(Model.)

J. DESMOND.

INJECTOR.

No. 526,918. Patented Oct. 2, 1894.

Fig. 2.

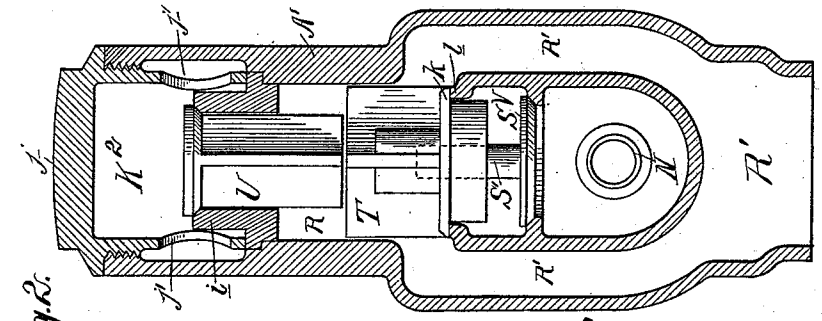

Fig. 1.

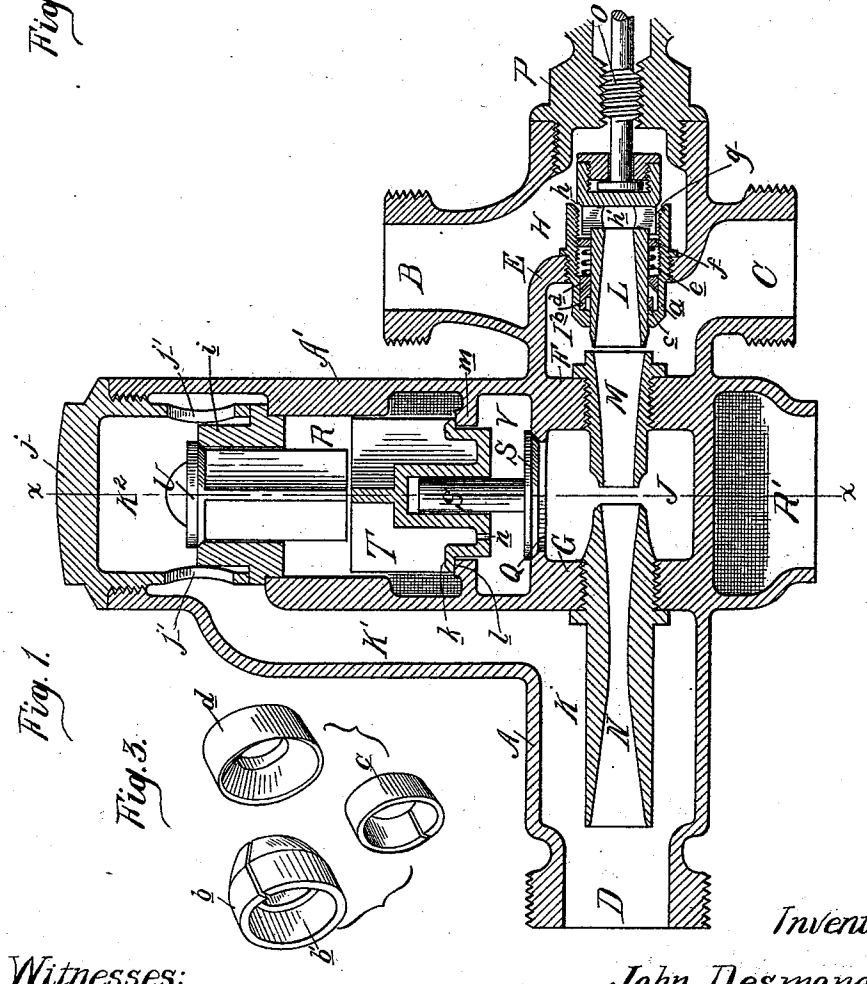

Fig. 3.

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UNITED STATES PATENT OFFICE.

JOHN DESMOND, OF DETROIT, MICHIGAN, ASSIGNOR TO THE PENBERTHY INJECTOR COMPANY, OF SAME PLACE.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 526,918, dated October 2, 1894.

Application filed April 10, 1894. Serial No. 507,016. (Model.)

To all whom it may concern:

Be it known that I, JOHN DESMOND, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Injectors, of which the following is a specification, reference being had therein to the accompanying drawings.

The invention refers more particularly to a new construction, combination and arrangement of devices for enabling the injector to start and restart automatically with absolute certainty; further, in the construction and operation of a movable steam nozzle arranged to operate as a steam and water valve, and further in the specific arrangement of the valves whereby they will not only stand the excessive wear necessary, for instance, in a locomotive injector, but also permit the injector to continue to work if the valves should become leaky.

Figure 1 is a vertical central section of an injector embodying my improvement. Fig. 2 is a cross section thereof on line *x x* Fig. 1. Fig. 3 is a perspective view of the packing rings of the steam tube, detached.

The outer casing or shell comprises a horizontal portion A and a vertical arm A′ the former being provided with open branches B, C and D for connecting the injector with the steam and water supply and with the boiler as in the usual manner. Partition walls E F and G divide this casing interiorly into a steam chamber H, a water chamber I, an overflow chamber J and a pressure chamber K and these chambers communicate with each other through the steam tube L, the lifting tube M and combining and discharge tube N, which are secured in the partition walls E, F and G respectively.

The tubes M and N are fixed and the steam tube slides for the purpose of controlling the admission of steam and water in the following manner: The rear end of the steam tube has a swivel connection with a screw threaded valve stem O which engages in a screw plug P secured in the end of the casing. The steam tube which is made cylindrical on the outside, slides through a stuffing box which consists of a box *a* secured by screw threads in the partition E, and two soft metal packing rings *b c*. The ring *b* is conically reduced at one end and provided with a recess *b′* into which the ring *c* is engaged. The two rings are split open, with the split ends located on opposite sides when the rings are in position. The packing ring *b* is held in place by means of a loose collar *d* which is conically recessed to fit against the conical end of the packing ring *b*. The collar *d* is held in place by a spring *e* and the spring is held in place by a collar *f*, which is screw threaded into the box *a*. The rear end of the box *a* terminates in a valve seat *g* and the rear end of the steam tube has an offset *h* whereby said rear end forms the valve for the seat. Steam admission ports *h′* are provided near the rear end of the steam tube to admit steam from the steam chamber H into the steam tube when the shoulder *h* is withdrawn from the valve seat.

The front end of the steam tube is adapted to closely approach the rear end of the mouth of the lifting tube, when the rear end of the steam tube is closed to the entrance of the steam, the steam tube thus forming at the same time the valve for regulating the admission of steam and water whereby separate valves for this purpose are dispensed with and the construction and operation are thereby greatly simplified.

The arm A′ of the casing communicates at its lower end through a valve port Q with the overflow chamber J, at its upper end it communicates through passage K with the pressure chamber K^2 and between the two ends it communicates through the exhaust chamber R with the overflow branch R′. There are three valves S, T, and U located in this arm in upright positions, one above the other. The upper or pressure valve U is seated upon a valve seat formed on the upper end of a bushing *i* removably held in place by a hollow screw plug *j* which forms the pressure chamber K^2 on top of the valve communicating through ports *j′* with the pressure chamber K. The lower or vacuum valve S controls the valve port Q and is guided in its movement by a stem S′ engaging in the guide bearing formed in the intermediate valve T. The intermediate valve or plunger T is located between the exhaust chamber R and

the valve S and forms a water seal chamber V between the two valves. The plunger has a shoulder *k* around its upper end by means of which it is seated on a valve seat *l* formed by an apertured partition *m* through which the plunger passes. The upper side of the plunger is cup shaped and a pin hole *n* is placed in the bottom of the cup. Both the valves T and U have wings to guide them in their vertical movements and these wings extend in close proximity to each other as shown.

In practice, the parts being arranged, constructed and shown as described the whole operation of starting the injector consists in gradually retracting the steam tube by turning the valve stem O. In turning it to open, the valve formed on the steam tube lifts up from its seat *h* and admits the steam into the tube and from there into the injector. The pressure of the steam acting against the under side of the valve S lifts up that valve and admits the steam into the chamber V and acting against the under side of the plunger T lifts the latter off from its seat and this in turn will lift the valve U, thus giving to the steam a free exhaust, and driving out the air. The valve U is made suitably smaller so that there is a preponderance of pressure for lifting the valves against the pressure of steam acting on top of the valve U, and if desired the stem S′ of the lower valve may be made to impinge against the plunger T so that, in opening, it lifts both the valves T and U off their seats. In withdrawing the steam tube to admit steam to the injector the forward end of the steam tube operates as a water valve and controls the admission of water into the lifting tube (after the air is exhausted) in proportion to the amount of steam admitted into the rear end of said tube. The water drawn into the lifting tube first escapes into the chamber J, from there into the chamber V and thence into the overflow branch and as the stream gradually establishes itself through the combining and discharge cone it will also find its way from the pressure chamber K through the passage K′ into the chamber K^2 and from there out, past the valve U, into the overflow. As the jet gradually becomes stronger the pressure of the water in the pressure chamber will gradually increase and that in the vacuum chamber J will gradually decrease. The valve U cannot close because it is upheld by the valve T which in turn is upheld by the pressure of the overflow against its under side (or against the under side of the valve S). As soon as the overflow into the chamber J ceases (or nearly so) the valves S and T are free to close, but while the valve S drops immediately to its seat, the valve T being in form of a plunger, cannot do so because of the chamber V being full of water which cannot get out except as it is gradually displaced around the plunger into the overflow. This delays the closing of the valve T and consequently of the valve U. As the stream passing through the combining and delivery tube cannot enter the boiler until its force is sufficient to overcome the boiler pressure (there being the usual check valve between the boiler and delivery branch D) the delay in the closing of the valve U keeps the overflow from the chamber K open and therefore the stream can fully establish itself into the delivery chamber before it meets with the boiler pressure, but when it has obtained sufficient force the pressure of the incoming water acts against the valve U and the latter therefore forces the valve T to its seat and both valves become seated and the stream will force its way into the boiler. Should from any cause the stream become broken, the pressure of the steam would again open the valves S, T, and U and the stream would re-establish itself in the same manner as before described.

The operation of the valve U makes the injector start and restart automatically with absolute certainty and in less time than it would require otherwise. As the pressure valve U and plunger T open and close together it is obvious that they may be united together. However it is preferable to make them separate for the reason that they can be better fitted to their seats.

My invention in regard to the construction and operation of the overflow valves consists broadly in controlling the seating of the pressure valve by a water check, by which I mean a valve which is prevented from coming to its seat immediately by a cushion of water.

It is well nigh a practical impossibility to make injector valves absolutely tight, as there are so many difficulties to contend with. In particular the action of chlorides, which in some water are always present, becomes particularly destructive on the valves when the water is boiling hot. Carbonic acid gas is quite as destructive on the zinc, tin, lead, copper and other metal in the composition for the valves, and thus by the corrosion of these metals, a leakage is produced in a short time. This leakage being thus difficult to prevent, I propose taking care of it in this way, placing the valves in an upright position, the leakage from the pressure valve will fall in the cup-shaped recess on the top of the plunger T. From there it will leak through the pin-hole *n* into the water chamber V from which in turn, if the valve S leaks, it will be drawn in by the vacuum into the chamber J and thus pass into the injector tube.

The expedient of controlling the seating of the valve U by a water check prevents it also from being damaged, as it would otherwise seat with a blow.

The same difficulty as to leakage is connected with the use of a movable steam tube. This difficulty however I have overcome by the use of the peculiar packing described. It will be seen that the two packing rings *b c*

are held by the steam pressure against the end wall of the box *a* and around the steam tube, and as the rings are split open they are free to contract and fit tight around the steam tube.

What I claim as my invention is—

1. The combination with the overflow chambers of the combining and delivery tubes of the injector and the overflow branch into which said chambers separately communicate, of valves interposed between said overflow branch and said overflow chambers, and co-operating to automatically control the overflow from said chambers into the overflow branch, and a water check applied to the valve controlling the overflow from the delivery tube, substantially as described.

2. In an injector, the combination with the casing containing separate overflow chambers for the combining and delivery tubes, of a vacuum valve adapted to be unseated by the pressure of the overflow from the combining tube, an intermediate valve or plunger adapted to be unseated by the pressure of the overflow from the vacuum valve, and a pressure valve adapted to be unseated by the intermediate valve and seated by the pressure of the overflow from the delivery tube under the control of the intermediate valve acting as a water check, substantially as described.

3. In an injector, the combination with the casing containing separate overflow chambers for the combining and delivery tubes, of the vacuum valve, an intermediate valve or plunger, and a pressure valve contained in a vertical arm of the casing one above the other, a pressure chamber formed in the arm of the casing above the pressure valve and communicating with the overflow chamber of the delivery tube, an intermediate valve chamber between the pressure valve and the intermediate valve or plunger, and communicating into the overflow branch of the injector, and a lower valve chamber between the intermediate valve and the vacuum valve and communicating through a port controlled by the vacuum valve with the overflow chamber of the combining tube, said valves operating as set forth to automatically control each other in seating and unseating, substantially as described.

4. In an injector, the combination with the casing containing separate overflow chambers for the combining and delivery tubes, of the vertical arm A′ communicating with said overflow chambers and provided with an overflow branch R′, the valves T and U in said arm interposed between said overflow chambers and the overflow arm, and the vacuum valve S interposed between the valve T, and the overflow chamber of the combining tube, and co-operating with the valve T to unseat the valve U by the pressure of the overflow from the combining tube, and to form a water check to delay the seating of said valve against the pressure of the overflow from the delivery tube, substantially as described.

5. In an injector, the combination of the casing A, the overflow chambers K and J, the vertical arm A′ of the casing communicating with the overflow chambers K and J and with the overflow branch R′, the valves U, T and S contained in said vertical arm one above the other and co-operating as set forth to seat and unseat automatically, the cup or recess on top of the intermediate valve T and the pin hole *n* in the bottom of said cup, substantially as described.

6. The combination with the casing and partition separating the steam and water chambers of the injector, of a movable steam tube, extending through a stuffing box in said partition and adapted to form a water valve, lateral steam admission ports into the steam tube, and a valve seat around the rear end of the steam tube adapted to seat against the rear end of the stuffing box to form a steam valve for admitting the steam into the lateral ports of the steam tube, substantially as described.

7. The combination with the casing and partition separating the steam and water chambers of the injector, of the movable steam tube L provided with two valve seats adapted to form the steam and water valve of the injector as described, and a stuffing box consisting of the box *a*, the split rings *b c*, the collars *d f* and the spring *e* interposed between the collars, all arranged to operate substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN DESMOND.

Witnesses:
JAMES WHITTEMORE,
M. B. O'DOGHERTY.