No. 714,217. Patented Nov. 25, 1902.

R. D. & J. C. METCALFE.

INJECTOR.

(Application filed July 22, 1901.)

(Model.)

Fig. 1.

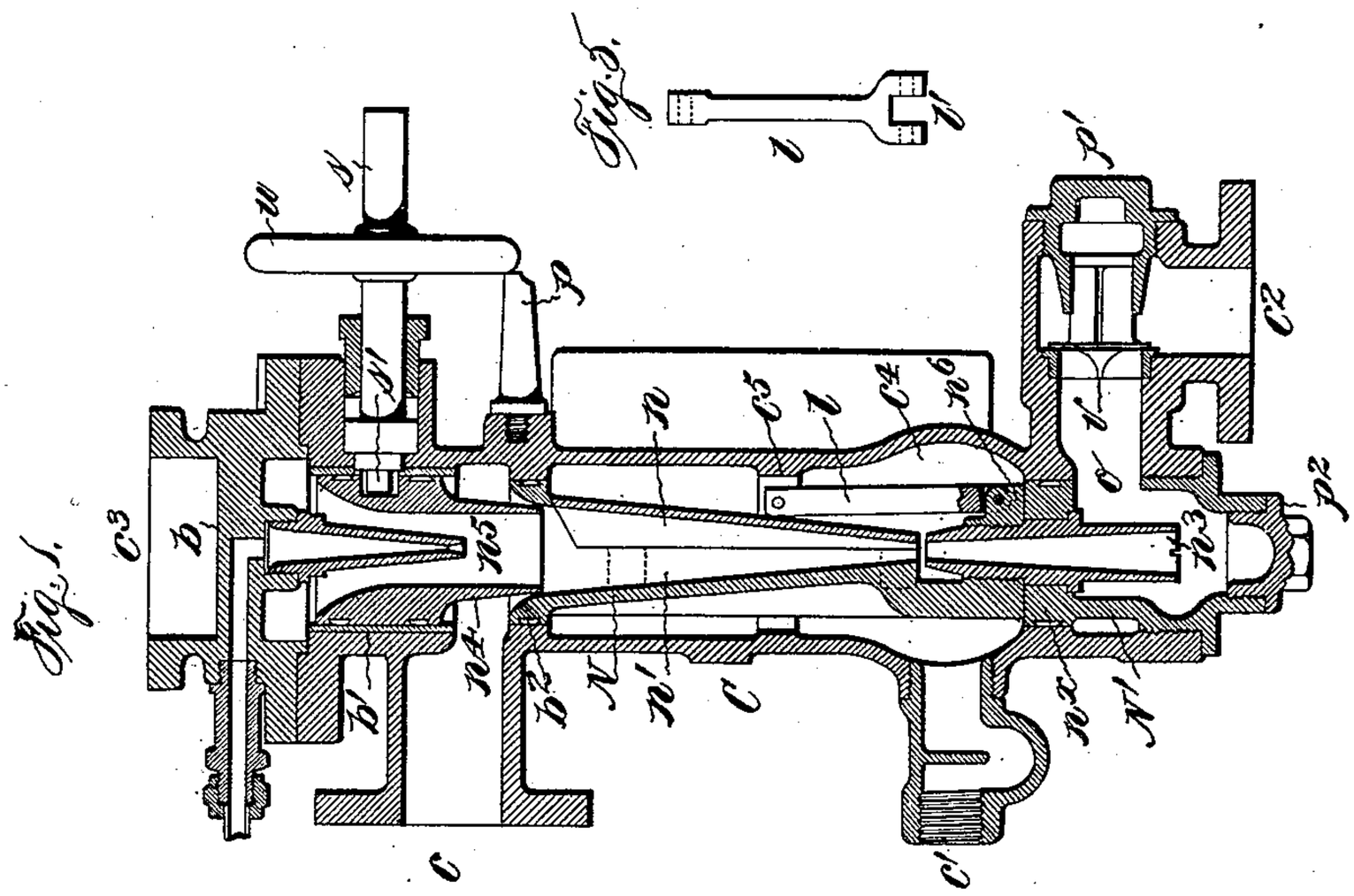

Fig. 2.

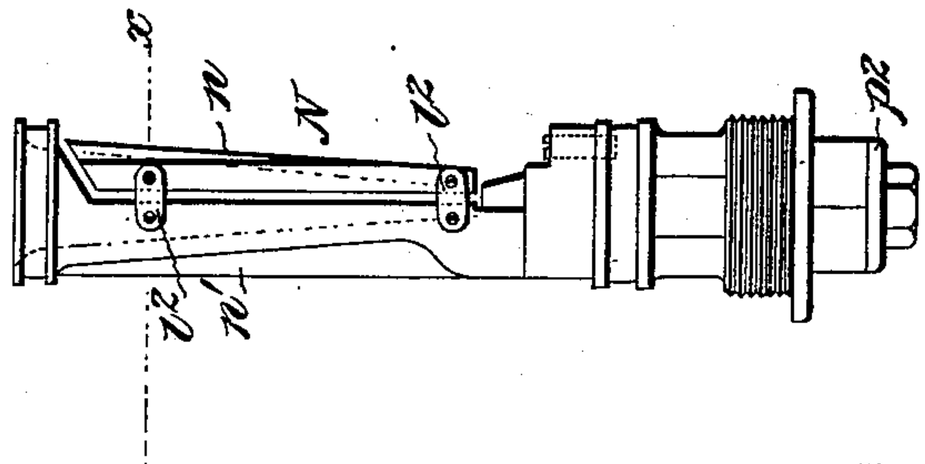

Fig. 2a.

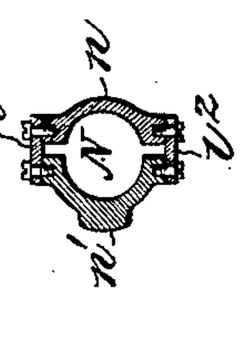

Fig. 3.

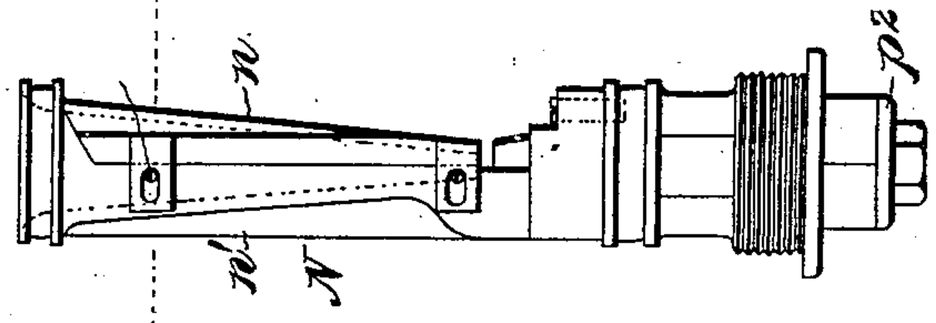

Fig. 3a.

Fig. 4.

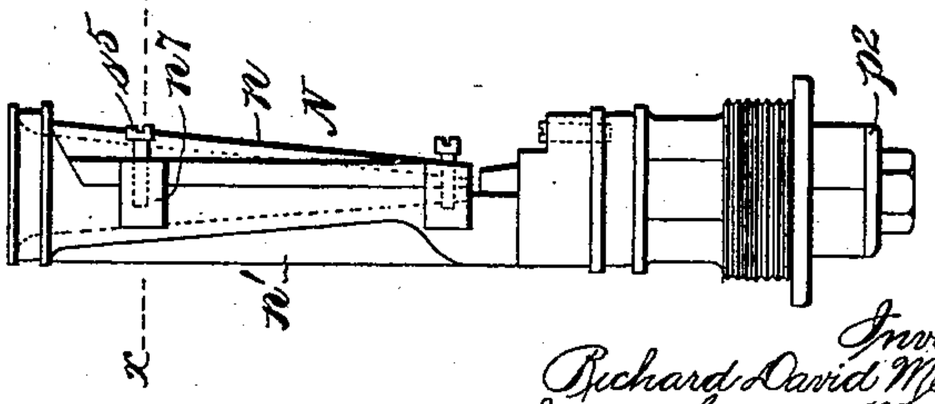

Fig. 4a.

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UNITED STATES PATENT OFFICE.

RICHARD DAVID METCALFE AND JAMES CROXON METCALFE, OF MANCHESTER, ENGLAND.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 714,217, dated November 25, 1902.

Application filed July 22, 1901. Serial No. 69,321. (Model.)

To all whom it may concern:

Be it known that we, RICHARD DAVID METCALFE and JAMES CROXON METCALFE, subjects of the King of Great Britain and Ireland, residing at Fallowfield, Manchester, county of Lancaster, England, have invented certain new and useful Improvements in Injectors; 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 drawings, and to letters of reference marked thereon, which form a part of this specification.

Our invention has relation to boiler-injectors, and more especially to that type known as "flap-nozzle" exhaust-steam injectors having a divided combining-nozzle, the one part, termed the "flap," being hinged or pivoted at one end near the steam or lifting nozzle, the said flap having pendulous motion on its pivot from and to the stationary part of the nozzle. It is obvious that when so constructed the passages formed for the escape of the steam and water to the overflow-chamber in starting the injector are wedge or V shaped, widest at the inner or smaller end of the nozzle and gradually diminishing in cross-sectional area from the inner end of the nozzle to the hinge-joint of the flap, forming when the flap begins to swing away from the stationary part of the nozzle a surface against which the steam and water impinges that inclines outwardly in the direction of flow of the jet of steam from the steam-nozzle and of the water from the water branch, the major portion of fluids flowing from the combining-cone to the overflow through the wider part of the passages or at the free end of the flap, at which point the pressure is necessarily greater than at any other point along the inner face of said flap, thus tending to produce back pressure, the volume of fluids flowing from the combining-nozzle being of course determined by the amplitude of the pendulous swing of the flap. On the other hand, the flap being hinged at the wider end of the nozzle consequently swings away from the end of least cross-sectional area and the volume of fluids passing from the nozzles is comparatively small.

The present invention has for its object certain improvements in the type of injector referred to, whereby the efficiency of the injector is materially increased and whereby the injector can be started more rapidly and at a comparatively higher pressure, as will now be fully described, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical section of an exhaust-steam or supplementary live-steam injector embodying our invention. Figs. 2, 3, and 4 are elevations of the combining-nozzle, illustrating various ways of connecting the flap or movable portion with the stationary portion of the nozzle. Figs. 2^a, 3^a, and 4^a are sections taken on line $x\,x$ of Figs. 2, 3, and 4, respectively; and Fig. 5 is a detail view of the link for connecting the movable and stationary parts of the combining-nozzle shown in Fig. 1.

Referring more particularly to Fig. 1, C indicates the casing, provided with the water branch c, the overflow branch c', and the delivery branch c^2 and having secured thereto at its feed end a branch c^3 for connection with a source of exhaust-steam supply or with a source of live-steam supply when used as a supplementary live-steam injector. The branch c^3 has formed therein a cross-bar or bridge b, having a passage for connection with a source of live-steam supply, said passage opening axially into the casing C and having screwed thereinto a steam-nozzle n^5. The feed end of casing C has a lining or bushing b' for and in which the steam or lifting nozzle n^4 is adjustable by means of a spindle s, carrying at its inner end a roller on an eccentric-pin s', which roller works in a suitable recess and acts upon said nozzle n^4 to move the same lengthwise of the casing or toward and from the combining-nozzle for well-known purposes.

The spindle s extends through a stuffing-box and carries a hand-wheel w, having its inner face proximate to a pointer p graduated also for a well-known purpose.

The delivery branch c^2 has a seat for the usual check-valve v, whose stem is guided in a plug p', screwing into said branch.

The construction of injector so far as described is well known, our improvements residing in the construction of the combining-cone and the slight modification in the construction of the injector-casing C, whose internal cross-sectional area is somewhat increased at its point of connection with the overflow branch c' to provide an overflow-chamber c^4 of such a capacity as to insure a free flow of fluids therefrom to the overflow branch c', which is in direct communication with said chamber and substantially in the line of flow of the fluids.

The combining-nozzle N irrespective of its flap n can be made in two or more parts, as usual; but according to our present invention it is a single casting comprising the stationary part n' of the nozzle, the bearing $n^\times$ for and into which the delivery or forcing nozzle n^3 is screwed, and the portion N', constructed to be screwed into the delivery end of casing C and having an opening o, leading to the delivery branch c^2.

The inner end of the combining-nozzle N is open and adapted to be closed by a plug p^2, screwing into said end, which is squared externally for the application of a key or wrench, as shown in Figs. 2, 3, and 4, the plug p^2 having likewise a squared projection, so that access can be had to the forcing-nozzle n^3, whose inner end is nicked for a screw-driver, and by removal of said nozzle access is had to the combining-nozzle, which is made bodily removable from its casing, the outer wider end of said nozzle fitting a bearing b^2 in said casing and having grooves for a packing, similar grooves being formed in the cylindrical portion of the bearing $n^\times$.

The flap n, which, as usual, constitutes one-half or substantially one-half of the combining-nozzle N, has a forked projection, which may be about midway of its length, though we prefer to form it nearer to the inner or small end of the nozzle than to its outer end, as shown in Fig. 1, and in said projection is pivoted one end of a link l, whose opposite end l' is forked, Fig. 5, and pivoted to a boss or ear n^6 on the part n^2 of the nozzle N.

The flap n is provided with guide-lugs n^2 near its outer and inner ends, (shown in dotted lines,) sliding on preferably flattened faces formed on opposite faces of the nozzle part n', while the outward swing of the flap is limited by rib c^5 in casing c, against which the forked lug of link l abuts.

When the flap n is connected with the nozzle-section n', as described, it is obvious that the pressure of the water on said flap will cause it to move bodily in an arc of a circle from and to the part n', thus forming a slot-like passage on diametrically opposite sides of the nozzle of uniform width throughout its length and extending from the delivery end of the nozzle to its head or outer end, a substantially uniform pressure being exerted over the entire face of the flap, a free escape for the fluids being thus provided and back pressure, so fatal to the starting, avoided. On the other hand, in starting an injector it is practically impossible to form a partial vacuum in so small a space as is usually provided by the overflow-chamber unless the whole of the steam has an unobstructed flow to the atmosphere, and this cannot be attained by the means hitherto proposed, not even by the use of the well-known flap-nozzle, wherein, as hereinbefore referred to, the steam flowing along the inclined inner face of the movable portion results in more or less back pressure. This is obviously avoided when the flap is connected with the stationary part of the nozzle, as described, thereby forming perfectly-straight slots diametrically opposite each other and extending substantially over the full length of the nozzle, affording egress of steam and water at every point of the length of the nozzle through passages the width of which varies automatically under the pressure of the fluids and the influence of a vacuum from maximum when steam is turned on to *nil* when the jet is fully eatablished. On the other hand, should there be an excess of pressure during the working of the injector this is instantly relieved by the flap opening to a greater or less extent. It is also evident that when the flap is hinged to the wider end of the nozzle or below its head the length of the passages formed is considerably less than when said flap is connected in accordance with this invention, the passage then extending from the smaller end of the nozzle clear to its head or seating, and as this is packed fluid-tight its length can be reduced to a minimum. This construction also enables us to reduce the dimensions of the casing C so that the internal parts of an injector of given capacity can be contained in a casing at least two numbers or sizes smaller than would otherwise be required. By enlarging the overflow-chamber and arranging the overflow branch in line therewith said chamber is at all times in direct communication with the atmosphere and affords a free flow of fluids out of the same.

The mode of connecting the flap portions of the combining-nozzle with the stationary portion thereof may be variously modified without departing from the spirit of our invention. As shown in Figs. 2 and 2^a, for instance, the two parts n and n' of the combining-nozzle are connected by links l^2, like parallel rulers, whereby the extent of the swing of the flap n from the nozzle is determined, the links l^2 being pivoted to ribs or flanges formed on the nozzle parts. As shown in Figs. 3 and 3^a, the flap n has slotted lugs or ears n^3, and the nozzle part n' has pins or screws s^3

projecting through said slots, whereby the flap is guided in a rectilinear direction at right angles to the longitudinal axis of the nozzle, the lugs n^3 projecting from longitudinal ribs n^4, while the screws s^3 are screwed into flat-faced ribs on the nozzle part n'.

As shown in Figs. 4 and 4^a, the flap n has perforated lugs or flanges n^7 overlapping ribs n^5 on the stationary part n', into which ribs n^5 are screwed the guide and limiting screws s^5.

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

1. In an injector, the combination with the casing of a longitudinally-divided combining-nozzle, one part thereof linked to the other to be capable of movement therefrom in an arc of a circle, substantially as described.

2. In an injector, the combination with the casing of a longitudinally-divided combining-nozzle, one part thereof connected to the other by a link, the ends of which are pivoted respectively to the two parts, substantially as described.

3. In an injector, in combination, a casing, a combining-nozzle contained in said casing and divided longitudinally into a fixed part and a moving part, and a link l pivoted at one end to said moving part and at the other end to a fixed part of the injector, substantially as and for the purpose described.

4. In an injector, in combination, a casing, a combining-nozzle contained in said casing and divided longitudinally into a fixed part and a moving part and a link pivoted at one end to said moving part near the center of the latter and at the other end to a fixed part of the injector, substantially as and for the purpose described.

5. In an injector, in combination, a casing, a combining-nozzle contained in said casing and divided longitudinally into a fixed part and a moving part and a link pivoted at one end to said moving part near the center of the latter and at the other end to a fixed part of the injector, so that the two parts can separate to a greater extent at one end of the nozzle than at the other end, substantially as and for the purpose set forth.

In testimony that we claim the foregoing as our invention we have signed our names in presence of two subscribing witnesses.

RICHARD DAVID METCALFE.
JAMES CROXON METCALFE.

Witnesses:
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ELDORE A. KING.