(No Model.) 3 Sheets—Sheet 1.

J. Y. SMITH.

TRIPLE EXHAUST NOZZLE.

No. 487,299. Patented Dec. 6, 1892.

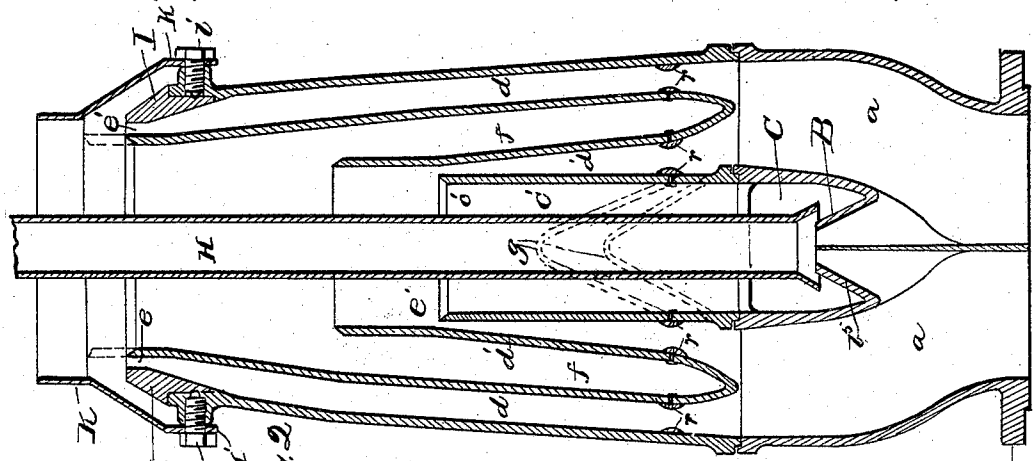


Fig. 2.

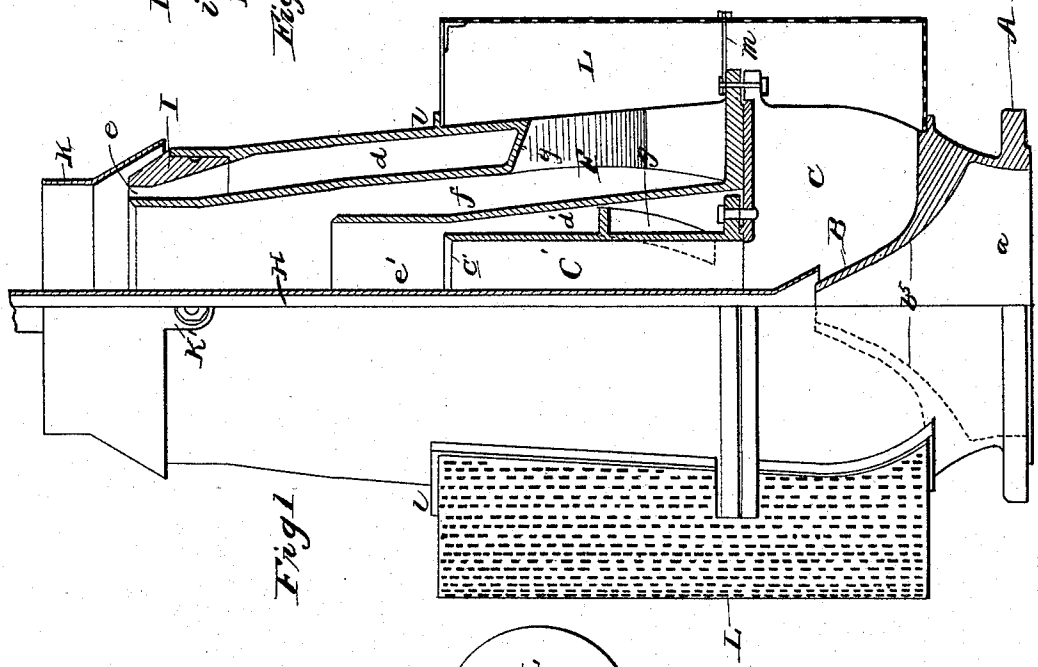


Fig. 1.

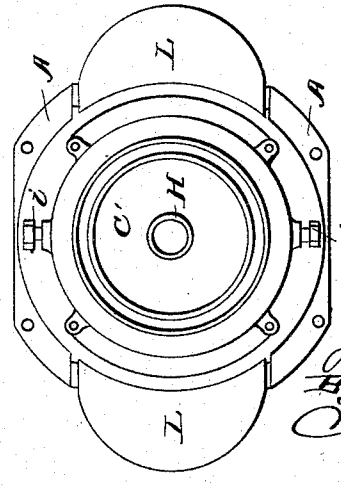


Fig. 3.

Witnesses

J. M. Fowler Jr.

Alex. Stewart.

Inventor

John Y. Smith

By Church & Church

his Attorneys.

(No Model.) 3 Sheets—Sheet 2.

J. Y. SMITH.

TRIPLE EXHAUST NOZZLE.

No. 487,299. Patented Dec. 6, 1892.

Fig. 5.

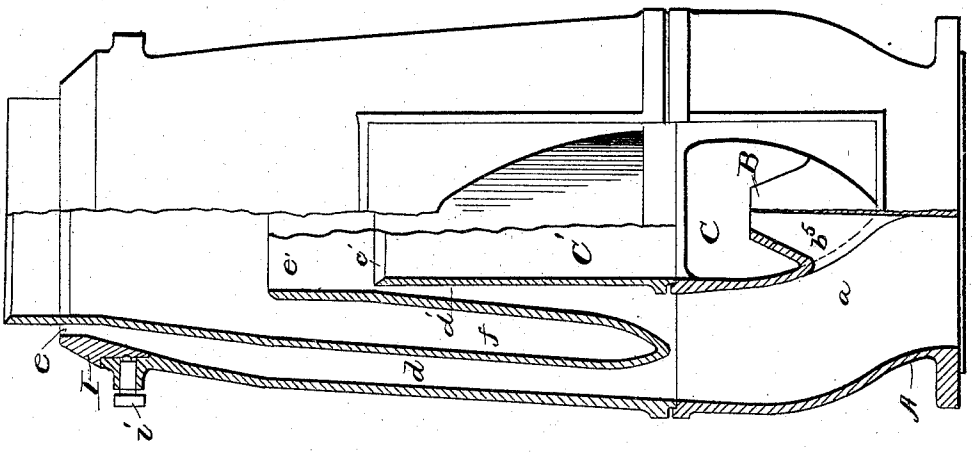
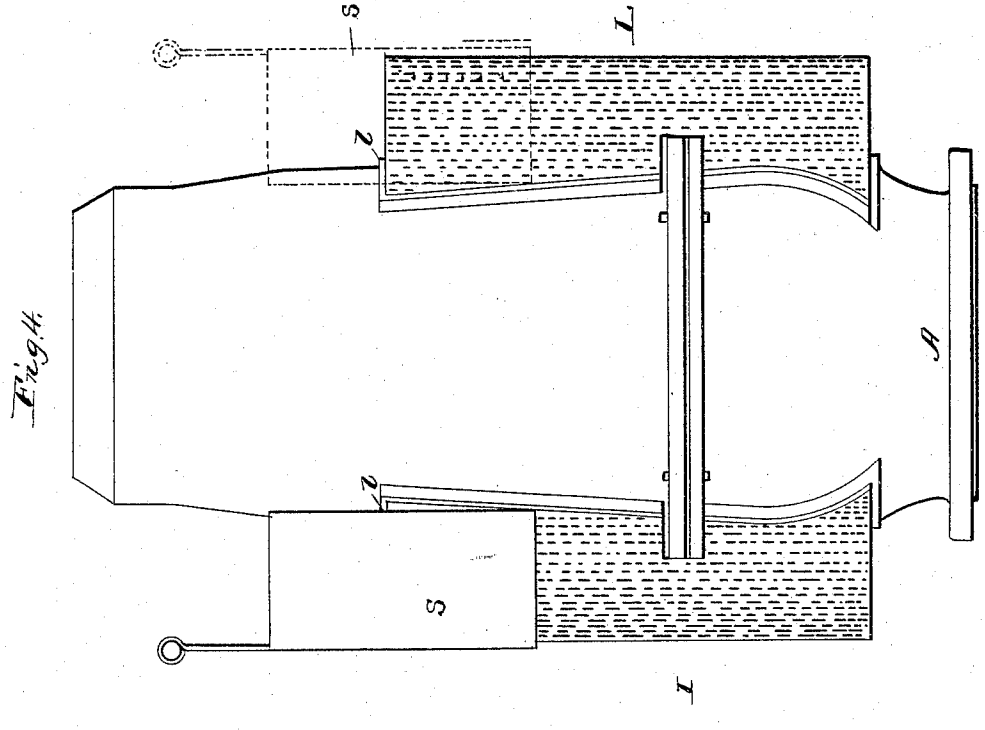


Fig. 4.



Witnesses:
J. M. Fowler Jr.
Alys Stewart.

Inventor
John Y. Smith
By
Church & Church
his Attorneys.

(No Model.) 3 Sheets—Sheet 3.

J. Y. SMITH.

TRIPLE EXHAUST NOZZLE.

No. 487,299. Patented Dec. 6, 1892.

Fig. 7.

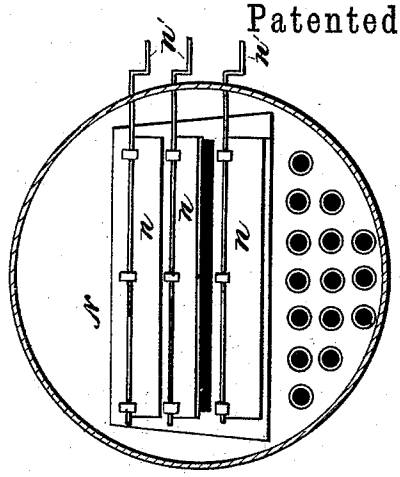
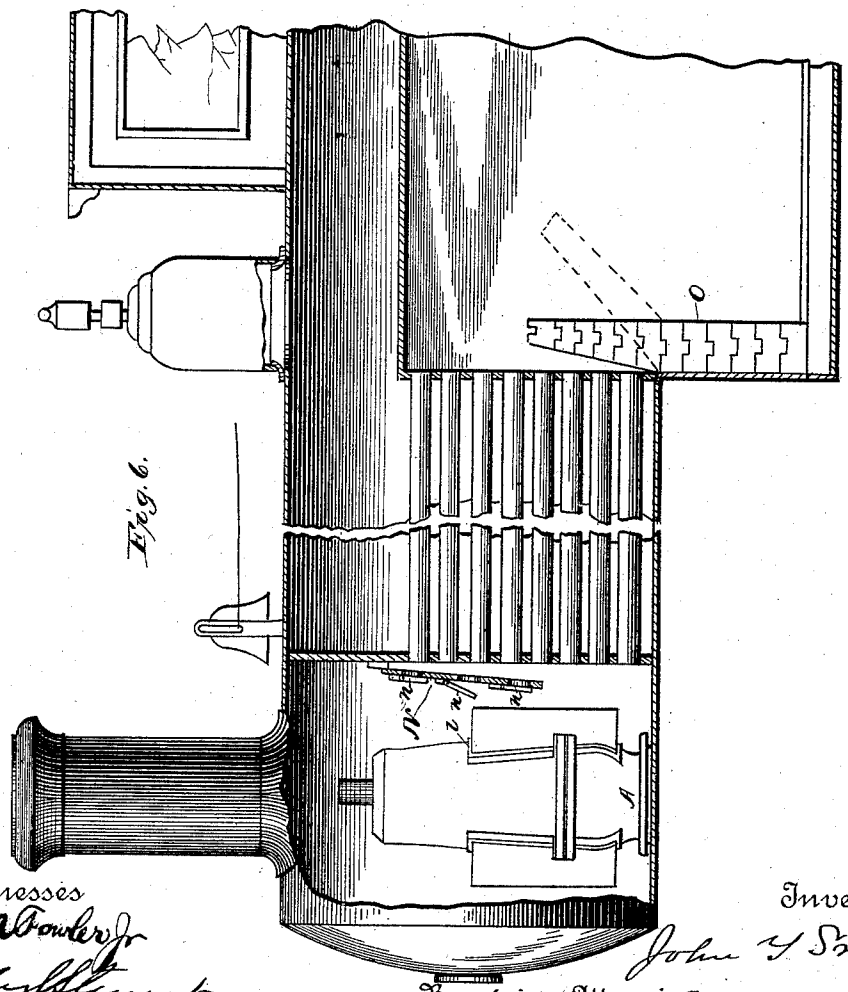


Fig. 6.



Witnesses
M. Fowler Jr
Alex. Hamilton

Inventor
John Y. Smith
By his Attorneys
Church & Church

UNITED STATES PATENT OFFICE.

JOHN Y. SMITH, OF DOYLESTOWN, PENNSYLVANIA, ASSIGNOR TO THE SMITH EXHAUST PIPE COMPANY, OF SAME PLACE.

TRIPLE-EXHAUST NOZZLE.

SPECIFICATION forming part of Letters Patent No. 487,299, dated December 6, 1892.

Application filed May 13, 1892. Serial No. 432,887. (No model.)

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 Triple-Expansion Blast or 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 letters of reference marked thereon.

This invention relates to ejector or blast apparatus designed especially for use in connection with locomotive and similar boilers and to be operated by the exhaust-steam from the cylinders, although capable of being operated by steam from any source, exhaust apparatus of the same general character being shown in patents heretofore granted to me, and particularly in Patent No. 406,483, dated July 9, 1889, to which reference is hereby made.

As in said prior patent, this invention has for its main objects to create and maintain a practically uniform and even flow of air through the furnace and boiler flues, to increase the volume of gaseous products or air discharged in proportion to the volume and pressure of steam, to reduce back-pressure, keep the flues clear from ashes and cinders, to prevent the escape of sparks, and to accomplish these objects with the simplest and least number of mechanical parts.

A further object is to so construct and arrange the parts of the exhaust apparatus as that they may be assembled and adjusted before being placed in position on the smoke-box, doing away with the necessity of special fitting for each individual locomotive.

Referring to the accompanying drawings, Figure 1 is a vertical section, partly in elevation, through the ejector detached, taken in a plane longitudinally of the boiler. Fig. 2 is a section through the same, taken in a plane at right angles to Fig. 1. Fig. 3 is a top plan view. Fig. 4 is a side elevation of the ejector, and Fig. 5 is a section, partially in elevation, taken in the same plane as Fig. 2, to show the air or gas openings more clearly. Fig. 6 is a section taken longitudinally of the boiler, showing the whole exhaust apparatus. Fig. 7 is a detail front elevation of the depending diaphragm or deflector-plate.

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

As in prior devices of this kind, the ejector is located in the smoke-box at the forward end of the boiler, (when the application is to a locomotive-engine,) immediately below the smoke-stack and in position to receive steam from the respective cylinders through the two exhaust-passages, the entire volume of steam being received in the ejector through the divided passages *a* in the base A, which latter is adapted to seat and be bolted in the smoke-box in the ordinary manner. From the base A of the ejector the steam is conveyed and discharged through nozzles acting successively or at different levels upon the volume of air in order to gradually increase as much as possible the speed of the moving column of air or gas. The combined areas of the exhaust-nozzles are preferably slightly less than those of each branch of the divided passage in order to increase the effectiveness of the blast; but the areas of the divided passages are greater than those of the exhaust-ports, an advantage of which construction lies in the tendency to prolong the action of each discharge from the cylinders, producing the more uniform and continuous effect.

Referring particularly now to Figs. 1 and 2, it will be seen that the base-section A, which is preferably cast in one piece, is provided with a central nozzle B, of relatively-small area, discharging vertically from the divided passage, while passages C enter the base from opposite sides and combine in a single central duct C′ immediately over the central nozzle B, said duct C′ being of relatively-large area and terminating in a nozzle *c′* at a point some distance above the base-section. The top section, which is also preferably cast integral, seats upon the base-section and surrounds the ducts C, being formed with ducts *d d′*, terminating, respectively, in nozzles *e e′*, the inner wall of the upper nozzle being preferably somewhat extended to prevent the accumulation of oily products on the outer wall. The ducts *d d′* register at the bottom with the divided passage *a* on opposite sides. The upper section is provided

with induction-openings F, preferably located immediately over the induction-opening C, said induction-openings F passing into an annular chamber *f*, located between the ducts *d d'* and opening out between the nozzles *e* and *e'* in what might be termed a "mingling-chamber," the effect of which is that the products, air, gases, &c., drawn into the ejector through the openings F are acted upon first by the steam and products escaping from the nozzle *e'*, by which they are given an impetus, and then by the steam escaping at high pressure through the nozzle *e*, by which they are given still greater impetus, one of the nozzles acting on the inside and the other on the outside of the said products, or such portion as does not commingle therewith, and carries the same upward with practically the velocity of the steam.

For the purpose of causing the steam rushing upward toward the nozzles *e e'* to distribute itself evenly without creating retarding eddies or causing back-pressure on the opposite side bridges *g* of conical shape are arranged over the openings C and F, as shown in dotted lines, Fig. 2, and in full lines, Fig. 1, the bridge over the opening F being preferably formed by the upper wall of the opening itself, as shown.

To further carry out the purposes of this part of the invention, the small central nozzle B discharges directly into cylindrical duct H, extending way through the injector and terminating at any suitable point above the same. A body of steam discharged into this internal cylindrical duct rushes way through it at high speed, together with such quantity of air and products as may be taken in at the lower end, and, being discharged into the smoke-stack in advance of the products passing through the other passages of the ejector, clears the passage for the latter, or in other words, drives the air or products out of the stack in advance of the main body and leaves a free passage for the same.

It will be noted that in carrying out the present invention in practical form the ducts and passages have been straightened from bottom to top of the ejector and that practically no retarding-eddies or back-pressure can be created at any point.

I design in the present instance to eliminate the oil products from the steam tending to gum and stop the nozzles by causing the steam to enter the base-section through curved passages, as shown in my before-mentioned patent, whereby the centrifugal force of such products will carry the same to the outside of the curve and against the wall dividing the passages. Now by converging the side walls b^5, Figs. 1 and 5, terminating in the nozzle B, from the extreme sides of the passage, the said oily or heavy products will be forced up and out the nozzle B, where, running over the edge of said nozzle, they find a ready escape through the lateral openings C, into which the nozzle projects.

At the top of the ejector, it is well known, an accumulation ordinarily forms on the edges of the nozzles which is difficult to remove, and in addition to providing a hardened removable nozzle I, at this point held in by set-screws *i*, I provide a thin metal shield K, somewhat in the form of a nozzle, the area of which is never less than that of the combined discharge-openings in the ejector, which shield surrounds the upper end of the ejector and is held in place by ears K', engaged by the set-screws *i*. Products which ordinarily accumulate on the edges of the ejector now pass on and are deposited upon the shield; but as the shield is open at the lower edge fine ashes and cinders are drawn up through the same by action of the steam, air, gas, &c., escaping from the ejector and effectually scours and keeps the inner surface of the shield clean, and its upper face edge is too thin to hold any deposits. This shield, it will be understood, although being capable of a universal use, is, nevertheless, particularly adapted for use in connection with ejectors having a means for preventing the entry of ashes, cinders, &c., at the lower end, and especially in the present form of ejector, in which a screen entirely covers the induction-openings. It is not necessarily employed, however, as the inner wall of the upper nozzle may be extended, as shown in full lines, Fig. 5, and dotted lines, Fig. 2. The escaping steam then serves to remove the accumulations in a measure.

Surrounding the induction-openings on each side of the ejector is formed a flange or extension *l*, within which fits tightly at its edges a screen L. This screen, preferably a foraminous plate, is formed of a single sheet extending from side to side with top and bottom heads, all confined within the flange *l* at their free edges, and the whole held in place by bolts—such as *m*—attached to or forming a part of bolts uniting the top and bottom sections of the ejector and passing out through openings in the screen, with nuts applied thereto, as shown clearly in Figs. 1 and 3. The convex shape of the screen and their attachment to the ejector, it will be seen, at once enables the whole device to be assembled complete for insertion in the smoke-box and dispenses entirely with the necessity of special fitting in each individual case.

The particular shape of the screens or the mode of their application, it is obvious, is immaterial, for rectangular screens might be employed with good effects.

As before stated, the ejector is located in the smoke-box at the forward end of the locomotive-boiler and it receives the bulk of air, gas, products, &c., at or near the bottom of the box and in such position as that under normal circumstances the tendency might be to create the greatest draft through the lowermost flues, and thereby cause the fuel to be drawn into the flues from the fire-box, besides creating difficulties incident to boiler construction and manipulation well known to

those skilled in the art, and therefore not necessary to state at this time. To overcome this tendency and to enable a uniform draft to be maintained through the boiler-flues, as well as to permit of its regulation and the portion of the grate-surface upon which the greatest draft shall act, I design to employ, first, a deflector-plate N, depending from the front sheet of the boiler at a point above the topmost flue and having a vertical series of dampers *n* therein independently controlled from the outside by means of cranks *n'* or other convenient means, whereby any one of said dampers may be opened or closed and the draft through the flues at approximately the same level regulated; secondly, I employ what I shall term an "evener" or "regulating-wall" O, located in the fire-box a short distance in front of the flues and of sufficient height to cause products passing over the same to enter the flues well distributed from top to bottom. This protecting-wall, it is obvious, may be vertical, as shown in full lines, or inclined, as shown in dotted lines, the usual method of construction being to form the same of bricks or sections, which may be successively placed in position one above the other until the wall is built of the desired height, and should it be found at any time that the height needs altering this is easily accomplished by adding or removing one or more sections. The height is adjusted to the draft to prevent the fine fuel being drawn into the flues and passing out as sparks, cinders, &c.

In operation it will be found that the opening and closing of the dampers *n* directly controls the quantity of air passing through any of the flues or part of the grate. Thus when the topmost damper is opened the greatest draft will pass through the front of the grate, and when the lowermost damper is opened the greatest draft will pass through the back of the grate. In some instances where it is desired to increase the rapidity with which the exhaust-steam shall pass through the ejector-passages said passages are provided with contracted portions, and in the present instance these contracted portions are formed by removable rings plano-convex in cross-section and preferably formed by segments *r*, adapted to be inserted within the ducts *d d'* and to be held in place by bolts or otherwise, as shown in Fig. 5.

In operation the exhaust-steam creates a powerful and uniform draft through the fire-box, boiler-flues, and ejectors, the screen serving to prevent the entry of sparks, cinders, &c., into the ejector, and the space around the ejector serving as a "dead-air space," so to speak, into which any sparks and cinders drop and from which the feeble updraft around the ejector fails to lift them. The gas, smoke, ashes, &c., of a light character circulating in the smoke-box move upward at a comparatively-slow rate of speed around the rapidly-ascending column of exhaust-steam, gas, &c., and, combining therewith or being acted upon thereby, are forced rapidly out through the stack, preventing any undue friction or retardation of the rapidly-ascending column. This arrangement enables me to regulate to a nicety the rate at which the air shall be drawn through the fire-box, for by moving dampers S so as to close more or less the induction-openings in the ejector the volume, and the consequent effectiveness of the rapidly-moving column from the ejector, is varied and a larger or smaller volume of relatively-slowly-moving air, gas, &c., passes up around the outside of the ejector and through the stack.

The construction of the ejector is simple in the extreme, but three castings being employed, which are of simple character and may be quickly and easily fitted up by machine-work and by unskilled labor. Hence the initial cost is greatly reduced.

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

1. In an exhaust apparatus, the ejector having the divided passage with the branches diametrically opposite each other and merging in annular nozzles near the top and the upper and lower air or gas openings in the side walls located on diametrically-opposite sides and between the branches of the divided passage below their point of union, substantially as described.

2. In an exhaust apparatus, the ejector having the divided passage in the base for the entry of steam, merging into independent annular nozzles above the base, the diametrically-opposite lateral air or gas opening in the base between the branches of the divided passage passing to the center of the ejector, and the lateral air or gas opening above the first-mentioned openings and also entering between the branches of the divided passage leading to the outer nozzle and communicating with an annular duct between the steam-nozzles, substantially as described.

3. In an exhaust apparatus, the ejector having the divided passage with the branches merging in annular nozzles at the top and the air or gas openings in the side walls between the branches, having the conical bridge over the same, whereby the steam in the branches of the divided passages pass upward without forming eddies, substantially as described.

4. In an exhaust apparatus, the ejector having the divided passage with the branches merging in annular nozzles at the top, the air or gas opening in the side wall of the base, having the conical bridge over the same, and the air or gas opening above the first-mentioned openings, having the top thereof conical, whereby the branches of the divided passage approach gradually, substantially as described.

5. In an exhaust apparatus, the ejector having the divided passage with the branches merging in annular nozzles at the top and the central nozzle at the bottom, the air or gas opening in the base between the branches

of the divided passage opposite the central nozzle, the air or gas openings in the side wall above the first-mentioned openings, also between the branches of the divided passage, and the annular duct between the steam-nozzle, to which said openings lead, substantially as described.

6. In an exhaust mechanism, the combination, with the ejector having the steam-passages in the base and the lateral air or gas openings, of the screens surrounding said air or gas openings, connected to and carried by the body of the ejector, substantially as described.

7. In an exhaust mechanism, the combination, with the ejector having the steam-passages in the base and the lateral air or gas openings, of the convex screens bridging the said air or gas openings, mounted on and having their edges held by the body of the ejector, substantially as described.

8. In an exhaust mechanism, the combination, with the ejector having the air or gas openings in its side walls and the flanges on the outer surface, surrounding said openings, of the screens having their edges held by the flanges, substantially as described.

9. An ejector for exhaust mechanism, consisting of the integral base-section having the divided passage and lateral air or gas openings between the branches of the divided passage and the integral upper section fastened directly on the base-section and having the annular nozzles in communication with the passages in the lower section, substantially as described.

10. An ejector for exhaust mechanism, consisting of the integral base-section having the divided passage and lateral air or gas openings between the branches of the divided passage and the integral upper section fastened directly on the base-section and having the lateral air or gas openings, the ducts registering with the branches of the divided passage and through which the air or gas openings pass, and the annular nozzles in the upper portion, substantially as described.

11. In an ejector for exhaust mechanism, the combination, with the lower central nozzle and upper annular nozzle, of the central cylindrical duct having its entrance over the central nozzle at the bottom and its exit above the annular nozzles and in position to discharge in line with the discharge from said annular nozzles, substantially as described.

12. In an ejector for exhaust mechanism, the combination, with the lower central nozzle with lateral air or gas openings thereto and the upper annular nozzles, of the central cylindrical duct having its entrance over the central nozzle extending vertically through the ejector and discharging above the same, substantially as described.

13. In an ejector for exhaust mechanism, the combination, with the annular nozzle at the top, of the shield K above the nozzle for the reception of accumulations, substantially as described.

14. In an ejector for exhaust mechanism, the combination, with the annular nozzle at the top and the air and gas openings at the bottom and means for preventing the entry of ashes therein, of the shield K above the nozzle, with its bottom open around the outside of the ejector, whereby ashes are drawn through it and accumulations removed, substantially as described.

15. In an ejector for exhaust mechanism, the combination, with the base-section, of the upper section cast integral with the annular ducts therein and the annular nozzle removably secured at the top of the ejector, substantially as described.

16. In an exhaust apparatus, the combination, with the boiler having flues therein, the smoke-box, and the ejector located therein, of the apron or deflector-plate depending between the flues and ejector, having the vertical series of independently-operated dampers therein, substantially as described.

17. In an exhaust apparatus, the combination, with the boiler having flues therein, the fire-box, the smoke-box, and the ejector located therein, of the apron or deflector-plate depending between the ejector and flues, the vertical series of independently-pivoted dampers in said plate, and the independent cranks for operating the same, substantially as described.

18. In an ejector such as described, the combination, with the upper nozzles, of the small central nozzle at the bottom, having the converging walls extending from side to side of the steam-passages, whereby oily products are caught and carried out at the top of the nozzle, substantially as described.

19. In an ejector such as described, having the divided passage in the base and the nozzles at the top, the small central nozzle at the bottom, having the converging walls extending from side to side of each branch of the divided passage, whereby oily products are caught and carried out at the top of the nozzle, substantially as described.

JOHN Y. SMITH.

Witnesses:
ALEX. S. STEUART,
A. KELLY.