to the flame gradually diminishes as it approaches the top of the burner. For this purpose, and also for the purpose of preventing possible backflow of the

flame through any one of the passages *j*, each funnel-nozzle is nearer to the nozzle next above than it is to the one next below. With respect to the size of the funnels I would say, without desiring to restrict myself to the specific proportions, that in a burner built by me on the plan shown for a fifty-horse-power engine the diameter of the nozzle of the bottom funnel, *e*, is about three and one-half inches and that of the nozzle of the top funnel, *h*, is about six inches, and the total height of the burner from the base K to the top of funnel *h* is about fifteen inches.

In the furnace in which the burner is used the base K corresponds to the floor of the ash-pit, while the point *h'*, at which the top funnel rests on the shell *l*, is about where the furnace-grate surface would come if one were used. The funnels can be supported in place in any suitable way. In this instance they are held in place and connected together by bolts or screws *m*.

The shell *l* constitutes a drum, between which and the burner-funnels is space through which air can be supplied to the several passages *j*. Suitable openings, *n*, for admission of air are formed in the shell, and in the bottom funnel, *e*, are made openings *o*, through which air enters the funnel and mingles with the gas issuing from the tip or nozzle *d*.

Under the arrangement of the parts shown it will be noted that the series of funnels constitute a gradually-expanding passage whose walls, formed by the flaring walls of the funnel-nozzles, are intersected at intervals by the annular ducts *j*, through which the induced air-currents enter and mingle with the ignited gas. The flame is not confined to the top of the burner. When the apparatus is in action the flame is visible a short distance above the gas-tip *d* through the openings in the side of the bottom funnel, and it thence rushes up through the burner, filling the passage formed by the funnels, leaping from one nozzle to the other, and in so doing drawing in through the successive passages and incorporating with itself the air needed to complete combustion, until, issuing from the top of the burner, it rises in a mass or column of flame. The flame within the burner is not a smooth even flame, as it would be if there were mere surface contact between it and the entering air-currents, but is in violent agitation, due to the intimate commingling of the air with the combustible. The result is that I obtain combustion which, if not theoretically perfect, is nevertheless very complete and satisfactory, there being in practice no carbon deposit upon the retort or heating-coil, which is placed above and in contact with the flame.

In order to start the apparatus, the coil, by suitable means, must first be heated sufficiently to vaporize or gasify the hydrocarbon. The latter is then fed to the coil, is converted into a vapor or gas by passage therethrough, and then issues from the tip *d* and passes up through the burners. If, now, a torch be applied to the top of the burner, the gas or vapor will be ignited, the flame will extend downward through the burner to or nearly to the tip *d*, and the apparatus will then be in action. If it be desired to spread the flame still more than will be the case with the apparatus represented in the drawing, I may close the space circumscribed by the lowermost fold or turn of the coil with a soapstone slab, fire-brick, or other suitable instrumentality.

The apparatus represented in Fig. 2 is similar in principle and functions to that shown in Fig. 1, the only difference being that there are two burners employed instead of one. They are placed side by side, and intermediate between them is the stand-pipe or gas-supply pipe *c*, which at its bottom is forked or branched, as at *c' c'*, so as to supply the gas or vapor to such burner. The pipe *c* communicates with a coil, *b*, which is supplied with the hydrocarbon, as hereinbefore described, and is so placed as to be acted on by the flames of both burners.

This apparatus can be advantageously used in cases where it is desired to obtain large amounts of heat which shall be spread out or distributed, and not concentrated, as it is in a measure in the apparatus shown in Fig. 1.

I am aware that it has heretofore been proposed to use on petroleum-burners a series of superposed tapering funnels or tubes, between the contiguous ends of which air is admitted to the flame; but in all such of which I have knowledge the tubes are not surmounted by nozzles, and they act as a deflector simply, the entering air meeting only the exterior of the flame, which it crowds toward the longitudinal center or axis of the burner. Under my invention, however, the air does not rise by reason of the draft alone, as is ordinarily the case, but is injected into the body of the flame as the latter leaps from one flame-directing nozzle to another through the series, striking against and filling these nozzles and forcing the air into its body. In other words, I have what may be considered an injector, the actuating or motive power of which is the flame.

Having now described my invention and the best way known to me of carrying the same into effect, I state, in conclusion, that I do not desire to be restricted to the specific construction and arrangement of parts herein shown and described, inasmuch as the same can be varied without departure from my invention; but

What I do claim, and desire to secure by Letters Patent, is—

1. The combination, substantially as hereinbefore set forth, of a series of conical or tapering tubes or funnels, provided each at the top with a short flame-directing tube or nozzle, as described, and placed at intervals apart, so as to provide air ducts or passages between them, a retort or heater in which the hydrocarbon fuel is vaporized or gasified, a tip or nozzle from which the hydrocarbon gas or vapor so gener-

ated is discharged under pressure into the first funnel of the series, and air-openings which admit air at a point where it will meet the gas issuing from said nozzle, the arrangement being such that the gas or vapor, when ignited, burns in the body of the burner and passes up in an inflamed condition through the passage formed by the flame-directing funnel-nozzles, substantially as and for the purposes described.

2. The funnels formed with short flaring nozzles and placed in series so as to constitute a burner, provided with a central expanding or flaring flame-passage, with air-admission passages *j* in its walls, in combination with the coil or other retort or heater for the hydrocarbon fuel, the gas jet or nozzle, the pipe leading therefrom to the coil or retort, and means for feeding the hydrocarbon fuel to the retort, substantially as hereinbefore set forth.

3. In a burner for hydrocarbons, a series of superposed funnels provided with short flame-directing nozzles, and formed and arranged with respect to one another substantially as herein shown and specified, in combination with the gas tip or nozzle and means for supplying the same with hydrocarbon gas or vapor under pressure, substantially as hereinbefore set forth.

4. The heating-coil, formed with gently and uniformly downwardly-inclined folds or turns, proportioned so as to heat the hydrocarbons to the extent substantially as specified, and placed so as to receive heat from the burner, in combination with the series of superposed funnels provided with nozzles arranged to form a central flame-passage, with air-inlets *j*, the gas tip or nozzle, and the pipe leading therefrom to the coil, substantially as and for the purposes hereinbefore set forth.

In testimony whereof I have hereunto set my hand this 23d day of February, 1882.

ELBRIDGE BAKER.

Witnesses:
E. A. DICK,
P. B. DOING.