4 Sheets—Sheet 1.

J. DOWNES.

MEANS FOR UTILIZING EXHAUST STEAM.

No. 182,424. Patented Sept. 19, 1876.

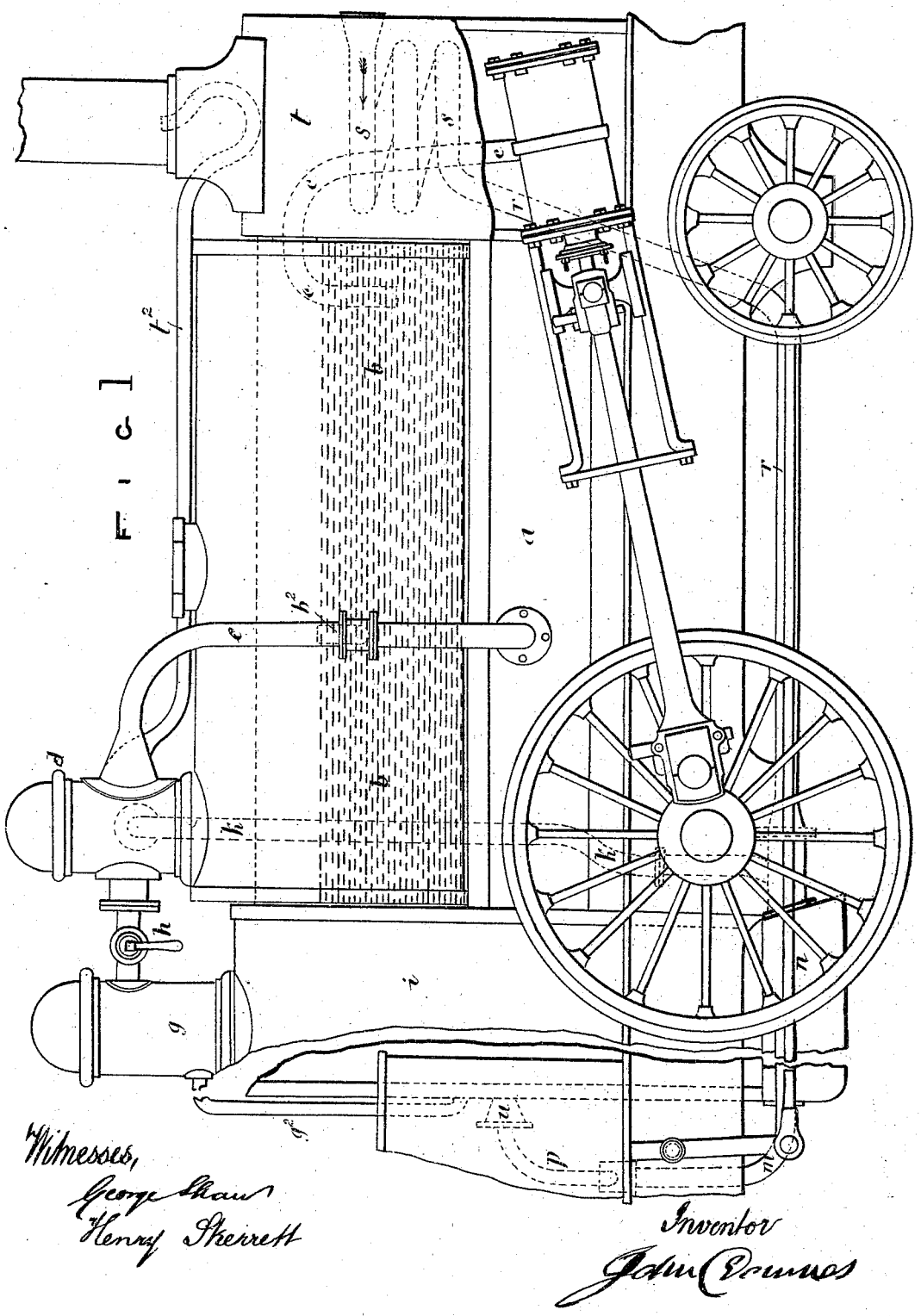

Fig 1

Witnesses,
George Shaw
Henry Sherrett

Inventor
John Downes

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J. DOWNES.

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FIG. III

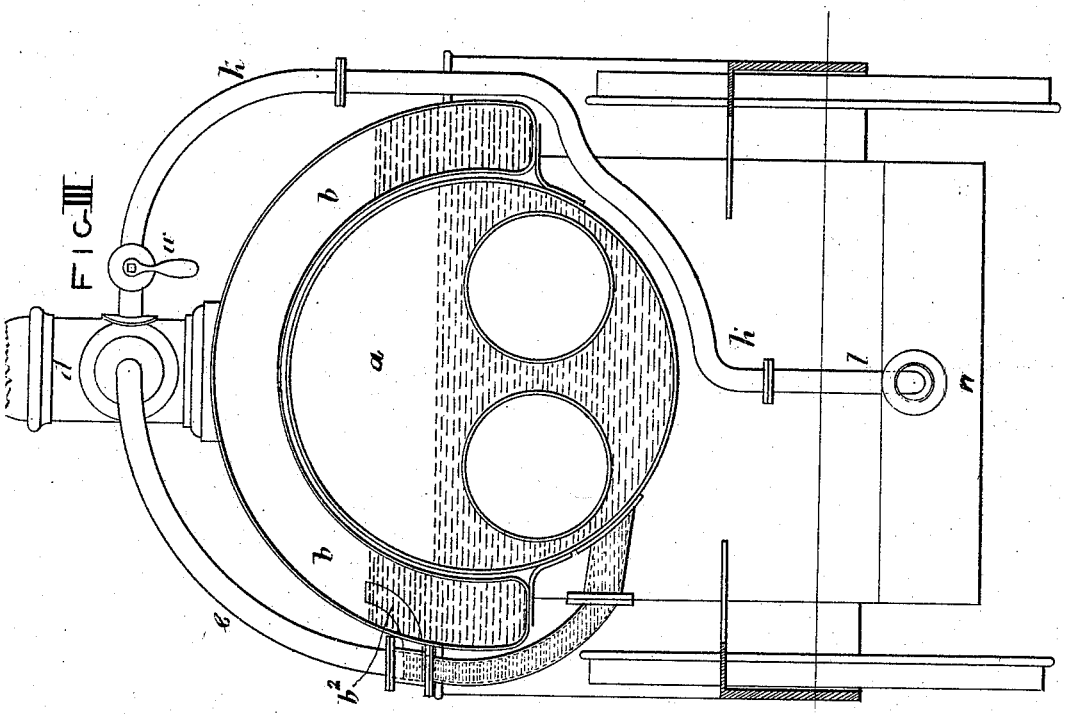
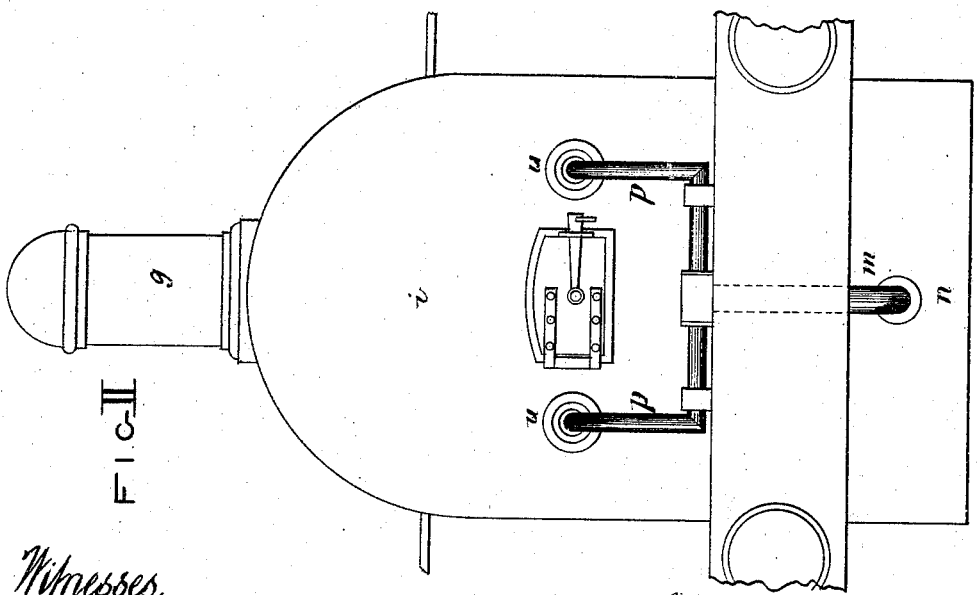


FIG. II



Witnesses,
George Shaw
Henry Sterrett

Inventor
John Downes

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J. DOWNES.

MEANS FOR UTILIZING EXHAUST STEAM.

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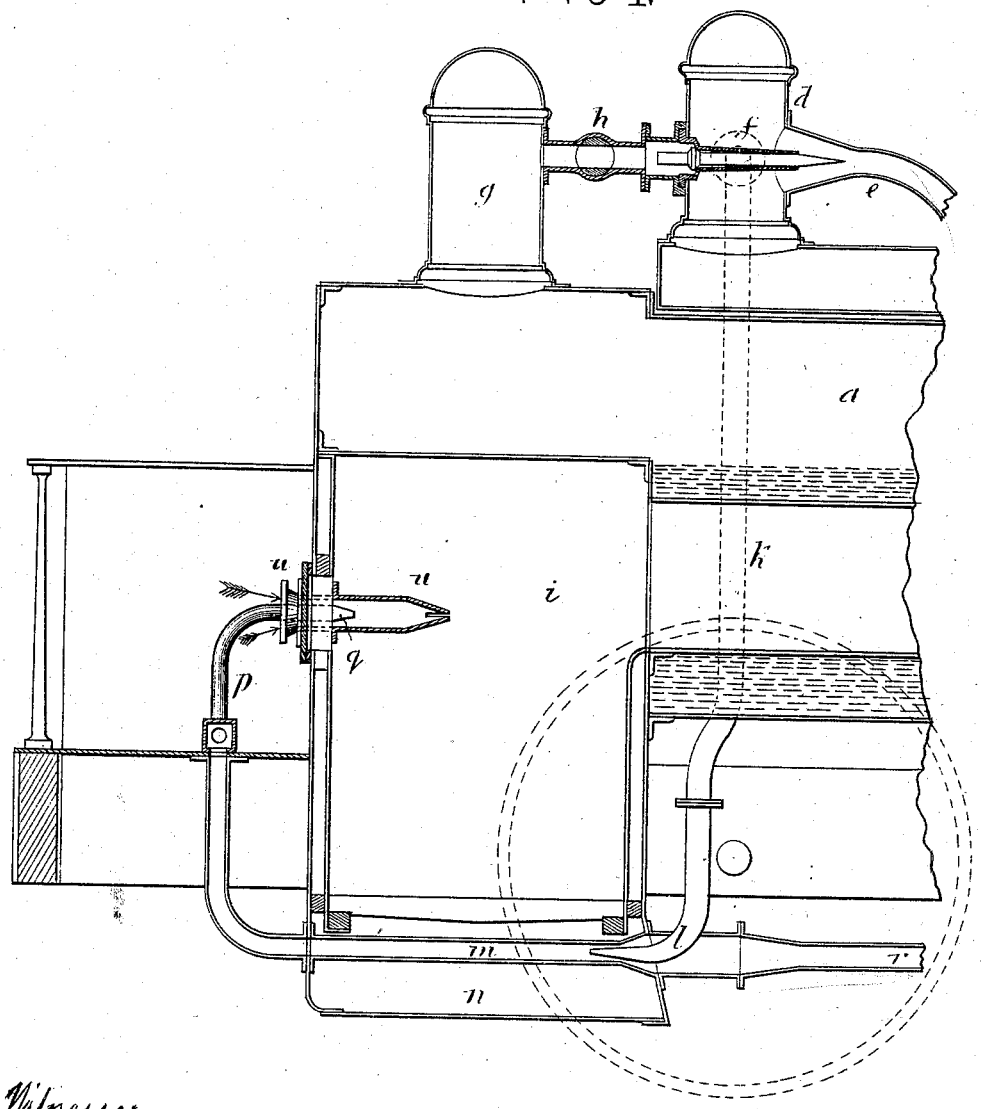
FIG-IV



Witnesses,
George Haas
Henry Sherrett

Inventor
John Downes

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J. DOWNES.

MEANS FOR UTILIZING EXHAUST STEAM.

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FIG V

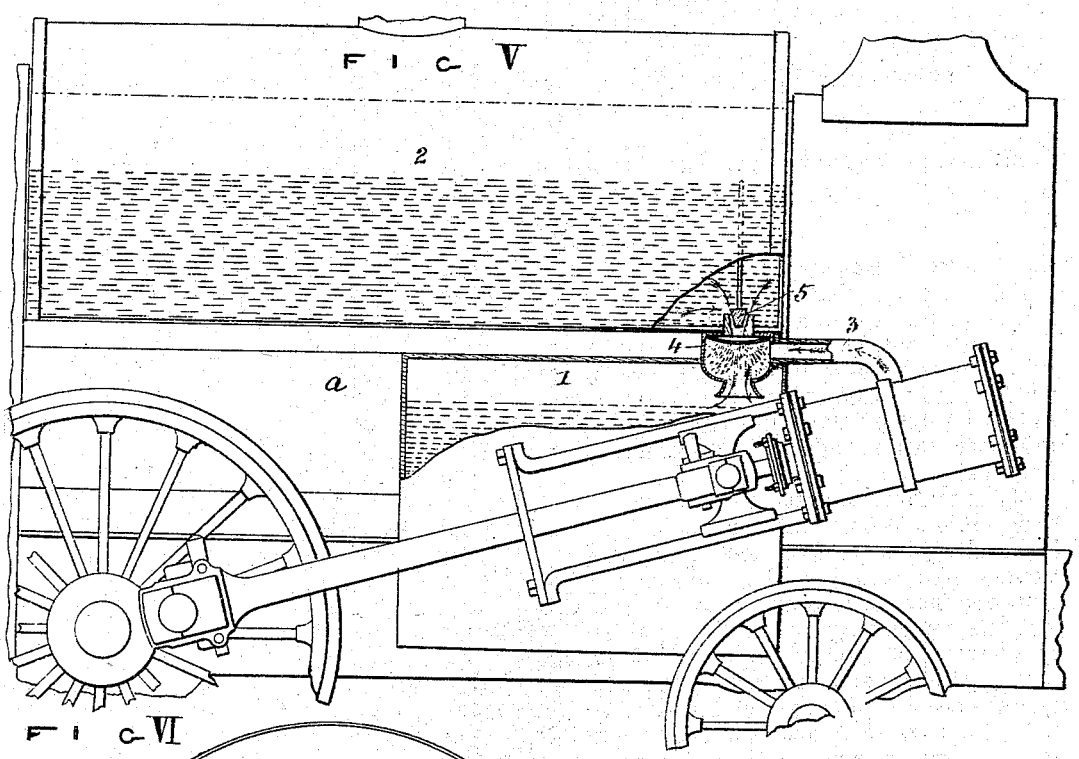
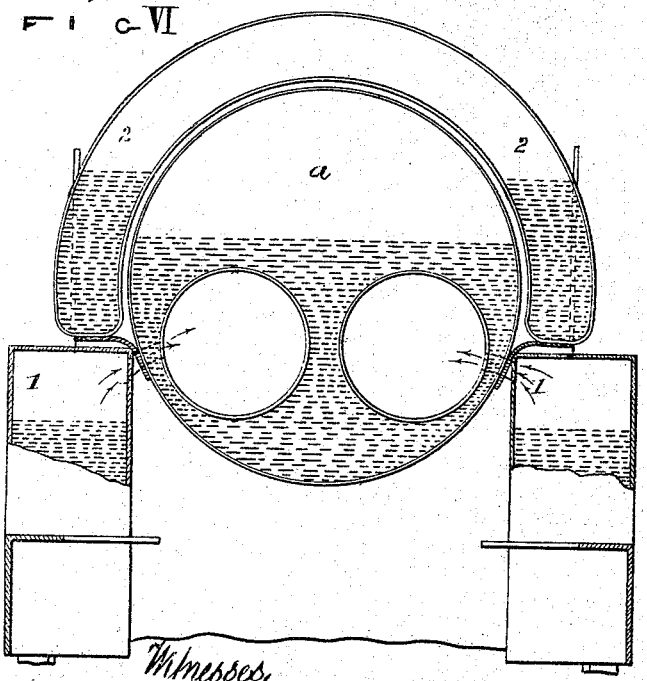


FIG VI



Witnesses,
George Shaw,
Henry Sherrett

Inventor
John Downes

UNITED STATES PATENT OFFICE.

JOHN DOWNES, OF HANDSWORTH, ENGLAND.

IMPROVEMENT IN MEANS FOR UTILIZING EXHAUST STEAM.

Specification forming part of Letters Patent No. **182,424**, dated September 19, 1876; application filed July 1, 1876.

To all whom it may concern:

Be it known that I, JOHN DOWNES, of Handsworth, in the county of Stafford, England, merchant, have invented new and useful Improvements in Locomotive and Stationary Steam-Engines, which improvements are fully set forth in the following specification, reference being had to the accompanying drawings.

My invention consists of the construction and combinations or arrangements of parts, hereinafter described, of locomotive and stationary steam-engines, the said construction and combinations of parts having for their object the condensing and utilizing of the exhaust steam of the said engines, and making them noiseless and smokeless, or nearly so, and the economizing of fuel and water.

My improvements are especially applicable to locomotive-engines for common roads and tramways, but may also be applied to stationary and marine steam-engines.

In carrying my invention into effect, I make the outlet-port for the passage of the exhaust steam from the cylinder considerably larger than the inlet-port, and I connect the said inlet-port with a tank or series of pipes, arranged as hereinafter described, and convey the said exhaust steam into the said tank, and from the said tank into the boiler. This tank is, by preference, lined with sponge, cork, india-rubber, or other material which will rapidly condense the exhaust steam, as well as deaden the noise. The tank may be divided into compartments or sections, the said compartments being in communication with one another. The water with which the boiler of the engine is fed is heated by the said exhaust steam before it is supplied by the pump or injector to the boiler. The tank is furnished with a valve to permit of the escape of exhaust steam when necessary.

From either compartment of the tank described a pipe passes to the fire-hole of the boiler-furnace, the said pipe being furnished with one or more jets and regulators. By means of the said pipe and its jet or jets and regulators the exhaust steam is conveyed from the tank or tanks into the furnace in the form of a spray, and tends by its action to increase the draft and suppress smoke. I also in a similar way convey the exhaust steam into the funnel of the engine for creating a draft. By arranging the parts in the manner described the exhaust steam is self-supplied, and requires no attention.

When my invention is applied to the engines of tramway-cars there is no noise of escaping steam, and the frightening of horses is avoided.

Having explained the nature of my invention, I will proceed to describe, with reference to the accompanying drawings, the manner in which the same is to be performed.

Figure 1 represents in side elevation, Fig. 2 in end elevation, and Fig. 3 in transverse vertical section, a locomotive steam-engine provided with my improvements. Fig. 4 represents a portion of the same in longitudinal vertical section.

The same letters of reference indicate the same parts in the several figures of the drawings.

Around the upper side of the exterior of the boiler *a* of the locomotive steam-engine I place a tank or secondary boiler, *b*, into which tank the exhaust steam from the steam-cylinder is conveyed by means of pipes connected with the outlet-ports of the said cylinders, the said outlet-ports being made considerably larger than the inlet-ports. One of these pipes is represented in Fig. 1, and is marked *c*, the upper end of the said pipe *c* dipping into the water with which the tank *b* is partly filled.

In the drawing, the tank *b* consists of a single chamber, but the said tank may be divided into compartments or sections communicating with each other, and the said tank may be lined with sponge or other material which will rapidly condense the exhaust steam, and deaden the noise of the entering steam. The exhaust steam passed into the tank *b* by the pipes *c* is partly condensed therein, and the water in the said tank is brought to a boiling or nearly boiling heat.

The heated water in the tank *b* may be fed to the boiler *a* by a pump, or by an injector; or the said water, as well as the uncondensed exhaust steam in the tank may fed to the boiler *a* by an injector in the following manner: On the end of the tank *b* is a dome, *d*,

from the side of which a pipe, *e*, passes to the bottom of the boiler *a*, a valve or valves, opening inward, being situated at that end of the pipe *e* connected with the boiler. In the said dome *d* is an injector, *f*, in connection with the steam-dome *g* of the boiler *a*. b^2 is a pipe communicating between the tank *b* and pipe *e*, passing to the boiler *a*, and conveying the condensed water from the tank *b* to the said pipe *e*. By opening the stop-cock *h* high-pressure steam is admitted to the injector *f*, and the condensed water and exhaust steam are forced, by the action of the injector, along the pipe *e*, and through the valve or valves in its bottom end into the boiler *a*.

For the purpose of promoting the draft through the furnace *i*, increasing the combustion of the fuel therein, and preventing the formation of smoke, I convey a portion of the exhaust steam from the tank *b* to the said furnace *i* by means of the pipe *k* passing to the under side of the boiler. The lower end of the said pipe *k* is furnished with a nozzle-piece, *l*, which opens into the pipe *m*, passing through the ash-pit *n* of the furnace, or through the furnace itself. This pipe *m* is provided with branch pipes *p p*, each of which has at its end a jet, *q*, situated within the bell-mouth pipe *u*, projecting into the furnace *i*. The exhaust steam conveyed to the pipes *u u* mixes with the air entering the said pipes, and the mixture of exhaust steam and air passes into the furnace *i*. The inner ends of the bell-mouth pipes *u u* are flattened out, and provided with slits, so as to inject the mixture of exhaust steam and air into the furnace in the form of spray.

The jet *q* and the bell-mouth pipe *u* may be dispensed with, and the pipe *p* may deliver the exhaust steam direct into the ash-pit or fire-box.

The exhaust steam is somewhat superheated in its passage through the pipe *m*, which is heated by the furnace *i*. The quantity of exhaust steam passing to the furnace through the pipes *k m p*, and jets *q*, may be regulated by the stop-cock *w*; or the exhaust steam may be brought direct from the dome *f*, over the top of the tank *b* to the bell-mouth pipes *u u*. The exhaust steam alone may be conveyed to the bell-mouth pipes *u u* in the manner described, or a mixture of exhaust steam and heated air. In the latter case the pipe *m* is connected to the pipe *r*, which passes to the smoke-box *t*, the said pipe *r* terminating in a coil, *s*, fixed in the said smoke-box. (See Fig. 1.) The end of this coil *s* is open to the air. The air circulating through the coil *s* becomes heated thereby, and, mixing with the exhaust steam supplied by the nozzle *l*, enters the furnace by the jets *q*. The draft through the furnace, and the combustion of the fuel therein are thereby promoted, and smoke prevented. The draft of the furnace may also be promoted by conveying the exhaust steam from the dome *d* into the smoke-box *t* by the pipe t^2.

In addition to conveying the exhaust steam, or a mixture of exhaust steam and heated air, to the front of the furnace *i*, one or more pipes may convey the exhaust steam through the bottom of the furnace, to blow vertically into the ash-pit, and through the bars of the grate; or the exhaust steam may be conveyed to the furnace *i* through the back thereof. By passing the exhaust steam into the fire-box it becomes so heated that on its escape into the atmosphere it is not condensed, and is, consequently, invisible.

By means of a pipe, g^2, connected with the steam-dome *g*, surplus steam may be conveyed to the furnace to deaden the fire and prevent noise of escaping steam from the the safety-valve when the engine is standing.

Instead of employing a tank around the upper part of the boiler for condensing the exhaust steam, one or more tanks for the exhaust steam may be situated at the side or sides of and below the boiler, the said exhaust tank or tanks being used in combination with a cold-water tank or pipes around the boiler.

This modification of my invention is illustrated in longitudinal section in Fig. 5, and cross-section in Fig. 6, where 1 1 are the tanks for the exhaust steam at the sides of and below the boiler *a*, and 2 is the tank around the boiler, serving as a cold-water tank. 3 is the exhaust-steam pipe from the cylinder in communication with the tank 1. The pipe 3 opens into the tank 1 by means of the small chamber 4, the upper part of which is perforated with small holes, forming a rose. Between the cold-water tank 2 and the chamber 4 is a valve, 5. The exhaust steam passing through the pipe 3 from the cylinder is mainly condensed by means of the spray or jets of cold water delivered through the perforated top of the chamber 4 from the cold-water tank 2. The valve 5 is worked by rods and levers from the foot-plank of the engine. By means of the said rods and levers the valve 5 may be opened and closed at pleasure. When the engine is stationary the valve 5 is closed, and cold water is prevented from passing to the condensing-tank 1; but on starting the engine the said valve 5 is opened, when the greater part of the exaust steam from the cylinder is condensed by the cold water meeting it on its passage to the tank 1. The hot water in the tanks 1 1 is pumped therefrom by pumps worked from eccentrics on the axis of the driving-wheels of the engine or otherwise.

The framing of the engine may be utilized so as to carry the exhaust-tanks.

The exhaust steam in the tanks 1 1 may be conveyed to the front, back, and bottom of the furnace of the locomotive by an arrangement of parts essentially the same as that already described with respect to Figs. 1, 2, 3, and 4, excepting that the pipe conveying the exhaust steam is connected directly to the tank instead of to a dome.

The improvements described and illustrated may be applied to locomotives in which the boiler is situated vertically instead of horizontally, and the said improvements are also ap-

plicable to locomotive steam-engines for tramways, and to marine and stationary steam-engines.

In applying the said improvements to locomotive steam-engines for tramways and to marine and stationary steam-engines, I arrange or combine the parts constituting my invention, substantially in the manner described and illustrated, with respect to a locomotive steam-engine, such changes only being adopted as are necessary to adapt my improvements to the particular steam-engine with which they are to be used.

Having now described the nature of my invention, and the manner in which the same is to be performed, I wish it to be understood that I do not limit myself to the precise details herein described and illustrated, as the same may be varied without departing from the nature of my invention; but

I claim as my invention of improvements in locomotive and stationary steam-engines—

1. The combination, substantially as described, of the feed-water tank, the exhaust-pipes leading thereto, and the exhaust-steam blast-pipe, through which the surplus exhaust steam in said tank is conveyed to the fire-box or furnace, as and for the purposes set forth.

2. The combination, substantially as set forth, of the feed-water tank, the exhaust-steam pipe or pipes leading thereto, and the blast and boiler feed connections leading from said tank, whereby the exhaust steam in the said tank is conveyed both to the fire-box or furnace, and, together with the feed-water, to the boiler, substantially as described.

3. The combination and arrangement, substantially as set forth, of the feed-water tank, the exhaust-steam pipe or pipes leading thereto, the surmounting dome, the live-steam injector, and the boiler feed-pipe, through which the exhaust steam and the water in said tank are conveyed to the boiler.

4. The feed-water tank and the exhaust-steam pipe or pipes leading thereto, in combination with the air pipe or pipes, and the exhaust-steam pipe leading from said tank, and arranged to operate in connection with said air pipe or pipes, substantially as described, and for the purpose of conveying a mixture of exhaust steam and heated air to the furnace.

JOHN DOWNES.

Witnesses:
GEORGE SHAW,
HENRY SKERRETT,
Of 37 Temple Street, Birmingham.