WILLIAM BAXTER.

STEAM ENGINES

FOR STREET CARS &c.

Patented Nov. 14, 1871.

No. 120,930

FIG.1.

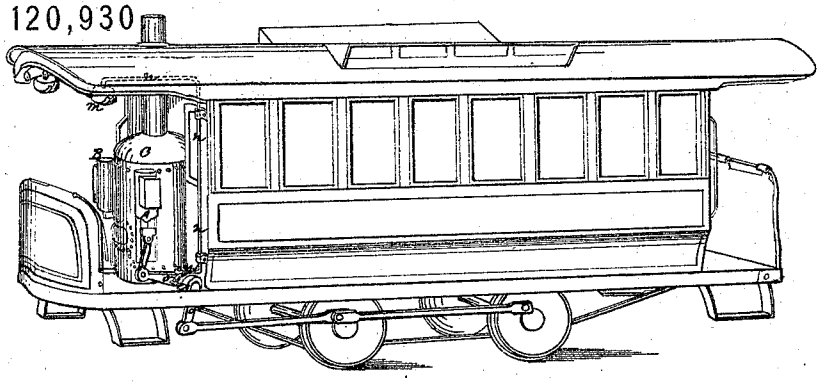

FIG.2.

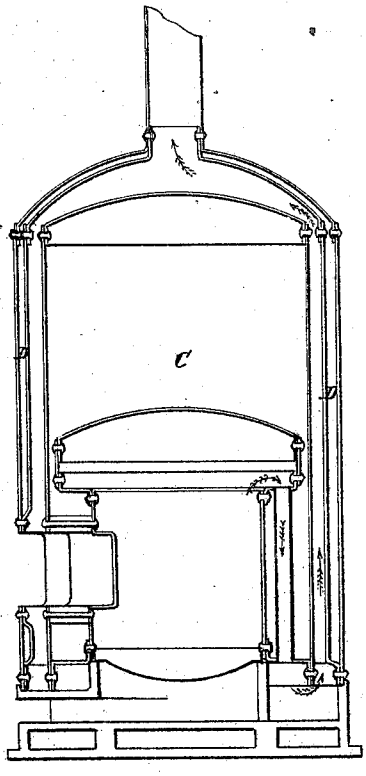

FIG.3.

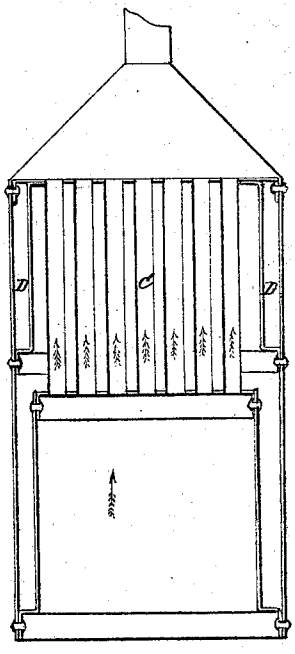

FIG.5.

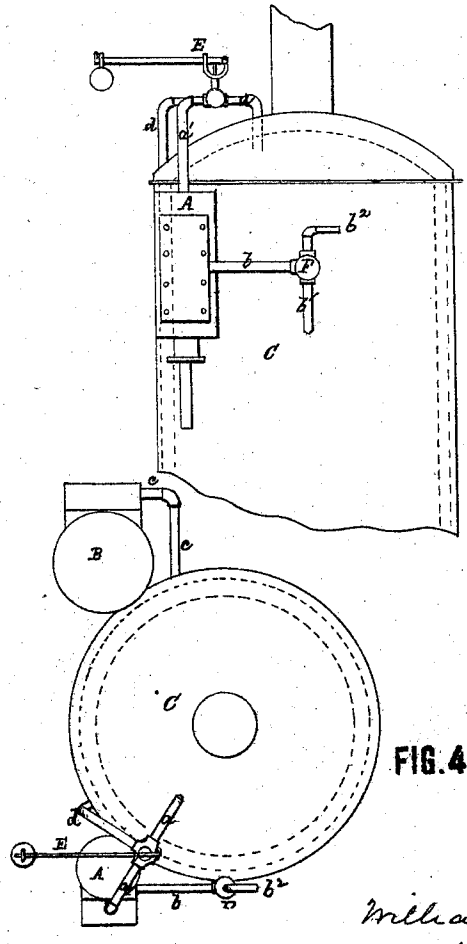

FIG.4.

WITNESSES.

C. B. Nottingham.

J. B. Nottingham

William Baxter
by his attorney
A. Pollok

AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

WILLIAM BAXTER, OF NEWARK, NEW JERSEY, ASSIGNOR TO HIMSELF, A. J. HALSEY, AND WILLIAM BAXTER, JR., OF SAME PLACE.

IMPROVEMENT IN BOILERS AND ENGINES FOR STREET-CARS.

Specification forming part of Letters Patent No. 120,930, dated November 14, 1871.

To all whom it may concern:

Be it known that I, WILLIAM BAXTER, of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Steam-Engines for Street-Cars and other purposes, of which the following is a specification:

My invention relates to steam-engines designed for traction or road-engines for street-cars, for steam-plows, and for like purposes. It can best be explained and understood by describing it with special reference to its use for the purpose of street-car propulsion, which involves most if not all the difficulties that lie in the way of the successful and economical employment of steam for traction purposes. A street-car, when once in motion, requires but little power to propel it on a level grade, a large increase of power is needed to put it in motion when it has once stopped, and a very great power is required to enable it to overcome ascending grades. Among the many plans adopted to use steam with the car, the best heretofore devised has been to employ an engine large enough and of sufficient power to overcome the resistance at the moment of starting and to cause the car to mount such grades as were to be encountered on the road. But the machine thus made, having much more power than required for the level grade, was necessarily large and cumbersome, its first cost was heavy, and the daily expense of running it was such as to make it a failure so far as concerned propelling a street-car by steam, the car becoming nothing more nor less than a boxed-up locomotive.

What is needed with a street-car is a cheap engine occupying but little room, consuming a small quantity of fuel, having a normal power sufficient to keep the car in motion over ordinary grades and a reserved power that can be called into play at any time for the purpose either of starting the car or of driving it up heavy grades. It has been my object to produce an engine possessing these characteristics; and my invention consists in the means hereinafter described by which this object has been attained.

In carrying out my invention I employ, in connection with a boiler of suitable construction and two or more steam-cylinders, arranged in such manner that the steam from one may be exhausted into and used expansively in the other, a steam-chamber or space so connected with the boiler and cylinders that, First, it will receive the exhaust steam from one cylinder and transmit it to the other, where it is used expansively. Second, it will, when the engine is at rest, accumulate the steam generated by the boiler until the steam it contains stands at the same pressure as that in the boiler, and will, when the engine again moves, transmit this steam to the cylinder which ordinarily receives the exhaust steam, whereby both cylinders will have the same or nearly the same steam pressure in starting the car, thus furnishing the extra or reserved power necessary to put the car in motion. Third, should a heavy or long up-grade be encountered, requiring a long-continued increase of power, communication between the steam-chamber and the boiler may be opened, so as to permanently, or for as long period as required, increase the pressure in the exhaust-cylinder to the extent desired. Fourth, should this power be insufficient it may be still further increased by cutting off the exhaust steam of the first cylinder from the second, in which it is ordinarily used expansively, and opening communication between the steam-chamber and boiler, using live steam at full pressure in both cylinders, making both of them high-pressure for the time being. Thus, with an engine of, say, four-horse power, nominally, it will be perceived that the power can be increased from that point up to twenty or twenty-four-horse power, as would be the case when both cylinders use live steam. A boiler such as ordinarily used with an engine of the nominal power first named will be sufficient to supply the steam needed for two cylinders when working high-pressure steam, for the two cylinders, when thus operating, would increase the draught, causing the boiler to generate steam rapidly, while the car, going up a steep grade, would run more slowly, and the engine would consequently work off a less number of cylinders full of steam per minute.

The manner in which my invention is or may be carried into effect will be understood by reference to the accompanying drawing, in which—

Figure 1 is a perspective view of a street-car to which is applied a steam-engine made in accordance with my invention. Fig. 2 is a vertical central section of an upright boiler provided with a steam-chamber, the boiler being such as that for which Letters Patent have heretofore been

granted me. Fig. 3 is a like section of an ordinary upright boiler, showing the manner in which the steam-chamber may be applied to or combined with it. Fig. 4 is a top view of the engine, and Fig. 5 is a side view of the upper part of the same.

The apparatus shown in the drawing, and which I prefer to employ in carrying out my invention, consists of the two cylinders A B, the smaller of which receives steam direct from the boiler C through the pipe *a a'*. The boiler is vertical, as when thus made it occupies less room, and the cylinders are arranged one on each side of it. Steam from the cylinder A is exhausted into and used expansively in the large cylinder B, passing out, through pipe *b b'*, into a steam-chamber or space which I prefer to arrange around the body of the boiler, as shown at D in Figs. 2 and 3. From the steam-chamber it passes through pipe *c c* to the large cylinder B, and from this cylinder it is exhausted into the feed-water apparatus in the usual manner.

When the car to which the engine thus constructed is applied is running at its normal rate on a level road, steam is taken from the boiler into the small cylinder, and, after having done its work there, is exhausted into the steam-chamber, and as the second or large cylinder is supplied from this chamber the steam is thereby worked or used very expansively and economically.

There is a compensating safety-valve at E, between the steam-pipe *a* and the small cylinder-pipe *a'*, and at the same point there is a branch connection, *d*, which, extending between the steam-pipe *a* and steam-chamber D, puts the two in direct communication when the safety-valve is open. When the engine is running at its normal rate this valve remains closed, but when the car stops for any purpose whatever, steam generated in the boiler in excess of the pressure allowed by the valve will raise the valve and pass over through the pipe *d* into the chamber D, where it will accumulate. A safety-valve applied in the usual manner to the steam-chamber will prevent the pressure of steam in the chamber and boiler from becoming excessive. Thus, instead of blowing off the steam when the car stops I accumulate it in the steam-chamber, so that when the car starts the large cylinder which is fed from the chamber will have higher steam, which furnishes the extra or reserved power necessary to start the car from a state of rest. Of course this increase of power in the large cylinder is only for the first few strokes of the piston, serving for the ordinary stoppages when taking in or dropping passengers.

Should it be necessary to increase the power of the engine—to overcome a heavy or long grade, for instance—I raise the safety-valve E and throw open communication between the boiler and steam-chamber, the small cylinder still exhausting, as before, in the chamber, and in this manner I increase the pressure in the large cylinder. Should the grade, however, be still greater and this power be found insufficient, then a three-way cock, F, between the pipes *b* and b^1 is turned so as to cut off the exhaust of the small or first cylinder from the pipe *b*, through which it enters the steam-chamber, and turns it into a pipe, b^2, which leads directly to the feed, thus avoiding back pressure, using live steam in each cylinder and working them both under high pressure for the time being.

By the employment in this manner of a steam-chamber intervening between the two cylinders I am enabled to have the engine work under four different conditions to progressively increase its power in proportion to the resistance to be overcome and to accumulate at each stoppage power enough to cause the second or large cylinder when the car again starts, to work at full pressure for a few strokes, the full power of the engine being thus exerted to make the start, and being then reduced, so soon as the car is in motion, to the limit required to keep the car moving under ordinary conditions.

I have indicated the arrangement of parts I prefer to employ; but it is manifest that the same may be greatly varied without departure from the principle of my invention. The steam-chamber may be of any suitable construction, and, instead of surrounding the boiler like a jacket, may be placed at any suitable point within, upon, or outside of the boiler. So a pair of cylinders on the compound plan I have described may be placed on each side of the boiler; or I can use a pair of large cylinders of the same size, with valves so provided as to cut off the steam very short and admit steam from the steam-chamber later in the stroke, means being provided to so cut off the steam as to reduce the power when and to the point desired. These are but a few of the many modifications which may be employed without departure from the principle which lies at the foundation of the invention.

I use the vertical boiler and engine for the reason that they take up less floor space for a given amount of power than any other form of boiler and engine. They will, for instance, fit snugly into a niche in the front of the car, as seen in Fig. 1, leaving only one-half of the diameter of the boiler to project out on the platform beyond the front of the car, while the interior of the car has still the same seating capacity as if it were adapted to be used with horses.

When the engine is fitted to the car the feed-water tank is best placed under the rear part or platform of the car, the steam-exhaust pipes from the engine leading back into this tank; and from the tank is another pipe, which returns any vapor which may be left up through the smoke-pipe, by this means subduing the noise of the exhaust steam and the puffing. Pipes lead, also, from the various safety-valves, cylinder-cocks, &c., to conduct into the feed-water tank any steam which might otherwise escape into the air, the engine being thus made entirely noiseless.

In order to give warning to vehicles and pedestrians of the approach of the car, one or more bells can be hung on the front of the car, connected by rods with the cranks of the engine, so as to be kept constantly in motion, as shown in Fig. 1, *m* representing the bells and *n* the actu-

ating-rods which are connected with the cranks of the engine.

These cranks *o*, which communicate motion from the engine to the wheels of the car, are right-angled levers or bell-cranks, which allow the car to have a large amount of motion on its springs without affecting to any appreciable degree the working parts of the engine or altering relation of the stroke of the piston to the length of cylinder.

The other mechanism of the engine-valves, eccentrics, links, &c., are substantially the same as on the ordinary locomotive, and need not be specifically described.

Having now described my invention and the manner in which the same is or may be carried into effect, what I claim, and desire to secure by Letters Patent, is—

1. The mode herein described of accumulating the power needed to start the car by the employment, in connection with the steam-cylinders operating together as described, of a steam-chamber into which the excess of steam generated by the boiler during the stoppage of the engine is received and from which, when the engine is again started, it is fed to the second cylinder, or that cylinder which receives the exhaust steam of the first cylinder, substantially as shown and set forth.

2. The combination, with the steam-chamber, boiler, and steam-cylinders operating together, as specified, of the pipes and safety-valve connecting the first cylinder and the boiler with the steam-chamber, substantially as shown and described, whereby the steam pressure in the said chamber is automatically increased upon stoppage of the engine and after the engine has again started is reduced to its original or normal state, for the purposes set forth.

3. The combination of the steam-cylinders, steam-chamber, and boiler with connecting and exhaust-pipes and valves under the arrangement, substantially as shown and described, whereby steam from the boiler may be used in said cylinders under the four conditions herein specified.

4. The arrangement of the steam-chamber or space around the boiler, substantially as herein shown and described.

In testimony whereof I have signed my name to this specification before two subscribing witnesses.

WM. BAXTER.

Witnesses:
G. N. ABEEL,
ELIM CRANE.

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