

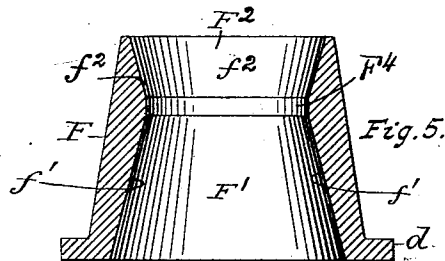
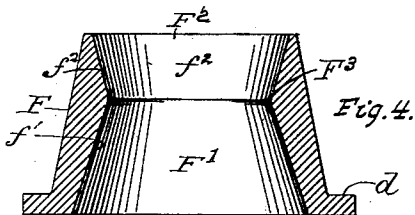
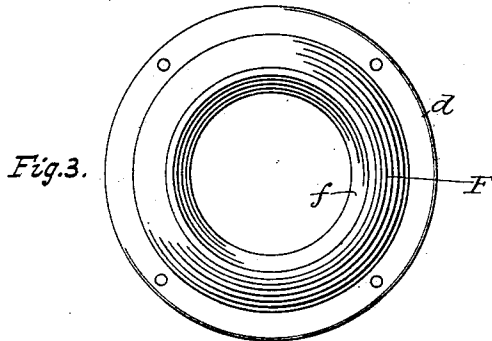
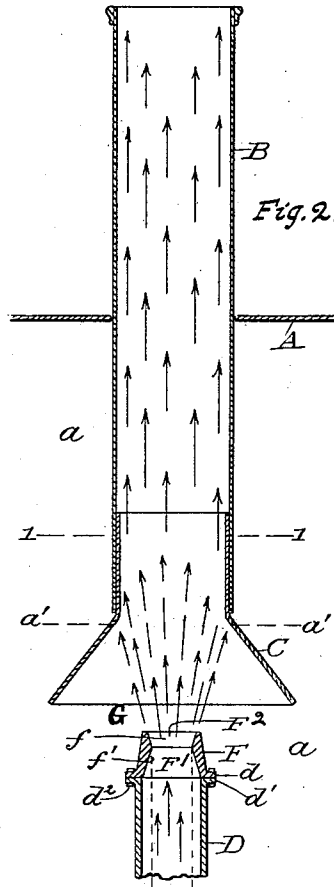
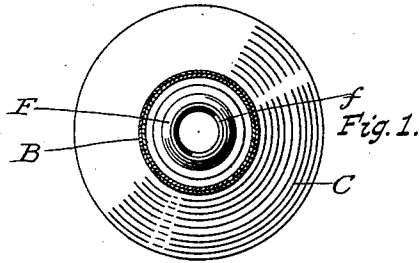
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Patented Sept. 26, 1899.

W. A. BUCKBEE.
LOCOMOTIVE EXHAUST PIPE.

(Application filed Apr. 29, 1899.)

(No Model.)



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LOCOMOTIVE EXHAUST-PIPE.

SPECIFICATION forming part of Letters Patent No. 633,566, dated September 26, 1899.

Application filed April 29, 1899. Serial No. 715,000. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. BUCKBEE, a citizen of the United States, residing at Rensselaer, in the county of Rensselaer and State of New York, have invented new and useful Improvements in Locomotive Exhaust-Pipes, of which the following is a specification.

My invention relates to exhaust-pipes of locomotives and for producing a continuous vacuum in the smoke-arch and smoke-stack for inducing a draft through the burning fuel in the fire-box of the locomotive and the flues of the boiler and thence out through the smoke-stack; and it consists in the novel devices and novel combinations of parts and devices herein shown and described, and more particularly pointed out in the claims; and it is designed more particularly for use in the class known as "single-cylinder compound locomotives."

The objects and advantages of the invention will be fully understood from the following description when taken in connection with the annexed drawings, in which—

Figure 1 is a plan of the invention, taken at line 1 in Fig. 2. Fig. 2 is a sectional elevation illustrating the invention. Fig. 3 is a plan of the exhaust tip or nozzle of the exhaust-pipe on an enlarged scale. Fig. 4 is a view of the same in section, and Fig. 5 is a view in section illustrating a modification.

Similar letters of reference refer to similar parts throughout the several views.

In the drawings, A is the crown-plate of the smoke-arch of the locomotive, and a is the smoke-arch chamber. B is the smoke-stack of any suitable construction. C is the hood communicating from the smoke-arch chamber to the smoke-stack, and D is the exhaust-pipe leading from the exhaust-chambers of the cylinders (not shown) of the locomotive. All these above-mentioned parts and devices are so well known that a particular description of the same is unnecessary.

F is an exhaust tip or nozzle of the exhaust-pipe D, which discharges the exhaust-steam from the cylinders of the engine into the smoke-arch at a point below the smoke-stack and relatively central in the same. Heretofore this exhaust tip or nozzle portion of the exhaust-pipe was made with a throat having its inner vertical lines of side of the same

about parallel or slightly tapering inwardly as they were extended upwardly to the discharge-mouth of said tip or nozzle, so that the exhaust-steam from the cylinders escaping from the same into said exhaust-pipe was when discharged from the latter in condition of high temperature and expansive force, so that when entering the hood depending from the lower end of the smoke-stack and the stack itself the volume of the exhaust-steam would quickly expand to such an extent as to fill the chamber of the stack in its area of opening in about a uniform degree of density and move upwardly with great velocity through the stack to its discharge therefrom, and thereby operate as an elastic piston moved by expansive force of the exhaust-steam through the entire length of the stack and operating to induce a vacuum or a strong suction on the hot gaseous products evolved in the fire-box by combustion of fuel therein which passes successively into the smoke-flues of the boiler, the smoke-arch, and hood, thus inducing strong sharp drafts of air into the burning fuel from below the grate, while at the same time the natural pressure of the outer atmosphere is being met by the reacting force of the exhaust-steam resisting this atmospheric pressure.

In simple engines of locomotives there occur four discharges of the exhaust-steam to one revolution of the wheels, so that in the time of each revolution of the same the exhaust-steam discharges are made in such close successions as to be about or nearly continuous. In single-cylinder compound engines of locomotives there are only two discharges of exhaust-steam at each revolution of the drive-wheels, and consequently the discharges are made relatively at longer intervals and after the exhaust-steam has become low in temperature and reduced in its expansive force as compared to the temperature and expansive force of exhaust-steam from simple-engine cylinders, and by reason of this less number of discharges of exhaust-steam at lower temperature and with less expansive force from single-cylinder compound-engine locomotives this class of locomotives have failed to make steam as fast and in quantity as they should do for keeping up speed and hauling heavy loads as is necessary for mak-

ing schedule time on roads in passenger and freight service. I have discovered that the cause of this failure to make steam rapidly and in ample volume in this class of locomotives arises from the low expansive force of the exhaust-steam at the time of its discharge from the discharge-openings of the exhaust pipe or column as heretofore provided for effecting either a direct straight vertical discharge or a flaring discharge into the chamber of the smoke-arch communicating with the flue of the smoke-stack. Although these old forms of discharge-openings of the exhaust-pipe are adapted to effect good results for stimulating the draft in the old class of simple-cylinder engines from the furnace-grate to the discharge end of the smoke-stack, because the exhaust-steam from simple high-pressure cylinders is of high temperature and great expansive force when being discharged from the exhaust-pipe, yet these old forms of discharge-openings of the exhaust-pipe entirely fail to stimulate the draft in compound-engine locomotives from the furnace-grate to the discharge end of the smoke-stack, because the discharged steam from the high-pressure cylinder of compound locomotive-engines is reduced in its expansive force first in its passage through the receiver and next in its passage through the low-pressure cylinder. I have also discovered that the expansive force of exhaust-steam from the low-pressure cylinders of compound engines of locomotives may be increased in its expansive energy at its point of discharge from the tip or nozzle of the exhaust-pipe by a mechanical contraction of the volume of exhaust-steam at a point between the discharge end of the chamber of the exhaust-pipe and the discharge end of the tip or nozzle of that pipe to an area a little greater or less than one-half of that volume of the exhaust-steam when discharging from the upper end of the chamber of the exhaust-pipe and that by mechanically controlling the expansion of this contracted volume of exhaust-steam in its passage from its point of greatest contraction in the nozzle or tip to the intake or lower end of the smoke-stack the entire volume of each exhaust discharge may be made to fill the flue of the smoke-stack in its cross-area so completely and uniformly as to cause this exhaust-steam to operate as an upwardly-moving elastic piston which is adapted to drive the atmosphere before it out of the stack, and thereby effect a partial vacuum between the furnace-grate and the discharge end of the smoke-stack, so that the draft of the locomotive will be stimulated for drawing the gaseous products of combustion from the fire-box into the smoke-stack and fresh air into the mass of fuel in combustion in the furnace, and thereby produce a rapid and best condition of combustion for developing in furnace a high degree of temperature for rapidly generating and uniformly maintaining an ample

quantity of steam at high pressure at all times.

In the drawings, F is an exhaust-steam-discharge tip or nozzle embodying elements adapted to contract the volume of exhaust-steam in its cross direction before its discharge into the smoke-stack and also to so control the expansion of the exhaust-steam in its discharge and upward passage that it may directly enter into the flue of the smoke-stack without meeting any material resistance and fill the same in its entire cross-sectional area from the time of its start to its finish of passage to and through said flue. This exhaust-nozzle F may be made of any suitable metal and with size and proportions of essential parts or elements as may be found to be suitable for use with exhaust-pipes and smoke-stacks as locomotives differing in size and hauling capacities may require. It is preferably made with a vertical length about equal to one-half (more or less) of the diameter of the chamber of the exhaust-pipe D at the point of connection of the former with the latter, and comprises the steam-contracting chamber F', located in its lower-half portion, and the outwardly-flaring chamber F², contained in the upper-half portion, and the throat F³, intermediate between said two chambers F' F². My general practice in proportioning the said two chambers F' F² and throat of this nozzle has been to make the steam-contracting chamber F' with a length of vertical extension from the plane of its lower end or bottom to the throat F² about twice that of the vertical extension of the flaring upper chamber F² and making the diameter of the throat F³ such as to produce an area of opening equal to about one-half the area of the said steam-contracting chamber at its lower or bottom end, where it connects with the chamber of the exhaust-pipe D, so as to adapt this steam-contracting chamber F' to contract the volume of discharge exhaust at its point of passage through the throat F³ to one-half the area it had when first entering the said steam-contracting chamber from the chamber of the exhaust-pipe D. The angles of the inclination of the inner side-wall surfaces f' of chamber F' and f^2 of chamber F² are shown to be made about or nearly the same and are in reversed directions from the throat F³. These relative proportions may be varied as circumstances may require. This nozzle F, embodying the said chambers F' F² and throat F³, may be connected with the upper end of the exhaust-pipe D by making it integral with the latter or by mounting it on the upper end of said pipe and securing it thereto by any suitable means, yet I at present prefer to employ flanges d d' and bolts d^2 , as shown, for making a secure connection of this nozzle to said pipe. When connected with said exhaust-pipe, this nozzle is to be so located in relation to the intake end of the flue of the smoke-

stack B that the vertical axial line of the nozzle may be about coincident with that of said intake of the smoke-stack flue, while at the same time this nozzle is arranged below the plane of the lower end of the smoke-stack, so that if the lines of the inclination of the circular inner side surface-walls F^2 were extended upwardly and outwardly, as indicated by dotted lines in Fig. 2, they would touch the circumferential line of the flue of the smoke-stack at its point of intake, as also illustrated in same figure. When located, arranged, and secured as described, this steam-controlling exhaust-discharge nozzle F will be relatively about central to the chamber of the hood C, generally provided, depending below the lower end of the smoke-stack and having its lower end rim concentric to the upper end rim of the chamber F^3 of the nozzle and so distant all around therefrom as to produce between said hood and nozzle an unobstructed circular form of smoke-intake opening G, having an area so large as to freely admit the products of combustion being drawn into the said hood and thence be drawn into the flue of the smoke-stack by the draft induced by the exhaust discharges from this nozzle F acting as pistons moving upward through the said flue and producing a partial vacuum into which the smoke and cinders may be freely drawn at the time the natural outside atmosphere is being prevented entering into the smoke-stack from above.

Although the steam-contracting chamber F' is shown to be made in the detachable nozzle F , yet the spirit of my invention will not be departed from should a similar form of chamber be formed in the exhaust-pipe D itself and be wholly omitted from said nozzle, in which case the throat F will be in situation at or near the plane of the upper end of the said exhaust-pipe, when a like contraction of the volume of exhaust-steam will be effected in the same manner by throat F^3 and then be allowed by the walls of the flaring chamber F^2 to expand uniformly all around to a diameter corresponding to that of the flue of the smoke-stack and move upward through the same and operate as a piston for inducing a suitable draft for stimulating the combustion of the fuel. As this modification (not shown in the drawings) does not involve any invention or effect any different change of operation or result, it will be understood that in some cases a steam-contracting chamber operating as chamber F' in nozzle F may be made in the body of the exhaust-pipe, while the flaring discharge-chamber F^2 by its walls starting from the throat F^3 will operate to control the circumference of expansion of the exhaust-steam the same as above described.

In Fig. 5 is shown a throat (marked F^4) having an extension of length greater than the throat F^3 , (shown in Fig. 4,) which may be found to be of advantage when the axial line of the exhaust-pipe, to which the nozzle may be applied, is not exactly in line with that of

the flue of the smoke-stack which is to receive the exhaust discharges.

By employment of this invention in locomotives having compound engines there may be produced a draft uniformly steady and soft, yet sufficiently strong for furnishing an ample supply of fresh air for supporting combustion of fuel in the furnace without lifting the finer portions thereof and for drawing the hot products of combustion at a rate of movement through the boiler-flues which may be most advantageous for permitting the flues to absorb heat and transmit it to the water in the boiler for generating the steam required, and thereby effect a saving of a very large per cent. of coal in a given mileage and time of haulage of a train as compared to that required for the same mileage and time of hauling by compound-engine locomotives employing exhaust nozzles or tips of the constructions as heretofore made and applied for use.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. An exhaust-steam-discharge tip or nozzle having central in it a throat which is adapted to contract as described the area of the volume of exhaust-steam passing into it from a larger chamber below, and also having a chambered discharge-mouth formed by outwardly-flaring side walls which are extended from said throat on unbroken lines of like inclination so as to adapt said walls to control the angle of expansion of the contracted volume of exhaust-steam after its passage from said throat, substantially as and for the purposes set forth.

2. An exhaust-steam-discharge tip or nozzle having in its lower-half portion an exhaust-steam-contracting chamber and in its upper-half portion an outwardly-flaring discharge-chamber which is formed by walls having their inner side surfaces extended flaringly in like lines of unbroken inclination as described, and having between said two chambers a throat-opening of area about one-half of that of the lower end of the said steam-contracting chamber, the tip or nozzle being adapted to be arranged in a line below the intake end of a smoke-stack flue and be securely connected with the upper end of an exhaust-steam pipe or column, substantially as and for the purposes set forth.

3. In a compound-engine locomotive the combination with the flue, of its smoke stack or pipe, of an exhaust-pipe arranged in line relatively central with said flue and below the same and having connected with its upper end an exhaust-steam-discharging nozzle or tip which is provided with a steam-contracting chamber adapted to receive exhaust-steam discharges from the cylinders of said locomotive, and having a throat-opening, at the upper end of said steam-contracting chamber, of area, described, as compared with the area of said steam-contracting chamber at the

lower end thereof, and also having a steam-discharge chamber communicated to from said throat and inclosed about by inclined wall-surfaces which are extended in unbroken lines of like inclination outwardly and upwardly from the said throat to a rim of circumference less than the circumference of the lower end of said steam-contracting chamber substantially as and for the purposes set forth.

4. In a compound-engine locomotive, the combination with the flue of its smoke stack or pipe and an exhaust-pipe arranged below said flue and relatively central thereto, of the discharge nozzle or tip F having in its lower-half portion the steam-contracting chamber F' , communicating with the chamber of said exhaust-pipe, and in its upper-half portion the flaring discharge-chamber F^2 , and the throat-opening F^3 , communicating from said steam-contracting chamber to said flaring discharge-chamber, the walls of said chambers being reversely inclined, the said throat-opening being of smaller area than the area of the bottom of said steam-contracting chamber and the angle of inclination of the inner side-wall surfaces f^2 of said flaring discharge-chamber being adapted to control the area of expansion of the discharged exhaust-steam at the

intake of said flue to an area equal to that described by the circumference of said flue, substantially as and for the purpose set forth.

5. In a compound-engine locomotive, the combination with the smoke-stack, and outwardly-flaring hood pending from the lower end of said stack and concentric to the flue of the same, and an exhaust-pipe arranged below the intake end of said flue and central in relation to the same, of the discharge-nozzle F connected with the upper end of said exhaust-pipe and having throat F^3 of area described and the discharge-chamber F^2 having its circumferential wall-surfaces f^2 extended outwardly from said throat on lines of inclination adapted to cause the exhaust-steam discharges to expand to a circumference corresponding to that of the intake-opening of the flue of the said smoke-stack and fill the area of the same, and the unobstructed smoke-intake opening G between the lower end rim of said hood and the upper end rim of said nozzle, substantially as and for the purposes set forth.

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Witnesses;

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