

Aug. 27, 1929.

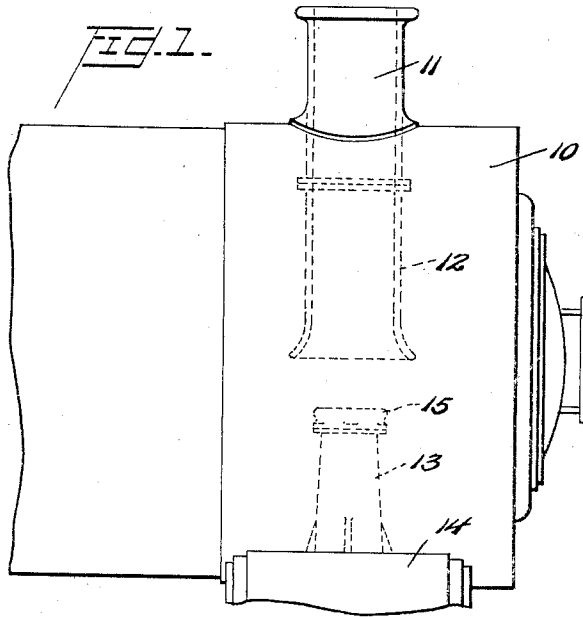
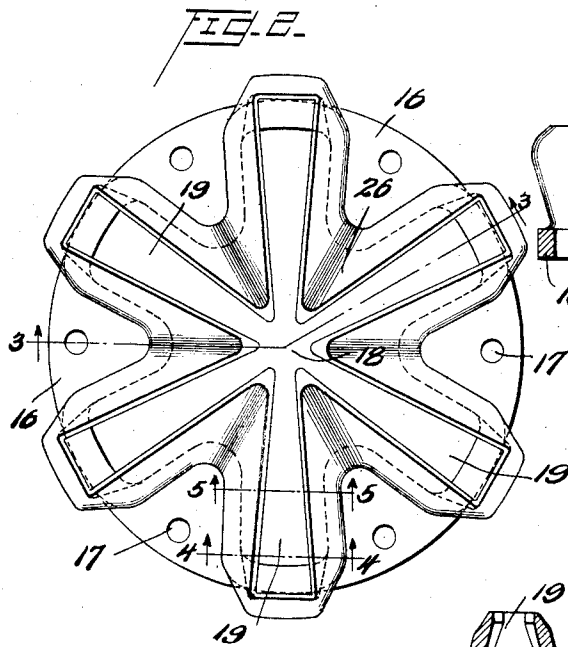
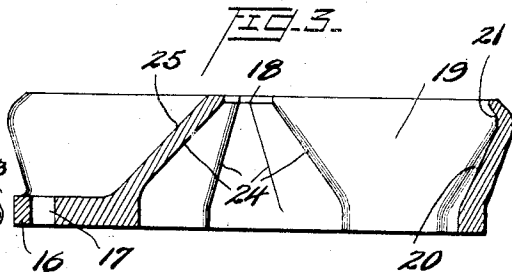
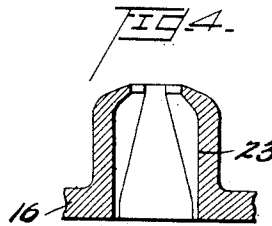
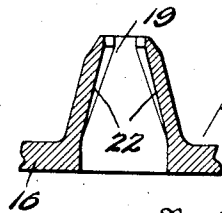
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EXHAUST NOZZLE

Filed April 18, 1927

3 Sheets-Sheet 1



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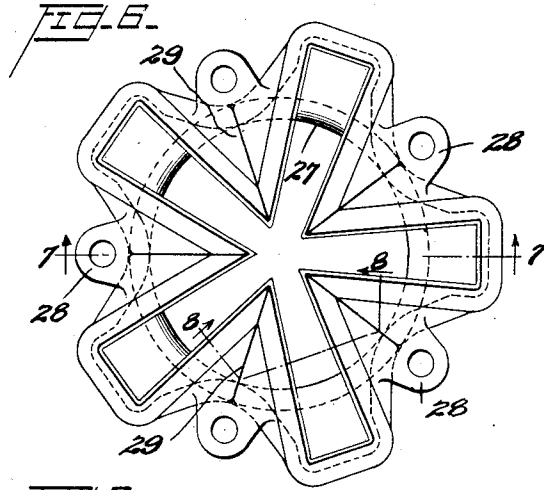
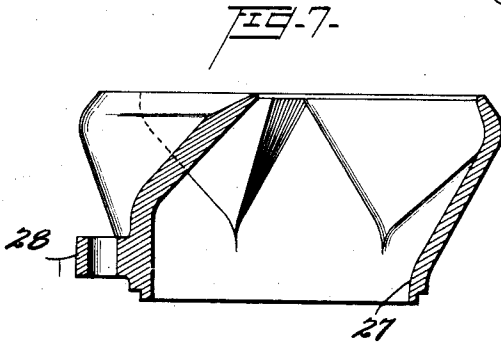
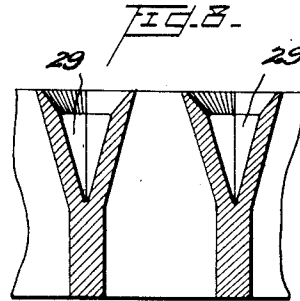
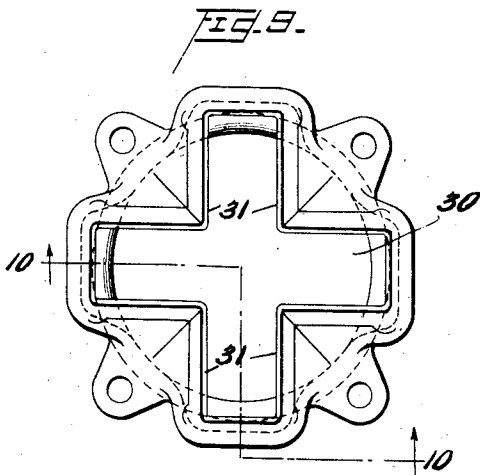
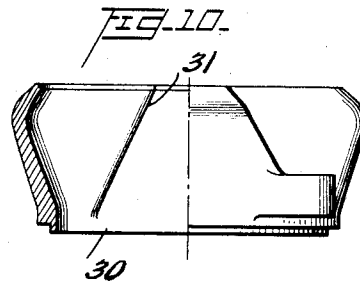
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EXHAUST NOZZLE

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3 Sheets-Sheet 2



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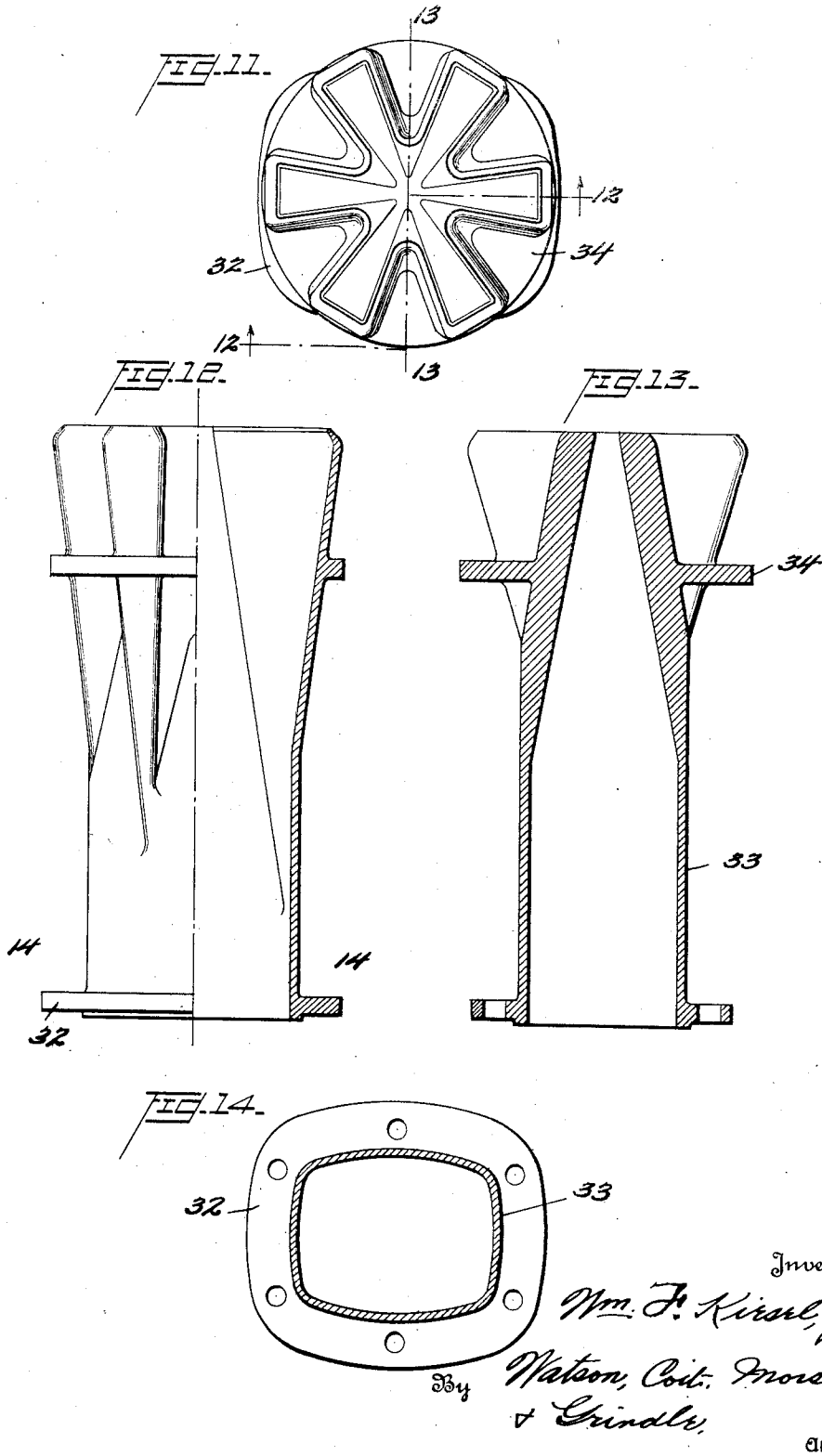
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EXHAUST NOZZLE

Filed April 18, 1927

3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE.

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EXHAUST NOZZLE.

Application filed April 18, 1927. Serial No. 184,757.

This invention relates to exhaust nozzles for improving the draft for burning fuel under boilers, and more particularly to that type of exhaust nozzle arranged in the smoke box of a locomotive.

It is a general object of the present invention to provide a novel and improved type of exhaust nozzle.

More particularly it is an object of the invention to provide an exhaust nozzle having a plurality of branches radiating from a small central passage and all connected thereto to make one opening.

Another object of the invention consists in providing an exhaust nozzle of the type described, with a constantly decreasing cross-sectional area from the receiving end to the discharging end.

One of the features of the invention comprises arranging the opening of the nozzle in such a manner that all surfaces of the steam jet emitted therefrom are so located as to permit of direct contact with the flue gases.

Another feature of the invention comprises the arrangement of the exhaust nozzle with a plurality of elongated passages radiating from a central opening, each passage being quite narrow contiguous to the opening, and increasing in width in direct proportion to the distance from the opening, whereby a jet is produced of such character as to give a maximum entrainment of the gases with the exhaust steam so that a substantially constant velocity and pressure may exist throughout the full cross-section of the stack.

A further object of the invention comprises an exhaust nozzle and exhaust pot formed as an integral unit.

Other and further objects and features of the invention will be more apparent to those skilled in the art after a consideration of the accompanying drawings and following specification, wherein are disclosed several exemplary embodiments of the invention with the understanding, however, that various modifications may be made therein without departing from the spirit of the invention as expressed in the appended claims.

In said drawings:

Fig. 1 is a side elevation of the smoke box of a locomotive, showing in dotted lines the relative position of the exhaust pot, exhaust nozzle, stack and stack petticoat;

Fig. 2 is a plan view of one form of exhaust nozzle;

Fig. 3 is a vertical section taken on broken line 3—3 of Fig. 2;

Fig. 4 is a transverse vertical section through one of the radial slots, taken on line 4—4 of Fig. 2;

Fig. 5 is a section similar to Fig. 4 but taken on line 5—5 of Fig. 2;

Fig. 6 is a plan view of a modified form of exhaust nozzle;

Fig. 7 is a vertical central section on line 7—7 of Fig. 6;

Fig. 8 is a vertical section on broken line 8—8 of Fig. 7;

Fig. 9 is a plan view of a further modified form of exhaust nozzle;

Fig. 10 is a side elevation and half vertical section on line 10—10 of Fig. 9;

Fig. 11 is a plan view of a combined exhaust nozzle and exhaust pipe;

Fig. 12 is a side elevation thereof, and partial section on line 12—12 of Fig. 11;

Fig. 13 is a section on line 13—13 of Fig. 11; and

Fig. 14 is a transverse section on line 14—14 of Fig. 12.

With the increasing size of locomotives, the difficulties of providing adequate draft facilities for increased fuel consumption are a serious problem. The stack should be larger in diameter to give egress to the greater gas volumes at a reasonable velocity, and the length should be as great as possible to avoid loss of draft from the pulsating exhaust steam jet. The present invention contemplates the provision of an exhaust nozzle of such shape that the exhaust steam and entrained gases completely fill the stack below the top thereof with a current of gas and steam having substantially equal velocity throughout the full cross section. Cylinder back pressure is kept at a minimum.

Referring to the drawing there is shown in Fig. 1 at 10, the so-called smoke box at the forward end of a locomotive boiler. It is surmounted by a stack 11, which continues within the smoke box in the form of a petticoat 12. Mounted directly below this petticoat and concentric therewith is the so-called exhaust pot or exhaust pipe 13, secured to the cylinder saddle 14 and communicating, through passages in this saddle, with the exhaust ports of

the cylinders. The arrangement disclosed is more or less conventional. An exhaust nozzle 15 is adapted to be secured to the upper end of the exhaust pipe in order to properly direct the exhaust steam into the petticoat, and to entrain the flue gases therewith, so as to provide suitable draft for the fire.

In Figs. 2 to 5 is shown one form of exhaust nozzle adapted for attachment to the upper end of an exhaust pipe or pot. It comprises a suitable casting, having the base ring 16 provided with suitable apertures 17 to receive securing means for fastening the nozzle in position.

The nozzle is so arranged that the steam outlet at the top is in a substantially horizontal plane. The exit aperture lying in this plane is composed of the small central port 18 and six radiating ports 19. Each of these radiating ports, adjacent to the central port, is quite narrow, being less in width than the diameter of the central port. They extend outwardly to a distance greater than the internal radius of the exhaust pipe, and increase in width substantially directly in proportion to the distance from the central port. This increase in width is to provide additional steam to care for the larger volume of gases between the ports as the distance from the center increases. The outer ends of these radial ports are substantially tangential to the circumference of the base ring 16, although this is not necessary. As shown at 20 in Fig. 3, the end wall of each radial passage leading to a radial port, flares outwardly to 21 and then bends inwardly, so that at the exit the steam is directed radially inwardly at a slight angle. As shown in Fig. 5, the side walls 22 leading to the exit converge both vertically and horizontally. As shown in Fig. 4 near the outer end of one of the radial passages, they are substantially parallel to each other, as at 23. The edge 24 defining the junction between adjacent walls of two radial passages is inclined at substantially an angle of 45°. The outer surface 25 of this wall has the same angle.

The convergence of the walls 22 provides between each pair of passages and their defining walls a wedge-like channel 26 leading in from the edge to substantially the center of the nozzle. These wedge-like grooves carry the flue gases, so that they arrange themselves between walls of steam emerging from the ports 18 and 19 and are entrained therewith in such a manner that the velocity of the gases approximates that of the steam. The spread of the steam jets at the circumference of the nozzle due to expansion will produce practically a solid area of a mixture of gases and steam, all having the same velocity, at a section of the stack materially below its top.

The total area of the ports 18 and 19 is less than the area of the exhaust pipe. From the

bottom of the exhaust nozzle to the top, the cross-sectional area of the steam passages continually decreases so that the velocity of the steam continually increases and is a maximum when it reaches the outlet ports. It will be noted that all surfaces of the steam jet face outwardly, so that they have relatively equal entraining effect on the gases.

In Figs. 6 to 8 is shown another form of exhaust nozzle. The form disclosed in the first modification is provided with six radial passages, whereas the present form is provided with five. In every other sense it is substantially identical with the form already described. For certain types of locomotives, the greater angle included between adjacent radial steam passages is of some advantage to insure proper entrainment of the gases. As shown in Fig. 6 the exhaust pipe has the internal diameter indicated by the reference character 27, and the radial passages extend a material distance beyond this diameter, as is best shown in Fig. 7. The base ring is absent in this form, and a plurality of projecting bosses 28 are provided, one between each two radial steam passages. They are adapted to be bolted to similar projections on the exhaust pipe. By this construction, the passage of the gases into the channels 29 between the steam jets is less interfered with, and a better velocity of gas can be obtained.

Figs. 9 and 10 show a further modified form of construction wherein but four radial passages 30 are disclosed, these passages having their exits so designed that the edges thereof are parallel to each other. In plan, the total steam exit area is cruciform. The steam passages leading to the exits have substantially the same converging arrangement as in the prior forms, so that the steam velocity increases from the entrance to the exit of the nozzle.

In certain types of locomotives it may be found desirable to form the exhaust pipe or exhaust pot, and the exhaust nozzle, as an integral structure, and the two may be cast in one piece as shown in Figs. 11 to 14 inclusive. In this construction, there is disclosed a base flange 32 of any suitable configuration to conform to the exhaust passage in the cylinder saddle. Extending upwardly from the base flange is the pipe 33 here shown as substantially rectangular in cross-section with slightly convex walls. This pipe gradually merges into the exhaust nozzle which in outlet plan is identical with that of any of the previously described modifications. In Fig. 11 it is shown as having the same outlet configuration as Fig. 2. Owing, however, to the great distances and more space available, the passages leading to the outlets converge more gradually and the walls forming the ends of the radial passages diverge more gradually. This results in less change in steam velocity per unit of distance and thus reduces the back

pressure. It may be desirable to provide a reinforcing band or ring 24 around the nozzle adjacent to the upper surface thereof. The effect of this is not only to strengthen the structure, but to produce a turbulence of the flue gases, before they are entrained by the steam, resulting in a better mixture and insuring a greater velocity of these gases.

It has been found by experiment that any number of radial steam exits from three to eight may be used effectively. A greater number than eight is not desirable for the angle between them becomes so small that suitable gas entrainment is not effected. Certain types of locomotives, dependent upon their service, may be found to operate better with one number of passages than with another, and therefore it is important that various numbers can be provided in order to give sufficient flexibility to the design to permit making the relative steam and gas areas, the spread and the outside diameter of the nozzle, theoretically correct to suit any predetermined or desired stack diameter and length. The present invention permits the combined exhaust steam and entrained gases to completely fill the stack at any desired position relative to the height of the stack, and allows the two to maintain a substantially equal velocity throughout the cross-section area of the stack, and at the same time reduces cylinder back pressure to a minimum.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. A nozzle having a plurality of walls defining an outlet configuration comprising a plurality of areas radiating from a communicating central area, said radiating areas being wider at their outer ends than where they join said central area, and each longer than the diameter of the central area.

2. An exhaust nozzle for locomotives comprising a body having a steam passage there-through decreasing in cross-sectional area from entrance to exit, said passage being divided into sections by pairs of opposed walls radiating from a central portion of the passage, the walls of each pair converging from bottom to top and diverging radially to thus define wedge-like spaces between the pairs of walls for the passage of gas in streams whose faces are parallel to the faces of the issuing steam jets, said central portion of the passage being in full communication with the said sections and having less area than any one of them.

3. In a locomotive, a smoke box, a stack entering said smoke box and an exhaust nozzle below and concentric with said stack, said nozzle comprising a body having a steam passage therethrough decreasing in cross sectional area from entrance to exit, the outlet of said passage defining a single steam jet having a plurality of radiating arms and a cen-

tral portion, all surfaces of said jet facing toward the combustion gases in said smoke box, the spread of the jet being such as to produce a practically solid area of mixed gases and steam all of the same velocity in the stack below its top, the central portion of any of said steam passage being less in diameter than the length of said arms.

4. A unitary exhaust pipe and exhaust nozzle for locomotives, including in combination, a base flange adapted to be secured to the cylinder saddle, a pipe integral with said flange, said pipe having its outline gradually merging from bottom to top into the configuration of an exhaust nozzle, said nozzle having an outlet opening comprising a plurality of areas radiating from a central area and diverging in width substantially directly in proportion to the distance from the central area, said radiating areas being defined by vertically converging side walls and end walls diverging for the greater part of their length.

5. A unitary exhaust pipe and exhaust nozzle for locomotives including in combination, a base flange adapted to be secured to the cylinder saddle, a pipe integral with said flange, said pipe having its outline gradually merging from bottom to top into the configuration of an exhaust nozzle, said nozzle having an outlet opening comprising a plurality of areas radiating from a central area and diverging in width substantially directly in proportion to the distance from the central area, said radiating areas being defined by vertically converging side walls and end walls diverging for the greater part of their length, the cross-sectional area of said nozzle portion decreasing toward the outlet.

6. A unitary exhaust pipe and exhaust nozzle for locomotives including in combination, a base flange adapted to be secured to the cylinder saddle, a pipe integral with said flange, said pipe having its outline gradually merging from bottom to top into the configuration of an exhaust nozzle, said nozzle having an outlet opening comprising a plurality of areas radiating from a central area and diverging in width substantially directly in proportion to the distance from the central area, said radiating areas being defined by vertically converging side walls and end walls diverging for the greater part of their length, said side walls also defining exterior wedge-like channels for combustion gases.

7. An exhaust nozzle for locomotives, comprising a body having a steam passage there-through decreasing in cross-sectional area from entrance to exit, said passage being defined by pairs of opposed walls radiating from a central portion of the passage, the walls of each pair converging from bottom to top and diverging radially substantially directly proportional to the distance from the center, the angle between adjacent walls of contiguous pairs being such that they meet in

edges which extend to the top surface of the nozzle, all of said edges defining a central passage which at the surface of the nozzle is less in diameter than the length of passage confined between a pair of said walls.

8. A locomotive exhaust nozzle having a plurality of walls defining communicating steam passages and an outlet area, said outlet area including a central port and a plurality of elongated ports radiating therefrom and in communication therewith, the central port having a maximum diameter less than one half of the total diameter of the outlet area.

9. A locomotive exhaust nozzle comprising a body formed of a plurality of walls defining a steam conduit composed of a plurality of elongated passages radiating from and in full communication with a central passage, all of said passages converging to an outlet port, said central passage near said port having an area less than any one of said elongated passages.

In testimony whereof I hereunto affix my signature.

WILLIAM F. KIESEL, JR.