(No Model.)

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EXHAUST APPARATUS FOR LOCOMOTIVES.

No. 406,484. Patented July 9, 1889.

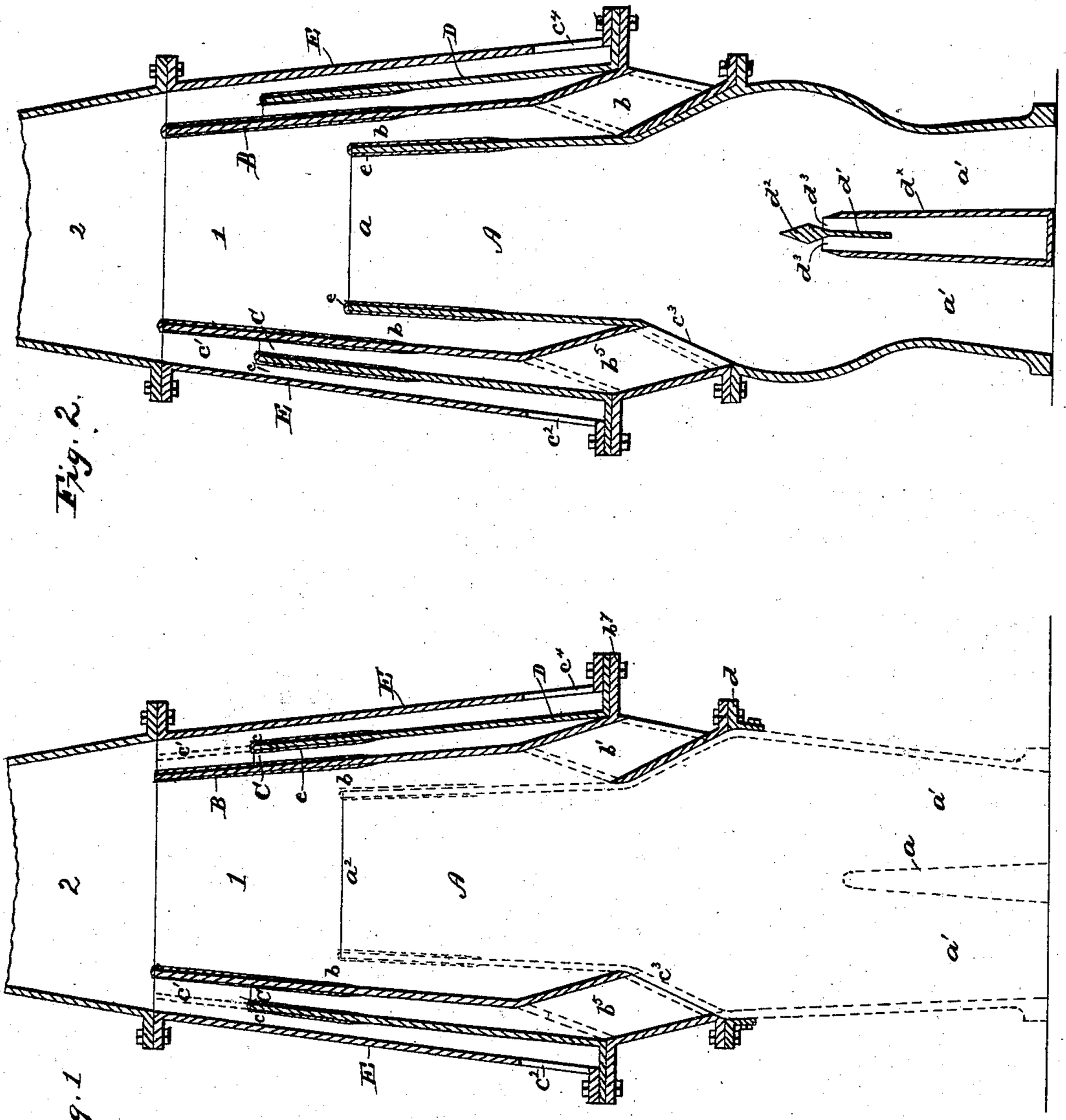

Fig. 2.

Fig. 1

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EXHAUST APPARATUS FOR LOCOMOTIVES.

SPECIFICATION forming part of Letters Patent No. 406,484, dated July 9, 1889.

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To all whom it may concern:

Be it known that I, JOHN Y. SMITH, of Doylestown, in the county of Bucks and State of Pennsylvania, have invented certain new and useful Improvements in Exhaust Apparatus for Locomotives; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the figures and letters of reference marked thereon.

The blast or exhaust apparatus heretofore most generally used in locomotive-boilers consists of one or more jet tubes or nozzles communicating with and receiving exhaust-steam from the two cylinders alternately, said nozzle being located within the smoke-chamber and beneath the smoke-stack, so that the steam issuing in successive jets from the nozzle will be projected into and through the smoke-stack to draw or force the gaseous products of combustion through the latter. Experience has demonstrated that with an apparatus of this kind but a relatively small portion of the available power of the exhaust-steam is utilized, wide fluctuations in the draft are produced, and, when both cylinders exhaust into a common blast-pipe, back-pressure is developed. An attempt has been made, but with limited success, to overcome these and other defects in the single-nozzle ejector by adding thereto an annular steam-nozzle surrounding the central blast-pipe and communicating with the same steam-supply chamber or passage, the two blast-pipes acting in concert. As in the case of the single jet-pipe, this duplex blast apparatus is located in the smoke-box beneath the smoke-stack, and its mode of operation, in so far as the action of the steam upon the gaseous products of combustion is concerned, is substantially the same as the single blast-pipe—that is to say, the successive blasts of steam are projected directly into the column or body of highly-rarefied gaseous products and are driven through the smoke-stack, thereby forcing out a certain volume of gaseous products. This double blast-pipe apparatus has been found to possess, in greater or less degrees, most, if not all, of the defects of the single blast-pipe—that is to say, a relatively small proportion of the available power of the exhaust-steam is utilized, back-pressure is produced, and wide fluctuations in the draft are observable, each succeeding blast of steam producing a momentarily-violent draft or influx of air through the furnace, followed by a period of comparative rest. Having studied and practically tested the operation of both of the varieties of blast apparatus referred to, I believe I have discovered not only the true cause of their defective action, but a means whereby it can be overcome or lessened in a material degree.

Heretofore the jet orifice or orifices have been located beneath the smoke-stack, so that the steam issuing therefrom is projected directly into the column or body of highly-rarefied gaseous matter, and as the steam expands and is propelled through the smoke-stack it operates mainly to force or push the gases before it into and through the smoke-stack. The volume of gaseous matter thus expelled by each blast of steam is relatively small, and though the movement, and consequent draft, is rapid it is of correspondingly short duration. This is due in part, at least, to the manner of applying the blast, for the gases, being at a much higher temperature and more rarefied than the steam, are displaced are driven laterally, as well as vertically, by the expansion of the steam as it issues from the jet orifice or nozzle, so that but a very small proportion is carried by the friction or contact of the steam into and through the smoke-stack, the larger proportion of the expelled gases being driven out of the smoke-stack by the steam expanding therein and forming a fluid-piston, which in traversing the smoke-stack forces out the gases contained therein, while the gases in the smoke-box follow behind the piston. The immediate effect of this action is the formation of interfering counter currents or eddies in the smoke-box, a momentary checking of the draft as the steam is driven into the gases and before it has expanded so as to fill the interior of the smoke-stack, and a further

checking of the draft as the steam-piston emerges from the smoke-stack, frequently followed by a return or downward movement of the gases in the upper portion of the smoke-stack, which not only aids in checking the draft, but imposes a greater burden upon the next succeeding blast. To overcome, or in a great measure obviate, this defective action and to increase the power and regularity of the draft in the furnace and through the flues, two things are necessary: first, that the area of the blast apparatus be increased, so as to effect a free passage for the exhaust-steam to prevent back-pressure, and, second, that the steam emerging from the nozzles shall be caused to act upon and mingle with the gaseous matter within a confining flue or flues to prevent lateral displacement and distribute the steam throughout the length of the moving column of gases, the latter being drawn and carried instead of pushed into and through the smoke-stack. In my patent, No. 378,340, and application, Serial No. 260,404, I have disclosed a system, together with the necessary apparatus for carrying the same into effect, whereby the improved results can be secured; but said system, if adopted, involves an entire reconstruction of the apparatus now generally employed or the substitution of a different blast apparatus, whereas in my said prior patent and application the new principle has been shown in its application to a blast apparatus, of which one element—the inner ejector—comprises an annular steam-nozzle and central air or induction opening. In the present instance the application is made to a central steam-nozzle of the ordinary or usual type, the principal object being to so modify and change the structure of the blast apparatus that by the addition of certain elements in the described relation to each other and the central blast-pipe most, if not all, of the improved results may be attained, while preserving and utilizing the old form of blast-pipe.

To this end my said invention consists in the combination and arrangement of certain parts and elements, as hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a vertical longitudinal section through an ejector or blast apparatus illustrating one application of my invention. Fig. 2 is a similar view illustrating a modification.

Similar letters of reference in the several figures indicate the same parts.

The letter A designates the jet or blast pipe as ordinarily constructed, sometimes provided with a bridge or division-piece a in the base to form two passages a', each communicating with the exhaust-ports of one of the cylinders and both uniting in a common orifice or nozzle a^2 through which the exhaust-steam escapes into the smoke-stack.

Surrounding the upper portion of the blast-pipe A, and held at a distance therefrom to form an air-passage b, is a tube or flue B, whose upper end stands above the steam-nozzle a^2, forming the confining-chamber 1. The air-passage b communicates through suitable inlet passages or ports b' with the exterior of the blast apparatus below the nozzle a^2. Steam delivered from nozzle a^2 is received within the confining-chamber 1 and mingled with the highly-heated products of combustion drawn through passage or passages b. The walls of the confining-chamber being in close proximity to the nozzle limit the lateral expansion of the steam and direct the latter, mingled with the air or gases drawn through passage b, into the smoke-stack or a confining chamber or flue 2. The air-passage b, nozzle a^2, and confining-chamber 1 constitute the inner ejector. Surrounding this inner ejector, or the mouth thereof, is the outer ejector comprising a steam-nozzle C, and an air passage or nozzle c adjacent thereto, with or without a confining-chamber c' below the end or mouth of tube B, (this confining-chamber can, if desired, be dispensed with and the nozzles C and c located at the end of tube B, as shown by dotted lines in Fig. 1,) said confining-chamber opening into the auxiliary confining chamber or flue 2, with which the inner ejector communicates. The air-passage c communicates through ports c^2 and c^4 with the exterior of the blast apparatus, and the steam-nozzle C with the interior of pipe A through ports or passages c^3.

As thus constructed and arranged, the apparatus comprises, in addition to the ordinary blast-pipe A, first, a confining-flue and air-inlet co-operating with the nozzle of pipe A, to confine the steam and cause it to mingle with and carry forward the air or gases, and, second, a supplemental blast apparatus taking steam from the same source as the inner nozzle, and thus enlarging the escape for the exhaust-steam, with a separate air or gas supply passage co-operating with the steam-nozzle of the outer exhaust apparatus and a confining wall or flue to prevent lateral pressure or movement of the steam as it escapes, and compelling the fluid products to move forward and combine with the products of the inner ejector, so that both ejectors are caused to operate in unison, the escaping steam acting continuously upon the air or gaseous products to draw and carry them into and through the blast apparatus instead of merely projecting the steam into or against a larger body of highly-heated gases, as when a single nozzle a^2 is employed.

Turning now to the special embodiment of the invention shown, illustrating a simple, convenient, and effective attachment for the ordinary blast-pipe, it will be observed that the combined internal and external ejectors are formed by the addition of three tubes or flues B, D, and E, connected together and detachably secured in position upon blast-pipe

A or to a ring d, fastened on the exterior of said blast-pipe. The flue B is formed or provided, at or near its base, with two series of passages, the one b^5 registering with steam-ports c^3 and connecting nozzle C with the steam-space in pipe A, and the other b' connecting air space or passage b, between flue B and the nozzle of pipe A, with the exterior of the apparatus. The flue or section B is provided with a shoulder or flange b^7, to support the base of a flue D, which latter forms, in conjunction with the exterior of flue B, the nozzle C, and, in connection with flue or casing E, the induction passage or nozzle c. The casing E is bolted or otherwise secured to the flange b^7, and is provided with inlet ports or openings c^2 and c^4. The flue or dividing wall D, lying between the casing E and flue B, preferably terminates below the mouth of said flue, leaving a chamber or passage c', which serves as a confining-flue and mingling-chamber for the outer ejector; or it may, if desired, terminate in line with the mouth of said flue B, as shown in dotted lines, Fig. 1, when the auxiliary confining-flue 2 is employed, the latter being bolted or otherwise detachably secured and forming a prolongation of casing E. This auxiliary confining-flue can, if desired, be removed and the apparatus used without it, as each ejector will have its independent confining-chamber; but for various reasons I prefer to employ the chamber 2 and cause both ejectors to discharge into it, as thereby the strength or sharpness of the blast is increased or can be varied by the substitution of different sizes of flues 2. Valves or dampers may also be applied for controlling the inlet-openings b' and c^4 and the steam-ports c^3, or the passages connecting therewith.

To still further increase the capacity and thereby improve the apparatus, the bridge or division-piece a is removed or dispensed with and a hollow bridge $d^\times$ open at the ends is inserted in its place in the lower end of the blast-pipe A. In the upper open end of this hollow bridge-piece is inserted a plate or partition d', the upper edge whereof is provided with an angular bar d^2, or one having inclined faces. A space or orifice d^3 is thus formed on both sides of said bar d^2, through which air or gas is drawn by the steam flowing through passages a' and entering the large chamber above the bridge $d^\times$, whereby an additional supply of air is drawn in and carried forward by the steam before arriving at the nozzles.

Having thus described my invention, what I claim as new is—

1. In an exhaust apparatus such as described, the combination of the central blast-pipe A, an air-passage adjacent to said nozzle, and a confining flue or chamber in advance of and surrounding said nozzle and air-passage and into which they both discharge, as set forth.

2. In combination with the central steam-pipe, an inclosing wall or tube supported in proximity to but removed from the exterior of said steam-pipe and extending beyond the nozzle, with inlet ports or passages opening from the exterior of the apparatus to the space between the exterior wall and the steam-pipe, substantially as described.

3. In combination with the outer ejector, consisting of the annular steam and air pipes, the inner ejector comprising the annular air-pipe, central steam-nozzle, and confining-chamber, substantially as described.

4. In combination with the blast-pipe A, provided with nozzle a^2, and steam-ports, as described, a detachable connection consisting, essentially, of an outer ejector; the steam-passage leading to its nozzle registering with the steam-ports in blast-pipe A, and a central flue to receive the nozzle a^2 and form an air-passage and confining-flue, as and for the purpose set forth.

5. As an attachment for the ordinary blast-pipe A when provided with steam-ports in the sides, an annular ejector provided with steam and air passages and a confining-flue, combined with a central flue to receive the nozzle of the blast-pipe and form, in conjunction therewith, a central ejector with air-passage and confining-flue, substantially as described.

6. In combination with blast-pipe A, a tube or flue B, supported on said blast-pipe and provided with two series or sets of passages, the one extending from ports in pipe A to the exterior of tube B, and the other from the exterior of the apparatus to the interior of tube B, said tube B extending beyond the nozzle of pipe A to form a confining-chamber, as set forth.

7. In combination with blast-pipe A, perforated at a point below the nozzle, flue or pipe B, provided with passages leading from said perforations to the exterior of said flue, an inclosing-casing E, and a wall or flue D, interposed between said casing and flue B, with inlet-passages leading to the spaces between A and B and D and E, substantially as described.

8. In combination with the outer ejector, having steam-nozzle and air-passage, the inner ejector provided with air-passage, a central steam-nozzle, and a confining-flue, and an auxiliary confining-flue into which both ejectors discharge, substantially as described.

9. In combination with a blast-pipe A, the hollow bridge open at the ends and top, and the division plate and bar having inclined faces, substantially as described.

10. In combination with the blast-pipe A and the flue B, forming, in conjunction therewith, an air-passage surrounding the nozzle, and a confining-chamber, the hollow bridge inserted in the base of the blast-pipe and

provided with air-inlet openings, substantially as described.

11. In combination with the blast-pipe A and the outer ejector applied thereto and receiving steam from said blast-pipe whose nozzle forms part of an inner ejector, the hollow bridge located within the blast-pipe A and provided with inlet-openings situated below the steam-ports leading to the outer ejector, substantially as described.

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