No. 637,176. Patented Nov. 14, 1899.

F. E. & F. O. STANLEY.

BURNER FOR STEAM GENERATORS.

(Application filed July 31, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

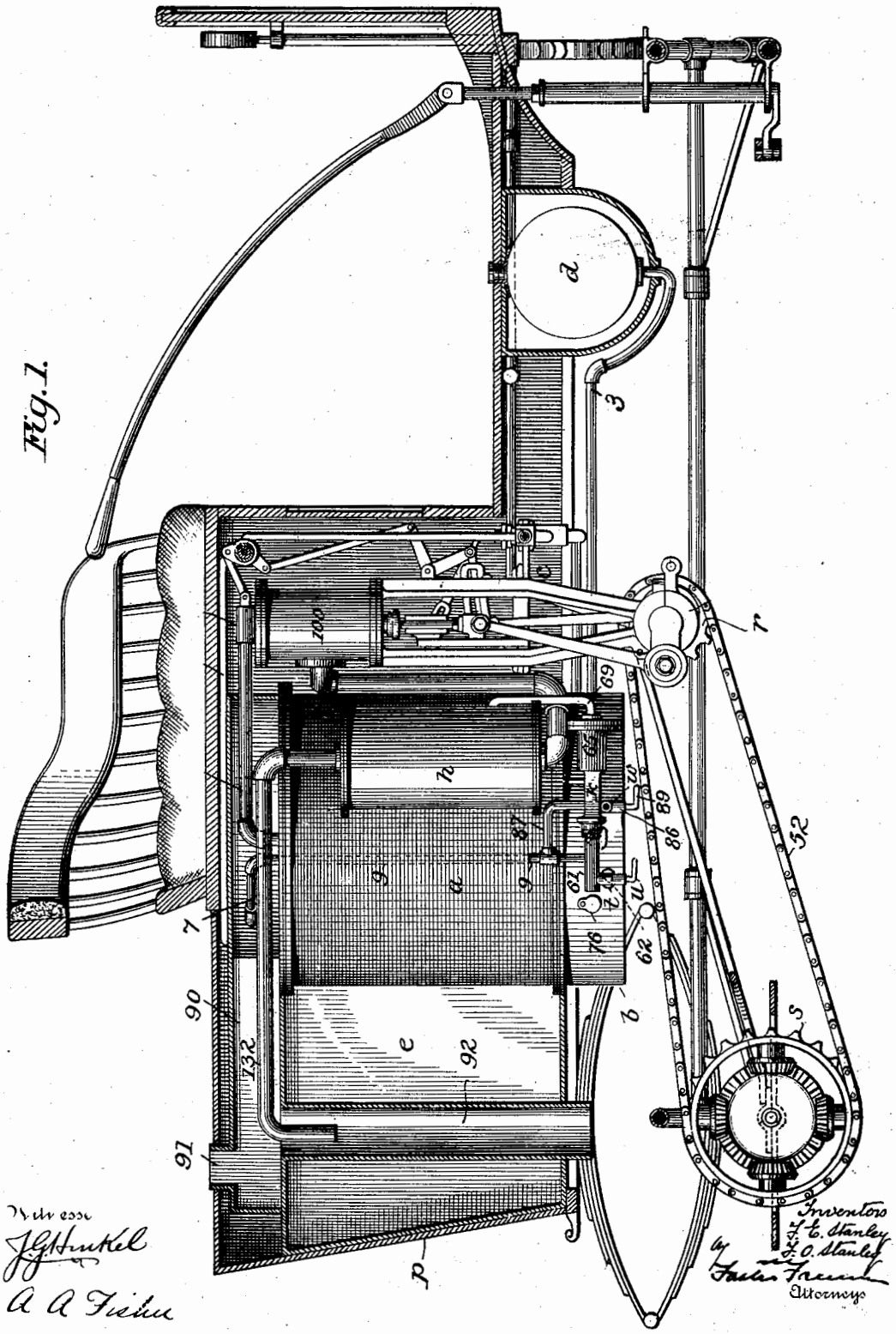

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Fig. 2.

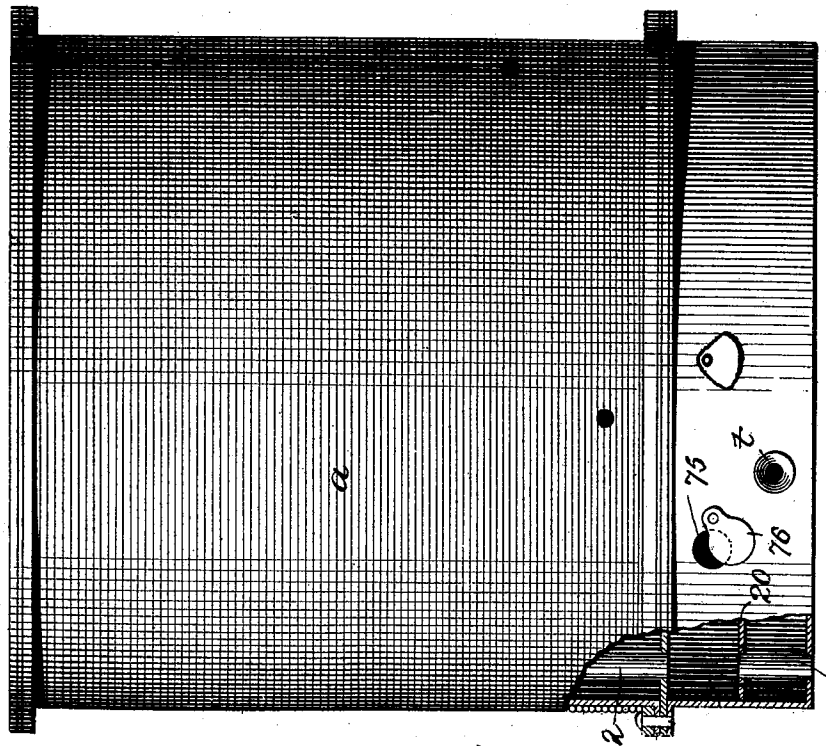
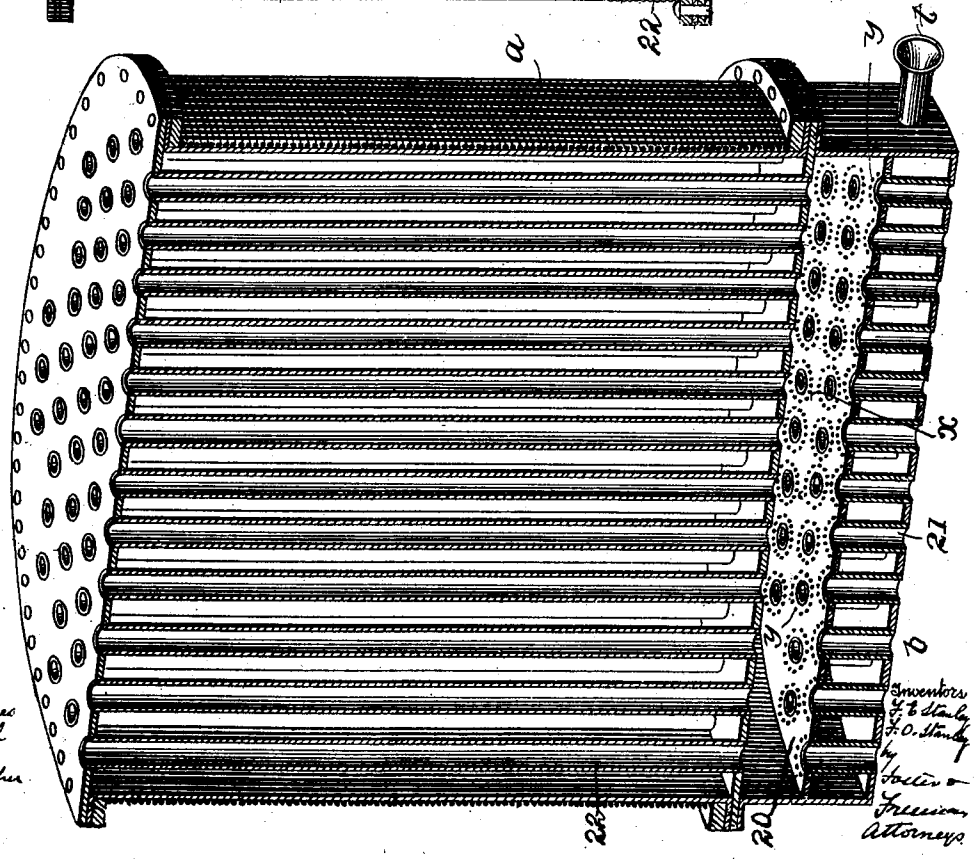


Fig. 3.



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UNITED STATES PATENT OFFICE.

FRANCIS E. STANLEY AND FREELAN O. STANLEY, OF NEWTON, MASSACHUSETTS.

BURNER FOR STEAM-GENERATORS.

SPECIFICATION forming part of Letters Patent No. 637,176, dated November 14, 1899.

Application filed July 31, 1899. Serial No. 725,654. (No model.)

To all whom it may concern:

Be it known that we, FRANCIS E. STANLEY and FREELAN O. STANLEY, citizens of the United States, residing at Newton, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Burners for Steam-Generators, of which the following is a specification.

Our invention relates to burners for heating liquid for use in connection with portable steam-generators—that is, those carried by moving vehicles and exposed to the action of varying air-currents; and it consists of means for securing a uniform combustion of gases over a large area, of preventing smoke, and regulating and maintaining the flame in all its conditions, as fully set forth hereinafter, and illustrated in the accompanying drawings, in which—

Figure 1 is a sectional view of a motor-vehicle, illustrating our improved burner and its adjuncts as applied to such a structure; Fig. 2, an elevation of the burner and boiler in part section. Fig. 3 is a vertical sectional and perspective view of the burner and boiler.

To illustrate our invention, we have shown it in Fig. 1 in connection with a vehicle having a body *p* surmounted by a seat, with a platform below, which is an oil-tank *d*, the body portion containing a water-tank *e* with a vertical flue 92, a boiler *a*, and an engine 100, the exhaust from which passes through a muffler *h* and exhaust-pipe 132. The said engine drives the rear axle through a chain 52, passing around sprocket-wheels *r s*.

The burner *b* consists of a casing having a flat top 20 and provided with a series of air-tubes 21, each extending from the top to the bottom of the casing and arranged directly below the boiler *a*, the two being separated by a space (closed by the outer shell of the casing) only sufficient to secure a proper intermediate combustion-chamber *x*. In the top of the burner-casing and preferably in a circle surrounding each air-tube are perforations *y*, and with the interior of the burner-casing communicates a pipe *t*, through which the mixture of air and gas (of any suitable character) passes to the burner. The gas issues forcibly from the perforations *y* in a series of annular flames, each ring of flame surrounding an air-pipe 21, through which the air is drawn freely and directly upward without interference, and the hot gases flow up through the boiler flues or tubes 22, each of which constitutes a chimney. An abundance of air is thus supplied to the interior of each annular flame. Each circular series of perforations *y* constitutes a burner by itself, and all coöperate with the boiler-tubes above to secure and insure a natural draft, while the assembling of a series of such burners secures a broad area of flame over an extended surface, so that all parts of the boiler will be equally heated, insuring the rapid heating and evaporation of the contents of the boiler. It has been found that by thus assembling a series of annular burners, supplying each with air from a central tube and admitting air only through the annular flames to the combustion-chamber in which the burners are arranged, and arranging the same below a boiler with an intermediate combustion-chamber a most perfect and effective combustion is secured and maintained under all conditions, so that whether the flame is at a maximum or minimum there is no deposit of carbon on the head of the boiler-plate nor in any of the tubes and no smoke nor odors resulting from imperfect combustion. Furthermore, by the arrangement of such a burner below a boiler having vertical tubes with the air-tubes of the burner vertical and freely open below not only is a most effective natural draft secured, but the air and flame are so properly commingled as to secure a most vivid and effective combustion within or about the boiler-tubes and a more rapid and uniform generation of steam than could otherwise result, while the necessity of using appliances for artificially forcing the draft or controlling the flow of the gases is avoided.

One of the most beneficial results of the arrangement and construction of burner and boiler is the capacity to regulate the character of the flame or extent of combustion, and consequently the generation of steam, by simply varying the flow of gas to the burner. This is done by turning the cock *u* or by the valve of the regulator *k*, as set forth hereinafter, and the flame can thus be reduced so as to be barely visible or may be increased

to its maximum or varied to any intermediate extent.

As the entire assemblage of burners is arranged within a chamber closed at the sides and to which air can pass only through the tubes concentric with the burners, the flame may be reduced so as to be barely visible, so that without increasing the boiler-pressure there is maintained constantly "master-light" capable of being increased to a maximum, but which cannot be changed or extinguished by a transverse flow of air, which would result in the escape of unconsumed gases and the deposit of soot and objectionable odors and in the necessity of frequently relighting the burner.

The effective combustion and rapid and regular heating of the boiler results in part from the fact that all the burner-outlets over the extended area of the burner are supplied from the same source and are regulated in unison; further, from the combustion-chamber being wholly closed at the sides and the admission of air from below the entire area of the burner, so that all parts are supplied regularly and uniformly, and the flame thus burns uniformly over the full area, which could not result if one part of the body of flame was fed with an excess of air over any other part, and, further, from the arrangement of the boiler-tubes and the air-tubes of the burner each vertically there is practically no deflection of the air in its upward flow, lateral air-currents invariably resulting in imperfect combustion and in heating or cooling some of the boiler-tubes more than others and in warping and irregular expansion and leakage.

It will be seen that the air-tubes of the burner are directly open to the external air and that there are no parts below the lower flat bottom of the burner. This is important, as any obstruction to the upward flow of air would tend to draw down the flame through the tubes, while the presence of any object below the air-tubes will deflect the air striking such object upward, and thus has resulted in causing smoke and carrying the flame upward into and out of the hood or in extinguishing the limited master-light.

The action of a burner construction, as set forth in connection with a boiler and intermediate chamber, is absolutely uniform. Each unit of the burner at all times acts precisely as every other, so that whether the burner be of greater or less area the heating effect is the same at one point as another. It is not possible, therefore, to overheat any one part of the boiler; but the main advantage of this uniform action lies in the fact that the flame, whatever its condition, is maintained uniform throughout, so that there can be no incomplete combustion at any point and there is no smoking, deposit of soot, or clogging up or impairing the efficiency of the boiler-tubes. When the flame is reduced to reduce the evaporating effect, the reduction is the same over the whole area and a uniform action results and there is no danger of the flame being extinguished. There is no volume of explosive gases to result in injury in any way, as unless there is a proper proportion of air and gas no flame can be maintained. Any accidental improper mixture, should such occur, that can be contained in the casing of the burner would be too small in volume to produce any other effect by its sudden ignition than to extinguish the light.

It is most desirable in a motor-vehicle to maintain the flame and pressure and yet to prevent it exceeding a maximum amount without the necessity of attention upon the part of the operator. Further, it is essential to prevent the overheating of the parts of the burner and boiler. It is not sufficient to depend upon a safety-valve, (with which, of course, the boiler may be provided,) because this simply relieves the boiler in case of excess of pressure; but it is requisite in case the pressure becomes too low that the burner be supplied with additional fuel, whereby to secure increased evaporation and the desired increase of pressure, and that the pressure be prevented from becoming too great. For this and other reasons a regulator *k* of suitable construction is used.

A valve-case 61 of the regulator is supplied with gas through a tube 9, which flows into the case in front of a port to which is fitted a valve controlled by a diaphragm in the casing 65, and upon withdrawing the valve the gas will flow in a forcible jet through a nozzle opposite and extending into the mouth of the pipe *t*, which is larger than the nozzle, so that the passage of the forcible jet of gas carries with it a suitable proportion of air to form a mixture which enters the chamber of the burner and is consumed at the outlets *y*, as before described. It will be seen that by this means the burning mixture is formed and contained in the burner-casing only and not in the gas-conducting tube.

The valve of the regulator is controlled by pressure from the boiler admitted through a pipe 69; but the port is not absolutely closed by the inward movement of the valve, as the parts are so adjusted that at all times sufficient gas may pass to and from the nozzle 62 to insure a mixture that will burn without soot and permit of a low, but regular and smokeless, master-light being maintained. This master-light may be so low as practically to have no effect in heating the boiler; but slight as it is it cannot be accidentally extinguished, inasmuch as the combustion-chamber is closed at the sides and is supplied with air only through the tubes 21, as before described, and there can be no lateral air-currents above the burner, the upward movement of air through these tubes having no effect to extinguish the flames. When the apparatus is to be put out of operation, however, the flow through the nozzle may at once be closed by turning the stem of the valve *u*,

which closes the passage between the casing 61 and the nozzle.

The condition of the flame may be observed at any time through an opening 75 in the side of the casing, which is normally closed by means of a hinged cap 76.

The oil-tube 9 forms part of a tube 7, passing upward through the boiler and across the top thereof and downward and out at one side and communicating with a pipe 3, leading to the bottom of the oil-tank *d*, Fig. 1. As a result of this arrangement after the water in the boiler has once been heated there is stored up a sufficient heat to volatilize the oil passing through the supply-pipe for almost any desired length of time during which the vehicle may be temporarily arrested, and the flame of the burner may be reduced to a minimum without danger of arresting the production and forcible projection of gas, and the master-flame may be maintained and will not be extinguished until the water in the boiler becomes cooled to, say, below 180° Fahrenheit, which will not result within any ordinary period of time during which the vehicle must be temporarily arrested.

If the vehicle is to remain at rest for a long time, it is best to extinguish the flame; but in such case it can be relighted so long as the water remains sufficiently heated to volatilize the oil in the oil-pipe.

As the oil-passage in the pipes extending from the oil-tank to the nozzle is a closed passage throughout, the heating of the oil therein and its expansion as it becomes volatilized insure its forcible projection from the nozzle and the positive upward projection of the mixed gases through the openings of the burner. This not only insures a thorough combustion without smoke, but also prevents the backflow of flame to the nozzle. The forcible jet is also the means of securing a mixture of air and gas for the burner, as is essential, as gas alone will not secure a flame of sufficiently intense heat for practical purposes, while it will result in smoke and the speedy clogging of the boiler-tubes. It will be evident that the vapor in these parts of the oil-channel outside of the boiler or burner is liable to condense, especially when the flame of the burner has been extinguished for some time, and that if in such case the valve controlling the flow to the nozzle is opened oil will be injected into the burner and smoke the boiler. We therefore provide a blow-off cock between the nozzle and that part of the pipe which remains heated—for instance, that in the boiler. This may be a special cock, or we may utilize the valve 89, controlling a port *w* immediately above it intended for connection with a detachable igniter. When after extinguishing the burner and before the boiler cools the flame is to be relighted, the valve 89 is opened and the condensed vapor is allowed to escape, after which the valve 89 is closed and the valve *u* opened to admit the vapor to the nozzle.

A serious objection to motor-vehicles has been the escape of smoke and the odors which result from the products of combustion, as well as the difficulty of disposing of these products of combustion without the necessity of using an upright chimney, which is objectionable for many reasons. To avoid these results, a cap 90, Fig. 1, is arranged above the top of the boiler and extends backward over the water-tank *e* and is provided at the top with an escape-opening 91 about flush with the top of the vehicle-body and with a tube 92, extending downward through the water-tank and into which is turned the end of the exhaust-pipe 132, leading from the top of the muffler *h*. As a result of this construction when the apparatus is in motion the steam from the exhaust is thrown downward through the pipe 92, carrying with it the products of combustion or heated air passing from the top of the boiler into the casing 90 and projecting the same toward the road-bed beneath the carriage, so that no upwardly-projecting pipe is requisite, while the steam and products of combustion are effectively disposed of. Further, by this means when the burner is at its maximum any free or unconsumed gases are brought in connection with the particles of vapor and are absorbed by the latter, preventing the odors which might otherwise be perceptible, so that in running there is practically no odor whatever. This arrangement is specially serviceable in connection with the use of a master-light, as when the engine is at rest and the flame is reduced to a minimum the heated air, which could not escape through the pipe 92 without a forced draft, will pass naturally from the burner and through the flues, (there being no exhaust-steam at such time,) and this heated air will escape through the opening 91, thus insuring sufficient upward draft to supply the burners and maintain the pilot-flame alive.

It will be seen that the constructions above set forth are specially applicable in connection with a portable steam-generator—that is, one in which the boiler and burner are in motion and exposed and subjected to the action of air-currents and which result in conditions that do not prevail when the boiler and burner are stationary and inclosed—and that by said construction difficulties heretofore resulting in preventing the rapid and steady generation of steam, producing smoke, reducing the effectiveness of the boiler, &c., are avoided.

We do not here claim the construction of the engine or boiler and discharge-flues nor of the parts of the vehicle herein shown to illustrate the operation of an invention and claimed in our applications, Serial Nos. 726,613, 698,448, and 733,802.

Without limiting ourselves to the precise construction and arrangement of parts shown and described, we claim—

1. The combination in a portable steam-generator, of a boiler, a burner consisting of a casing having a continuous top plate, burn-

ing-openings therein, a combustion-chamber above the said plate closed at the bottom by the burner and at the top by the bottom of the boiler, and also closed at the sides, air-tubes extending through the top plate and through the bottom of the casing and communicating directly with the external air, a mixing-tube extending through the side of the casing, and means for injecting directly a forcible jet of gas under pressure into said tube, substantially as described.

2. The combination in a portable steam-generator, of a burner having vertical air-tubes communicating at the bottom directly with the external air, and gas-burning openings encircling the upper ends of the tubes, a boiler having vertical tubes arranged above the burner, both arranged to permit an unobstructed flow of the air through the burner into the boiler-tubes, and an intermediate combustion-chamber closed at the sides and at the bottom by the burner, substantially as described.

3. The combination in a portable steam-generator, of a vertical tubular boiler and a burner consisting of a casing having a flat perforated top and air-tubes extending from the top to the bottom of the said casing to communicate directly with the external atmosphere, an intermediate combustion-chamber closed at the sides and arranged below the boiler, and means for supplying the casing with a burning mixture under pressure, whereby all the air and gaseous matters passing to the boiler pass unobstructedly through the burner-casing and meet and flow upward with the flame from the burner, substantially as set forth.

4. The combination with the nozzle 62 communicating with the burner and oil-pipe leading thereto, and a heater independent of the burner for heating part of the oil-pipe above the nozzle, of a blow-off cock arranged to discharge oil from the pipe below the said heater, substantially as set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

FRANCIS E. STANLEY.
FREELAN O. STANLEY.

Witnesses:
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