No. 624,430. Patented May 2, 1899.

F. BRUNBAUER.

INJECTOR.

Application filed Aug. 5, 1898.)

(Model.) 2 Sheets—Sheet 1.

Fig. 1.

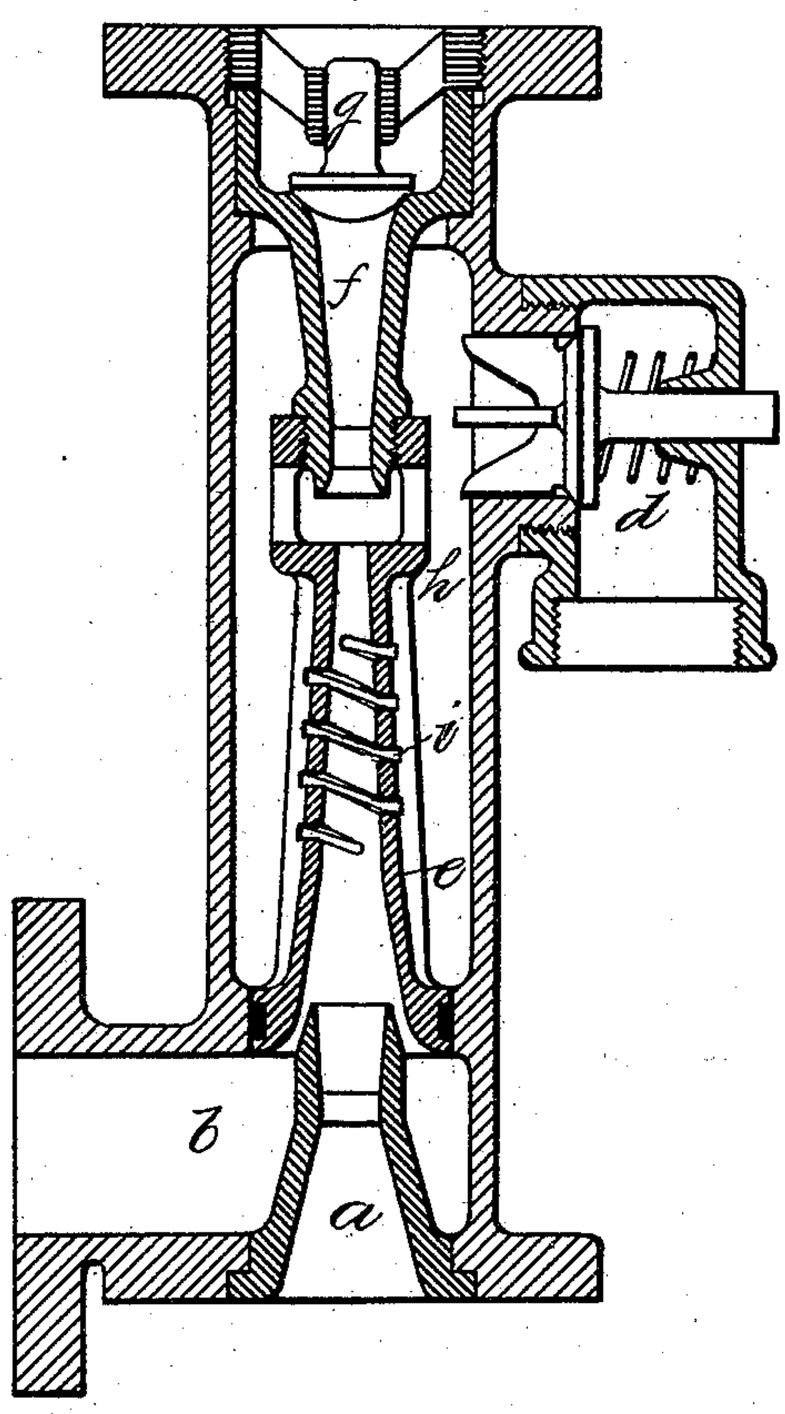
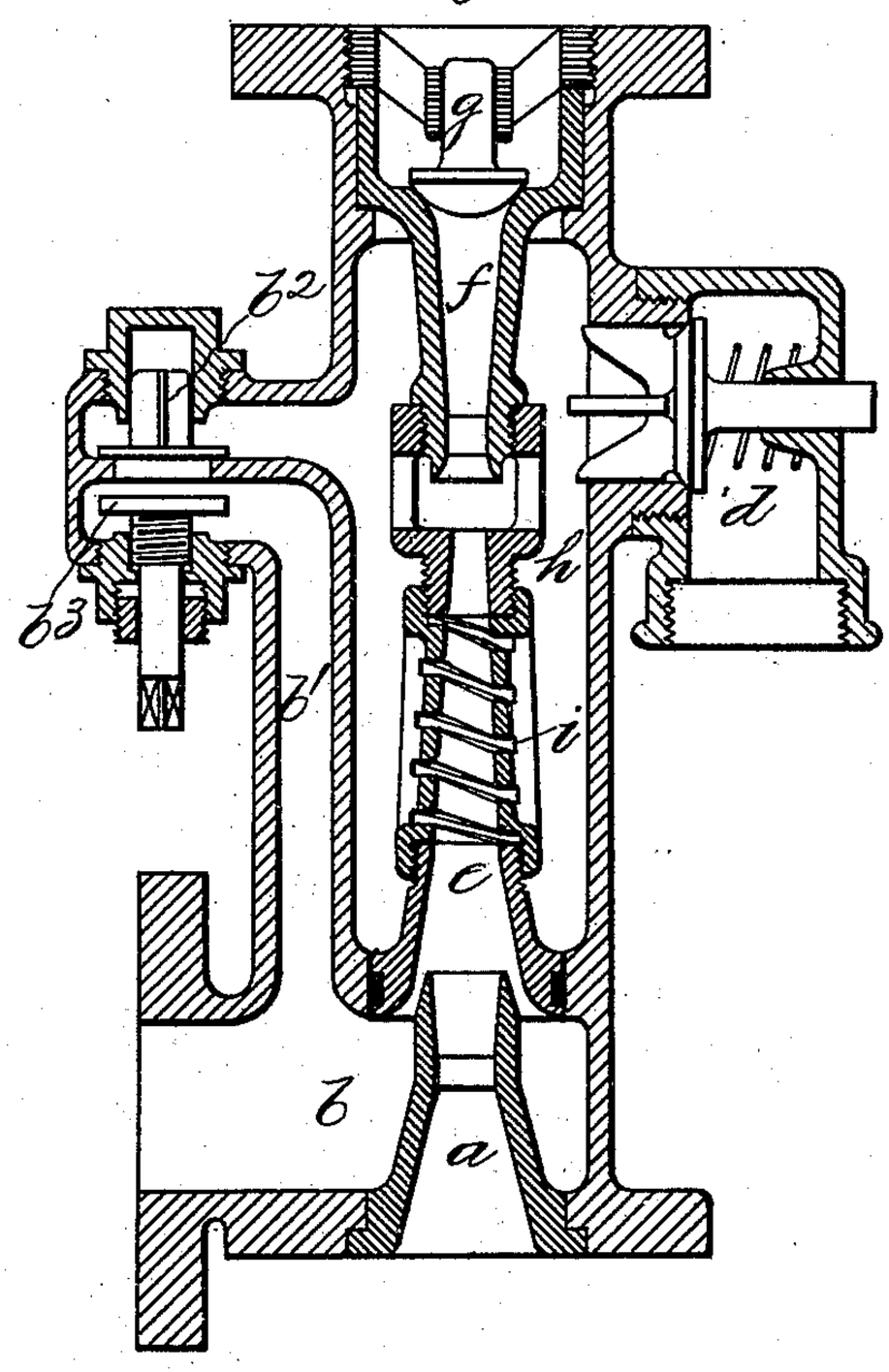


Fig 2.



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(Model.) 2 Sheets—Sheet 2.

Fig. 3

Fig. 4.

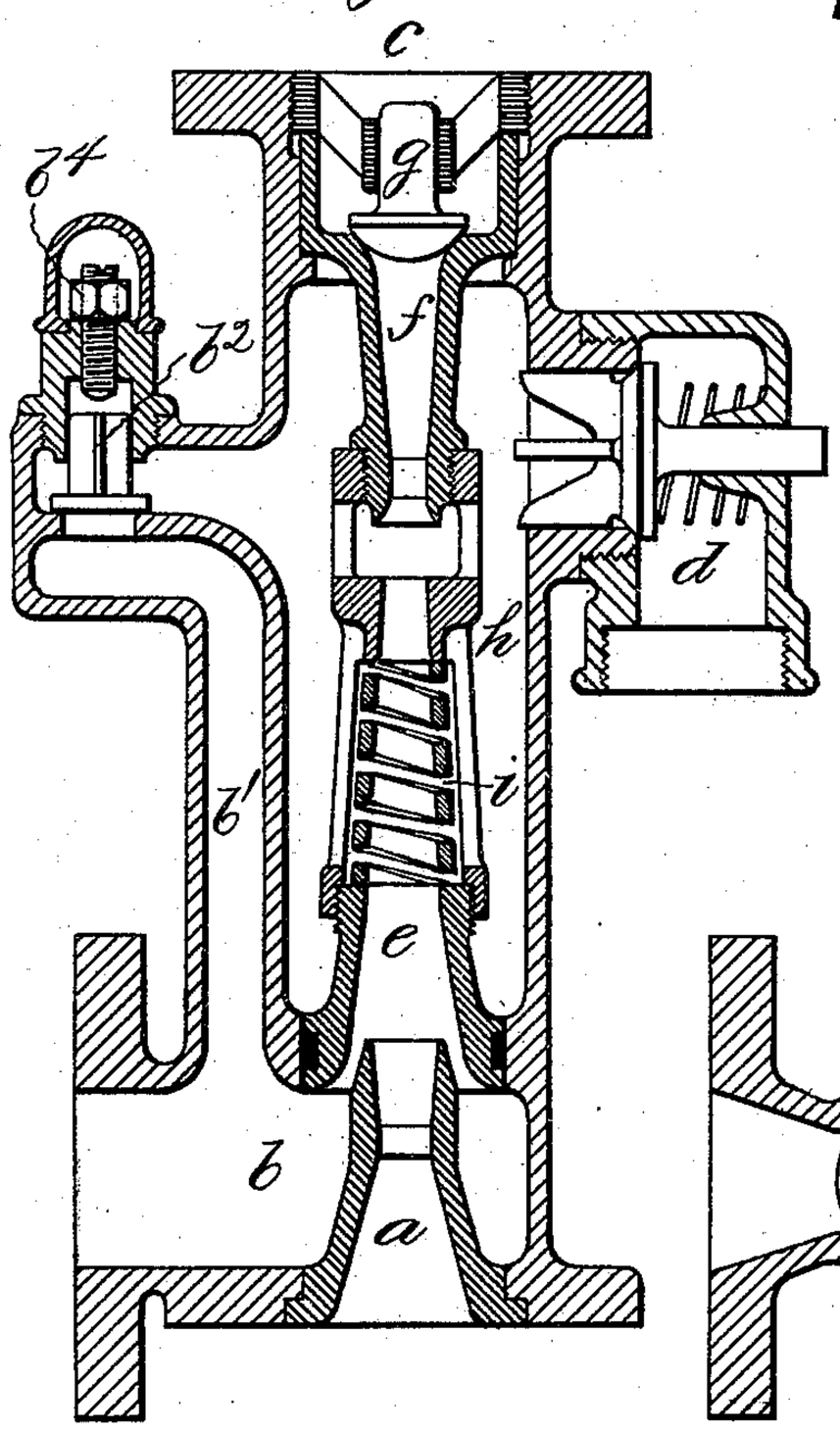
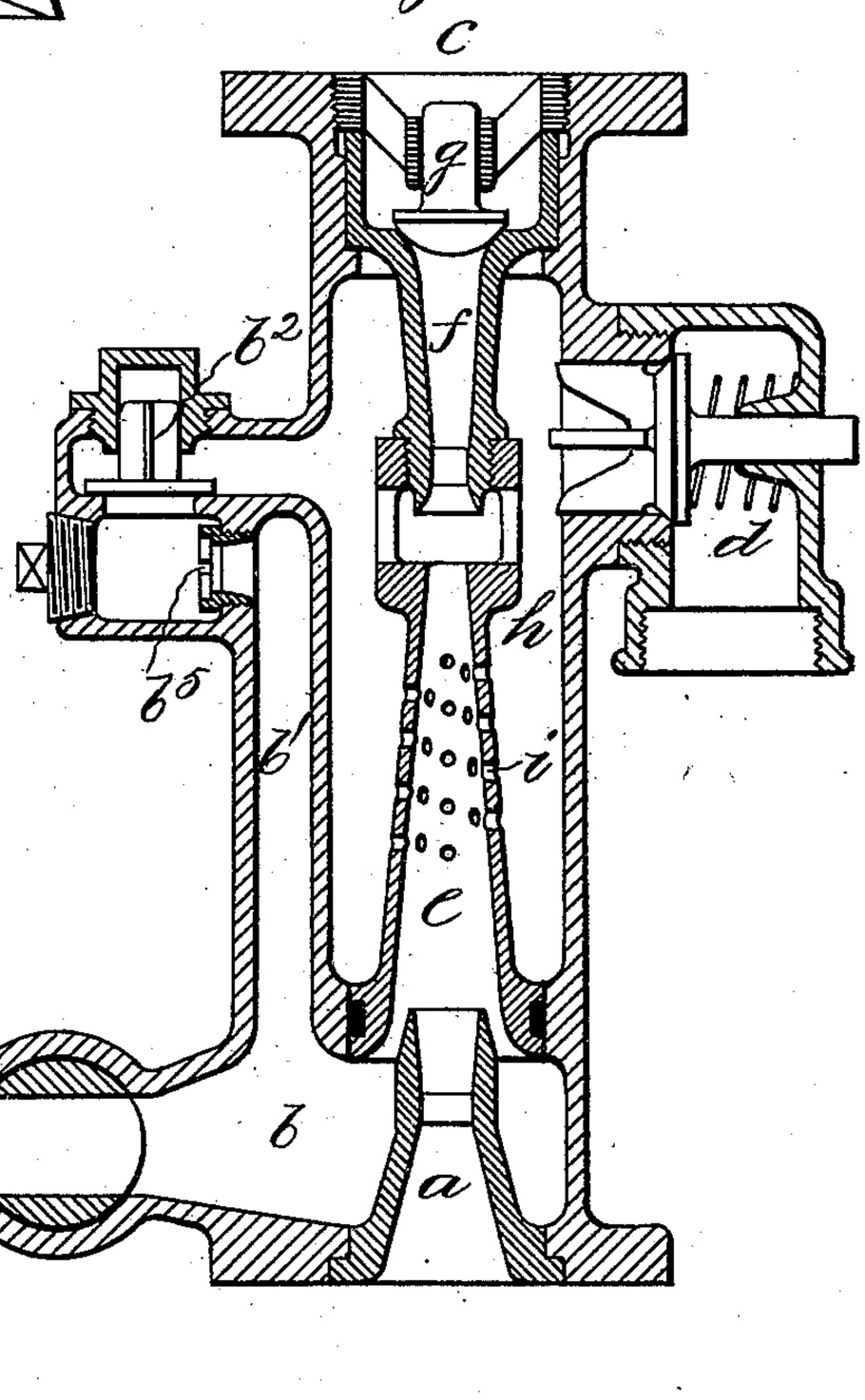


Fig. 5.



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UNITED STATES PATENT OFFICE.

FERDINAND BRUNBAUER, OF VIENNA, AUSTRIA-HUNGARY.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 624,430, dated May 2, 1899.

Application filed August 5, 1898. Serial No. 687,838. (Model.)

To all whom it may concern:

Be it known that I, FERDINAND BRUNBAUER, a subject of the Emperor of Austria-Hungary, residing at Vienna, in the Province of Lower Austria, in the Empire of Austria-Hungary, have invented certain new and useful Improvements in Injectors; and I 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.

In injectors as heretofore constructed the combining-nozzle traversed by the steam entering through the steam-nozzle with the feed-water sucked from the water-chamber is provided for the purpose of facilitating the starting of the injector with overflow perforations or passages of various forms communicating with the overflow-chamber or the combining-nozzle is formed as a flap-nozzle. All these constructions are very sensitive and have numerous drawbacks which culminate chiefly in the fact that the jet passing through the combining-nozzle undergoes sudden interruptions on its whole extent, which very easily conduce to great disadvantages and especially entail considerable loss of overflow-water, especially at those overflow passages or perforations of the combining-nozzle situated near to the steam-nozzle—that is to say, where the jet of water is still considerably mixed with steam.

In the case of combining-nozzles that are provided with the ordinary perforations there is the further disadvantage that it is not possible to suck up the water with a high pressure of steam, because there is not a sufficiently wide passage from the interior of the nozzle to the overflow-chamber. Further, in the ordinary combining-nozzles and also on account of the nature of their perforations the feeding of a large quantity of water with a comparatively small consumption of steam is quite impossible, although it has been known for a long time that the jet of water draws with it the air contained in the overflow-chamber through the perforations of the combining-nozzle, and thereby produces a vacuum in the said chamber, so that more water can be sucked up and the amount of delivery of the injector increased; but since the perforations in the nozzles as heretofore carried out have all been such that only few and unfavorably-situated points of contact with the jet of water passing through the combining-nozzle are presented to the water that is additionally sucked up the result is that only a small quantity of water can be carried along mechanically.

Now this invention has for its objects to obviate all these disadvantages, and in injectors of all kinds, both suction-injectors and those which act with a flow of feed-water under certain pressure, to insure an easy and perfectly certain starting and an increased capacity for drawing in further water. This is effected by forming the combining-nozzle with an outlet or outlets arranged in a helical way, and, especially in injectors for working with a head of water, by further providing a device for regulating the cross-sectional area of additional suction in order to prevent a free flow or overflow of the water.

The accompanying drawings represent in longitudinal section various examples of apparatus constructed according to this invention. Throughout these drawings, *a* indicates the steam-nozzle; *b*, the water-chamber; *c*, the water-outlet to the boiler; *d*, the overflow-valve; *e*, the combining-nozzle; *f*, the discharging-nozzle; *g*, the check-valve, and *h* the overflow-chamber.

As shown in Figures 1 to 4, inclusive, the passage in the combining-nozzle *e* is formed by a helical slot *i*, which pierces the nozzle-wall and may be formed in various ways and whereby the nozzle *e* is provided for a suitable length at each point with an exit into the overflow-chamber *h*.

The steam that issues from the steam-nozzle *a* on starting the injector finds an easy passage through the perforation *i* into the chamber *h*, and thence past the overflow-valve *d* into the atmosphere, so that a certain suction will take place even with the greatest steam-pressures. This arrangement of the perforation in the nozzle is also of great importance for the movement of the water in the combining-nozzle, because in every cross-section of the jet only one point of the edge of the said cross-section is in communication

with the overflow-chamber *h*, while all the other parts of this periphery have no perforation, and consequently the jet is guided thereby. The perforation thus extends always along the periphery of the cross-section of the jet in its advance toward the discharging-nozzle, and the jet has sufficient time to become formed before any part of its periphery which has passed by a place of perforation reaches the next following place of perforation situated in the same radial plane. In this manner, therefore, it is also possible to provide a sufficiently wide passage from the combining-nozzle to the overflow-chamber in accordance with the degree of steam-pressure, and it is also possible to suck up the water by means of the whole steam which is supplied through the steam-nozzle.

The helical perforation or passage *i*, which is shown in Fig. 1 as being formed in a combining-nozzle consisting of a single piece, can be readily produced in a lathe, if the nozzle *e*, as shown in Fig. 2, is composed of two or more parts, in one of which the perforation is cut.

Fig. 3 shows an example of a nozzle in which the perforation or passage *i* is formed by making the combining-nozzle by rolling up a strip of sheet metal after the manner of a spiral spring, and Fig. 4 shows it formed by making the nozzle in a similar manner from a rod of rectangular cross-section. The interstices, of screw-thread shape, which are thus produced in both cases constitute perforations in the combining-nozzle in accordance with the object of this invention.

In the arrangement shown in Fig. 5 the passage is constituted by a number of holes *i*, formed along a helical line in the wall of the nozzle *e*. When the injector shown in Fig. 5 is in operation, the jet of water passing through the combining-nozzle *e* draws the air contained in the overflow-chamber *h* with it through the perforations *i*, and thus forms a vacuum there. The combining-nozzle being provided with perforations, as stated, the injector will, as is well known, by means of this vacuum, draw in further water and deliver it into the boiler. The more numerous and the more favorably situated these perforations are the greater will be the increase in the quantity delivered. This applies in the most favorable manner imaginable to the helical or screw-thread-like perforations hereinbefore described, because the jet of water passing through the nozzle *e* comes repeatedly into contact along its whole periphery alternately with the perforations *i* in the nozzle, and thus acquires a considerably-increased capability of additional suction. In connection with this, as shown in Figs. 2, 4, and 5, the water-chamber *b* of the injector is connected by means of a passage *b'*, provided with a valve b^2, with the overflow-chamber *h*. By the action of the vacuum obtaining in the overflow-chamber the additional suction-valve b^2 is raised and a certain amount of water is sucked through the passage *b'* into the overflow-chamber *h* and is carried along by the jet in the nozzle *e*.

The combining-nozzle provided with one or more helically-arranged perforations *i*, as hereinbefore described, can be employed in injectors of the majority of existing types, it being immaterial whether they have single or or double nozzle arrangements. By means of the combining-nozzle constructed as herein described a more easy starting and increased capability of additional suction are obtained, even if the injector instead of acting merely with a suction action works with the feed-water flowing to it under a certain head. In that case also a vacuum is formed in the overflow-chamber; but the amount of water entering through the passage *b'* must not be too great in this case, because otherwise the vacuum would disappear again and the pressure of the inflowing water might be produced in the overflow-chamber, so that after the raising of the overflow-valve *d* there would be a free flow or overflow of the water from *b* to *b'* and *h* to *d*. For the purpose of removing this drawback the injector is provided with a regulating device which determines the cross-sectional area of the additional suction once for all in a suitable manner. As shown in Fig. 2, this device consists of a valve b^3, which can be screwed higher or lower, so as thereby to reduce more or less the passage of the valve b^2. As shown in Fig. 4 it consists of a screw b^4, adapted to regulate the lift of the valve b^2, and as shown in Fig. 5 it consists of a nozzle b^5, which is inserted in the passage *b'*. The lift-regulating screw b^4 (shown in Fig. 4) may also be employed, if the additional suction-valve b^2 go wrong, to press the same completely down upon its seat. Obviously the object of this regulation of the cross-sectional area might also be effected by other forms of construction of this regulating device which is set or adjusted and is then left for some time in this position for the purpose of regulating the cross-sectional area of additional suction according to the pressure of the water under which the injector has to work in each case in such a manner that rather less water is allowed to flow in under pressure than the jet of the injector could additionally suck up. The regulating device herein described may also be employed in purely suction injectors for the purpose of moderating any suddenly-increased additional suction impulses that might take place, and thereby insuring a regular working of the injector. The use of this device is also of advantage in cases where the injector has to work sometimes entirely by suction and sometimes only partially by suction—that is to say, with a varying pressure of suction-water.

I claim—

1. In an injector, the combination with the overflow-chamber and the steam and discharging cones or nozzles, of an intermediate combining cone or nozzle communicating with

the overflow-chamber at successive points between the inlet and outlet of said cone, no two of said points lying in one and the same radial or horizontal line, for the purpose set forth.

2. In an injector, the combination with the overflow-chamber, and the steam and discharging cones or nozzles, of a combining-cone provided, intermediate of its inlet and outlet, with a spiral passage or passages in communication with the overflow-chamber, for the purpose set forth.

3. In an injector in which the overflow-chamber is in communication with a source of water-supply, a combining-cone in communication with said overflow-chamber at successive points intermediate of the inlet and outlet of said cone, no two of said points of communication lying in one and the same radial or horizontal line, for the purpose set forth.

4. In an injector in which the overflow-chamber is in communication with the water branch or chamber, a combining-cone in communication with said overflow-chamber at successive points intermediate of the inlet and outlet of said cone, no two of said points of communication lying in one and the same radial or horizontal line, for the purpose set forth.

5. In an injector in which the overflow-chamber is in communication with the water branch or chamber, a combining-cone provided intermediate of its inlet and outlet, with a spiral passage or passages in communication with the overflow-chamber, for the purpose set forth.

6. In an injector, the combination with the water branch or chamber and the overflow-chamber, of a by-path leading from said water-chamber into the overflow-chamber, a port in said by-path, a valve for said port controlled by pressure variations in the overflow-chamber, and means for varying the area of said port, for the purpose set forth.

7. In an injector in which the overflow-chamber is in communication with a source of water-supply, the combination with said overflow-chamber, the steam and discharging cones or nozzles and a combining cone or nozzle provided between its inlet and outlet with passages in communication with the overflow-chamber the centers of which passages lie in different radial planes; of a valve controlling the communication between the overflow-chamber and source of water-supply, and means for varying the area of the passage controlled by said valve, for the purpose set forth.

8. In an injector, the combination with the water branch or chamber, the steam and discharging cones or nozzles, the overflow-chamber, and a combining cone or nozzle provided between its inlet and outlet with passages communicating with the overflow-chamber the centers of which passages lie in different radial planes; of a by-path in communication with the water-chamber and with the overflow-chamber at a point in advance of the outlet of said combining-cone, a port in said passage, a valve for said port controlled by pressure variations in the overflow-chamber, and means for varying the area of said port, for the purpose set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

FERDINAND BRUNBAUER.

Witnesses:
C. B. HURST,
IGNAZ ÜBLEIS.