J. L. WARDEN.

Air and Gas Injector.

No. 220,006. Patented Sept. 23, 1879.

Fig. 1.

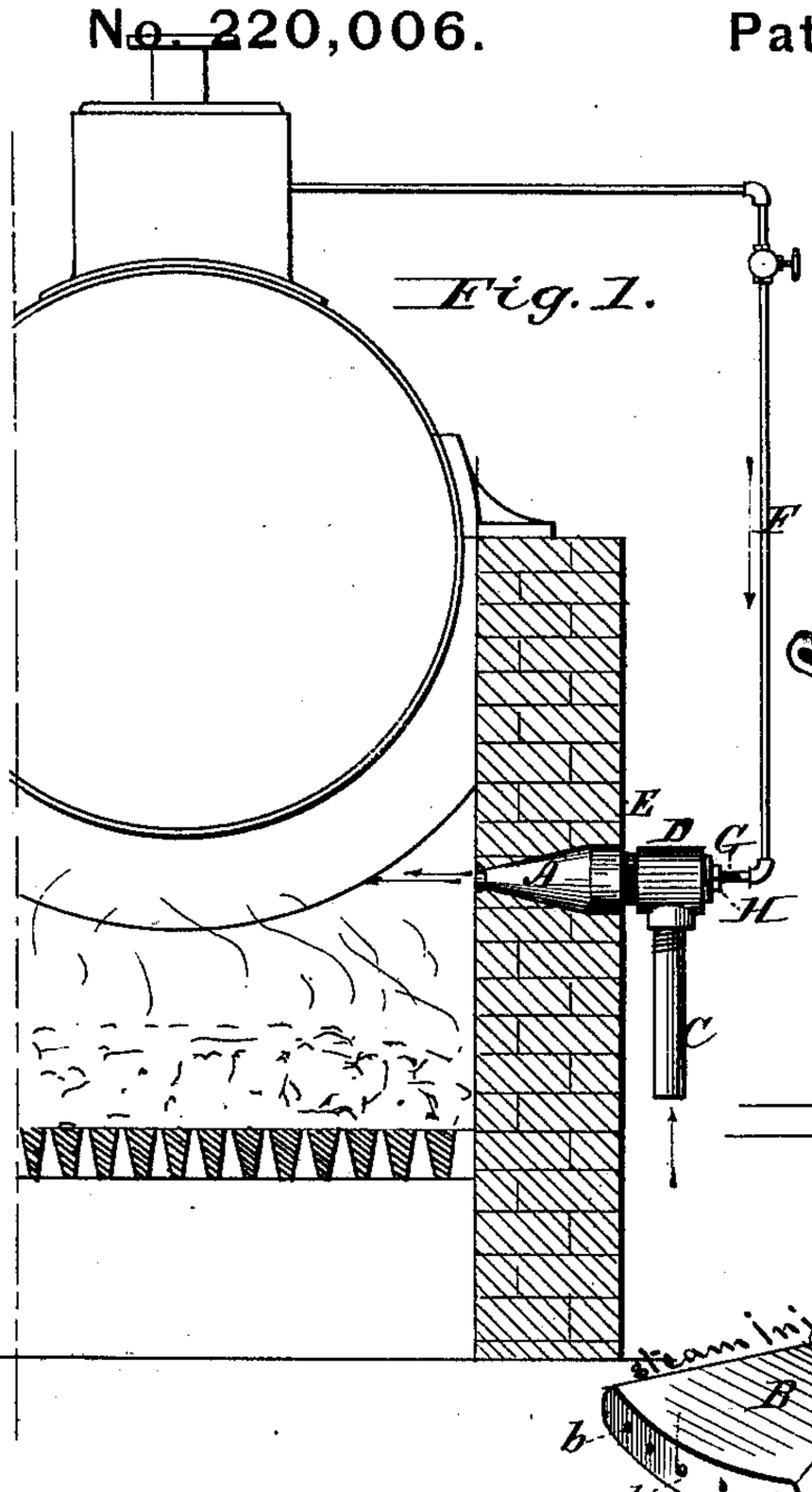


Fig. 2.

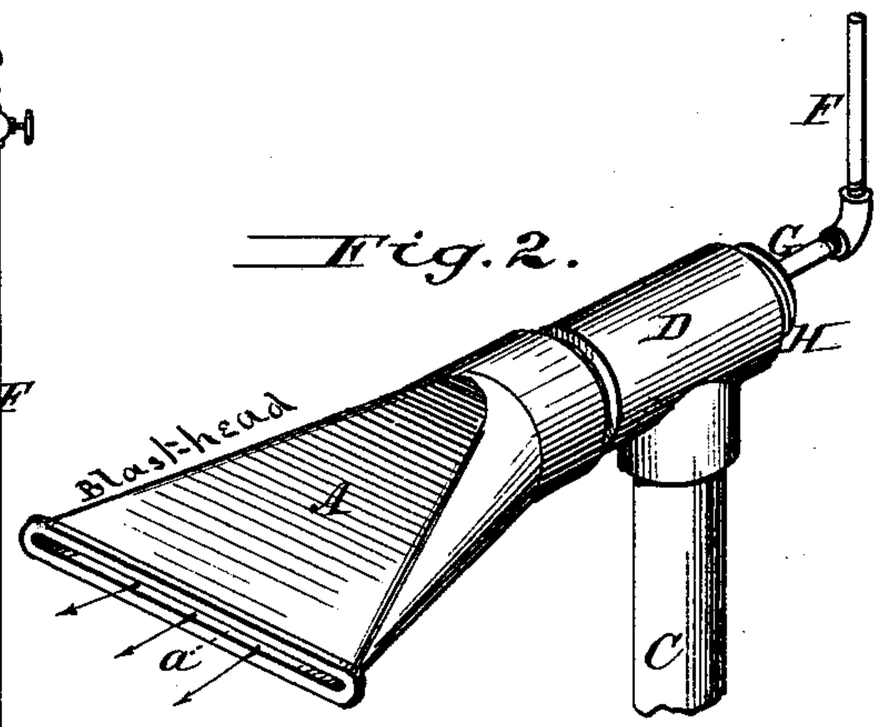


Fig. 3.

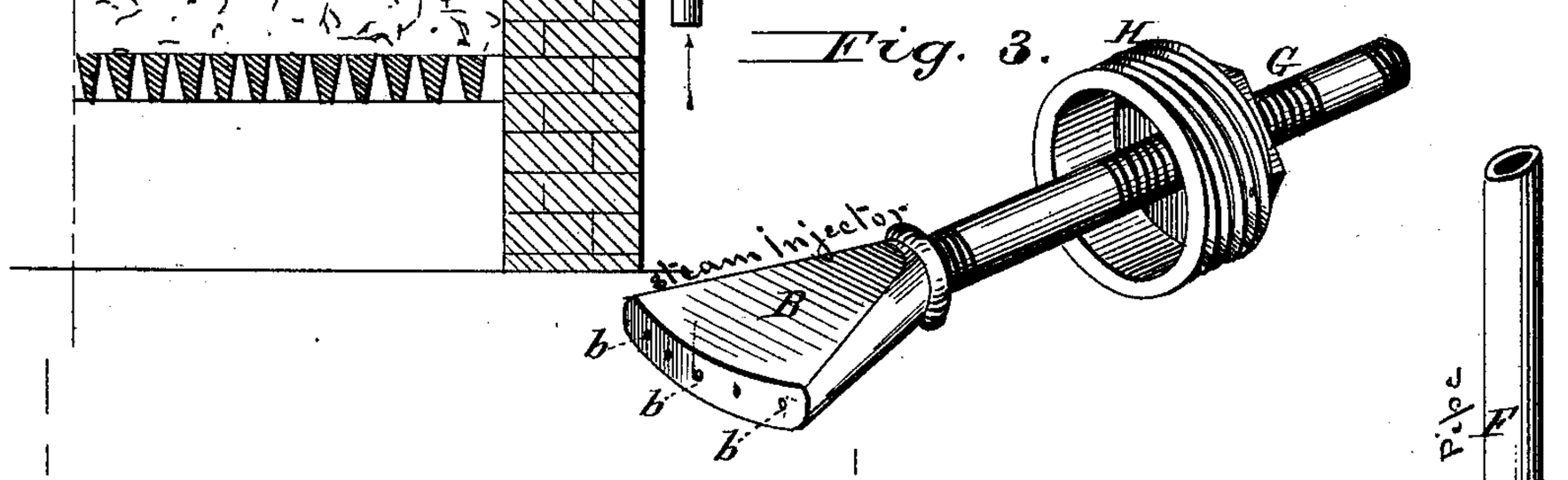
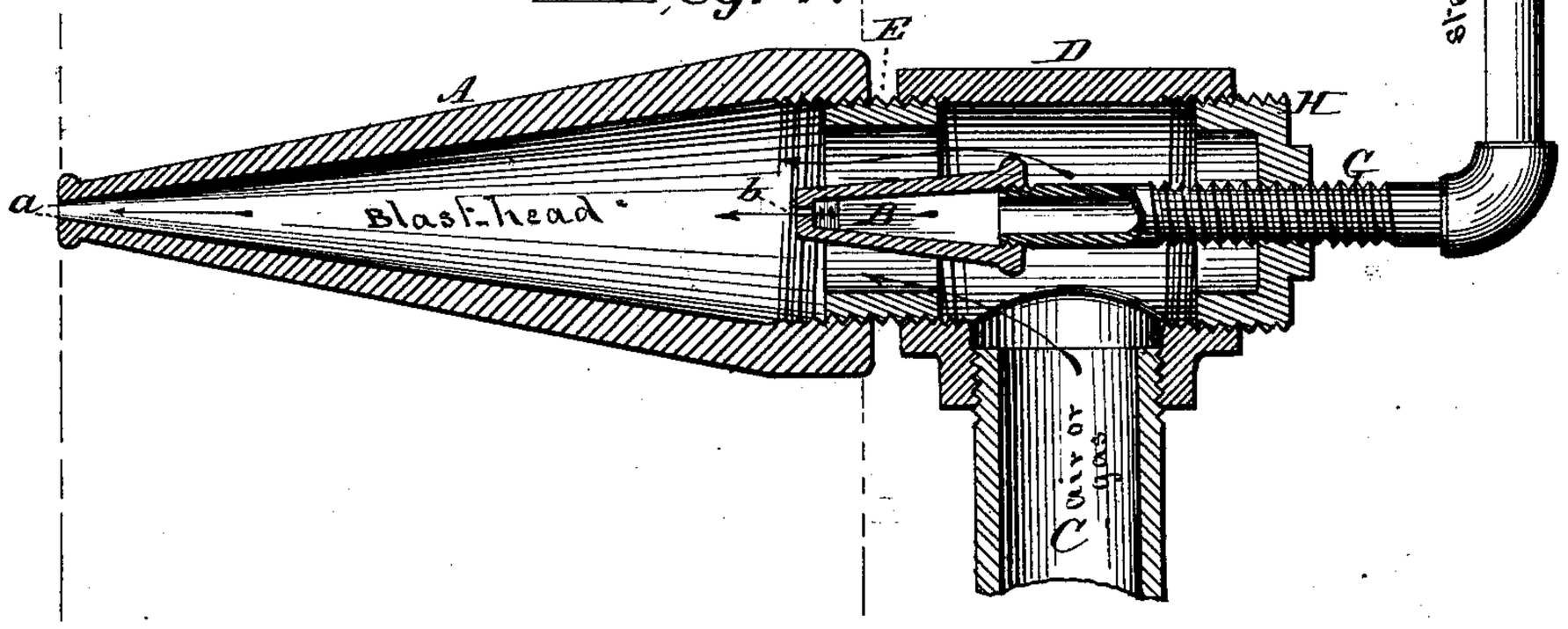


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOSEPH L. WARDEN, OF HARRISON TOWNSHIP, ALLEGHENY COUNTY, PA.

IMPROVEMENT IN AIR AND GAS INJECTORS.

Specification forming part of Letters Patent No. **220,006,** dated September 23, 1879; application filed March 20, 1878.

To all whom it may concern:

Be it known that I, JOSEPH L. WARDEN, a resident of Harrison township, county of Allegheny, and State of Pennsylvania, have invented a certain new and useful Improvement in Air and Gas Injectors, whereof the following is a full, true, and exact description, reference being had to the accompanying drawings.

My improvements consist in combining with a flat spreading blast-head set in the furnace-wall a steam-injector head of corresponding form, arranged within and having such relation to the blast-head that the plane of both heads will stand horizontal, so as to spread the steam into a horizontal fan-like sheet into the flat spreading-chamber of the blast-head. These two heads are separate and distinct attachments, and their connection is effected by means of the air or gas pipe, so as to allow the steam-injector head to be taken out for cleaning, and to give access to the interior of the blast-head for the same purpose without entering the interior of the furnace or drawing the fires. These two flat flaring heads, one projecting within the other, co-operate to give the best results in injecting the greatest volume of air or gas, or air and gas combined, with the smallest volume of steam; and for this purpose the area of the outlet in the steam-injector head is so proportioned to the long narrow blast-exit, that the velocity of the steam shall be exhausted at or but slightly beyond the blast-exit, and thereby not only avoid back pressure in the blast-head, but obtain the most thorough commingling of the steam with the air or gas at their point of admission into the combustion-chamber, and which is due to the decreased velocity of the steam from the comparatively small openings in the steam-injector head.

This construction and combination also effect the exposure of a greater surface of steam to the air or gas within the blast-head, thus obtaining a more effective suction in the air or gas pipe, and, consequently, a larger volume of blast with a comparatively small volume of steam.

The steam-injector head is adapted for adjustment in relation to the blast-head to give the proper distance between the exit-openings of each for the purpose stated and to allow of the ready separation of these two heads when required.

My object is to inject air and gas into the furnace, intimately mixed with a much less volume of steam, to obtain the full benefit of the combustion of the air or gas, and the desired economy of fuel. To this end I use steam in a small volume, with air and gas in a large volume, in thin sheets, spread over the combustion-chamber.

Referring to the drawings, Figure 1 represents a cross-section of so much of a furnace as illustrates the application thereto of my air and gas injector. Fig. 2 shows the blast-head; Fig. 3, the steam-injector head and its supporting screw-plug; and Fig. 4, a vertical section of the blast and steam heads, as connected and arranged in relation to each other, and showing the manner of removably supporting the steam-injector head.

My injector is used with furnaces to supply atmospheric air, either alone or in combination with other fluids, as natural or artificial gases, or the gases from hydrocarbons, to increase the combustion and save fuel. It is constructed of two separate and distinct head-attachments, one, A, forming the blast-head, to be placed in the wall of the furnace in suitable relation to the bottom of the boiler, and the other, B, forming the steam-injector head, arranged to project within said blast-head.

The blast-head has a flattened flaring form with a narrow exit-opening, *a*, the full width of the flattened end, to project the blast in a large volume and in an unbroken thin horizontal sheet into the combustion-chamber, and the steam-injector head has also a flattened flaring form, with a series of small openings, *b*, in its end, to project the steam in a comparatively small volume into the blast-head in a horizontal row of jets, or a thin, broad sheet, spreading it within the blast-head chamber and in a horizontal line with its narrow exit-opening.

The blast-head connects with an induction-pipe, C, through which the air or gas, or both, are drawn by the vacuum created by the steam-injector. This connection is made by a T-coupling, D, and a screw coupling or ring, E, the latter screwing into said T-coupling and into the screw end of the blast-head.

The steam-injector head connects with a pipe, F, leading to the boiler by means of an intermediate screw-pipe, G, which is supported in central position within the T-coupling by a screw-plug, H, which closes the outer end of said coupling D, as shown in Fig. 4. This screw-pipe G supports the steam-injector head in a central position within the blast-head, and the extent of the injector-head within the latter is governed by the width of the blast-head exit and the length of said head.

The width of the flat end of the steam-injector, however, must be such as to allow it to be passed into and through the screw-ring coupling E, according as it may be desired to adjust it in or out of the blast-head, such capacity for adjustment being obtained by the screw-pipe G and its supporting screw-plug.

To accomplish the best results from my invention the area of the blast-head outlet should be as nearly as possible the same as the area of the combined inlet of the air and gas induction-pipe and of the steam-injector head. In this construction I prefer that the area of the steam-injector outlets shall equal, as nearly as possible, one-fifteenth (more or less) of the area of the blast-outlet and the air-inlet, these two areas being as nearly as possible the same.

I prefer to divide the steam-inlet into jets, (three or more,) arranged so that the steam on its entrance into the blast-head will be spread into a flat sheet like a fan, and directed in a horizontal plane through the blast-head in line with its horizontal narrow exit, and by this construction effect a more thorough commingling of the blast with the steam within the blast-head, or at their entrance within the combustion-chamber, and give a greater exposure of steam-surface under high velocity to the inflowing air or gas, thus increasing its volume by increasing the suction power of the induction-tube with a comparatively small volume of steam, thus using the minimum of live steam to combine with and force into the furnace the maximum of oxygen or other gas spread over the greatest possible surface and in the most economical proportions.

The steam-injector head I spread to the greatest possible extent compatible with the size of the outer fittings, and instead of the perforations shown it may have a slit across the entire flattened end.

I may use a thimble or short pipe to connect the screw-ring with the T-coupling.

Should rust, scale, or other matter clog the steam-openings in the injector-head, it can be withdrawn by unscrewing its supporting-plug H, and cleaned, and at the same time give access to the interior of the blast-head.

The induction-pipe may extend over or within the tail-pipe from an oil-still, benzole-tanks, the sitting pans, or crude-oil tanks, or any receptacle of hydrocarbon products, and the vacuum formed in said pipe will carry the gas therefrom to the furnace for combustion.

The screw-pipe G is long enough to give the required adjustment of the steam-injector head within the blast-head, and the flatwise position of said steam-injector head is fixed before the screw-plug is screwed into the outer end of the T-coupling.

The steam and air and gas induction pipes may be provided with cocks or valves for regulating the flow of both the steam and air, or cutting them off, as may be found necessary.

The state of the art shows that the fish-tail or flat spreading form of a blast-nozzle for injecting air and gas into furnaces has been used to increase the combustion and save fuel; and various constructions of steam-injectors and blast-heads have been combined for this purpose, in which a steam-pipe injector has been arranged within an air or gas injector or blast-head; but so far as I know, the specific improvements embraced in my claims are new, and produce results and advantages not enhanced in the former plans.

I claim—

1. In an air and gas injector, the combination, with the steam-pipe C and the flat spreading blast-head A, of the steam-injector head B, having flat spreading sides terminating in a long narrow exit end within said flat spreading blast-head, whereby to inject the steam therein in a wide thin sheet, substantially as shown and specified.

2. The combination, in an air and gas injector, of a steam-injector head, B, having flat sides terminating in a long narrow exit end, with an air or gas blast-head, A, having flat spreading sides terminating in a long narrow exit, the plane of both heads standing horizontal, and the areas of their exits adapted to inject air or gas into the furnace in a thin unbroken sheet in greater volume than the steam, substantially as shown and specified.

In testimony that I claim the foregoing as my invention I have hereunto set my hand in the presence of two subscribing witnesses.

JOSEPH L. WARDEN.

Witnesses:

WM. LITTLE,

W. I. TROTH.