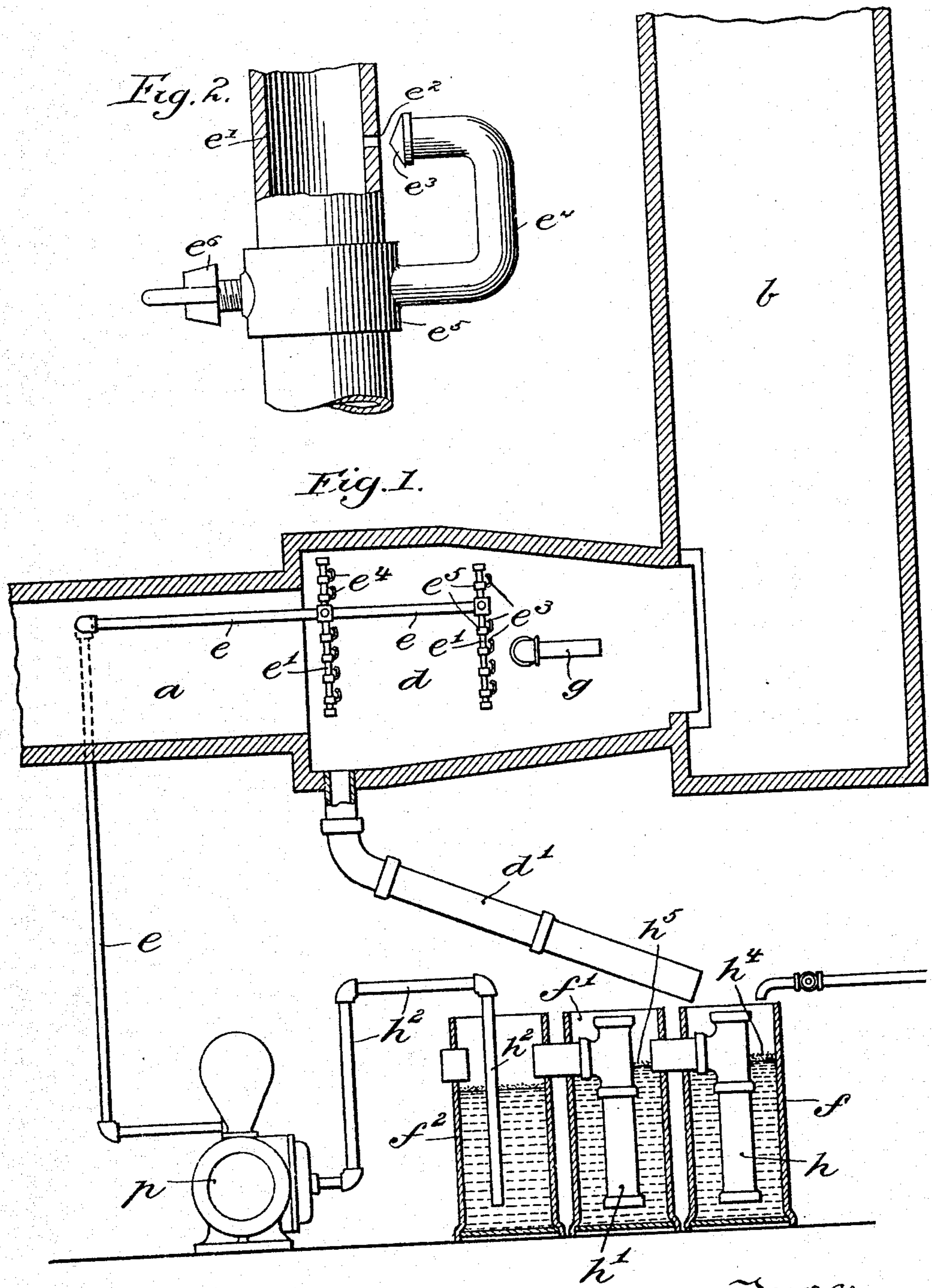


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24,469.

PATENTED JUNE 26, 1906.

W. CLINE.
APPARATUS FOR PURIFYING SMOKE.
APPLICATION FILED FEB. 1, 1905.



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WILLIAM CLINE, OF LANCASTER, PENNSYLVANIA, ASSIGNOR OF ONE-THIRD TO JOHN F. BRIMMER AND ONE-THIRD TO WILLIAM FUHRMAN OF LANCASTER, PENNSYLVANIA.

APPARATUS FOR PURIFYING SMOKE.

No. 824,469.

Specification of Letters Patent.

Patented June 26, 1906

Application filed February 1, 1905. Serial No. 243,659.

To all whom it may concern:

Be it known that I, WILLIAM CLINE, a citizen of the United States, residing at Lancaster, in the county of Lancaster and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Purifying Smoke, of which the following is a specification.

My invention has relation to an apparatus whereby the heavy and thick products of combustion may be removed from smoke prior to its entrance to and exit from the stack proper, and in such connection the invention contemplates an arrangement and combination of parts whereby the washing of the smoke and the precipitation of the heavier and thicker products of combustion are efficiently performed without interfering with the draft.

Heretofore manufacturers and others who desired to use soft coal or similar fuel have been restricted in or deterred from its use by reason of the heavy clouds of smoke issuing from the stack after each firing of the furnace or furnaces, said heavy clouds of smoke being considered by the authorities in many municipalities a public nuisance. Some attempts to palliate or remove this defect of soft coal as a fuel have been devised, such attempts being directed along two main lines—to wit, first, the more complete consumption of the fuel in the furnace, flue, or stack, or, second, the screening and washing of the smoke in either the smoke-stack or an auxiliary flue or condensing-chamber leading from the flue of the furnace to the stack. In the first of these attempts the reorganization of the furnace or the change in plan of the stack and flues was necessary, and such reorganization or change has been so expensive as to practically prevent the use of such means for the purposes required. In the second of these attempts the introduction of screen-plates or baffle-plates in the stack or flue-chamber, as well as the introduction of liquids in said stack and chamber, have together served to increase rather than decrease the nuisance, inasmuch as a serious diminution of the draft results from the introduction of such impediments as plates or screens or spraying-nozzles in the flue or stack.

The object of my present invention is to provide a simple and practical device or ap-

paratus whereby the heavy or thick particles of the smoke are removed prior to the exit of the smoke from the stack and without impairing the draft, but, on the contrary, remarkably increasing said draft to thereby secure a more complete consumption of the fuel prior to the exit of the products of combustion from the stack.

The nature and scope of my invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof in which—

Figure 1 is a view illustrating diagrammatically an apparatus for carrying out my invention, the stack being illustrated in vertical section, whereas the flue and flue-chamber are illustrated in transverse section. Figure 2 is an enlarged plan view, partly section, illustrating in detail one of the spraying devices.

Referring to the drawings, *a* represents the flue from a furnace or heater, and *b* represents the stack or chimney. The vertically-arranged flue *a* is connected with the stack *b* by a flue box or chamber *d*. The cross-sectional area of the inlet into chamber *d* from the flue *a* is coequal with the cross-sectional area of said flue *a*, and the cross-sectional area of the outlet from chamber *d* into the stack *b* is also equal to the cross-sectional area of said flue *a*. Depending into the chamber *d* is a plurality of one or more branch pipes *e*, which when formed substantially as hereinafter described constitute a device for pulverizing or atomizing a liquid, water by preference, which is applied to said branch pipes *e* through pipe *e'*. From the bottom of the chamber *d* extends a drain-pipe *d'*, conducting the liquid collecting in the chamber *d* to a tank *f*, arranged to receive the liquid with the heavier and thicker particles of the smoke passing through the flue-chamber *d*.

Each branch pipe *e* is constructed and arranged substantially as shown in Fig. 2. The pipe *e* has at a certain distance apart a series of perforations *e''*, the walls of which are preferably straight. The liquid in the pipe *e* is projected through these perforations straight out from the pipe *e* in a direction in which the products of combustion are traveling through the flue-chamber *d*. Op-

ite each perforation e^2 is arranged a stud of preferably conical shape, the apex of the cone approaching the perforation e^2 , as clearly illustrated in Fig. 2. The jet of liquid issuing from each perforation e^2 is pounded or pulverized into a fine mist or spray, the series of jets thus forming a more or less thick veil of vapor traveling toward the back end of the flue-chamber d . This veil of vapor effectually separates the thicker and heavier particles of the products of combustion passing through the chamber from the fire-gases and deposits said particles in the base of the chamber d . The minute particles of liquid issuing from the sprayer-pipe will in passing into the smoke become highly heated and will expand toward the back end of the chamber d , thus accelerating the passage of the products of combustion toward the stack, as well as cleansing the smoke from the heavy and thick impurities. As illustrated in Fig. 1, two sprayer-pipes e' are provided—one some distance beyond the inlet end of the chamber d and the other at said outlet end, but beyond the outlet from flue a . If desired, however, but one pipe e' may be used, or more than two may be required, according to circumstances. At the base of the chamber d is a pipe g , conveying exhaust-steam from the engine or other source to the stack d . While not necessary, the injection of this exhaust-steam will be desirable to prevent contraction or contraction of the smoke which might per- take place if the liquid introduced through sprayers e' were cold. In Fig. 2 the ends e^3 of the sprayer-pipes e' are each re- sibly carried at one end of a hook-shaped bracket e^4 . The other end of this bracket e^4 is similar, as at e^5 , to surround the pipe e' and be adjustable longitudinally along the pipe e' . A set-screw e^6 serves to lock the bracket e^4 to the pipe e' . As explained, the operation of the device is as follows: A liquid, preferably wa- ter, is forced through pipe e to one or more sprayer-pipes e' and issues from said pipes in vaporized or atomized form. The di- rection of the travel of this vapor is both up- ward and transversely across the chamber d as well as longitudinally toward its stack end. The veil or veils of vapor in chamber d dis- turb the heavy and thick particles of smoke, and the liquid collecting in the base of the chamber d and carrying these particles is drained off by pipe d' into the tank f . The pipe e may be supplied with liquid un- der pressure from any suitable source. How- ever, in large plants where great quantities of liquid are to be supplied to the sprayers it may be found necessary in order to operate the device with economy to reutilize the spent liquid drained off from the chamber d . This reutilization of the water or liquid

forms a feature of my present invention. As clearly illustrated in Fig. 1, the vat or tank f is but one of a series of communicating vats f, f', f^2 . The vat f has a stand-pipe h , forming an outlet for water or liquid at the bottom of tank or vat f into the next tank or vat f' . This tank f' has a similar stand-pipe h' , form- ing an outlet for the liquid from the base of tank f' to the tank f^2 , and a pipe h^2 , travers- ing the tank f^2 and terminating near its bot- tom, is the supply-pipe to a pump p , which forces the liquid to the pipe e , which supplies the sprayers. The waste liquid flowing to the first tank f will rise in said tank with a thick scum h^4 of the smoke impurities col- lecting on its surface and with the bottom of the tank filled by relatively pure liquid. This relatively pure liquid ascends the stand- pipe h and overflows into the tank f' , in which it ascends with a scum h^5 of impurities on its upper surface, and the still less impure water overflows through into the next tank f^2 . The purer portion of liquid in the base of tank f^2 is then pumped to the sprayers for re- utilization in the chamber d . Besides being more economical with regard to waste of liq- uid, this reutilization of the liquid insures the delivery to the sprayers e' of a heated body of liquid, and the heated liquid when sprayed will vaporize more quickly and combine more completely with the gases of combustion than if the sprayed liquid were cold. A pipe m supplies fresh liquid to any one of the three tanks f, f' , or f^2 in series to compen- sate for the waste due to the evaporation of the liquid either in chamber d or in the tanks.

Having thus described the nature and ob- jects of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an apparatus of the character de- scribed, a flue leading from a furnace, a chim- ney or stack and a flue-chamber connecting the flue directly with the stack, said flue- chamber having inlet and outlet openings, respectively from the flue and to the stack, of an area in cross-section coequal with the cross-sectional area of said flue, in combina- tion with a sprayer located within the flue- chamber beyond the inlet from the flue and arranged to vaporize a liquid in a direction corresponding with the plane in which the smoke enters from the flue and traverses said flue-chamber.

2. In an apparatus of the character de- scribed, a flue leading from a furnace, a chim- ney or stack, and a flue-chamber connecting the flue directly with the stack, in combina- tion with a sprayer located in the flue-cham- ber beyond the inlet from the flue and ar- ranged to vaporize a liquid in a direction cor- responding with the plane in which the smoke enters from the flue and traverses the flue-chamber and a means for exhausting steam within the flue-chamber, intermediate of the inlet and outlet ends of said chamber.

3. In an apparatus of the character described, a flue leading from the furnace, a chimney or stack, a horizontally-arranged chamber connecting the flue directly with
5 said stack, a liquid-supply pipe entering the flue-chamber, a sprayer-pipe carried by the liquid-supply pipe and arranged to spray the liquid in front of the inlet from the flue into
10 said flue-chamber and in a direction corresponding with the plane in which the smoke enters and traverses said flue-chamber, in combination with a means for draining the
flue-chamber of spent liquid collecting therein, a series of settling-tanks for separating
15 the drained liquid from its impurities and a means for forcing the purified spent liquid to the vaporizing means in said flue-chamber.

4. In an apparatus of the character described, a flue-chamber, a sprayer arranged
20 to spray the products of combustion travers-

ing said flue-chamber and to collect purities therein, a drain-pipe for carrying the impure spent liquid from said chamber, a series of settling-tanks into one of which the drain-pipe discharges, an overflow-pipe from each tank arranged to discharge the liquid from the base of one tank in series to the base of the next tank in series, a pipe arranged to draw off the liquid from the last tank in series and a pump arranged to force the liquid from said pipe to the sprayer in the flue-chamber.

In testimony whereof I have hereunto set my hand, this 28th day of January, 1919, in the presence of two subscribing witnesses.

WILLIAM CLINE

Witnesses:

GEO. A. LANE,
C. G. BASSLER.