J. PLAYER.

EXHAUST PIPE.

APPLICATION FILED FEB. 9, 1909.

948,020.

Patented Feb. 1, 1910.

3 SHEETS—SHEET 1.

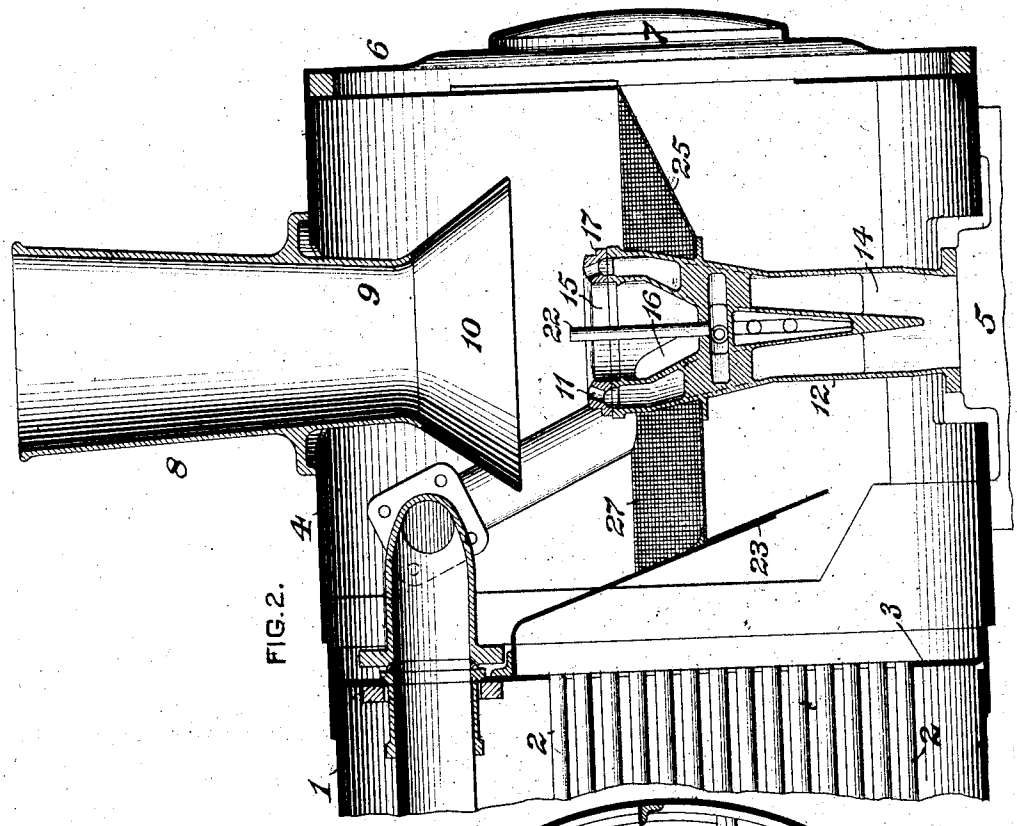

FIG. 2.

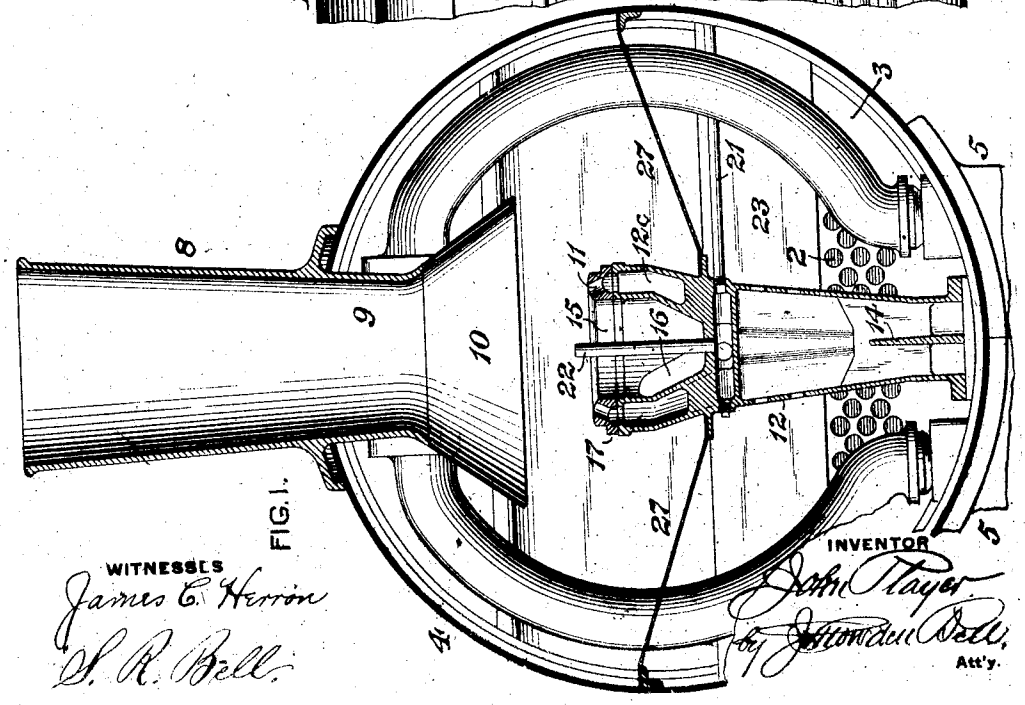

FIG. 1.

WITNESSES

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3 SHEETS—SHEET 2.

FIG. 5.

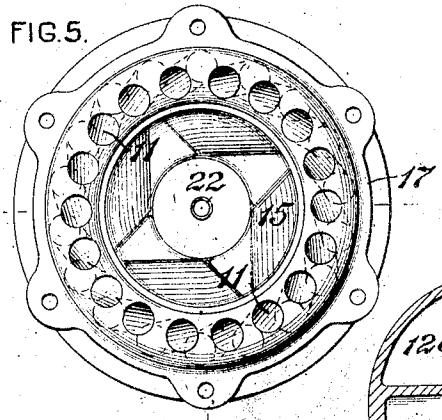


FIG. 6.

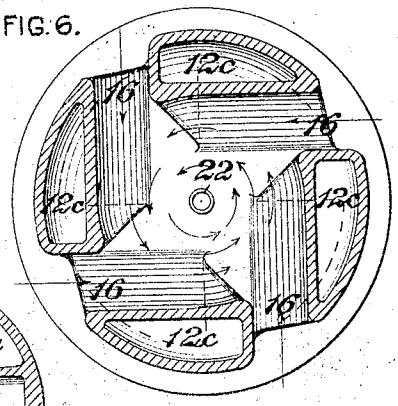


FIG. 7.

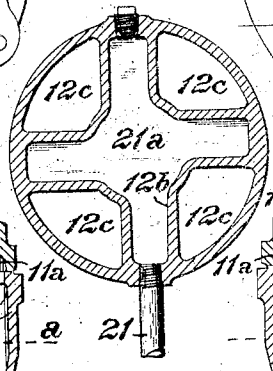


FIG. 3.

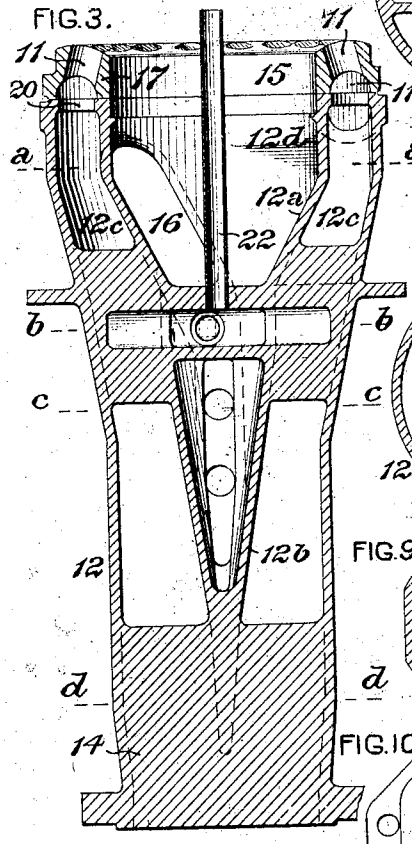


FIG. 8.

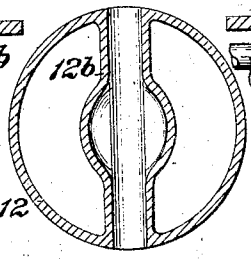


FIG. 9.

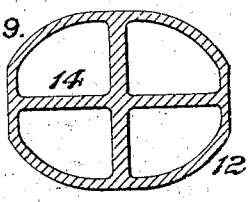


FIG. 10.

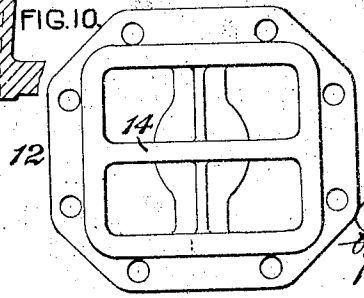
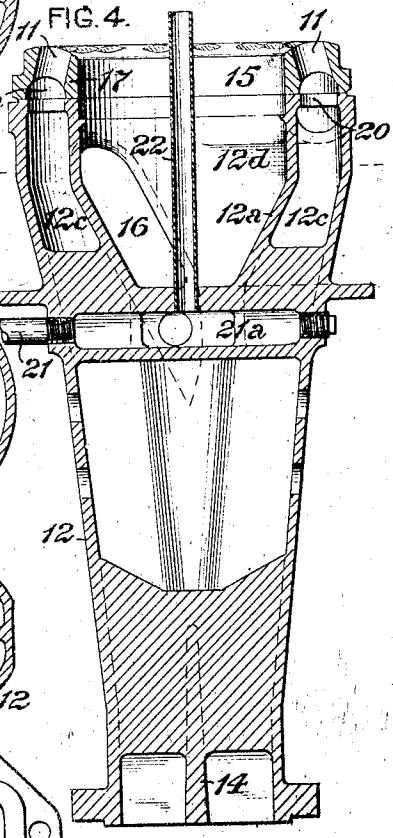


FIG. 4.



WITNESSES

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EXHAUST PIPE.

APPLICATION FILED FEB. 9, 1909.

948,020.

Patented Feb. 1, 1910.

3 SHEETS—SHEET 3.

FIG. 13.

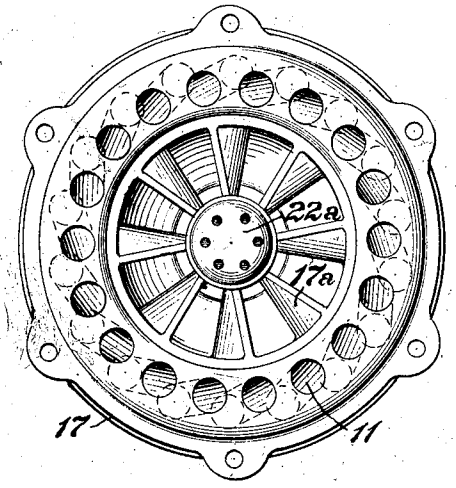


FIG. 14.

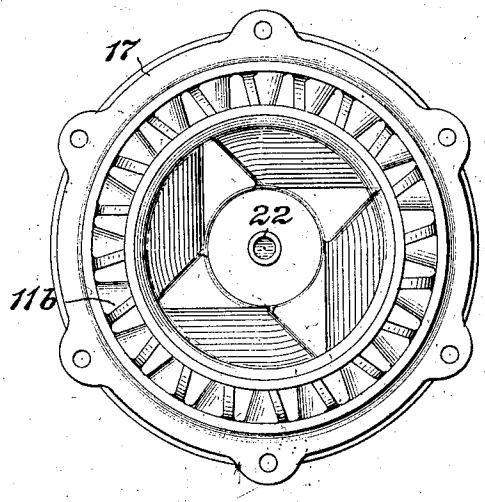


FIG. 11.

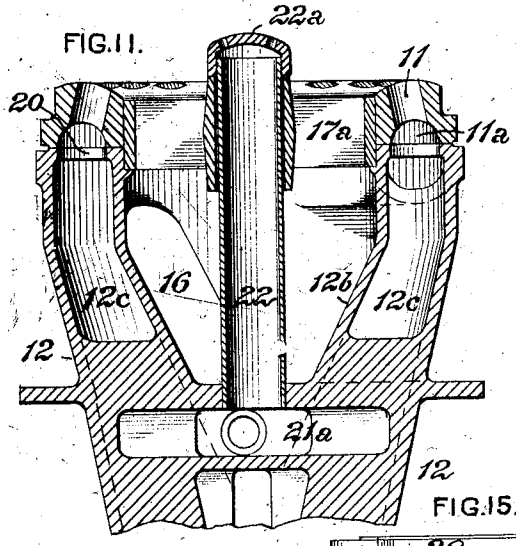


FIG. 12.

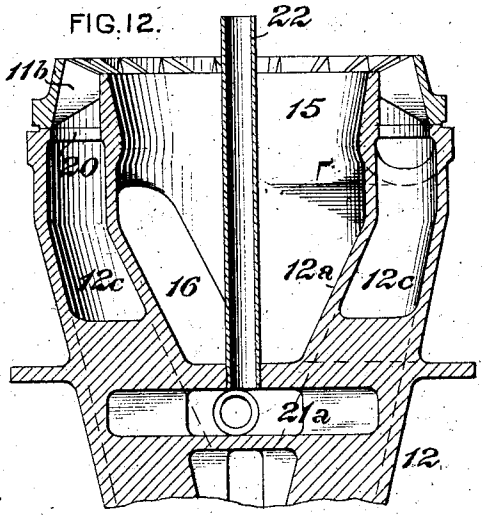


FIG. 15.

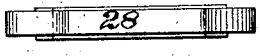


FIG. 16.

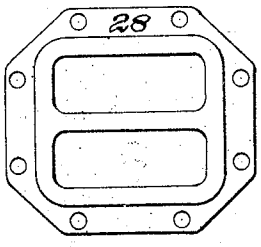
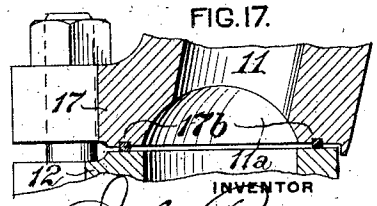


FIG. 17.



WITNESSES

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UNITED STATES PATENT OFFICE.

JOHN PLAYER, OF SCHENECTADY, NEW YORK.

EXHAUST-PIPE.

948,020. Specification of Letters Patent. Patented Feb. 1, 1910.

Application filed February 9, 1909. Serial No. 476,922.

To all whom it may concern:

Be it known that I, JOHN PLAYER, of Schenectady, in the county of Schenectady and State of New York, have invented a certain new and useful Improvement in Exhaust-Pipes, of which improvement the following is a specification.

My present invention is more particularly designed for application in connection with annular exhaust nozzles for locomotive engines, of the type set forth in Letters Patent of the United States No. 673,726, granted and issued to the Brooks Locomotive Works, as my assignee, under date of May 7, 1901, and in a pending application for Letters Patent filed by me June 17, 1908, Ser. No. 438,912.

The object of my invention is to provide an exhaust pipe for locomotive engines, which shall be of simple and inexpensive construction and ready adaptability in, and in connection with, smoke boxes and spark arresting appliances of the constructions known and approved in present practice, and in the operation of which there will be attained the advantages of freer steaming of locomotives, greater efficiency and economy in their performance by reason of reduction of back pressure on their pistons, and prevention of fire damages by the practical elimination of the ejection of sparks from the smoke stack, particularly when burning low grade fuel and lignite fuel.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings: Figure 1 is a vertical transverse section, in the central plane of the stack and exhaust pipe, through the smoke box, exhaust pipe, and stack of a locomotive boiler, illustrating an application of my invention; Fig. 2, a vertical longitudinal central section through the same and through the forward portion of the waist of the boiler; Fig. 3, a vertical central section, on an enlarged scale, taken in the plane of Fig. 2, through the exhaust pipe and exhaust nozzle shown in Figs. 1 and 2; Fig. 4, a similar section through the same, taken in the plane of Fig. 1; Fig. 5, a plan or top view of the same; Figs. 6, 7, 8, and 9, horizontal sections, on the lines *a a*, *b b*, *c c*, and *d d*, respectively, through the same; Fig. 10, a bottom view of the same; Fig. 11, a vertical central section through the exhaust nozzle and the upper portion of the exhaust pipe, showing the application of a spreader and blower nozzle; Fig. 12, a similar section, showing a modification of the structural detail of the exhaust nozzle; Fig. 13, a plan or top view of the construction of Fig. 11; Fig. 14, a similar view of the construction of Fig. 12; Fig. 15, a side view of a grinding block for making a steam tight joint between the exhaust pipe and cylinder saddle; Fig. 16, a plan view of the same, and; Fig. 17, a vertical section through one side of an exhaust nozzle and the adjoining portion of an exhaust pipe, showing improved means for making the joint between the same.

My invention is herein exemplified as applied in connection with a locomotive boiler of the type now standard on railroads, and with an exhaust pipe of the type set forth in Letters Patent No. 673,726 aforesaid. The shell or waist, 1, of the boiler, is provided with a plurality of fire tubes, 2, extending from the firebox, which is not shown, to the front tube sheet, 3, through which tubes, the products of combustion pass from the firebox to the smoke box, 4, which is secured, at its rear end, to the front ring of the shell, 1, and, at its bottom, to the cylinder saddles, 5. The forward end of the smoke box is closed by a metal front, 6, having a central door, 7, and it is provided at its top, with a stack, 8, having a downward extension, 9, with a flaring or conical lower end, 10, within the smoke box.

In the practice of my invention, I provide an exhaust pipe, 12, having an annular discharge cap, tip, or nozzle, 17, secured detachably to its top, and constituting its exit section. The spark arresting appliance illustrated, which is one of sundry suitably adaptable designs, and which, in and of itself, is not an essential of my invention, comprises inclined front and side sheets of wire netting or perforated plates, 25 and 27, extending from an inclined transverse deflecting plate or diaphragm, 23, located in front of the tube sheet, 3, to the front and sides of the smoke box, below inlet or entrainment passages, 16, hereinafter described, in the exhaust pipe, through which passages the gases of combustion are entrained in their traverse to the central discharge passage, 15, of the exhaust nozzle, 17.

In order to insure a tight joint between the exhaust nozzle and the exhaust pipe, the nozzle may have circular grooves or recesses formed in its bottom, to receive packing

rings or gaskets, 17ᵇ, of flexible metal or composition, which project outwardly below the groove and are clamped and held tightly between the nozzle and pipe by suitable fastenings, as bolts passing through peripheral lugs thereon.

The exhaust pipe, 12, which is connected, at its lower end, to the cylinder saddles, 5, and communicates with the exhaust steam passages thereof, has a vertical longitudinal central bridge, 14, extending upwardly from its base, for a distance proper to separate the currents of steam discharged from the cylinder exhaust passages, as in ordinary practice. The transverse area for the passage of exhaust steam through the exhaust pipe is preferably made uniform throughout said pipe, in order to maintain uniform velocity and volume in the column of exhaust steam before entering the exhaust nozzle, into which it is discharged through an annular exhaust steam discharge passage, 20, at the top of the exhaust pipe, said passage being formed between the outer shell of the exhaust pipe, and an inner shell or wall, 12ᵃ, extending downwardly and tapering inwardly to a plane below a plurality of inlet or entrainment passages, 16, four being shown in this instance, which extend through the space between the inner and outer shells.

The uniformity of area of the avenue of discharge of exhaust steam may be attained either by making the exterior of the exhaust pipe of such dimensions as to produce a practically uniform interior section, or by forming vertical partitions, 12ᵇ, in the exhaust pipe, said partitions being cored out, as shown in Figs. 3, 7, and 8, to prevent undue thickness of metal and reduce weight. This latter construction I deem the more desirable one, as thereby smoother and more uniform passages for the exhaust steam are provided, and all obstructions to its flow which would be caused by irregular shape are avoided. The number of exhaust steam passages corresponds with the number of entrainment passages, 16, (in this case four) but may be made greater or less in accordance with structural conditions and the requirements of service.

The several exhaust steam passages, 12ᶜ, leading into the passage, 20, through which the exhaust steam is discharged into the exhaust nozzle, are preferably inclined toward their upper ends, in order to enable a central gas discharge passage or space, 12ᵈ, in the exhaust pipe, around which passage they are located, to be materially enlarged above the transverse area that would be afforded if the steam passages, 12ᶜ, were vertical, and also to give to the exhaust steam a rotative motion before entering the exhaust nozzle, and to insure a more uniform distribution and pressure of steam as it enters the exhaust nozzle, especially at the points located above the entrainment passages, 16, by which the areas of the exhaust steam passages below the nozzle are of necessity reduced and are not in the direct path of the columns of exhaust steam. The entrainment passages, 16, are disposed tangentially relatively to the central gas discharge passage, 12ᵈ, and are preferably set conically, conoidally, or spirally in relation thereto, as shown in Fig. 6, and in Figs. 3, 4, 11, and 12.

The blower pipe, 21, which leads from the steam space of the boiler and is controlled by a valve in the usual manner, is preferably tapped into one of two threaded openings in the shell of the exhaust pipe, the other opening being closed by a suitable plug. The blower pipe delivers steam into a chamber or space, 21ᵃ, cored in the exhaust pipe, from which a vertical discharge section, 22, of the blower pipe, leads centrally to or near the top of the exhaust nozzle, so that entrainment of gases and consequent augmentation of draft may be effected when steam is discharged through the blower pipe. Said pipe may, of course, if preferred, be unconnected with the exhaust pipe and be applied externally thereto, in any suitable manner. As shown in Fig. 11, the top of the discharge section, 22, may be covered by a perforated cap, 22ᵃ, so as to divide the column of discharged steam into a plurality of jets.

The gases of combustion which are drawn, by the exhaust-blast, through the entrainment passages, 16, are discharged through the central passage or space, 12ᵈ, in the exhaust pipe which is surrounded by the exhaust steam passages 12ᶜ, and through a central gas discharge passage, 15, in the annular exhaust nozzle, 17, which registers with the passage, 12ᵈ. In the preferred form shown in Figs. 1 to 11 inclusive and Fig. 13, the exhaust nozzle is provided with a plurality of exhaust steam discharge passages, 11, which are disposed, in circular plan, around the gas discharge passage, 15, and are preferably drilled in the exhaust nozzle at angles to the axis thereof. In order to facilitate the drilling of the passages or holes, 11, a corresponding number of hemispherical recesses, 11ᵃ, may be cored on the under side of the exhaust nozzle, it being a well known fact that no matter at what angle the holes may be drilled, the center of the drill, when central with the base of the hemisphere, will, at all times, be at right angles to a plane which is tangential to the hemisphere, and will therefore start the hole in its correct position without slipping out of place.

The discharge passages, 11, may be drilled at any angle desired to produce the proper angle of impingement for each individual jet of steam, the jets, when combined, forming a spirally rotating annular column.

The discharge passages are shown as drilled angularly in two directions relatively to the central gas discharge passage, *i. e.*, at a tangential angle thereto, thereby deflecting the column outward, and at a radial angle which contracts the ultimate diameter. The combination of these two angles, in any desired ratio, produces an intermediate angle which can thus be determined to give any vertical or circumferential angle of impingement in the stack desired, and also to increase or decrease the pitch of the resulting spiral annular column of exhaust steam. When using stacks of large diameter, the discharge passages, 11, may be alternately or serially drilled at different angles, so as to give different angles of impingement and produce an annular column of exhaust steam that will completely fill the stack.

In lieu of drilling the exhaust steam discharge passages 11, in the nozzle, 17, as above described, they may be cored therein, or, as shown in Figs. 12 and 14, they may be the spaces between a plurality of ribs or guide vanes, 11^b, disposed spirally between the inner and outer shells or walls of the nozzle, substantially as set forth in my pending application Ser. No. 438,912 aforesaid.

The function of the tangential disposition of the lateral entrainment passages, 16, relatively to the central or vertical gas discharge passages, 12^d and 15, is to cause the products of combustion, drawn from the smoke box, to rotate as they enter said passages, and to still further rotate as they ascend through the center of the annular column of exhaust steam discharged from the exhaust nozzle. This rotative action is still further increased by the conoidal or spiral direction of the entrainment passages.

The inclined exhaust steam passages, 12^c, at the upper end of the exhaust pipe, cause the columns of exhaust steam that have been separated by their traverse around the walls of the entrainment passages, 16, to commence to rotate and to reunite before entering the discharge passages, 11, in the exhaust nozzle, thereby producing a more uniform pressure and volume of steam prior to its entry into the exhaust nozzle.

The function of the plurality of inclined exhaust steam discharge passages, 11, of the nozzle, is to impart a rotative effect to the annular column of exhaust steam issuing therefrom, and the subdivison of this annular column by its discharge through a plurality of separated openings, increases its diameter and volume and materially reduces its velocity, causing a more complete and effective admixture with, and entrainment of, the gases and solid products of combustion passing outside of this column, while the rotative movement of the products of combustion passing through the entrainment openings causes them to more thoroughly mingle with the annular column of exhaust steam. In burning lignite fuels, the fine sparks which are given off during combustion, which it has heretofore been almost impossible to control and prevent from being thrown out of the stack in showers like the tail of a rocket, are thoroughly mingled with the exhaust steam and ground out against the inside of the stack by the spirally rotative effect of the column of steam.

In order to impart a uniform rotative pitch to the gases passing out through the vertical central gas discharge passage, 15, said passage may, as shown in Figs. 11 and 13, be fitted with a suitable spreader or deflector, 17^a, which may be varied in form to suit different conditions, and which, however, is not essential to the successful operation of my improvement as hereinbefore described. In the instance herein exemplified, the spreader or deflector consists of a plurality of radial helically disposed blades, extending from a circumferential ring, fitting against the inner wall of the exhaust nozzle, to a central hub, which fits around the discharge section, 22, of the blower pipe, when the latter is applied in connection with the exhaust pipe and nozzle.

To facilitate the grinding of the joint between the base of the exhaust pipe and the cylinder saddles, a metallic joint ring, 28, preferably of cast iron, may be used. As shown in Figs. 15 and 16, said joint ring consists of a plate having an opening corresponding with that of the base of the exhaust pipe, 12, and similarly divided by a longitudinal central partition. The plate may be either provided with flanges of less thickness than its body and having holes for the passage of bolts, or may be of the same contour as the grinding surface and without flanges. The joint ring can be alternately and independently ground to the surfaces of the exhaust pipe and the cylinder saddles, respectively, and will enable much time and labor to be saved in handling a heavy exhaust pipe, as well as insure a better joint.

The joint ring above described is not claimed as a part of my present invention, and constitutes the subject matter of a divisional application filed by me September 16, 1909, Ser. No. 517,978.

The increased efficiency of the improved exhaust pipe and nozzle hereinbefore described, in producing a higher and more perfect vacuum in the smoke box and consequent greater and more uniform draft upon the fire, together with the substantial increase in the area of the stack permissible in the use of the improvement, materially reduces the consumption of fuel, and, by insuring better and more uniform combustion, diminishes the evolution of smoke from the

stac'. Further, by reason of the material enlargement of the total area of exhaust discharge opening which is rendered available, the back pressure in the cylinders of the engine is minimized, thereby largely increasing its efficiency. The disintegration of the jet, and the spiral action of the enlarged annular column of exhaust steam, effected by the plurality of spirally disposed discharge passages in the nozzle, together with the spiral action of the interior column of gases from the central gas discharge passage, effected by the plurality of lateral tangentially disposed entrainment passages, causes the gases and solid products of combustion to commingle perfectly with the annular column of exhaust steam, which will completely fill a stack of large diameter. The centrifugal action of the annular column causes the sparks and cinders to be thrown outward against the inside of the stack, and during their spiral rotation against the surface thereof, they are completely ground up and extinguished, so that when ejected from the stack, the sparks are dead.

Variations in the number, form, angle and positions of the lateral gas entrainment passages and the discharge passages of the exhaust nozzle, may be made in the discretion of a constructor skilled in the art, without departure from the spirit and operative principle of my invention, and I do not, therefore, limit myself to the specific structural details herein described and shown.

I claim as my invention and desire to secure by Letters Patent:

1. A locomotive exhaust pipe having an annular passage for the discharge of the blast jet, a central passage for the discharge of the entrained gases, and a plurality of lateral passages, for the entrainment of gases, leading from its exterior into, and disposed relatively to, said central discharge passage, so as to induce, by the action of the blast jet, rotation or gyration of the column of gases discharged from said central passage.

2. A locomotive exhaust pipe having an annular passage for the discharge of the blast jet, a central passage for the discharge of the entrained gases, and a plurality of lateral passages, for the entrainment of gases, leading from its exterior into, and disposed tangentially with relation to, said central discharge passage.

3. A locomotive exhaust pipe having a central gas discharge passage provided with a plurality of lateral passages for the entrainment of gases, leading thereinto from the exterior of the exhaust pipe, and a contiguous annular passage for the discharge of the blast jet, the wall or partition separating said central gas discharge passage and annular steam discharge passage being upwardly and outwardly inclined, so as to present the minimum obstruction to the exhaust steam entering said annular passage on the one side and provide exit for the rotation of the entrained gases on the other.

4. A locomotive exhaust pipe having a central gas discharge passage provided with a plurality of upwardly and outwardly inclined lateral gas entrainment passages leading thereinto from the exterior of the exhaust pipe, said passages being inclined upwardly and outwardly relatively to its vertical axis, and a contiguous annular passage for the discharge of the blast jet.

5. The combination of a locomotive exhaust pipe having an annular passage for the exhaust steam, a central passage for the discharge of the entrained gases, a plurality of passages for the entrainment of gases, disposed relatively to said central passage so as to induce, by the action of the blast jet, rotation or gyration of the column of gases discharged from said central passage, and an annular nozzle having a plurality of passages for the discharge of the blast jet.

6. The combination of a locomotive exhaust pipe having an annular passage for the exhaust steam, a central passage for the discharge of the entrained gases, a plurality of lateral passages, for the entrainment of gases spirally disposed relatively to the axis of said central passage, and an annular nozzle having a plurality of spirally disposed passages for the discharge of the blast jet.

7. A locomotive exhaust pipe having an annular passage for the exhaust steam, a central passage for the discharge of the entrained gases, a plurality of lateral passages for the entrainment of gases, and a plurality of spirally disposed passages for the exhaust steam, leading into said annular passage.

8. A locomotive exhaust pipe having at its top a central passage for the discharge of gases, an annular passage for the exhaust steam, and a plurality of passages for the exhaust steam leading into the annular passage and disposed relatively thereto so as to impart rotation or gyration to the column of steam passing into said annular passage.

9. A locomotive exhaust pipe having at its top an annular passage for exhaust steam surrounding a central passage for the discharge of gases, a plurality of spirally disposed lateral passages communicating therewith for the entrainment of gases, and a plurality of spirally disposed steam passages leading into said annular steam passage.

10. In a locomotive or other engine using forced draft, the combination of a smoke box, a smoke stack, and an exhaust pipe having an annular passage for the escape of the exhaust steam, surrounding a central gas passage having a plurality of passages leading thereinto and so disposed relatively thereto as to induce rotation or gyration of

the column of gases entrained and discharged therethrough by the action of the annular exhaust jet.

11. In a locomotive or other engine using forced draft, the combination of a smoke box, a smoke stack, an exhaust pipe having an annular passage for the exhaust steam, a central discharge passage having a plurality of entrainment passages communicating therewith and so disposed relatively thereto as to impart rotation or gyration to the column of gases discharged therethrough, by the action of the exhaust jet, and a detachable exhaust nozzle, of annular form, surrounding said central passage.

12. In a locomotive or other engine using forced draft, the combination of a smoke box, a smoke stack, an exhaust pipe having an annular passage for the exhaust steam, a central discharge passage having a plurality of entrainment passages communicating therewith and so disposed relatively thereto as to impart rotation or gyration to the column of gases discharged therethrough by the action of the exhaust jet, and an annular exhaust nozzle having a plurality of discharge passages surrounding said central passage.

13. In a locomotive or other engine using forced draft, the combination of a smoke box, a smoke stack, an exhaust pipe having an annular passage for the exhaust steam, a central gas passage having a plurality of entrainment passages communicating therewith and so disposed relatively thereto as to induce rotation or gyration of the column of entrained gases discharged therefrom by the action of the exhaust jet, and an annular exhaust nozzle having a plurality of spirally disposed discharge passages, surrounding said central passage.

14. The combination of a locomotive exhaust pipe having an annular passage for the discharge of the blast jet surrounding a central gas discharge passage having a plurality of lateral entrainment passages leading thereinto from the exterior of the exhaust pipe, and a spreader or deflector comprising a plurality of radially extending inclined blades or vanes, located within the discharge end of said central gas passage.

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Witnesses:
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G. M. COOPER.