R. G. BROOKE.

STEAM INJECTOR.

APPLICATION FILED APR. 18, 1910.

978,001.

Patented Dec. 6, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

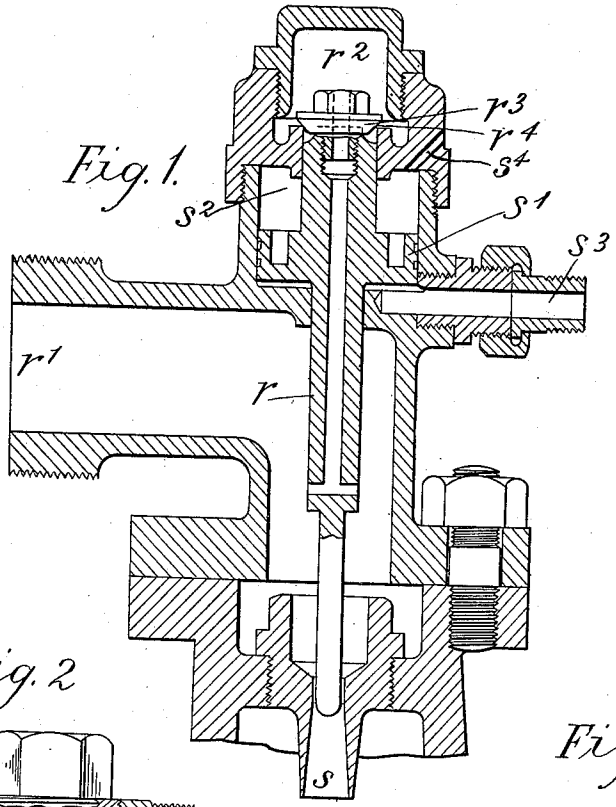


Fig. 2.

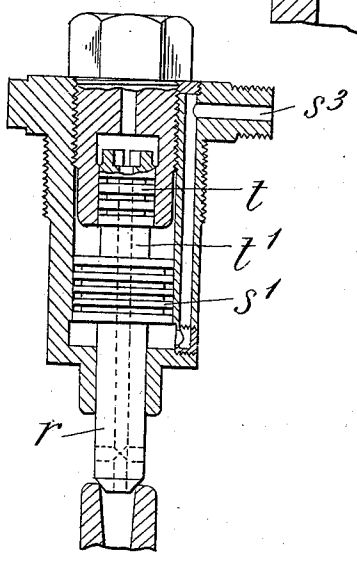
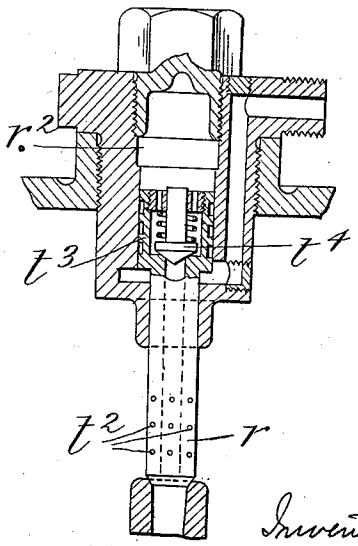


Fig. 3.



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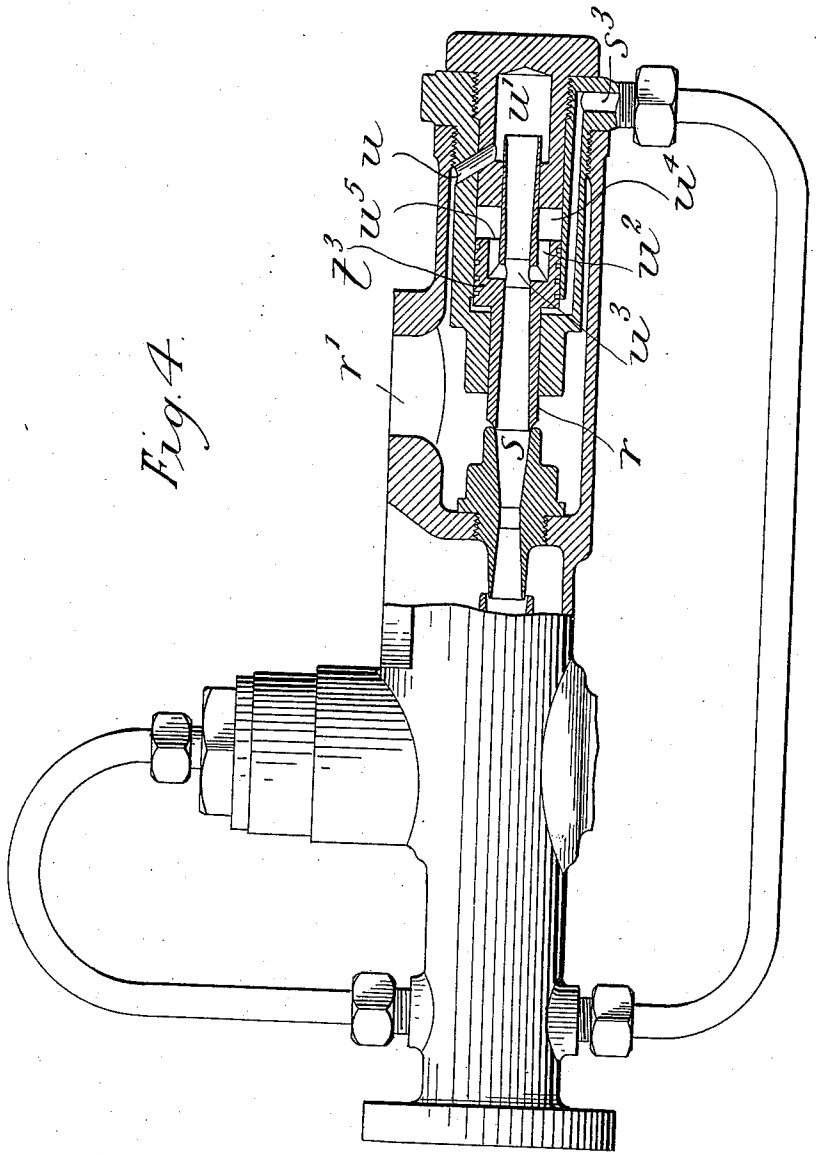
3 SHEETS—SHEET 2.

Fig. 4.



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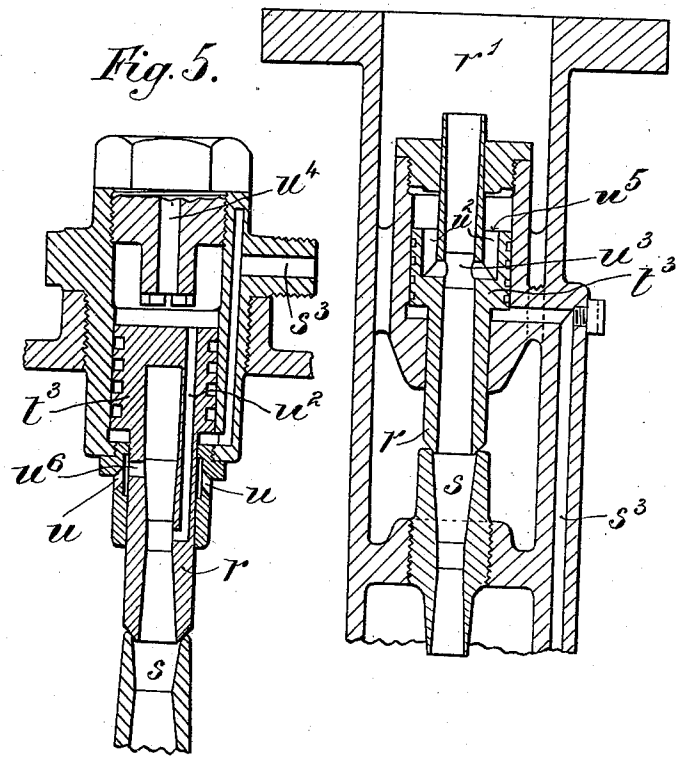
3 SHEETS—SHEET 3.

Fig. 6.

Fig. 5.



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UNITED STATES PATENT OFFICE.

ROBERT GRUNDY BROOKE, OF MACCLESFIELD, ENGLAND.

STEAM-INJECTOR.

978,001. Specification of Letters Patent. Patented Dec. 6, 1910.

Application filed April 18, 1910. Serial No. 556,123.

To all whom it may concern:

Be it known that I, ROBERT GRUNDY BROOKE, a subject of the King of Great Britain and Ireland, residing at Macclesfield, in the county of Chester, England, have invented Improvements Relating to Steam-Injectors, of which the following is a specification.

This invention relates to steam injectors and has for its object to facilitate the starting of such an injector both initially, and automatically after unintended interruption, especially when dealing with hot feed water and steam at high pressure, or when taking water from another injector, as when an exhaust injector works in conjunction with a live steam or supplementary injector. For this purpose, the area of the steam nozzle may be restricted when the pressure of fluid in the delivery or discharge chamber is at the value which obtains when the injector has not properly started or is not at work, and, conversely, increased to its normal or full area when the injector has formed its jet, so far as the restricted steam area will allow, and has by such jet set up a pressure in the delivery cone or chamber that will then allow the injector to form its final working jet and come fully into proper working condition.

In the accompanying drawings, Figures 1 to 6 are central longitudinal sections, each representative of a portion of an injector with a specific constructional embodiment of the invention.

As shown in Fig. 1, the requisite restriction of area of the steam nozzle is effected by means of a retractile spindle r which is made partly hollow to divert steam entering the injector at r^1 to a chamber r^2 where it is caused to act upon the said spindle r and move it into the steam nozzle s. To insure fluid tightness of the chamber r^2, when the parts are in the position shown, the extremity of the spindle r which extends into the chamber r^2, may be formed as or be provided with a valve r^3 co-acting with a suitable seat r^4 in the chamber. Upon the spindle r, in this case intermediate of its length, a piston s^1 is formed or provided that works in a chamber s^2 connected, as by a tube s^3 to the delivery or discharge chamber of the injector, so that when the injector has partially formed its jet and set up a required pressure in the delivery cone or chamber, such pressure, acting in opposition to pressure from the main steam inlet r^1 tending to force the spindle r into the steam nozzle s, overcomes such pressure and retracts the spindle and so permits steam to pass through the full area of the steam nozzle and enable the injector to form its final working jet and come fully into proper working condition. To avoid accumulation of counter-pressure upon the piston s^1 of the spindle r, the chamber s^2, within which such piston works, may be provided with a suitable relief port or passage s^4.

In Fig. 2 there is illustrated a simple modification of the arrangement shown in Fig. 1, the valve r^3 of the latter arrangement being replaced by a piston t and the spindle r provided with a passage t^1 so that steam at starting is led into the nozzle s through the spindle instead of around it, the spindle bedding itself on the steam nozzle as shown. Or, as a further modification, shown in Fig. 3, the spindle r through which steam may pass by way of perforations t^2, may be provided with a single piston t^3 and an intercepting or pressure valve t^4 in such a manner that a pressure is maintained in the chamber r^2 less than that acting on the opposite side of the piston when the injector has partially formed its jet and set up a required pressure in the delivery cone or chamber.

Other arrangements similar to the foregoing but permitting the use of a single piston without a valve and spring may be devised by taking advantage of the fact that if a small passage is taken off another through which steam is passing at high velocity and under pressure, the pressure in the passage leading off from the main passage is materially less than the pressure in the latter, this difference being more marked if the main passage is shaped and proportioned on the lines of a Venturi tube. One arrangement of this character is shown in Fig. 4 where steam from the steam inlet r^1 is conducted by a passage u, or passages, to a chamber u^1 and supplied in restricted fashion to the steam nozzle s, while starting, through the Venturi passage in the spindle r, u^2 being passages leading from the throat u^3 to the secondary steam pressure chamber u^4. During this time the steam pressure in the passages u^2 and chamber u^4 is materially less than the steam pressure in the inlet chamber r^1 but such pressure, acting on the face u^5 of the piston t^3, together with

that on the end of the spindle r in the chamber u^1, is sufficient to overcome the pressure set up in the delivery chamber and acting on the opposite side of the piston t^3. When the jet begins to form by means of the restricted steam supply, the pressure in the delivery chamber is sufficient to move the piston t^3. When this happens, although steam ceases to flow through the Venturi passage and the pressure in the chamber u^4 is consequently raised to that in the inlet chamber r^1, the pressure in the delivery chamber being slightly in excess of the steam inlet pressure will maintain the spindle r in its withdrawn position. Leakage of fluid from the chamber u^1 into the chamber u^4 past the spindle r is re-absorbed through passages u^2 as the pressure does not rise above a certain point in these passages.

Fig. 5 shows a modification of the arrangement shown in Fig. 4, according to which the steam chamber u^1 of Fig. 4, is dispensed with and steam passages u are arranged to supply a restricted quantity of steam to the steam nozzle s, at starting, through the passage u^6, and Venturi passage in the spindle r.

Fig. 6 shows an arrangement in which the spindle r has a Venturi passage open directly to the steam inlet r^1, the remaining parts essential to the invention being substantially the same as described with reference to Fig. 4.

What I claim is:—

1. In a steam injector, a casing having a steam inlet, a steam nozzle in such casing and in constant communication with the inlet, and a spindle subject to the opposing pressure of steam supplied to the injector and to the delivery pressure and adapted to automatically restrict the communication between the steam inlet and nozzle to curtail the steam supply at starting and to increase the said supply to its full value when a required delivery pressure is set up.

2. In a steam injector, a casing having a steam inlet, a steam nozzle in such casing and in constant communication with the inlet, a retractile spindle adapted to vary the communication between the steam inlet and the nozzle, means whereby the spindle can be advanced toward the nozzle to restrict the communication aforesaid, a piston on the spindle and a chamber within which the piston is free to slide and which has a connection with the delivery of the injector to enable pressure to act on one side of said piston in opposition to the means tending to advance the spindle toward the nozzle.

3. In a steam injector, a casing having a steam inlet, a steam nozzle in such casing and in constant communication with the inlet, a retractile spindle adapted to seat itself upon the steam nozzle and having a passage permitting a restricted supply of steam to pass into the nozzle at starting, a chamber concentric with the spindle connected at one end to the delivery of the injector, and a piston on the spindle working in said chamber and having a passage placing the other end of the chamber in communication with the first named passage in the spindle.

4. In a steam injector, a steam nozzle, a hollow retractile spindle in communication with the steam inlet of the injector and adapted to seat itself upon the steam nozzle and restrict the steam supply at starting, a chamber through which the spindle passes connected at one end to the delivery of the injector, and a piston intermediate of the length of the spindle working in said chamber and having steam passages placing the other end of the chamber in communication with the interior of the retractile spindle.

5. In a steam injector, a retractile spindle having a through-way passage shaped to resemble a Venturi tube, a steam nozzle on which the said spindle is adapted to seat itself at starting, a chamber through which the spindle passes connected at one end to the delivery of the injector, and a piston intermediate of the length of the spindle working in said chamber and having steam passages placing the other end of the chamber in communication with the constriction of the Venturi passage of the retractile spindle.

Signed at London England this sixth day of April 1910.

ROBERT GRUNDY BROOKE.

Witnesses:
H. D. JAMESON,
R. J. WILLIAMS.