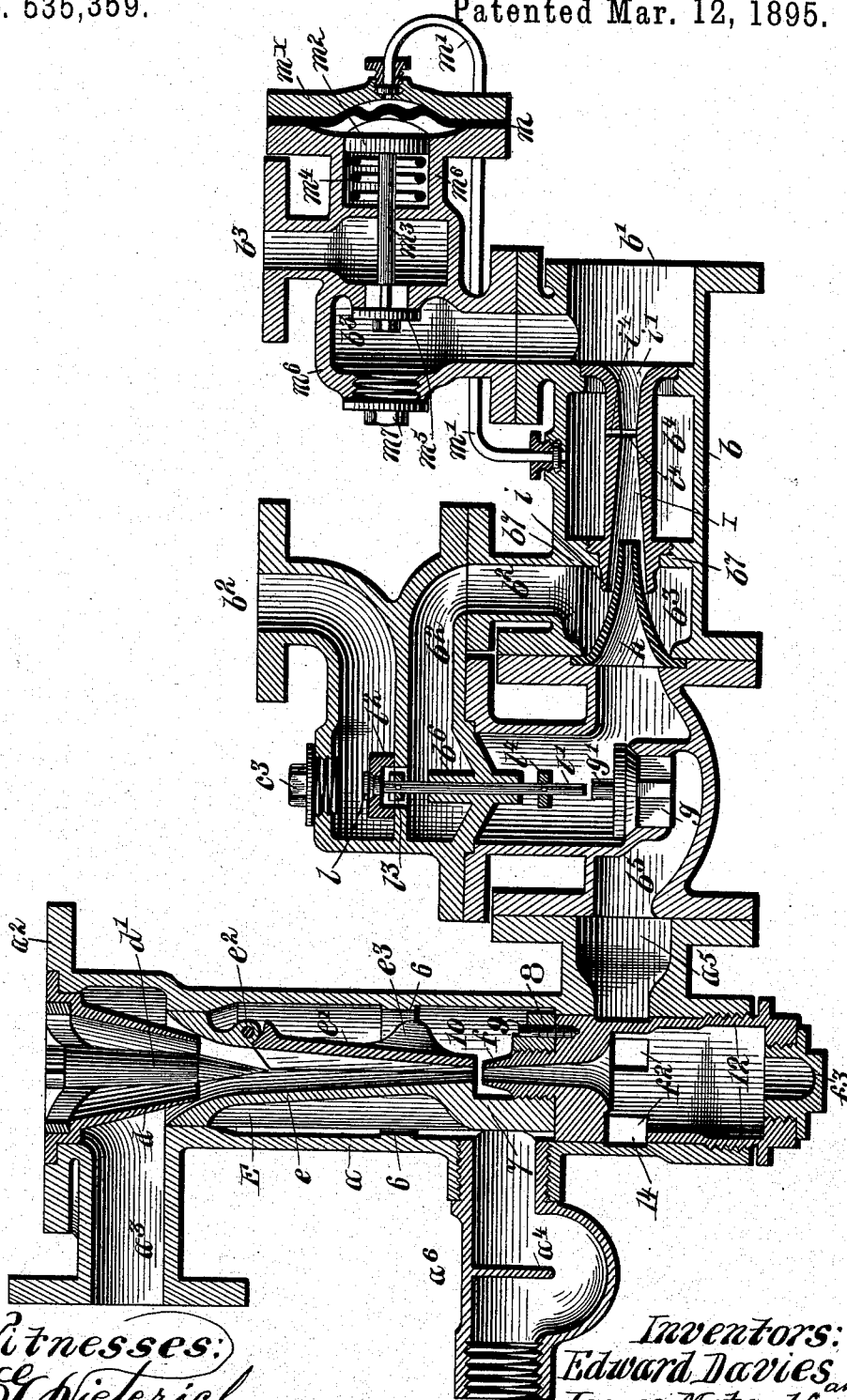


(Model.)

E. DAVIES & J. METCALFE.
INJECTOR.

No. 535,359.

Patented Mar. 12, 1895.



Witnesses:
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UNITED STATES PATENT OFFICE.

EDWARD DAVIES, OF LLANDINAM, AND JAMES METCALFE, OF ABERYSTWITH, ASSIGNORS TO THE PATENT EXHAUST STEAM INJECTOR COMPANY, LIMITED, OF MANCHESTER, ENGLAND.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 535,359, dated March 12, 1895.

Application filed January 31, 1894. Serial No. 498,654. (Model.) Patented in England April 20, 1887, No. 5,731; in France March 30, 1888, No. 189,692; in Belgium March 31, 1888, No. 81,249; in Italy April 2, 1888, XLVI, 99; in Victoria April 30, 1888, No. 5,796; in New South Wales May 4, 1888, No. 665; in Queensland May 15, 1888, No. 484; in Spain July 13, 1888, No. 8,147, and in Austria-Hungary August 7, 1888, No. 14,320, 38, 2,017, and No. 31,378, XXII, 1,920.

To all whom it may concern:

Be it known that we, EDWARD DAVIES, of Plas Dinam, Llandinam, in the county of Montgomery, and JAMES METCALFE, of No. 28 North Parade, Aberystwith, in the county of Cardigan, Kingdom of England, have invented certain new and useful Improvements in Injectors, (for which we have obtained Letters Patent in Great Britain, No. 5,731, dated April 20, 1887; in France, No. 189,692, dated March 30, 1888; in Belgium, No. 81,249, dated March 31, 1888; in Italy, No. 99, Vol. 46, dated April 2, 1888; in Victoria, No. 5,796, dated April 30, 1888; in New South Wales, No. 665, dated May 4, 1888; in Queensland, No. 484, dated May 15, 1888; in Spain, No. 8,147, dated July 13, 1888, and in Austria-Hungary, dated August 7, 1888—Austria, No. 14,320, 38/2,017, and Hungary, No. 31,378, XXII/1,920;) and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawing, and to letters and figures of reference marked thereon, which form a part of this specification.

Our invention has relation to injectors for steam engines or for other uses, and more particularly to that class of injectors known as compound injectors, in which high pressure or live steam is employed in addition to low pressure or exhaust steam for the purpose of imparting an increased velocity, and consequently a greater penetration to the jet of fluid than would be the case with low pressure or exhaust steam alone, as clearly defined in our applications for patents of the United States, Serial Nos. 498,653 and 498,655, and in the description of our present invention we will refer to the low pressure and high pressure steam injectors that constitute the compound injector as the exhaust steam and live steam injectors, respectively.

Our present invention has for its object chiefly the means for controlling the admis-

sion of the live steam to the live steam passage, or more properly, to the exhaust and live steam passage.

Our invention has also for its object other improvements in the compound injector, as will hereinafter appear.

In order that our invention may be fully understood we will describe the same in detail, reference being had to the accompanying drawing which illustrates our improved compound injector by an axial section.

The exhaust steam injector is of substantially the same construction as that shown in Figure 5 of our application for patent, Serial No. 498,653, and a reference to its elements will therefore suffice for a full understanding of its construction and operation.

a indicates the casing of the exhaust steam injector; *a*², the flange or union for connecting the same with the source of exhaust steam supply; *a*³, the water branch of well known construction and having a pocket and partition *a*⁴ to provide a liquid seal; *a*⁶, the overflow branch; 10, the overflow chamber; *a*⁵, the delivery branch; *d*, the exhaust steam cone; *d*¹, its cone spindle; *E*, the combining cone composed of two parts *e* and *e*¹ hinged together at *e*², the laterally movable part *e*¹ being provided with a boss or projection *e*³, which, together with an annular abutment 6 in casing *a* serves to limit the lateral motion of the hinged part *e*¹.

The combining cone *E* has an arm 7 that terminates in a ring bearing 8 into which is screwed the receiving and discharging cone *f* held against rotation by a screw 9, said cone preferably formed integral with a casing 12 provided with ports *f*² in communication with an annular chamber 14 that is provided with the delivery branch *a*⁵, and *f*³ is the screw plug screwed into the outer open end of said casing 12.

To the delivery branch *a*⁵ of the exhaust steam injector casing *a* is secured the receiving branch *b*⁵ of the live steam injector casing *b*, and in the passage leading from said

branch to the receiving cone h of said live steam injector is formed a valve port and seat for a back pressure valve g whose stem g' lies in the vertical plane of the stem l' of the live steam valve l that has its seat in a port formed in an inverted cup valve l^2 , which latter is adapted to control a port in the live steam passage b^2 that leads into the chamber b^3 formed by said receiving cone h and the combined combining and discharging cone i of the live steam injector.

The valve stem l' has two abutments l^3 and l^4 , the former l^3 adapted to impinge upon the cup valve l^2 and cause the same to open, and the latter abutment l^4 adapted to abut against the inner or lower end of a sleeve b^6 in which the stem l' of valve l is guided.

The receiving cone h projects into the receiving end i of the combining and discharging cone, leaving an annular passage for the live steam coming from chamber b^3 , said combining and discharging cone being screwed into an opening in a partition b^7 in casing b and forming between its discharging end i' and the said partition a chamber b^4 ; said combining and discharging cone being provided with a small port or ports i^4 . The delivery end b' of the injector communicates with an overflow branch b^8 in which is formed a valve port and seat for an overflow valve m^5 whose stem m^3 carries a piston m^2 that works in a cylinder m^6 in which is also contained a coiled spring m^4 that holds said valve normally to its seat. Between the cylinder head m^x and the piston cylinder, is secured a diaphragm m that is in communication with the chamber b^4 through a passage in said cylinder head m^x and a pipe m' connecting said passage with the chamber b^4 . Access may be had to the overflow passage b^8 and its valve m^5 through an opening in said passage b^8 normally closed by a screw plug m^7 .

When the injector is started with exhaust steam, the pressure arising from the jet of fluid produced will first cause the valve g to open sufficiently to allow the jet to pass to the live steam injector wherein the pressure arising from the same jet in chamber b^4 and transmitted through pipe m' to diaphragm m , the latter will cause the overflow valve m^5 to open and allow the fluid to escape freely. At the same time the live steam valve l is also caused to open, allowing a comparatively small volume of live steam to pass to the live steam injector. When the jet is established the pressure in chamber b^4 will decrease practically to nothing, causing the overflow valve to close, while the pressure of the established jet will be sufficient to move the valve g and the stem l' of valve l to the limit of their motion, determined by the abutment l^4 , thereby lifting the cup valve l^2 and admitting an additional quantum of live steam to chamber b^3 , and thereby adding increased velocity to the jet of fluid.

Should the jet fail, the pressure in passage

b^5 will sink approximately to nothing, while the pressure about the throat i^4 of cone i will rise to its highest, the valve g will move toward its seat impelled by its own weight and by the pressure of the live steam upon it and upon the valves l and l^2 , and the pressure existing in the chamber b^4 then acts to open the overflow valve m^5 which again closes as soon as the pressure at the throat i^4 and consequently in chamber b^4 sinks below the pressure exerted by the spring m^4 .

Owing to the small area of the valves l and l^2 exposed to the live steam, the pressure exerted by the latter to close the said valves will never exceed the pressure exerted by the jet produced by exhaust steam upon the valve g , more especially since the slight pressure required to lift the valve g is sufficient to lift the valve l of smallest area from its seat, thereby admitting a small quantity of live steam to the live steam injector, whereby the pressure at the throat i^4 of the combining and discharging cone i and consequently within the chamber b^4 is increased to the extent necessary to fully unseat the valve m^5 against the stress of its load or spring.

It is to be noted that the back pressure valve g has slight motion independently of the valves l , l^2 , so that pressure arising from a jet of fluid produced by exhaust steam alone will cause said valve g to open slightly, and thus sufficient pressure is exerted upon the diaphragm m to cause the valve m^5 also to open slightly before the pressure is increased by admission of live steam.

Of course it will be understood that instead of the diaphragm m a piston may be used.

Having thus described our invention, what we claim as new therein, and desire to secure by Letters Patent, is—

1. An injector comprising a passage for high pressure or live steam, a valve controlling said passage, an overflow passage in communication with the live steam passage, a valve controlling said overflow passage, and means whereby pressure arising from a jet of fluid produced by low pressure or exhaust steam will cause said valves to open.

2. An injector comprising a passage for high pressure or live steam, a valve controlling said passage, an overflow passage in communication with the live steam passage, a valve controlling said overflow passage, and means whereby pressure arising from a jet of fluid produced by low pressure or exhaust steam will cause the overflow and live steam valves to open successively.

3. An injector comprising a live steam passage, a valve controlling the same, and a supplementary valve caused to open by pressure arising from a jet of fluid produced by low pressure or exhaust steam to admit fluid to the live steam passage and cause the live steam valve to open.

4. An injector comprising a low pressure or exhaust steam passage, a high pressure or

live steam passage, a valve controlling said
live steam passage, a back pressure valve in-
terposed between the low pressure and high
pressure steam passages, and means whereby
5 pressure arising from a jet of fluid produced
by low pressure steam will cause said back
pressure and live steam controlling valves to
open.

In witness whereof we have hereto signed
our names in the presence of two witnesses.

EDWARD DAVIES.
JAMES METCALFE.

Witnesses:

PETER J. LIVSEY,
WILLIAM FAULKNER.