J. METCALFE, E. HAMER & R. METCALFE.

LOCOMOTIVE AND OTHER ENGINES.

No 180.488. Patented Aug. 1, 1876.

Fig. 2.

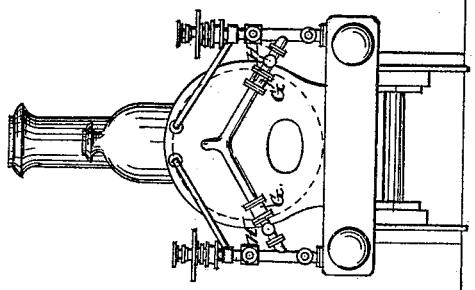


Fig. 1.

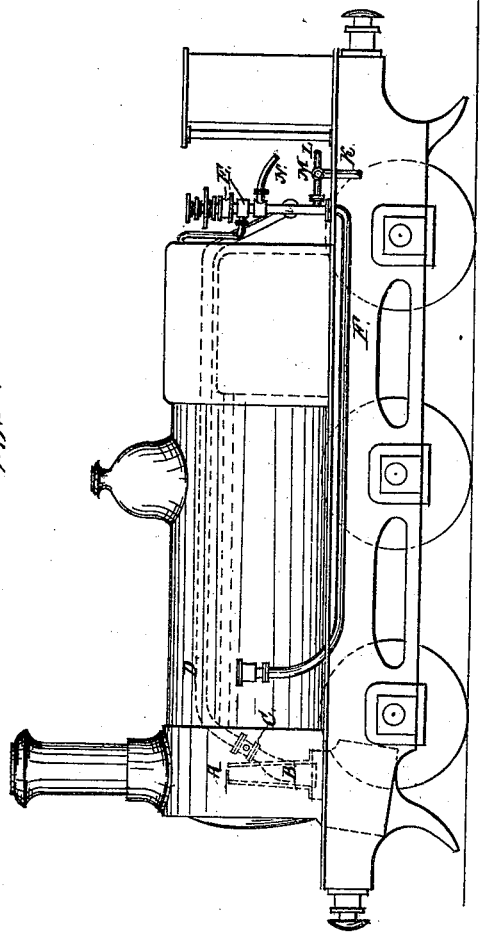
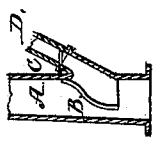


Fig. 3.



Witnesses:

Henri Guillaume
Chas Jacobsen

Inventors,

James Metcalfe
Edward Hamer
Richard Metcalfe
by Henry Orth atty

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JAMES METCALFE, EDWARD HAMER, AND RICHARD METCALFE, OF ABERYSWITH, GREAT BRITAIN.

IMPROVEMENT IN LOCOMOTIVE AND OTHER ENGINES.

Specification forming part of Letters Patent No. **180,488**, dated August 1, 1876; application filed May 13, 1876.

To all whom it may concern:

Be it known that we, JAMES METCALFE, locomotive fitter, EDWARD HAMER, locomotive superintendent, and RICHARD METCALFE, locomotive fitter, all of Aberyswith, in the county of Cardigan, subjects of the Queen of Great Britain, have invented or discovered new and useful Improvements Applicable to Locomotive and other High-Pressure Steam-Engines for Economizing Fuel; and we, the said JAMES METCALFE, EDWARD HAMER, and RICHARD METCALFE, do hereby declare the nature of the said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof—that is to say:

Our invention for improvements, applicable to locomotive and other high-pressure and compound steam-engines, consists of a novel mode for utilizing the exhaust steam or waste-steam by returning it to the boiler in connection with the feed-water by means of a return steam-pipe, having a bell-mouthed or inverted cone-shaped receiver, and provided with suitable catch and back-pressure valves.

Our invention may be applied to either locomotive, portable or fixed boilers, or any other kind of boiler generating steam, and requiring feed-water to be forced in under pressure by means of an injector or feed-pump.

Our invention is carried into practical operation in the following manner, when used in connection with locomotive-boilers, similar arrangements being applicable to other kinds of boilers: We insert in the blast-pipe a conical or bell-mouthed receiver, which collects the exhaust steam not required for draft, and allows it to pass through a pipe directly into the injector, where it meets with a stream of water from the feed-tank and steam from the boiler, and then, being partially condensed, passes with the feed-water along the feed-pipe and into the boiler. That portion of the exhaust steam which is condensed assists to increase the temperature of the feed-water, the remainder passing into the boiler as steam. This exhaust steam also assists in working the injector, and in some cases the injector may be worked with exhaust steam, without taking steam direct from the boiler for that purpose.

In the exhaust-steam pipe, between the blast-pipe and the injector, is inserted a back-pressure or catch valve, of which there may be more than one. These valves serve two distinct purposes: first, in case the engine is worked or not, if the injector, from any cause, should cease working, it prevents the water from running into the blast-pipe and steam-chest; second, it also serves to catch the exhaust at a considerable pressure. Thus, when the exhaust-port is opened the steam rushes out, and for an instant the pressure in the blast-pipe or branch pipe is approximate to that which obtains in the cylinders at the close of the stroke, and this pressure gradually diminishes, so that by allowing the catch-valve to close at a fraction of the stroke a quantity of exhaust is caught under considerable pressure. This valve may close by its own weight, and by the back pressure of the exhaust steam behind it; or by a spring, or other equivalent means; or it may be a slide-valve geared to the engines, and should, by preference, be placed as near as convenient to the slide-valve, and the box for receiving it may be cast in one piece with the blast-pipe.

And in order that our invention may be better understood, and more easily carried into practical operation, we will now proceed to describe the drawings hereunto annexed.

Figure 1 is a side elevation, and Fig. 2 an end elevation, of the boiler and apparatus complete, and Fig. 3 is a section of the blast-pipe and receiver, showing also spring catch-valve in exhaust-pipe.

A is the blast-pipe in the smoke-box of boiler. B is the bell-mouthed or inverted cone-shaped receiver of the exhaust-steam pipe. C is the spring-catch valve; D, the exhaust-steam pipe, through which steam passes to the injector E. F is the feed-water pipe from injector to boiler; G, back-pressure valves; H, tap in exhaust-

pipe; K, overflow-pipe; L, hot-water pipe; M, three-way cock; and N, supply-pipe.

Having now particularly described and ascertained the nature of our invention, and how the same may be carried into practical operation, we would have it understood that what we claim is—

In a locomotive or other steam-engine, the combination, with the exhaust-pipe and the injector, of a return steam-pipe, having a bell-mouthed or inverted cone-shaped receiver, and provided with suitable catch and back-pressure valves, substantially as described, for the purpose specified.

JAMES METCALFE.
EDW. HAMER.
RICHARD METCALFE.

Witnesses:
H. ELLIS HILL,
23 *Southampton Buildings,*
Chancery Lane, W. C.
CHARLES BARLOW,
23 *Southampton Buildings,*
Chancery Lane, London.