No. 750,202. PATENTED JAN. 19, 1904.

S. L. KNEASS.

INJECTOR.

APPLICATION FILED OCT. 6, 1903.

NO MODEL.

Fig. 1.

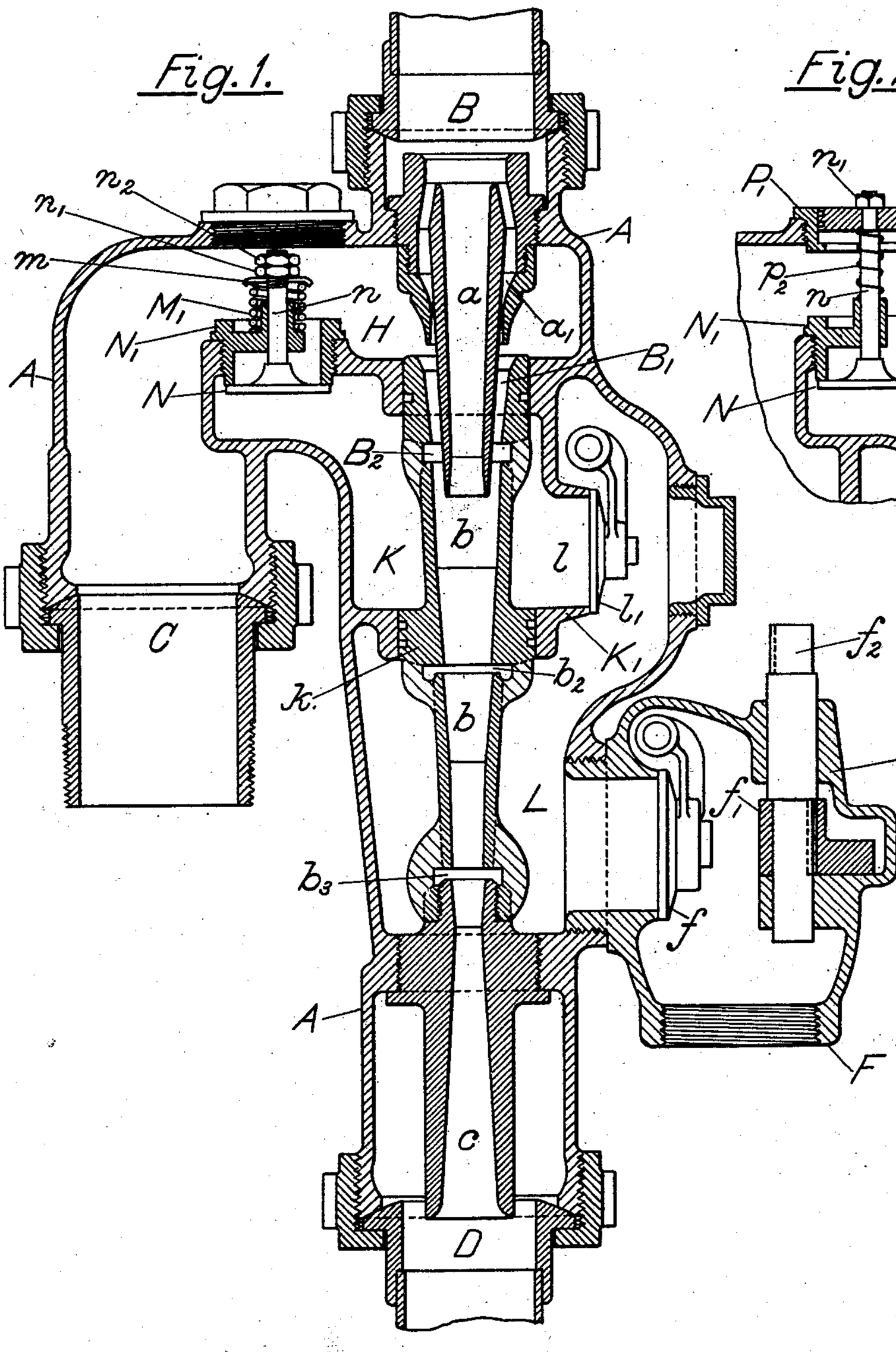

Fig. 2.

WITNESSES:

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No. 750,202. Patented January 19, 1904.

UNITED STATES PATENT OFFICE.

STRICKLAND L. KNEASS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO WILLIAM SELLERS & COMPANY, INCORPORATED, OF PHILADELPHIA, PENNSYLVANIA.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 750,202, dated January 19, 1904.

Application filed October 6, 1903. Serial No. 175,980. (No model.)

To all whom it may concern:

Be it known that I, STRICKLAND L. KNEASS, of the city and county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Injectors, of which the following is a specification.

My invention relates to that class of injectors which are designed to receive the water-supply under a head and are known technically as "non-lifting" injectors and is applicable to all forms having an overflow-chamber which contains one or more lateral openings to a forcing combining-tube.

For all injectors in which the entrance areas of the steam and the water are constant and the forcing combining-tube is provided with one or more openings into an overflow-chamber there is a steam-pressure which is hereinafter called the "limiting" steam-pressure, at which the maximum quantity of water is delivered to the boiler and below which the tendency is to spill at the waste-pipe. When an injector of this form is attached to a locomotive-boiler and receives its water-supply under a head, the usual position is below the running-board and out of convenient sight of the operator. It is then impossible for the operator to check the spill due to the falling of the boiler-pressure below the limiting steam-pressure of the tubes without frequent observation of the waste-pipe and readjustment of the water-supply; further, an extreme reduction of the boiler-pressure caused by an unusual load or gradient may break the continuity of the jet and all the entering water will be wasted at the overflow.

It has therefore been customary to design the tubes of a non-lifting injector so that the limiting steam-pressure shall be considerably below the pressure usually carried on the boiler in order to avoid the tendency to spill at the waste-pipe when the pressure falls; but this requires all of the entrance and discharge areas of the tubes to be increased, so that the injector shall deliver the desired amount of water at the higher steam-pressures.

It is an object of my invention to raise the limiting steam-pressure of injectors operating under a head.

It is a further object to increase the maximum capacity at the higher steam-pressures carried on locomotive-boilers without enlarging the diameters of the tubes or the amount of steam used, and it is a further object to widen the range of steam-pressures through which an injector may operate under a head without tendency to spill at the waste-pipe.

To this end my invention consists in a check-valve located between the water-supply chamber and an overflow-chamber and balanced against the head of the water-supply. The character of this valve and its balancing adjustment are exemplified in the drawings which accompany and form part of this specification, in which—

Figure 1 represents a vertical longitudinal section of an injector embodying my invention. Fig. 2 is a view of another form of the balanced check-valve shown in Fig. 1.

This type of injector is designed to operate in a vertical position, as shown in the drawings.

A is the body or casing; B, the steam-branch; C, the water-supply branch; D, the delivery feed branch connected with the boiler.

F is the waste-pipe casing containing the overflow-valve *f*, closing by gravity and forced tightly against its seat when desired by rotating the cam *f'* by means of the stem f^2

a' is the annular steam-nozzle, *a* the forcing steam-nozzle, and B' the annular combining-tube of the annular steam-nozzle.

bb is the forcing combining-tube.

c is the delivery-tube.

H is the water-supply chamber.

K is an overflow-chamber containing lateral opening B^2 between the combining-tube B' of the annular steam-nozzle *a'* and the rear end of the forcing combining-tube *bb*.

The port *l*, controlled by the hinged gravity check-valve *l'*, connects an overflow-chamber K with an overflow-chamber L. The chamber L contains lateral opening b^2 and lateral opening b^3 to the forcing combining-tube *bb*.

N is the balanced check-valve between the water-supply chamber H and an overflow-chamber K and is held upon its seat on the

cage N′ by the spring M′ with sufficient pressure to balance the head of water in the supply-chamber H. The spring M′ is under compression by the nut n', secured upon the threaded stem n and held in position by the jam-nut n^2.

m is a washer placed between the nut n' and the spring M′.

The valve N permits inflow to the overflow-chamber K from the water-supply chamber H when there is a sufficient vacuum at K, but prevents reflux of water or steam to the water-supply chamber when the continuity of the jet is broken. The nut n' upon the threaded stem n permits a variation of the pressure of the spring M′ upon the valve N to suit different heads of the water-supply.

In the injector shown in the drawings the forcing combining-tube bb is provided with a flange k, which fits closely in the transverse wall K′ of the body A, separating the overflow-chamber K from the overflow-chamber L. When the hinged gravity-valve l' is open, both chambers are in communication by means of the port l, permitting free outlet of steam and water from the overflow-chamber K to the overflow-chamber L, and thence through overflow-casing F to the air.

In Fig. 2, N is the balanced check-valve between the water-supply chamber H and the overflow-chamber K, seating upon the cage N′. n is the threaded stem rigidly fastened by the nut n' to the piston P, having an area the same as or slightly larger than that of the valve N and sliding in the bushing P′, which is screwed into the outer wall of the water-supply chamber H. The bushing P′ has a shoulder p to limit the downward stroke of the piston P, and the opening of the valve N and the upward stroke is limited by the seating of the valve N upon the cage N′. p^2 is a light spring acting upward upon the piston P, so that the valve N shall remain upon its seat unless there is a partial vacuum in the overflow-chamber K.

The operation of the injector is as follows: Water is admitted under a head to the branch C and flows freely into the receiving end of the combining-tube B′ of the annular steam-nozzle, thence from the lateral opening B^2 into the chamber K, and from the lateral openings b^2 and b^3 into chamber L. The water in chamber K passes through the port l' and mingles with the overflow from lateral openings b^2 and b^3, finding outlet to the air by opening valve f. The valve N will remain closed because the pressure upon the balanced check-valve N due to the head is balanced by the spring M′ or other device preventing outflow from the water-supply chamber H except through the annular combining-tube B′. When the steam-valve (not shown) is opened, the steam flows through the branch B and discharges through the steam-nozzles a' and a. The water entering the receiving end of the combining-tube B′ condenses the steam from the annular steam-nozzle a' and is delivered across the lateral opening B^2 to the forcing combining-tube bb, where it receives the impulsive action of the steam from the forcing steam-nozzle a, forming a continuous jet in the forcing combining-tube bb, with sufficient velocity to pass through the delivery-tube c and into the boiler against the initial pressure of the steam. If this pressure is at or below the limiting steam-pressure for the tubes of the injector, sufficient water will enter the receiving end of the combining-tube B′ and the pressure of the fluid in the overflow-chamber containing a lateral opening of the forcing combining-tube will be but slightly lower than that of the atmosphere. The valve N between the overflow-chamber K and the water-supply chamber H will then remain closed, because the compression of the spring M′ retains it upon its seat against the head of the water at H, and the entire water-supply of the forcing combining-tube bb will be delivered to it through the combining-tube B′ of the annular steam-nozzle a'. If, however, the steam-pressure be raised above the limiting pressure, the additional flow of steam will require an increased amount of water which cannot be supplied by the annular combining-tube B′ on account of the fixed area of water admission, so that the steam will not be entirely condensed within the usual parts of the combining-tubes, and the partial vacuum in the combining-tubes will then be communicated to the overflow-chamber K by means of the lateral opening B^2 and to the overflow-chamber L by means of the lateral openings b^2 and b^3, and this vacuum will overcome the balancing pressure of the spring M′ and open the balanced check-valve N for an inflow from the water-supply chamber H. This additional supply will then be drawn into the forcing combining-tube bb through the lateral openings B^2, b^2, and b^3 and forced into the boiler by the jet, increasing the capacity of the non-lifting injector and raising the limiting steam-pressure of the apparatus without the usual result of spilling at the waste-pipe when the steam-pressure falls below the pressure by which the maximum capacity of the injector is obtained. The pressure due to the head of water upon the valve N (shown in Fig. 2) is balanced by the pressure of the water-supply upon the attached piston P. The weight of the valve, stem, and piston is supported by the spring p^2, preventing outflow of water from the supply-chamber H except through the combining-tube B′. When the limiting steam-pressure of the tubes of the injector is exceeded, the partial vacuum within the overflow-chamber K, acting upon the valve N, will overcome the pressure of the head of water on the piston P and cause it to open, admitting an additional supply of water from the chamber H. When the pressure in the chamber L is lower

than in overflow-chamber K, there will be a flow of fluid from the annular combining-tube B′ at the lateral opening B^2 into the chamber K and, raising the valve l', will pass through the port l into the chamber L, and if the pressure upon the balanced check-valve N, due to the head of water and the partial vacuum in overflow-chamber K, is in excess of the pressure of the spring M′ the balanced check-valve N will open and there will be an inflow of water from the supply-chamber H into overflow-chamber K and through the open port l into an overflow-chamber L, where the entering water is drawn into the combining-tube bb at the lateral openings b^2 and b^3 and carried by the jet into the boiler. If the pressure in chamber K is lower than in chamber L, the valve l' will close the port l, and no additional water-supply will be admitted to the lateral openings b^2 and b^3 of the forcing combining-tube bb. If the internal pressure of the jet at the rearmost lateral opening of the forcing combining-tube contained in chamber K is lower than that of the surrounding fluid, the balanced check-valve N will open and an additional supply of water will be drawn in at the lateral opening B^2 and carried forward by the jet. When the balanced check-valve opens, the additional supply of water is admitted into the overflow-chamber without checking the flow through the usual entrance to the tubes. This additional supply largely increases the delivery of the apparatus at steam-pressures above the limiting pressure of the tubes alone.

My improvement allows a smaller size non-lifting injector than heretofore used under similar conditions to give the required capacity, permitting a reduction of the interior diameters of the tubes and of the weight of steam necessary for feeding the boiler. At the same time it enlarges the permissible range of steam-pressures and the range of capacities by increasing their maxima without affecting their minima, for with low steam-pressures the balanced check-valve is inactive and the operation of the apparatus is the same as that of a simple injector. Further, when applied to the form of injector shown in the drawings, which contains an overflow-chamber K, inclosing a lateral opening B^2, and when the temperature of the water-supply is above the overflowing temperature and the final overflow-valve f is tightly closed by the cam f the additional supply of water enters through the balanced check-valve N and is admitted at the rearmost lateral opening B^2 to the forcing combining-tube bb without passing through the annular combining-tube B′ of the annular steam-nozzle a' and is not subject to the heating action of the steam from this nozzle. It will therefore more easily condense the steam from the forcing steam-nozzle, raising the limiting temperature of the water-supply with which the apparatus can operate.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an injector, a water-supply chamber, an overflow-chamber provided with an outwardly-opening check-valve and containing a lateral opening to the forcing combining-tube, in combination with a check-valve between said chambers balanced against the head of the water-supply.

2. In an injector, a water-supply chamber, an overflow-chamber provided with an outwardly-opening check-valve and containing the rearmost lateral opening to the forcing combining-tube, in combination with a check-valve between said chambers balanced against the head of the water-supply.

STRICKLAND L. KNEASS.

Witnesses:
JOHN L. PHILLIPS,
E. R. HARPER.